Why Reverdy?

Our obsession: Quality!

Everything we sell, we manufacture it.

RAW INGREDIENTS

100% noble raw ingredients
No by-products, waste from the agri-food industry.
No brewers grains, integuments, middlings, husks etc.

0% molasses
By-product of sugar, responsible for pathological disorders such as choke, gastric ulcers and behavioural problems.

French cereals
Cereals harvested in the production areas close to our factory, in Normandy.
We support regional agriculture.

100% of raw ingredients without GMO*
Maize and French soya bean meal without GMO*
*<0.1 %

Feeds carrying the "Bleu Blanc Coeur" label
With extruded linseed naturally rich in omega 3.

Alfalfa 17 (Horse)
Special alfalfa for horses, certified non doping.

Raw ingredients transported by our own lorries
For added safety!

Optimal doses of vitamins
Accordance with international recommendations.
We get supplies from European leader of vitamins manufacturing
= Optimum sanitary guarantee and stability.

Highly assimilable trace elements
Zinc and copper in "hydroxy" form.
100 % of selenium supplied in organic form.

READ THE LABELS WELL...

MANUFACTURING

Certified factory
ISO 9001 and GMP+

A factory 100% dedicated to the horse
No risk of cross contamination.

One factory
A single manufacturing location, in Normandy.
Product homogeneity guarantee.
The same product, throughout the year, everywhere.

No "optimised formulas"
The formulation of our feeds does not vary according to cereal prices !
The same product, everywhere.

The production chain controlled from A to Z
From the arrival of the raw ingredients to the delivery of the finished product to the client.
Complete and absolute control over the quality of our products.

Steam pelleting
Pellets formed using steam and mechanical energy.
Nothing more !
No molasses used in the pelleting process.

SERVICES

Personalised delivery
A fleet of ten lorries for a personalised service.

Customer support
Our team in the office and on the ground are permanently at your disposal.

Technical brochure
We publish a popular scientific technical brochure*.
A work of reference, it will allow you to make an informed choice.
**Available free on request.*

Reverdy - ZA des Mesnils - 50520 JUVIGNY-LE-TERTRE
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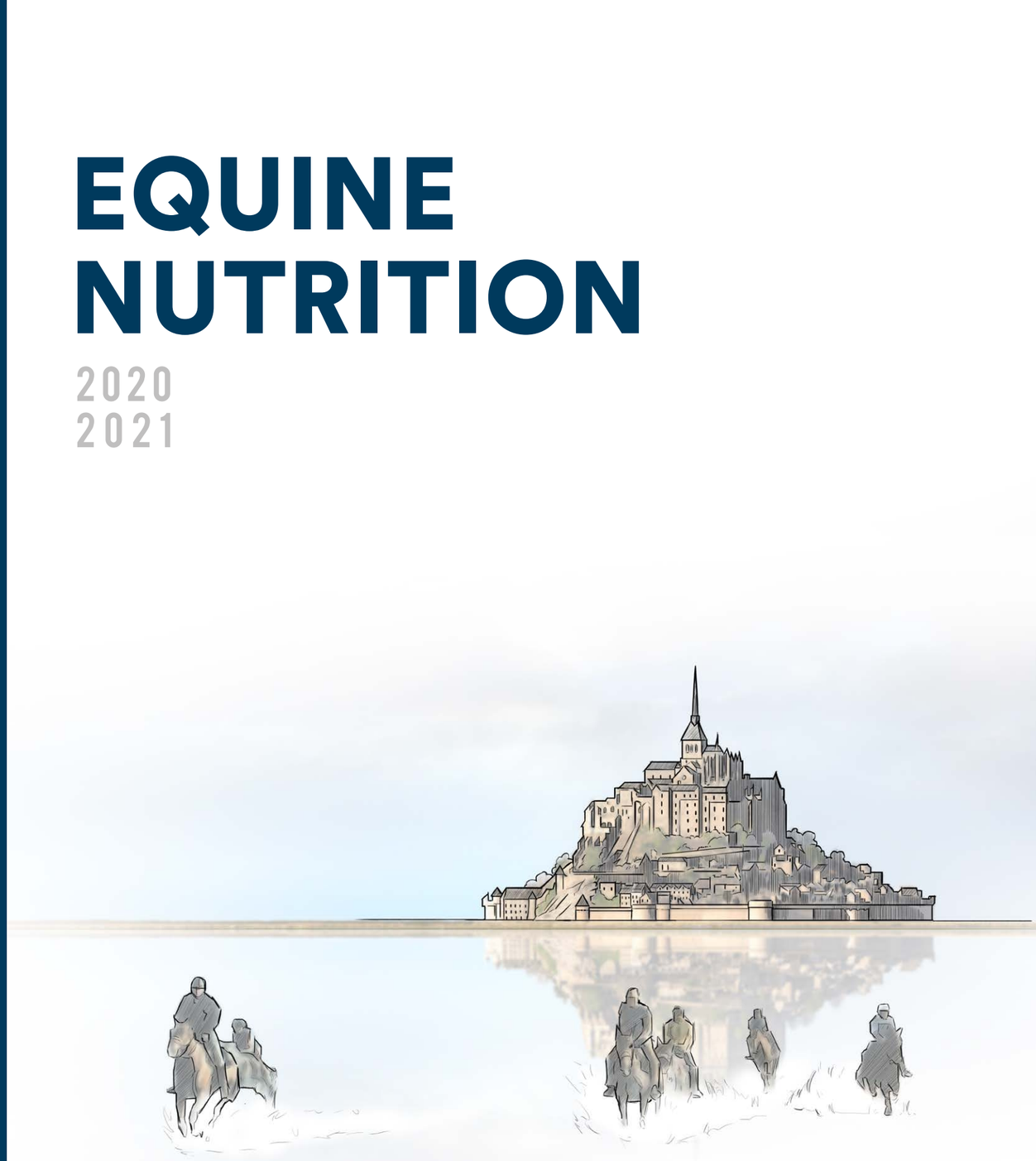
2020-2021

REVERDY EQUINE NUTRITION

EQUINE NUTRITION

2020
2021



REVERDY


ADULT
SPECIFIC ENERGY
PRÉVENTION DES COUPS DE SANG ET ULCÈRES GASTRIQUES
REVERDY


REVERDY
NUTRITION
ÉQUINE
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Feeds

Balancers and vitamin & mineral supplements

Nutritional supplements

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Written by Reverdy Equine Nutrition's Research and Development department

GFFET

ADULT RANGE

RACE RANGE

BREEDING RANGE

CB MB O DFS T

CEREAL BALANCERS

HAY BALANCER

N JO FS B M'T V QQMF N FO UT

VITAMIN AND MINERAL SUPPLEMENTS (CMV)

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BREEDING

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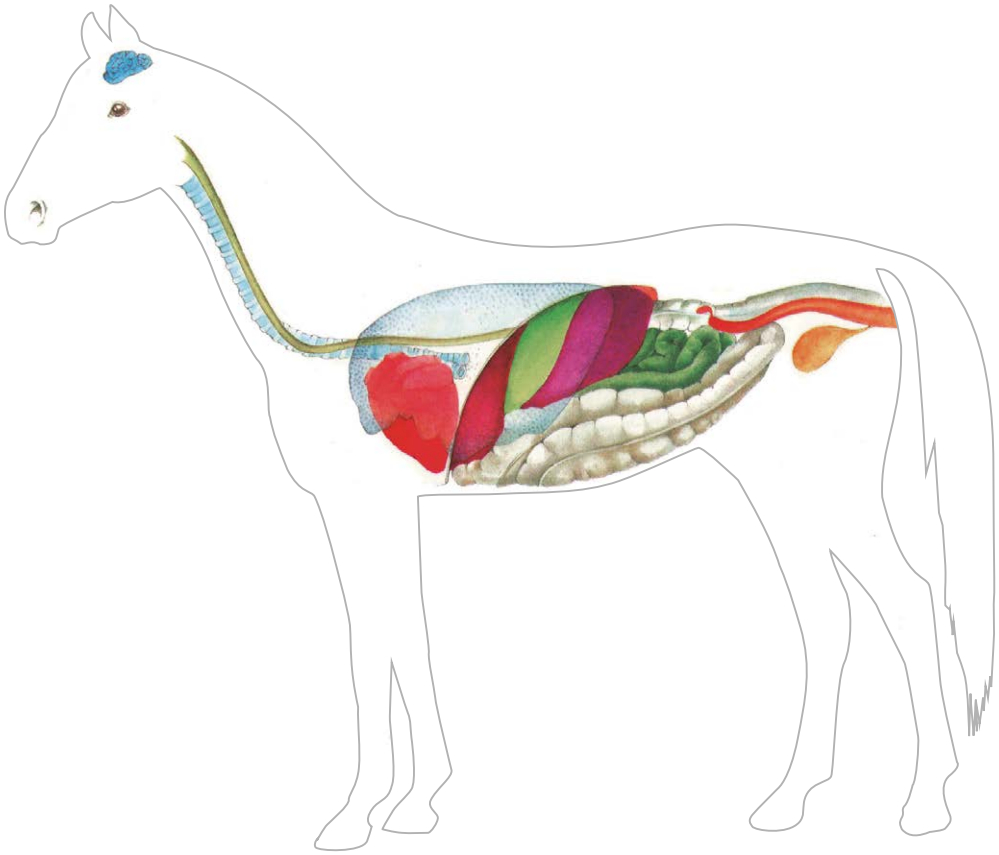


THE MOUTH

TEETH

● **Mastication: Fine grinding.**

- 1 kg of hay = 40 minutes, 3,000 actions of the jaw.
- 1 kg of cubes/pellets = 10 minutes, 1,000 actions of the jaw.

SALIVA

● **Humidifies feedstuffs:** facilitates the passage of feed through the oesophagus (lubrication) and buffers the stomachs' acid secretions.

● **Presence of enzymes** (amylase): starch digestion commences

- 1 kg of hay = 4 litres of saliva;
- 1 kg of cubes/pellets = 2 litres of saliva;

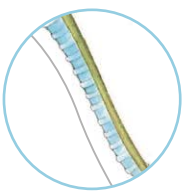
Daily production = About 40 litres.

IN PRACTICE

Have the wear and occlusion of the teeth checked at least once a year by a dentist.

Provide a sufficient quantity of forage (roughage), which will:

- Enable your horse to produce enough saliva to neutralise gastric acidity;
- Occupy your horse, especially if he is stabled (the ingestion of 8 kg of hay > 5 hours).



THE OESOPHAGUS

- Length: Approximately 130 cm.
- Transports feedstuffs to the stomach.

IN PRACTICE

Provide your horse with clean water, correct hydration will facilitate the passage of the alimentary bolus through the oesophagus.

Avoid cubes/pellets containing molasses, their agglomerating capacity increases incidents of oesophageal choke (obstructions).

THE STOMACH

• Volume: 15 to 18 litres, but it is only ever filled to 2/3 of its capacity (10 to 12 litres). This small funtional capacity is suited for the ingestion of small meals.
• Length of transit: half of the meal stays here for about two hours, the other half for 5 to 6 hours.
• **Regulates the transit.** Feed is passed to the small intestine in a sequential manner but a large starch rich feed will be held here longer than a small feed rich in fibres.
• The mechanical digestion is brief.
• **Gastric juices** (pepsin, hydrochloric acid) are continuously secreted, at quantity of 10 to 30 litres a day: they start the digestion of proteins.
• **A bacterial flora producing abundant lactic acid:** the most digestible carbohydrate are fermmented into organic acids (lactic acid), aggressive for the gastric mucous.

IN PRACTICE

Remember to:
- Distribute hay at will;
- Divide the daily ration into multiple small meals;
- Limit the amount of highly digestible carbohydrates fed (= fermentable): wheat, oats, flaked cereals, simple sugars (molasses), etc.

THE SMALL INTESTIN = ENZYMATIC DIGESTION

• Length: approximately 22 metres long.
• Volume: approximately 70 litres.
• Duration of passage of foodstuffs: approximately 4 hours.
• **Powerful enzymatic secretions** adapted to the alimentary content: they digest proteins, lipids and carbohydrates.
• **Absorption of minerals** (calcium, phosphorus, magnesium, trace elements etc.) **and vitamins.**

IN PRACTICE

To optimise enzymatic digestion you need to divide the daily ration into multiple small meals. It will limit the risk of too much of undigested feed reaching the large intestine.

Before any change of feed, you need to make a gradual transition (over a week or so). This allows the horse's body to adapt its digestice secretion to the new food. Thus, the risks if developing digestive disorders related ro undigested food are limited.

THE LARGE INTESTINE = CÆCUM + COLON = MICROBIAL DIGESTION

COLON

• Length: approximately 6 to 8 metres.
• Volume:approximately 96 litres.

CÆCUM

• Length: approximately 1.20 metres.
• Volume: approximately 30 litres.
• Average transit time: approximately 24 hours.
• **A highly active microbial flora** ferments the digestive contents on their arrival (mainly dietery fibres, but eventually also residual starch etc.):
- **Production of volatile fatty acids** which represent an important source of energy.
- **Production of microbial** unassailable **proteins** which are broken down into ammonia - a toxic product for the organism.
- **Synthesis of Vitamin K and B group.**
• The absorption of water (in the colon) allows the formation of droppings (faeces) which are expulsed by the rectum.

IN PRACTICE

Provide plenty of fibres (i.e. ad-lib hay) to help:
- Ensure a healthy cellulolytic gut flora;
- Provide bulk for the digestive system thus stimulating motility.

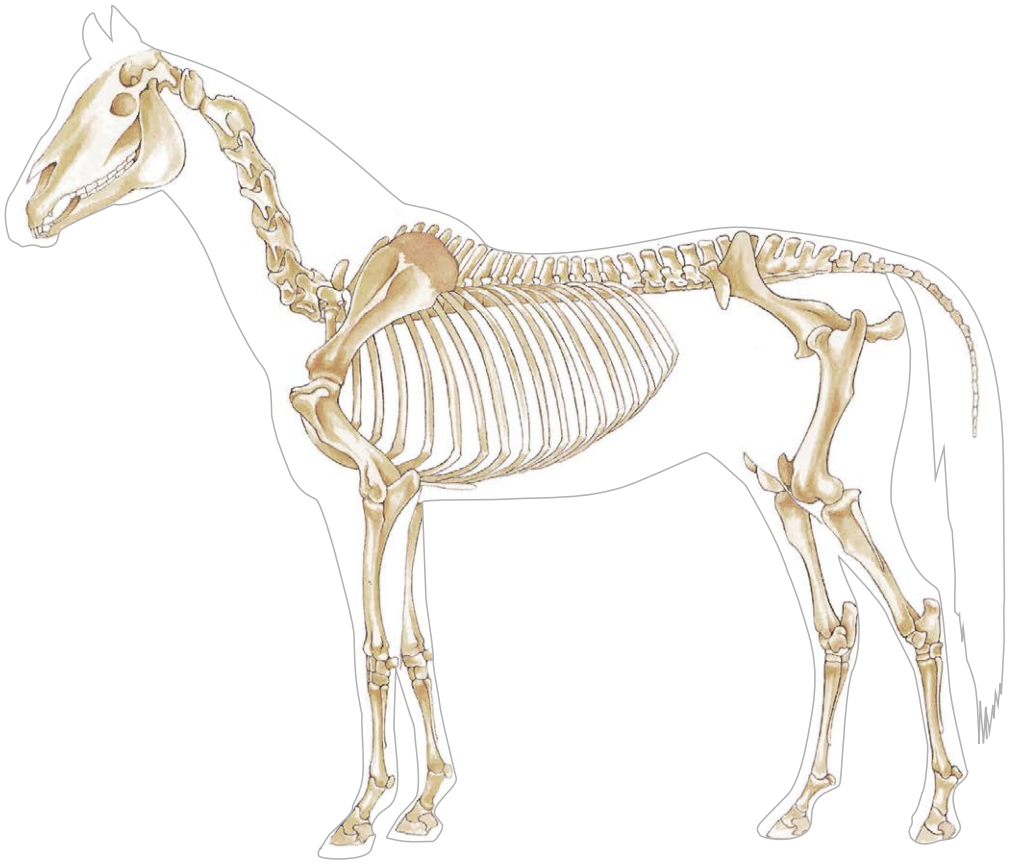
Support the intestinal flora by providing probiotics, prebiotics and/or postbiotics such as assimilation factors from the lactic fermentation of germinated barley, contained in most REVERDY feeds.

Favour quality over quantity of protein in the ration in order to:
- Meet the requirements of essential amino-acids;
- Limit the amount of waste protein reaching the large intestine of which the final product will be ammonia (toxic).

TO SUM UP

The horse is a monogastric herbivore presenting the following characteristics:
• **The mouth:** very effective mastication;
• **The stomach:** small in size, fast transit, and a gastric flora producing abundant lactic acid;
• **The small intestine:** brief but intense enzymatic digestion;
• **The large intestine:** very developed, prolonged action of the cellulytic flora;
• **Average time of the digestive process =** 30h.

OSTEO-ARTICULAR PHYSIOLOGY



THE GROWTH

DEFINITION

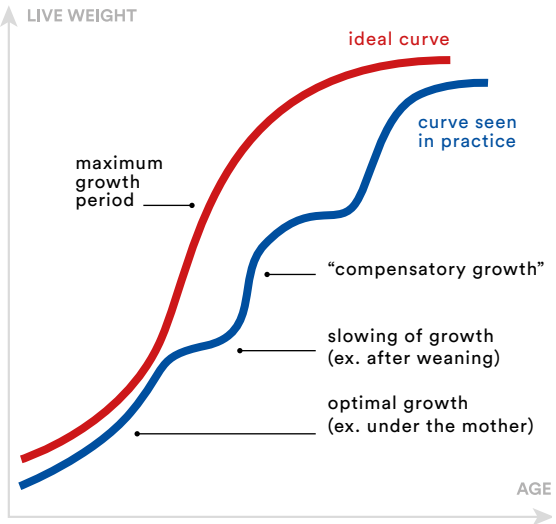
Quantitative evolution: an increase of the live weight with age, characterised by an average daily live weight gain (**DLG**) (expressed in grams per day).

PARTICULARITIES OF THE HORSE

- A high birth weight;
- A very high growth potential during the first 2 to 3 months of age (at its maximum around the age of 3 months);
- Fast growth up to the age of one year.

GROWTH CURVE

- The evolution of the weight is sensitive to the **energy level of the ration;**
- There is an interest in **regular weighing**: to shed light onto gross feeding errors.



(Source: WOLTER, 1999)

THE DEVELOPMENT

DEFINITION

• **Qualitative** evolution: the progressive realisation of an adult state by changes in the confirmation, chemical composition and the functions of different tissues and body regions.
• Speed of development: defines **precocity.**
• Characterised by **measurements** expressed in units of length (Height of withers, length of the trunk, width of the chest etc.).

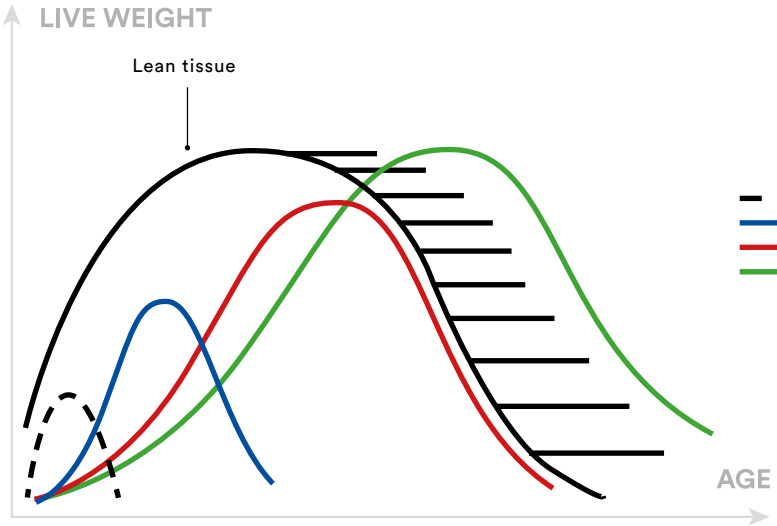
RELATIVE PRECOCITY OF THE DIFFERENT BODY REGIONS

• **« An adult horse is not simply "an enlargement" of an 18 month old youngster or a yearling, no more than a yearling is a bigger version of a foal at weaning (source: Capitain et al, 1976) ».**

• Each body region goes through its maximal development at a given age.
• Development of height › length › width.

RELATIVE PRECOCITY OF DIFFERENT TISSUES

• Development delayed in time.
• Development of the **nervous system › bones › muscles › fat.**
• Fat is laid down as soon as the level of energy being ingested Outweighs the possibility of development by the tissues.
• Variation factors:
- **Genetic determination:** breed, bloodline, sex etc.;
- Feeding: availability and balance of **indispensable nutriments (notably proteins (lysine), vitamins and minerals).**



The nervous system
Bones: head, canon, tibia, femur, pelvis, shoulder
Muscles: neck, limbs, rump, back, chest
Fatty tissues: peri-renal, intermuscular, sub-cutaneous, intramuscular

(Source: WOLTER, 1999)

KEY PERIODS OF GROWTH AND

FOAL UNDER THE MOTHER
(0 TO 6 MONTHS OLD)

MILK PRODUCTION
● At its maximum around 2 to 3 months, then diminishes from 3 months onwards: the energy requirements of the foal will therefore not be totally covered by maternal milk, so there is a risk of a retarded growth.

IN PRACTICE
Necessity of complementary feeding = FOAL.

FEEDING TRANSITION
● The digestive system of the foal must gradually become used to feedstuffs of vegetable origin provided by the complementary feed.

IN PRACTICE
Necessity of complementary feeding = FOAL.

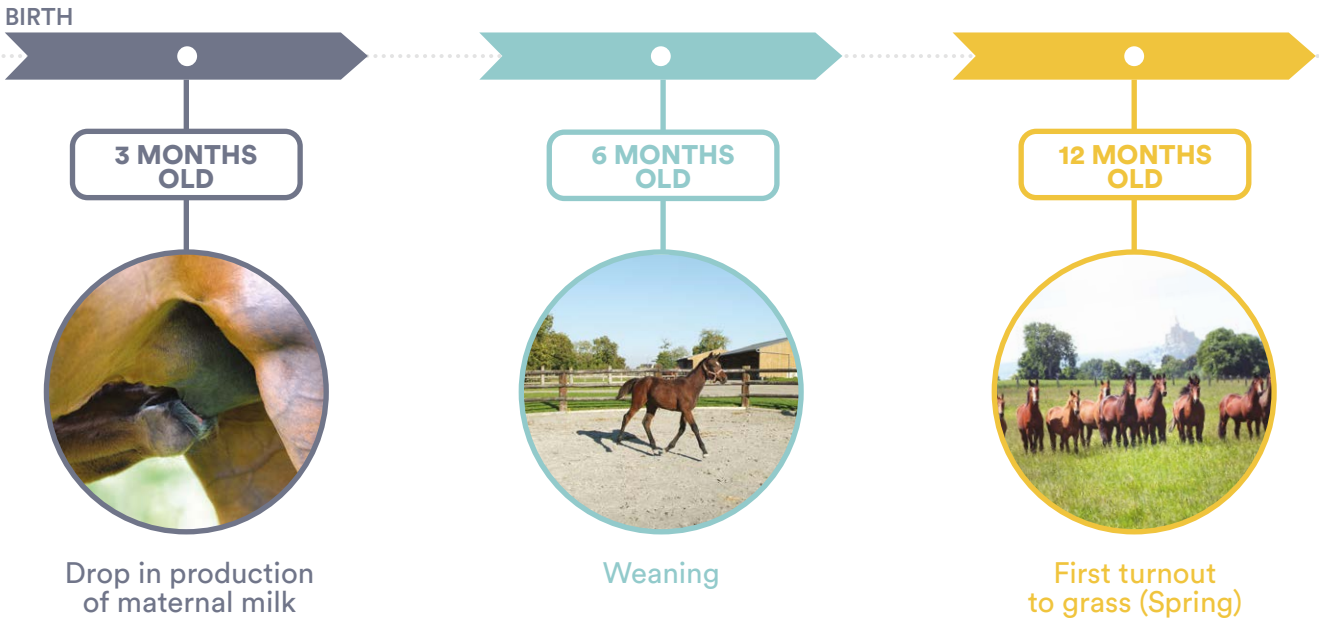
THE WEANED FOAL
(6 TO 12 MONTHS OLD)

WEANING = A CRUCIAL EVENT
● A badly prepared weaning can cause a "growth crisis" which may, or may not, be caught up by "compensatory growth";
● The date of weaning depends on the individual aptitude of the foal, and circumstances;
It becomes possible as soon as:
- The bodyweight is sufficient (for example a minimum of 225 kg for thoroughbreds;
- The foal is eating sufficient feed: approximately 2 litres a day of FOAL in two meals minimums.

IN PRACTICE
Delay weaning if the foal is weak and not eating enough feed.

Bring forward weaning if the foal is being artificially fed (bottle/bucket fed), or if the mother is short of milk.

AFTER WEANING
• If the forage being distributed contains a good level of protein it is possible to change feeds around the age of 7 to 8 months = BREEDING;
• However if the forage has low protein content, or if we wish to maximize the growth and development capacities of the foal, continued feeding of FOAL during the entire first winter is advised.



OSTEOCHONDROSIS
(Caure et lebreton, 2004/pagan et al. 2001/Robles et al., 2017, 2018)

It's an osteoarticular problem of multi factorial origin: the genetic and the environment (feeding, living conditions, etc.). From a nutritional viewpoint, respecting a few rules can help contribute to its prevention:
• In broodmares, during late pregnancy (last trimester):
- Ensure that protein, calcium, phosphorus, magnesium, trace elements (copper notably) and vitamin requirements are met;
- Avoid exceeding energy requirements (overfeeding), notably with highly digestible starch sources (wheat, oats, flaked cereals, etc.) That favor obesity and which are susceptible to result in hormonal unbalances (increase in the secretion of insulin, etc.) Which disturb the metabolism and the osteoarticular development of the foetus in utero* and at longer term.

DEVELOPMENT IN THE FOAL

YEARLING
(12 TO 24 MONTHS OLD)

FIRST TURNOUT TO GRASS (SPRING)
● The young spring grass is a potential menace to the yearlings' digestive system; it can disrupt the growth curve.

IN PRACTICE
Continue to make hay available and reduce the quantity of BREEDING fed whilst grass is abundant.

PREPARATION FOR YEARLING SALES
- Objective: m aximize muscular-skeletal development in the young horse;
- A specific feed = SALES PREP;
- Beware of overfeeding!

2 - 3 YEARS
(24 TO 36 MONTHS OLD)

BREAKING AND PRE-TRAINING
- An increase in energy requirements in proportion to muscular effort;
- Continued growth and development.

IN PRACTICE
Adjust quantity of feed according to work.

Maintain a high level of protein in the diet until the age of 24 months, or even 30 to 36 months for late developing big horses, for whom growth and development continues for longer after birth = BREEDING.

Change feed as soon as the protein requirements for growth decreases (around 24 months old) = food of the ADULT range to choose according to the activity and the discipline practiced (ADULT ENERGY, ADULT SCIENCE ENERGY, TRAINING or RACING).

18 MONTHS OLD

Auction Sales

24 MONTHS OLD

Breaking and Pre-training

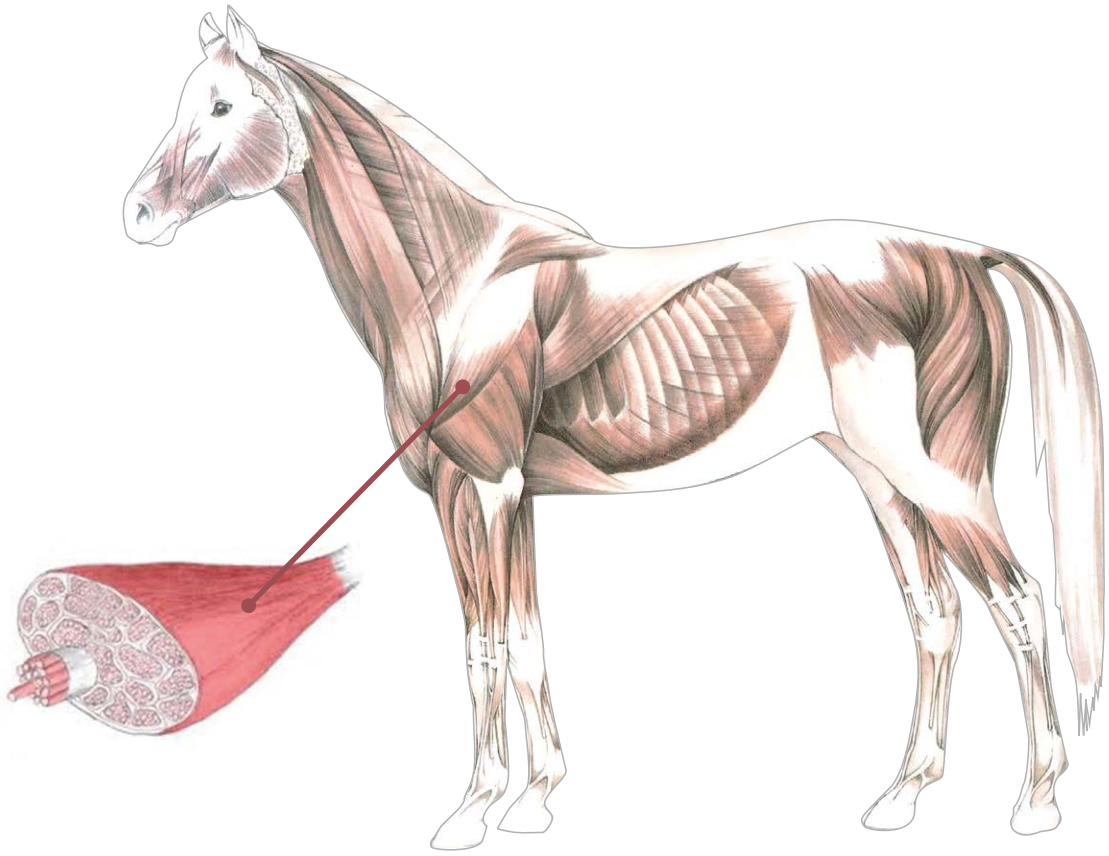
36 MONTHS OLD

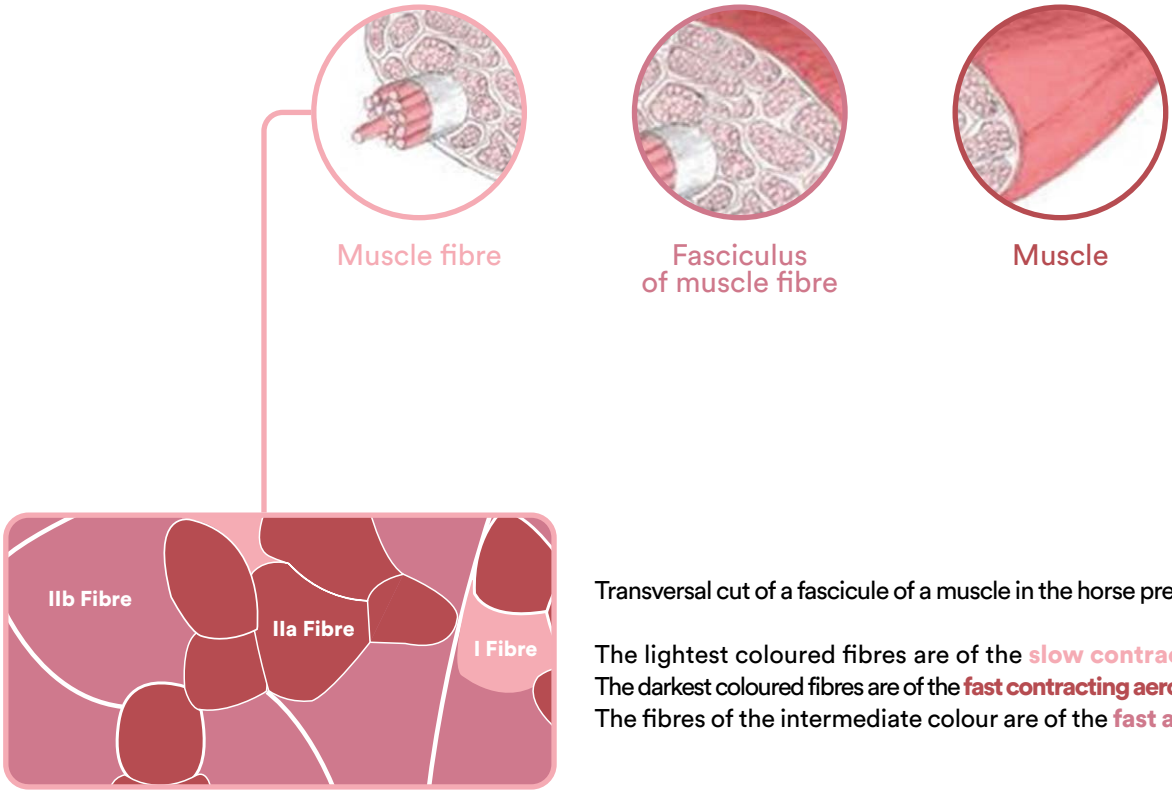
Breaking-in a riding horse

- In the foal (principally from birth up until the age of 12 months):
  - Make sure the foal receives sufficient good quality colostrum at birth: this contains growth factors beneficial to good osteoarticular development;
  - Make sure an optimal cover of protein, calcium, phosphoris, magnesium, trace elements (copper especially) and vitamins;
  - Avoid exceeding energy requirements (overfeeding), notably with highly digestible starch = evaluate body condition on a regular basis (presence of fatty tissues, etc.).

* In utero = while in the uterus of the mother

MUSCULAR PHYSIOLOGY





Transversal cut of a fascicule of a muscle in the horse prepared by colouration.

The lightest coloured fibres are of the **slow contractile (type I)**.
The darkest coloured fibres are of the **fast contracting aero-anaerobic (type IIa)**.
The fibres of the intermediate colour are of the **fast anaerobic (type IIb)**.

DETAILED MUSCLE ORGANISATION

BREED/SPECIES	TYPE I FIBRES	TYPE IIa FIBRES	TYPE IIb FIBRES	TYPE IIa + TYPE IIb
Quarter horse	9	51	40	91
Thoroughbred	11	57	32	89
Arabian pure-bred	14	48	38	86
Trotter	21	52	27	79
Man	62	34	4	38

Types of muscle fibres depending on breed (in total %) (Source: Snow and Valberg 1994)

TYPE I MUSCLE FIBRES

These fibres have great ability to use oxygen (**aerobic**) and have a **good energetic yield**: the combustion of substrate (**lipids**) is complete, without waste.

The preferred use of lipids spares glycogen and bestows an aptitude for prolonged effort.

These fibres **do not tire easily** but the speed at which they contract is **slow.** That limits the intensity of work produced. Therefore, they are used in priority at walk and are suited for **endurance** (long, slow) efforts.

TYPE IIa MUSCLE FIBRES

These fibres are intermediary, they contract quickly but are fairly economic in glycogen (good aerobic metabolism). The burning of carbohydrates is more or less complete, without any accumulation of lactic acid.

The energetic yield is **excellent** (moderate heat loss).
They are suited to intense prolonged efforts such as **long sprints**.

These fibres are responsible for the **maintenance of speed** (**staying power**). They also are of primordial importance to **thoroughbreds** and to **french trotters** running capacities over classic distances of approximately 2,500 metres.

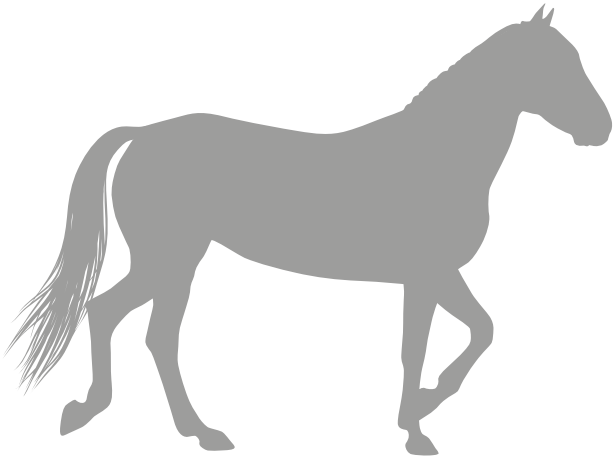
TYPE IIb MUSCLE FIBRES

A large quantity of **carbohydrates** is burnt in the almost total absence of oxygen (anaerobic).
The combustion is then incomplete and results in the production of **lactic acid,** which accumulates in the muscle cells.

The **energetic yield** is therefore **mediocre** (important thermal losses).
Since these fibres are the largest and have a very fast speed of contratction for efforts requiring **power** and short **sprints**.

These fibres are largely responsible for **innate speed** and are decisive for the **quarter horse breed**, performing races of 400 metres.

WORK OF MUSCLES DEPENDING ON THE PACE

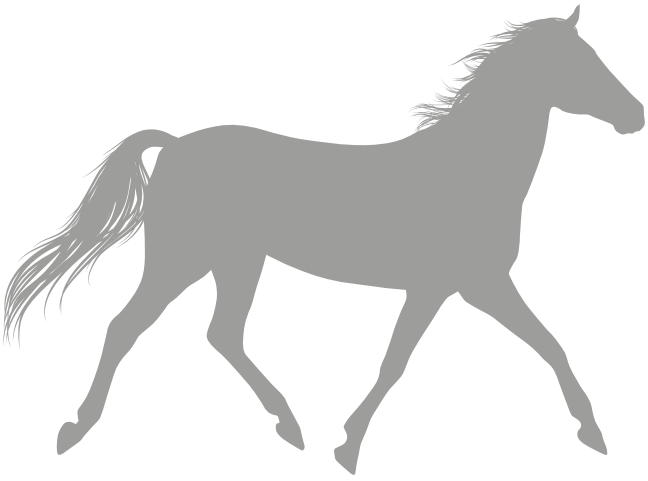


WALKING

● The muscles contract very slowly. The type I fibres are recruited in priority and uniquely generate energy **aerobically**.

● At this speed, the muscles burn mainly **fats**. The reserves are plentiful, their mobilisation and metabolism are fairly fast and are sufficient to regenerate energy used while walking.

IN PRACTICE
It is necessary to provide lipids yo horses that are trained in fast walking (endurance horses).
Fast walking is useful when reintroducing overweight horse into work.
It can also be beneficial for the osteo-articular system, especially if it has not been really used for a while.

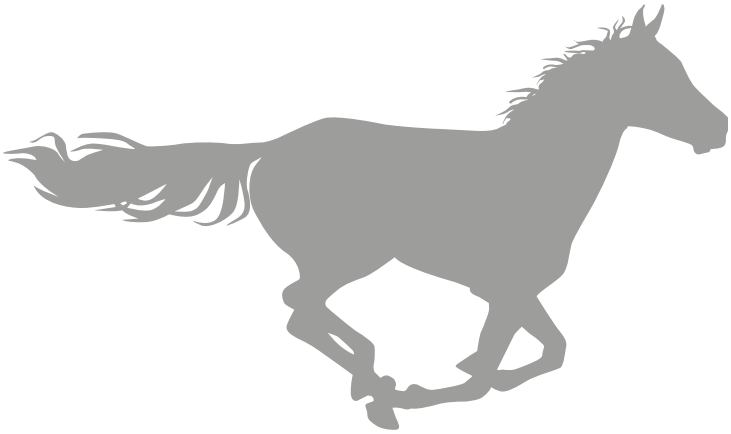


TROTTING AND CANTERING

● Type I fibres alone cannot contract fast enough to propel the horse, so **type IIa fibres** are recruited. They are in majority **aerobic** but use a **mix** of **glycogen** and **fats** to generate energy.

● Glycogen (or glucose): provides aerobically produced energy at twice the speed of lipids. It is mainly used when speed is increased.

IN PRACTICE
Carbohydrates should be added to the ration, especially in the form of starch. Indeed, this is the best energy source for the synthesis of glycogen as its digestion leads to an increase in the glycaemia and the insulinaemia Those are two of the most important parameters involved in the synthesis of glycogen (Pagan and al., 1998).
You need to proviede a part of lipids in the ration. They will be mainly used on the days of quiet exercise (slow and moderate speed). They allow a partial sparing of muscle glycogen reserves for the days of intense exercise.



VERY FAST TROTTING AND GALLOPING (SPRINTING)

● **Type IIb fibres** are also used. At this speed, energy is not uniquely produced aerobically.
Only the important combustion of carbohydrates without oxygen (**anaerobic glycolysis**) allows the generation of sufficient energy to maintain this speed.

● Disadvantage: the **production** and **accumulation** of **lactic acid** causes the intramuscular pH to drop which will be responsible for the appearance of muscular **fatigue**.

IN PRACTICE
It is really important to provide starch in the ration. It represents an ecvellent energy source for the synthesis of glycogen

WORK OF MUSCLES ACCORDING TO THE DISCIPLINE

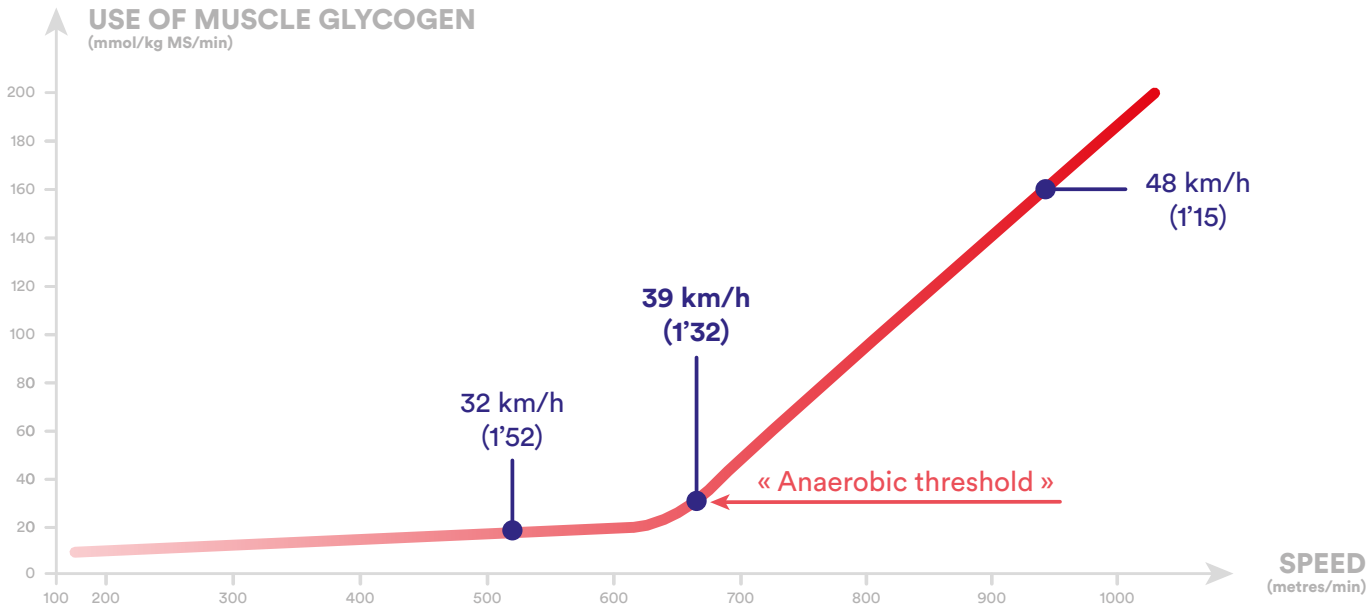
CONCEPT OF ANAEROBIC THRESHOLD

ENDURANCE EFFORT (12-19 KM/H)

Low use of muscular glycogen = the rest of required energy is produced by fat oxidation.

FASTER EFFORT

When speed increases, the use of muscular glycogen equally increases.
From a certain speed (as you can see on the graph below), the majority of energy production can no longer be assured aerobically: the horse reaches his "**anaerobic threshold**" or "fatigue threshold".
From this point onwards an important place is held by anaerobically produced energy, from where, there is **an exponential increase in the use of glycogen** and **an accumulation of lactic acid**. The horse enters into the "**red zone**".
Following this, muscle tiredness is rapidly felt: the effort cannot be sustained for a long period.
The brutal increase in the **consumption of glycogen** is caused by the recruitment and use of an **anaerobic metabolism** which has an **energetic yield 12 times inferior** of that of the aerobic metabolism.
The result is the production of a waste product responsible for the appearance of muscular fatigue: **lactic acid**.



INTERPRETATION OF TH GRAPH (PAGAN, 1998)

This shows the amount of muscular glycogen used per minute according to the speed of the horse.
This data was collected after different races (averages).
You can note that as longas the horse remains below 39km/h (1min32 sec per km), a very small amount of glycogen is used.
However, as speed increases the horse approaches his "**anaerobic threshold**".
From this point onwards, **glycogen is consumed in an exponential way**.

RACEHORSES

- Anaerobic threshold:
  - Unique to each horse: the point at which it reaches the “red zone”;
  - **The later the anaerobic threshold appears during effort, the better the horse.**
- The appearance of tiredness is caused by the accumulation of lactic acid.
- The aim of training is to delay to a maximum this threshold. To do, this we must **trigger a conversion of type IIb fibres into IIa fibres as shown by Essen and Lindholm (see the table).**
- The main principales of training are:
  - Work on stamina: long and slow exercise that increase the cardio-vascular and bio-mechanical effectiveness;
  - Increasing the aerobic capacity: work at slower speeds but approaching the anaerobic threshold;
  - Reinforce the aerobic power (stamina and resistance): work around the anaerobic threshold;
  - Stimulate the anaerobic power and the tolerance to lactic acid: repeated short exercises (interval training) which more or less exceed the anaerobic threshold.

LEVEL OF PERFORMANCE/TYPE II FIBRES	TYPE IIa FIBRES	TYPE IIb FIBRES
Excellent level (n=12)	58	15
Average level (n=12)	49	26
Sedentary (n=12)	41	35

TABLE (ESSEN ET LINDHOLM, 1985)

The authors have shown that the performance of American trotters running mainly over 1,600 meters is correlated to the distribution of type II muscle fibres.
Indeed, **the best horses in the study had a greater proportion of type IIa muscle fibres**.

ENDURANCE HORSES

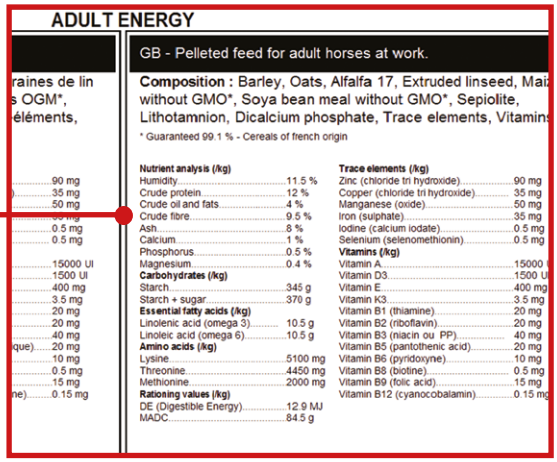
- Movement is nearly always maintained **aerobically produced** energy. Sometimes, energy requirements can exceed the capacity for aerobically produced energy.

Example: slopes or accelerations over longer or shorter distances.

- **The anaerobic threshold has therefore not the same importance as in the racehorses.**
- The appearance of tiredness is very often the consequence of an **exhaustion of the glycogenic reserves**, thus the importance of providing enough starch in the ration and usig of lipids, wich will preserve the glycogen reserves.
- Principal objectives of training:
  - **Increasing the efficiency of aerobic energy production**, notably by **increasing** the relative part of type I fibres by long and slow work sessions (fast walking, trotting);
  - **Improving cardio-respiratory and bio-mechanical effectiveness, and also bones solidity** by faster work sessions (canter) and/or on slopes.

FIBRES

CRUDE CELLULOSE



ADULT ENERGY

GB - Pelleted feed for adult horses at work.

Composition : Barley, Oats, Alfalfa 17, Extruded linseed, Mai without GMO*, Soya bean meal without GMO*, Sepiolite, Lithotamnion, Dicalcium phosphate, Trace elements, Vitamin

* Guaranteed 99.1 % - Cereals of french origin

Nutrient analysis (/kg)	
Humidity	11.5 %
Crude protein	12 %
Crude oil and fats	4 %
Crude fibre	9.5 %
Ash	8 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.4 %
Carbohydrates (/kg)	
Starch	345 g
Starch + sugar	370 g
Essential fatty acids (/kg)	
Linolenic acid (omega 3)	10.5 g
Linoleic acid (omega 6)	10.5 g
Amino acids (/kg)	
Lysine	5100 mg
Threonine	4450 mg
Methionine	2000 mg
Rationing values (/kg)	
DE (Digestible Energy)	12.9 MJ
MADC	84.5 g

Trace elements (/kg)	
Zinc (chloride tri hydroxide)	90 mg
Copper (chloride tri hydroxide)	35 mg
Manganese (oxide)	50 mg
Iron (sulphate)	35 mg
Iodine (calcium iodate)	0.5 mg
Selenium (selenomethionin)	0.5 mg
Vitamins (/kg)	
Vitamin A	15000
Vitamin D3	1500 U
Vitamin E	400 mg
Vitamin K3	3.5 mg
Vitamin B1 (thiamine)	20 mg
Vitamin B2 (riboflavin)	20 mg
Vitamin B3 (niacin ou PP)	40 mg
Vitamin B5 (pantothenic acid)	20 mg
Vitamin B6 (pyridoxyne)	10 mg
Vitamin B8 (biotine)	0.5 mg
Vitamin B9 (folic acid)	15 mg
Vitamin B12 (cyanocobalamin)	0.15 mg

The majority of the feeds in the REVERDY feed range are **complementary to forage**. They are mixtures of raw ingredients, vitamins and minerals. Their first objective is to provide the essential nutriments that are lacking in forage, thus meeting the individual nutritional requirements of different productions (muscular efforts, growth, lactation etc.).
Except for a few individual cases, **the aim of our feeds is not to supply fibres because they are already present in forage. This chapter on fibres is therefore dedicated to the different types of forage available (grass, hay etc.) rather than the range of REVERDY feeds.**

"CRUDE CELLULOSE"

Determined from an **analysis method** (Weende technique), that is more than a century old and imperfect because too powerful. Indeed, this method consists in dissolving a part of the fibres, and therefore underestimates the amount of vegetable **"wall"**. It is actually 2 to 4 times higher (Inra, 2004). Furthermore, it makes no distinction between the different types of fibres.

Conclusion: The method mainly interprets the concept of insoluble fibres, and neglects almost completely the soluble ones.

Horses have evolved for millions of years on **vast grassy plains**. Their digestive system has evolved by being in contact with this environment. A **microbial flora** has been progressively constituted, Thanks to which they can digest a high amount of fibres.
Over time, horses have conserved this **ability to digest important quantities of forage** to cover their nutritional needs.

Nowadays, the feeding of horses with significant amounts of cereals and supplements in order to optimize their growth and performance has too often led us to forger the importance of forage in the horse's diet.

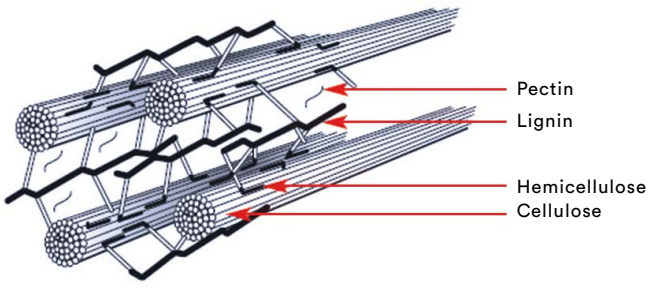
DEFINITION

DIFFERENT TYPES OF FIBRE

Plant walls are made of fibres resistant to the digestive enzymes produced by the horse.
We can distinguish two types:

- **Insoluble fibres = cellulose, hemicellulose** and **lignin**. They are found in hay, in straw and in more or less quantity in REVERDY feeds in the form of lucern (alfalfa), oats, wheat straw, etc.;
- **Soluble fibres = Pectin, mucilage, gums, etc.** They are present in REVERDY feeds in the form of extruded linseed (mucilage), carrots or dried chicory pulp (pectin), etc.

STRUCTURE AND COMPOSITION OF A PLANT WALL



DIFFERENT FORAGES

The majority of plants represented in forage fed to horses fall into one of two different categories:
- **Grasses** (rye grass, timothy, meadow fescue etc.): the leaves and sheathes are rich in fibres;
- **Legumes** (Lucerne, clover, etc.): miniature trees, the stem is ligneous and resembles a tree trunk.

WARNING

At an equal stage of development, legumes contain **higher levels of protein, energy and calcium** than grasses.
Thus their distribution must be rationed.

NUTRITIONAL INTEREST

MENTAL HEALTH

The horse is a nervous and worrying animal that psychologically needs to feel full. So feeding is an **occupational and tranquillising factor**. A stabled horse can suffer from boredom for a most of the day. This is a major factor in the occurrence of psychological and eating disorders. Feeding horses with forage is a very interesting way to fight boredom especially when placed in **nets.** These latter make the horse to consume his hay little by little, bite by bite. It further prolongs the time of ingestion, and therefore, the time of occupation.

BULK

It is inversely proportional to the digestibility (or the ability to ferment) of fibres. Non-digestible fibres increase the volume of the digestive contents, thus stimulating **intestinal peristalsis (=motility)** and limiting the risks of displacement or even twisting of the numerous intestinal loops. It is therefore a **primordial digestive hygiene** in the prevention of digestive disorders.

THE BUFFER EFFECT OF FORAGE:
A key element in the prevention of gastric ulcers

Acid is continually secreted in the stomach of horses, regardless of whether they are feeding or not. The **high intrinsic buffer ability** of forage associated with the considerable production of saliva that their ingestion engenders allows a **neutralisation of the acid attack**. Grass or hay produces twice the saliva of a cereal feed. If hay is not constantly available to horses, prolonged periods of fasting can occur, notably at night. Fasting leads to a rapid drop in the gastric pH and causes the gastric squamous mucosa to have lengthened exposure to the stomach's acid contents. The acid secretions being continuous, they must be permanently neutralized by saliva, which is rich in bicarbonates, and by the intrinsic buffering capacity of high-fibre forage, and even the calcium in legume hay (lucerne). Thus, when forage is lacking, the continuous acid secretions of the stomach are not tamponed. This leads to a rapid drop in the pH which can cause the forming of ulcers on the squamous mucosa in only a few days. Furthermore, an empty stomach can favour gastric-duodenal refluxes which contain bile acid, when associated with hydrochloric acid, they are extremely corrosive to the non-glandular mucosa.

"FEEDING A HORSE IS FEEDING HIS FLORA"

The horse is a non-ruminant herbivore or fermenter in the large intestine.
The large intestine has a capacity of about 125 litres and shelters billion of enzyme producing bacteria and protozoa which contribute to fibre digestion (fermentation). These microbes are absolutely essential to the horse as he cannot produce the enzymes without them. In return, the ingestion of fibre by the horse is indispensable to the hind gut micro-organisms.
Providing fibres **maintains a beneficial bacterial population which** prevents the proliferation of other bacteria potentially dangerous to the horse.

ENERGY SUPPLY

The nutritive value of forage is determined by:

- Its **fibres content;**
- The **fibres digestibility**, wich is inversely proportional to the degree of lignification (the hardening of the fibre by lignin as the plant ages).

The horse is able to digest practically the totality of forage cell contents, whilst bacterial fermentation can only digest 50% or less of the cell walls.

Thus forage represents an **often neglected energy source in horse nutrition**, as energetically, **2kg of good hay = approximately 1kg of barley**. The microbial flora in the hind gut is capable of producing volatile fatty acids by the fermentation of large quantities of fibre. These volatile fatty acids are able to be used as **a source of energy throughout the day** as ferment reactions continue a considerable time after the ingestion of a ration.

SUPPLY RECOMMENDATIONS

As explained, horses are fermenters in the large intestine. **Any diet that neglects fibre will have unwanted consequences.** Horses whose feeding is deficient in fibre can become, at worst, real 500kg termites capable of destroying the separations and doors of their stables.

THEORETICAL RECOMMENDATIONS

Fibre requirements are normally expressed as **crude fibre**. The minimum daily requirements are estimated at **15-18%** of the total ration (concentrates and forage).

PRACTICAL RECOMMENDATIONS

For Stabled horses, forage should ideally be provided **ad lib, in the form of grass hay**. If this is not possible the following is suggested:

- you should use **straw bedding**. This practice prevents fibre deficiency with all its ensuing consequences.

NB: Apart from a few cases of horses suffering from chronic digestive disorders (adhesions, perturbed microbial flora with aerophagia, ballooning, etc.), straw is readily accepted by horses if they have constant access. On the contrary, if they have only punctual access, they can go at it with voracity and declare colic due to an impaction of straw in one of the loops of the colon.

- You should provide **hay several times a day**. The recommendations go from 1 to 2kg for 100kg live-weight per day except for lactating broodmares and young growing horses for whom the daily ingestion can reach up to 2.5kg per 100kg live-weight.

Horses' good health is directly related to the amount of fibres they receive. we recommand that you provide **at least 1.5kg of hay per 100kg live-weight per day**, thus a minimum of 7.5kg of hay for a 500kg horse.

ABOUT REVERDY NATURAL FIBRES

This is an extremely high quality product composed from **additive free, dehydrated, chopped, and compacted grass**. Not only practical, this presentation allows **fibres to be added to the concentrate feed**. This practice is of interest on several levels:

- To start with, consuming hay at the same time as the concentrate ration will have a **positive effect, notably on starch digestibility,** as long as the quantity of hay consumed stays moderate (less than 400g dry matter per 100kg live-weight per feed). This valorisation of the concentrate ration is **improved when the hay is given chopped** rather than in long strands;
- Next, adding fibres to the ration **slows ingestion** by lengthening chewing time and increasing at the same time **saliva production**, a natural buffer for gastric acidity. Consequently adding 1 to 2 handfuls of REVERDY NATURAL FIBRES is judicious for horses that eat quickly and/or suffer from gastric ulcers.

“Feeding a horse is feeding his flora”

GRASS IS NOT THE PANACEA

(source: Wolter, 1999)

QUANTITATIVE ASPECT:

Grass production is very unequal and adjusts badly to the requirements of the horse.

- **In the spring it is too abundant**, even for mares with foals.
- **In the summer it is insufficient**, with a risk of accelerating the drop of milk production by mares and of exaggerating the feeding of young foals under the mother.

QUALITATIVE ASPECT:

It is in constant evolution and passes by an optimum fleeting. The young spring grass can be problematic at several levels:

- The **high water content** "encumbers" the stomach and leads to **early satiety**. This limits the total dry matter consumption, which increases the risk of an appearance of underfeeding.
- The **excess of non-complex nitrogen (non-protein)** associated with mineral unbalances (excess potassium, deficient in magnesium and sodium) and an absence of a fibrous (cellulose) structure reduces mastication and can lead to **diarrhoea at first - to grass turn out**. These are at the origin of high sodium and trace element (notably in copper) faecal losses.
- The **Richness in fructans**, complex sugars made from units of fructose that are not digested in the small intestine (absence of suited enzymes) but fermented in the large intestine, leads to the production of large quantities of volatile fatty acids and lactic acid. The **consequences** can be **the same as those associated with an excess of starch** arriving in the large intestine (diarrhoea, weight loss, laminitis, etc.).

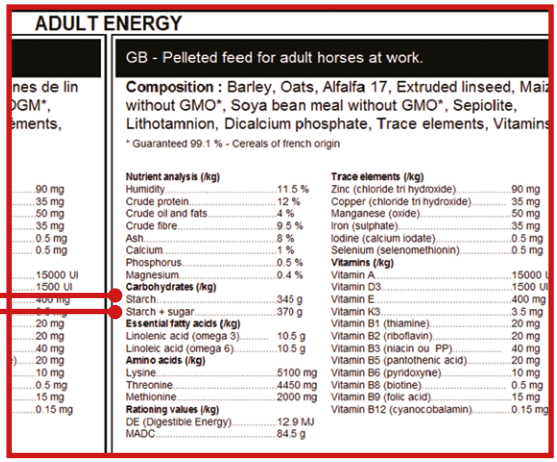
CONSEQUENCES:

- It is not surprising that in **regions where young grass generously unites these elements** (for example the Pays d'Auge valley in Normandy, France) that horses lose condition when first turned out. Therefore it is strongly recommended to **continue to provide ad-lib hay (or straw)** at the beginning of spring even if the growth of grass seems luxuriant and lush. This will allow the horse to meet his requirements in fibre without overloading elsewhere in nitrogen, fructans or potassium for example.
- On the contrary **very mature grass** is rich in insoluble fibres, therefore **not very digestible** while it is **largely depleted** in protein, phosphorus, trace elements, carotene etc.
- Even at the **most desirable stage of growth** (heading of grasses, and flowering for legumes), the composition of the grass is tributary to its botanical nature, the climate, and the quality of the soil. But systematically it appears deficient in at least **sodium, zinc, copper**, if not in **iodine** and **selenium**. Thus we should not be surprised by frequent alterations in mare fertility and bone development in youngsters, etc.


REVERDY

STARCH

STARCH
STARCH + SUGAR


ADULT ENERGY

GB - Pelleted feed for adult horses at work.

Composition : Barley, Oats, Alfalfa 17, Extruded linseed, Maiz without GMO*, Soya bean meal without GMO*, Sepiolite, Lithotamnion, Dicalcium phosphate, Trace elements, Vitamins

* Guaranteed 99.1 % - Cereals of french origin

Nutrient analysis (/kg)	
Humidity	11.5 %
Crude protein	12 %
Crude oil and fats	4 %
Crude fibre	9.5 %
Ash	8 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.4 %
Carbohydrates (/kg)	
Starch	345 g
Starch + sugar	370 g
Essential fatty acids (/kg)	
Linolenic acid (omega 3)	10.5 g
Linoleic acid (omega 6)	10.5 g
Amino acids (/kg)	
Lysine	5100 mg
Threonine	4450 mg
Methionine	2000 mg
Rationing values (/kg)	
DE (Digestible Energy)	12.9 MJ
MADC	84.5 g

Trace elements (/kg)	
Zinc (chloride tri hydroxide)	90 mg
Copper (chloride tri hydroxide)	35 mg
Manganese (oxide)	50 mg
Iron (sulphate)	35 mg
Iodine (calcium iodate)	0.5 mg
Selenium (selenomethionin)	0.5 mg
Vitamins (/kg)	
Vitamin A	15000 U
Vitamin D3	1500 UI
Vitamin E	400 mg
Vitamin K3	3.5 mg
Vitamin B1 (thiamine)	20 mg
Vitamin B2 (riboflavin)	20 mg
Vitamin B3 (niacin ou PP)	40 mg
Vitamin B5 (pantothenic acid)	20 mg
Vitamin B6 (pyridoxyne)	10 mg
Vitamin B8 (biotine)	0.5 mg
Vitamin B9 (folic acid)	15 mg
Vitamin B12 (cyanocobalamin)	0.15 mg

A molecule of reserve energy found in green plants, and stored in its organs of storage (seeds, roots, tubers, rhizomes and certain fruits) that allow the plant to survive during the dormant season. It is one of the principle calorie sources for the human species (cereals, etc.). **Furthermore, it is the primary energy source of the horse during effort and exertion.**

DEFINITION

A complex carbohydrate composed of many glucose molecules. It is the principal component of cereals.

% OF RAW INGREDIENT	STARCH	SIMPLE SUGARS
REVERDY Feeds	1 - 37.5	2.0 - 6.5
Oats	36.2	1.1
Berley	52.2	2.1
Maize	64.1	1.6

Table: The levels of starch and simple sugars found in cereals suitable for the horse. The levels found in the REVERDY range are given for comparison purposes only (Source: INRA, 2nd edition, 2004).

USE

Starch is a **versatile energy source** for the athletic horse. In the small intestine it is split into units of glucose which are then passed into the bloodstream. It can be used in different ways:

- Oxidised in order to directly produce energy;
- Stored in the form of muscle and hepatic glycogen or as lipids.

"[Starch] is the best energy source for the synthesis of glycogen as its digestion leads to an increase in the glycaemia* and the insulinaemia* Those are two of the most important parameters involved in the synthesis of glycogen**".**
(Pagan et al. 1998)

*Glycaemia = The concentration of glucose in the blood (blood sugar level)
* Insulinaemia = The concentration of insulin in the blood

Muscle glycogen is an important fuel:

- **It produces energy during effort** which favours performance;
- **It is stored in the liver**: it will then be used to produce glucose, which will be liberated into the bloodstream during work. This is essential, because glucose is the only fuel available to the central nervous system.

This regulation **helps prevent against the appearance of hypoglycaemia during exertion** which can be a potential cause of sudden tiredness.

FACTORS INFLUENCING STARCH DIGESTIBILITY

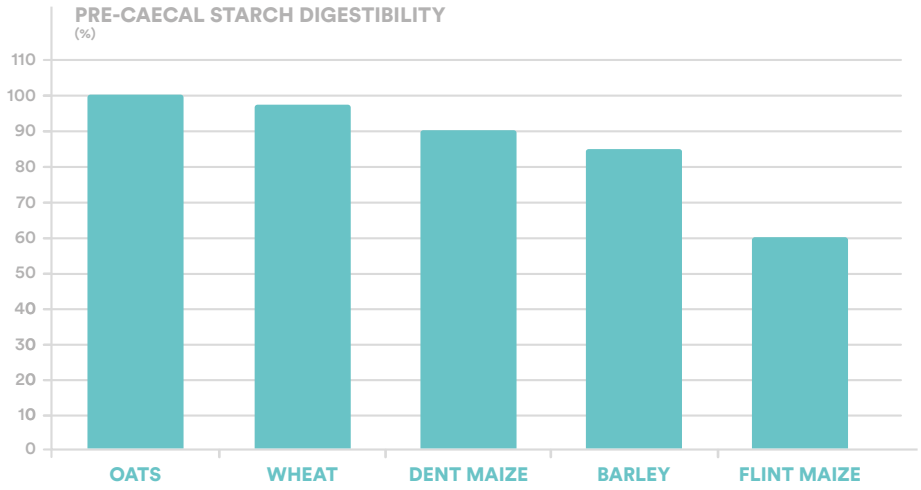
SOURCES OF STARCH

Even though all starches are constituted of glucose chains, **the way in which a molecule of starch is constructed varies greatly from one cereal to another** (the ratio amylose*/amylopectin*, nature of the endosperm* etc.). This difference in the architecture of different types of starch has an important impact upon the way in which it will be digested in the small intestine of the horse.

Amongst all the most commonly fed cereals to horses, **oats contain the most digestible form of starch followed closely by wheat, then comes barley and maize**. The digestibility of the starch contained in the latter depends on the variety of maize used (cf. the graph). Late varieties (dent maize) which are majoritarian in animal nutrition and used in our feeds, **contains a more digestible form of starch** than early varieties (flint maize). Furthermore, varieties containing a starch poor in amylose have greater digestibility. Thus, the **Waxy variety** of maize whose amylose content is close to 0% presents **superior digestibility to starch from dent maize varieties** which contain on average 25% amylose. Associated with flaking, Waxy maize provides very digestible starch.

PRE-CAECAL STARCH DIGESTIBILITY DEPENDING ON BOTANICAL TYPE

(Source: Jevardat de Fombelle et al., 2003)



***Amylopectin**: Branched chain of glucose molecules. It makes up 70 to 85% of starch. It is the most digestible form of starch which is responsible for the gelatinisation.
***Amylose**: Linear chain of glucose molecule taking a helical structure. It represents approximately 15 to 30% of starch composition knowing that the more amylose there is, the less the starch is digestible.
***Endosperm**: Plant tissue that is a nutritive reserve containing carbohydrates (starch) and proteins. Along with the embryo (germ) it makes up the centre of the seeds.

TECHNOLOGICAL TREATMENTS

We are able to distinguish many types:

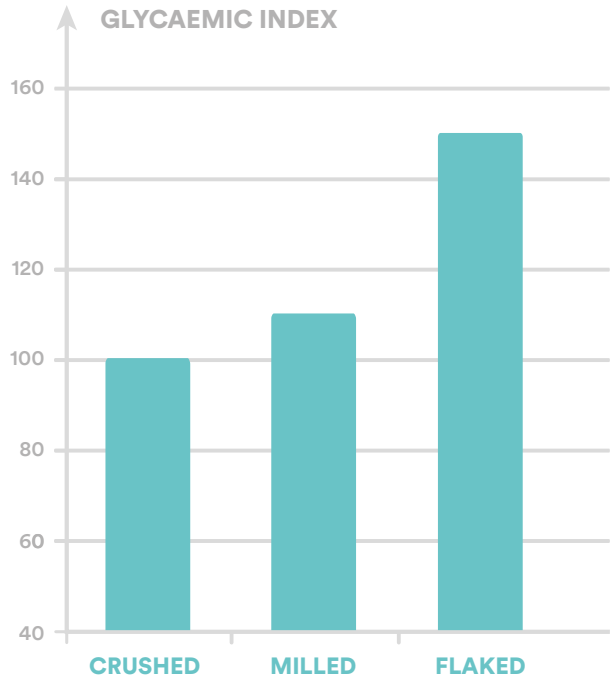
- **Mechanical**: grinding, rolling, crushing;
- **Thermic**, using dry heat: toasting, expansion, extrusion;
- **Thermo-mechanical** using a humid heat: flaking and granulation (to a lesser extent).

Their objective is to increase starch digestibility in the treated cereals. They are above all of interest in cereals possessing less digestible starch (maize and barley). Oat and wheat starch being already very digestible, technological treatments have little effect on their pre-caecal* digestibility.

Flaking is commonly employed in horse nutrition, it corresponds to a flattening and a steam cooking which leads to hydration and a partial predigesting of the starch = gelatinisation. In the case of maize starch, **flaking significantly increases its digestibility and therefore its glycaemic index** (cf. graph), a parameter that we shall now examine.

GLYCAEMIC INDEX OF MAIZE DEPENDING ON TREATMENT PROCESS

(Source: Hoekstra et al., 1999)



***Pre-caecal**: The parts of the digestive tube situated before the caecum (large intestine) = the stomach and small intestine

GLYCAEMIC INDEX (GI)

DEFINITION

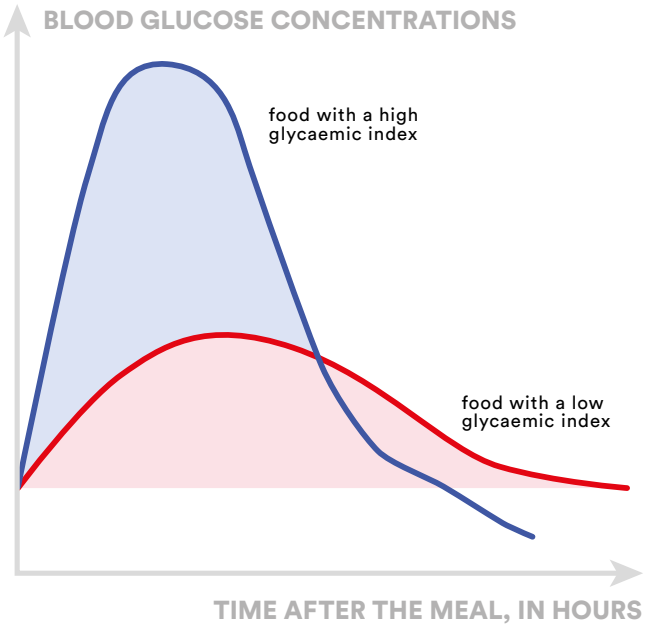
The glycaemic index is a system used to **classify food stuffs according to their effect on the glycaemia**.

Created by Canadian scientists at the beginning of the 1980's, it compares the exact quantity of carbohydrates available in each food, providing a numeric index based upon the glycaemia after a meal.
Initially development for human use, it has since been modified and recognised as being reliable for horses.

From a practical point of view, **it characterises the enzymatic digestibility of a carbohydrate source in the small intestine**:

- Feed sources that contain the most soluble carbohydrates, and that divide quickly during digestion have the highest glycaemic indexes;
- Those feed sources which contain the least soluble carbohydrates and who liberate very progressively glucose into the bloodstream (slowly digested) have the lowest glycaemic indexes.

EVOLUTION OF THE GLYCAEMIA AFTER A FEED DEPENDING ON THE GI OF FOOD



Whole maize grains, Ground maize, Flaked maize.

THE GLYCAEMIC RESPONSE AND HEALTH OF THE HORSE

The digestive system of the horse is adapted to having **many small meals throughout the day**; this corresponds to a life of grazing and browsing in a field. This type of diet leads to low glycaemic responses, even more so if the ingested foods have low glycaemic indexes (forage etc.). Furthermore, a very low glycaemic response is supposed to bring about a very low demand for insulin, so resulting in a **better long term stability of the glycaemia**. Thus the risks of fluctuations in the glycaemia and insulinaemia are diminished.

PATHOLOGICAL STATES RELATED TO/OR AGGRAVATED BY HIGH GLYCAEMIC INDEXES

The increase of the glycaemia following a meal leads to insulin being secreted into the blood, this hormone allows glucose to enter cells in order for it to be either used, or stored in the form of glycogen in the muscles and liver. Simplistically, one would think that the greater the digestibility of the starch, the better it is for the horse. However, in the case of starch, the adjective **"digestible" is synonymous with "fermentable".** Indeed, a starch easily digested in the small intestine is likely to be more easily fermented by the microorganisms (lactic flora) of the stomach. Secondly, **"digestible" says high glycaemic index**.

Thus, a ration with a high GI index is likely to lead to metabolic and digestive disturbances with more or less serious short and long-term consequences. The most frequent are summed up below :

● EXCESS FAT

The higher the glycaemic peak, the more insulin is secreted and greater is the quantity of glucose entering the cells. **In this case, part of the glucose cannot be stored in the form of glycogen. It will be transformed into fatty acids** which will then be stored in the adipose cells that constitute the fatty tissues situated at different places in the organism (under the skin, in the abdominal cavity, etc.). Therefore, the higher the glycaemic index of a carbohydrate, the more susceptible it is to promote an unwanted (in the majority of cases) excess of fat.

● BEHAVIOURAL PROBLEMS, EXCITABILITY

Insulin production brings an increase in the blood levels of a neurotransmitter that has an action on behaviour: the **serotonin**. Thus, the higher the glycaemic index of a carbohydrate, the greater will be the quantity of insulin and serotonin produced. It has been shown that a serotonin syndrome is manifested by mental and physical hyperactivity, a disorganisation of behaviour and mood change.
Consequently, the "excitable" properties of oats are not only due to avenin but can be equally explained by its highly digestible starch (this is equally valid for wheat and flaked cereals).

● CHRONIC MYOPATHIES (= "TYING- UP")

Two types exist:

- **Recurring equine rhabdomyolysis ("RER")**, the mechanism responsible for this condition is not fully known. However, it seems to be due to an **anomaly in the regulation of intra-cellular calcium** responsible for muscular contraction (while magnesium helps with muscle relaxation). These muscle cells present a dysfunction in carrying out the contraction – relaxation cycles. Also, during exercise (above all when long and slow) they may produce **excessive muscular contractions**, leading to the destruction of those affected muscle cells. This phenomena happens **mainly in nervous/excitable horses** (2/3 are female), it is logical that high glycaemic index carbohydrates are a predisposing factor (see below);
- **Polysaccharide storage myopathy (PPSM)** is seen less frequently (above all present in Quarter horses who are few in number in France). It is characterised by an excessive **accumulation of glycogen and an abnormal polysaccharide in muscular cells.**

It affects calm horses in good condition. Consequently, it is important to restrict the entry of glucose into muscular cells. Therefore the use of highly digestible carbohydrates is not advisable.

***Serotonin syndrome**: Excess of serotonin in the central nervous system

ABOUT WHEAT...

Including wheat in the diet of horses is **not desirable** for numerous reasons:

- Firstly, as explained by R.WOLTER (1999) “wheat, more than any other cereal, risks forming doughy lumps in the digestive tract because of its richness in gluten”, that is to say to **obstruct the digestive tract** (choke, oesophagus obstruction);
- Furthermore wheat grains contain an important quantity of **very fermentable starch** (common wheat starch = 60.5% crude starch I,NRA, 2004), very degradable and so equally easily digested by the enzymes of the horse.

Consequently, its incorporation into equine feeds is likely to modify different points of the digestion and metabolism of carbohydrates:

- On one hand, it may result in **an increase in gastric fermentations (microbial),** wich can be at the origin of painful distensions of the stomach through the large liberation of gases. Simultaneously the flora will produce an important quantity of lactic acid responsible for the appearance or **aggravation of stomach ulcers;**
- On the other, the high digestibility of wheat starch leads to a **large production of insulin** which can be a cause of harmful disruptions to the horse: **behavioural problems (excitement), muscle metabolism (tying-up) and osteoarticular problems (perturbed growth) etc.**

For all these reasons, we have chosen not to use this cereal.

● GASTRIC ULCERS

The higher the digestibility of the carbohydrate (high GI), the more susceptible it is to be fermented into organic acids (amongst them lactic acid) by the micro-organisms present in the stomach (see the diagram below). Thus lactic acid being aggressive for the gastric mucosa, its production favours the appearance of ulcers.

● OSTEOCHONDROSIS (OCD)

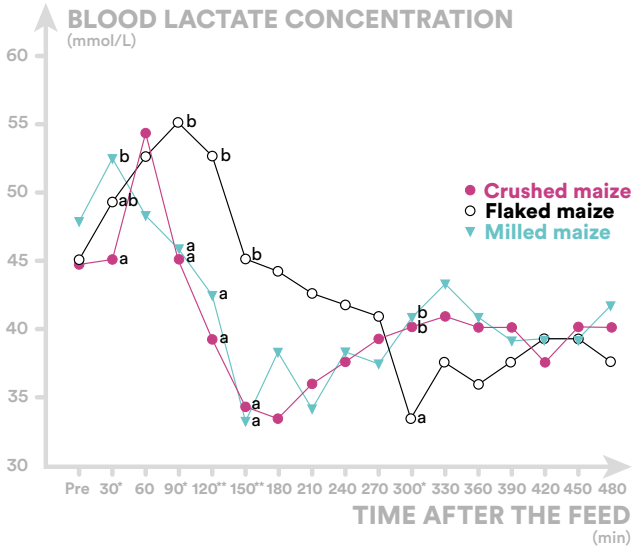
It has been demonstrated that mares producing foals suffering from OCD are statistically those who have, at the end of gestation, shown high insulin discharges after feeds. **Indeed, hyperinsulinaemia can interfere with the growth and development of cartilage cells resulting in :**

- A vascularisation defect of the growth cartilage at the cartilage-bone junction;
- The non replacement of the cartilage matrix by the bone matrix.

Thus, the junction between the cartilage and the bone will become irregular and the persisting cartilage soft and weak. Consequently, feeding high GI indexed carbohydrates to broodmares at the end of pregnancy, or to foals is a predisposing factor (see graph on the right).

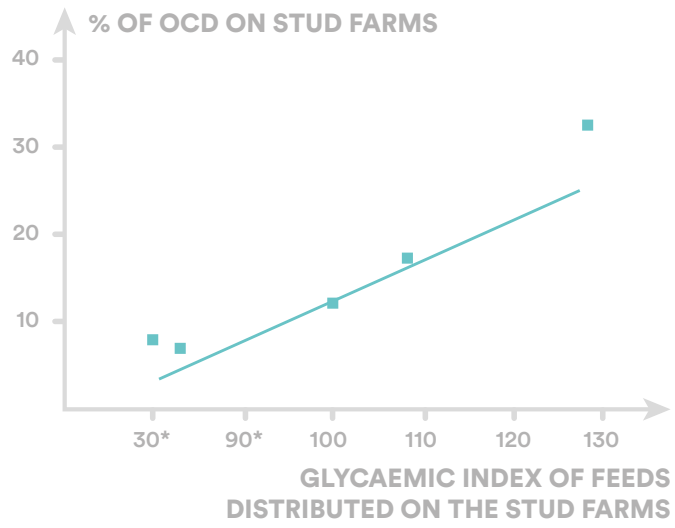
EVOLUTION OF THE BLOOD LACTATE CONCENTRATION AFTER THE FEED DEPENDING ON THE TECHNOLOGICAL TREATMENT UNDERGONE BY THE MAIZE

(Source: Hoekstra et al., 1999)



RELATION BETWEEN THE GLYCAEMIC INDEX OF FEEDS AND OSTEOCHONDROSIS

(Source: Pagan et al., 2001)



... AND FLAKED CEREALS

Flaking is a thermo mechanical procedure in a humid environment which significantly increases the digestibility and therefore the glycaemic index of cereals.Consequently, and even if it is **"the dose that poisons", we advise against the use of flaked cereals for breeding**, in particular for broodmare at the end of gestation and for foals under the mother. **We equally advise against their use in horses that suffer from the aforementioned pathological states**: excess fat, behavioural problems, chronic myopathies, gastric ulcers, Cushing's disease, equine metabolic syndrome and laminitis.

Flaked **cereals do have their interest for specific uses**. Indeed, it is recommended to use them (in moderation) if we wish to:

- Facilitate the digestion of starch, because of :
  - **Insufficient enzymatic secretions** in the senior horse;
  - Large **rations** of cereals in the **horse being worked intensely.**
- Improve body condition: **recover condition following a weight loss, preparing for the sale ring.**

● PATHOLOGICAL STATES IN PRESENCE OF INSULIN RESISTANCE

Horses suffering from **equine metabolic syndrome or from Cushing's' disease show hyperinsulinaemia** associated with a prolonged hyperglycaemia after a meal.
Now, insulin is able to simultaneously stimulate vasodilatation and vasoconstriction of blood vessels. In this way, **hyperinsulinaemia leads to disruptions to the blood flow notably in the foot, thus favouring laminitis.**
Therefore, it is logical to avoid feeding carbohydrates with a high GI, which will aggravate the hyperinsulinaemia and the hyperglycaemia, and hence the health of horses showing insulin-resistance.

The adjective digestible is a synonym of fermentable in the case of starch.

THE IMPORTANCE OF THE QUANTITY OF STARCH PER MEAL

As starch ingestion is likely to disturb the health of horses, it is important to reason the quantity distributed during a meal. Maximum recommendations made according to different health issues are shown below:

Digestion & Digestive health

Preventing gastric ulcers.	100g /100kg live-weight
To accompany gastric ulcer treatments.	50g /100kg live-weight
Preventing colics and hindgut acidosis.	150g /100kg live-weight

Muscles & Musculoskeletal Health

Preventing exertional myopathy in the **non-predisposed horse.**	100g /100kg live-weight
Preventing exertional myopathy in the **horse suffering from RER.**	50g /100kg live-weight
Preventing exertional myopathy in the **horse suffering from PSSM.**	15g /100kg live-weight

Metabolism & Metabolic Health

Preventing metabolic disturbances and laminitis in the **non-predisposed horse.**	100g /100kg live-weight
Preventing metabolic disturbances and laminitis in the **horse suffering from a metabolic disorder (EMS, Cushing's)/predisposed.**	30g /100kg live-weight
Accompany a case of acute laminitis if the horse is not overweight .	15g /100kg live-weight

Joint & Osteoarticular Health

Preventing osteoarticular disorders in the foal from conception	100g /100kg live-weight
Preventing osteoarticular disorders in the foal during growth	100g /100kg live-weight

TO SUM UP

The amount of starch in a feed per kg means nothing : it is essential to take into consideration the quantity distributed at each feed and also the digestibility of the starch used.

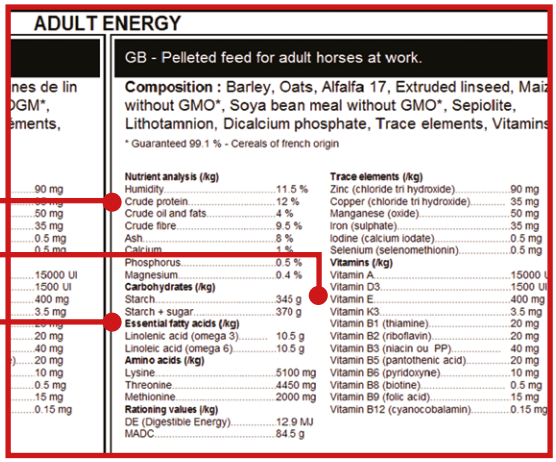
Then, it is preferable **to distribute a diet composed essentially from forage** because the low glycaemic index carries a lower risk of disrupting the regulation of the glycaemia and thus the health of the horse.

However, **in the athletic horse**, energy requirements being up to twice those of a horse at rest and knowing that the synthesis of glycogen is favoured by the appearance of sufficient glycaemic and insulin responses, **resorting to cereals that have a higher glycaemic index seems inevitable**.

To do this, giving a concentrate feed that associates, whilst respecting quantity recommendations, forms of "slow" starch (barley, maize) with a greater or smaller portion of digestible starch (oats, flaked maize, etc.), seems to be the best compromise in the healthy horse whose energy requirements are unable to be entirely fulfilled by forage.

OILS AND FATS

CRUDE OIL AND FATS
ESSENTIAL FATTY ACIDS


ADULT ENERGY

GB - Pelleted feed for adult horses at work.

Composition : Barley, Oats, Alfalfa 17, Extruded linseed, Maiz without GMO*, Soya bean meal without GMO*, Sepiolite, Lithotamnion, Dicalcium phosphate, Trace elements, Vitamins

* Guaranteed 99.1 % - Cereals of french origin

Nutrient analysis (/kg)	
Humidity	11.5 %
Crude protein	12 %
Crude oil and fats	4 %
Crude fibre	9.5 %
Ash	8 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.4 %
Carbohydrates (/kg)	
Starch	345 g
Starch + sugar	370 g
Essential fatty acids (/kg)	
Linolenic acid (omega 3)	10.5 g
Linoleic acid (omega 6)	10.5 g
Amino acids (/kg)	
Lysine	5100 mg
Threonine	4450 mg
Methionine	2000 mg
Rationing values (/kg)	
DE (Digestible Energy)	12.9 MJ
MADC	84.5 g

Trace elements (/kg)	
Zinc (chloride tri hydroxide)	90 mg
Copper (chloride tri hydroxide)	35 mg
Manganese (oxide)	50 mg
Iron (sulphate)	35 mg
Iodine (calcium iodate)	0.5 mg
Selenium (selenomethionin)	0.5 mg
Vitamins (/kg)	
Vitamin A	15000
Vitamin D3	1500 UI
Vitamin E	400 mg
Vitamin K3	3.5 mg
Vitamin B1 (thiamine)	20 mg
Vitamin B2 (riboflavin)	20 mg
Vitamin B3 (niacin ou PP)	40 mg
Vitamin B5 (pantothenic acid)	20 mg
Vitamin B6 (pyridoxyne)	10 mg
Vitamin B8 (biotine)	0.5 mg
Vitamin B9 (folic acid)	15 mg
Vitamin B12 (cyanocobalamin)	0.15 mg

DEFINITION

Lipids are **insoluble in water** but soluble in organic solvents. We can distinguish two principal groups:

SATURATED FATTY ACIDS (ex: palmitic acid)

These are above all present in solid fats (butter, lard, etc.) and in certain oils (palm oil, coconut oil, etc.).

UNSATURATED FATTY ACIDS

These are in general constituents of oils. Amongst them are different families:

- **Monounsaturated fatty acids**, such as **Omega-9** fatty acids (oleic acid) present in large quantities in hazelnut, olive and rape-seed oils;
- **Polyunsaturated fatty acids (PUFAs):**
  - **Omega-3** fatty acids: found in large quantities in **linseed oil** (linolenic acid) and in fish oils or in certain seaweeds in the form of superior derivatives (DHA, EPA);
  - **Omega-6** fatty acids (acid linoleic etc.): found in large quantities in grape seed, sunflower, corn and soya oils.

NUTRITIONAL INTERESTS

Oils and fats represent a less versatile energy source than starch.
They can only be oxidised aerobically to produce energy, or stored in the form of body fat (above all saturated fatty acids). Effectively fatty acids cannot be converted into glucose or used to synthesise glycogen. However, oils and fats do present numerous nutritional interests.

ENERGETIC DENSITY

Oils and fats are very high in energy. Thus they increase the energetic density of a ration allowing the **provision of sufficient energy in a limited volume of food**. In energy terms **1 litre of vegetable oil** corresponds to approximately **3kg of barley**.

MUSCULAR METABOLISM

The use of lipids in the ration allows:

- **A sparing of a part of muscular glycogen**, notably in type I fibres. Sparing muscular glycogen is interesting because it delays the appearance of tiredness;
- To **reduce heat production (caloric losses)** in the muscle cells. The conversion of oil into mechanical energy is more efficient than with carbohydrates.

Therefore, oils and fats are an interesting energy source for horses undertaking **prolonged efforts** during hot **and humid weather** such as during endurance events.

Nevertheless, it is **important to provide a sufficient amount of starch in horses' rations**, even for those performing on long distance efforts. Otherwise, they are expose to early depletion of their muscular glycogen reserves.

OMEGA-3 AND OMEGA-6 SOURCES

Like some amino-acids, they cannot be synthesised by the organism. This is where their name of **"essential" fatty acids** come from.

Essential structural components of the cell membranes, they condition the permeability and functional qualities of biological membranes. Their transformation within the organism results in terminal products - prostaglandins. These hormones have more or less beneficial properties:

- The two groups result in beneficial prostaglandins with anti-inflammatory, immunostimulating and hypocholesterolemic propertie;
- Omega-6 also engender harmful prostaglandins with pro-thrombotic, pro-inflammatory, pro-allergic and immunosuppressive properties.

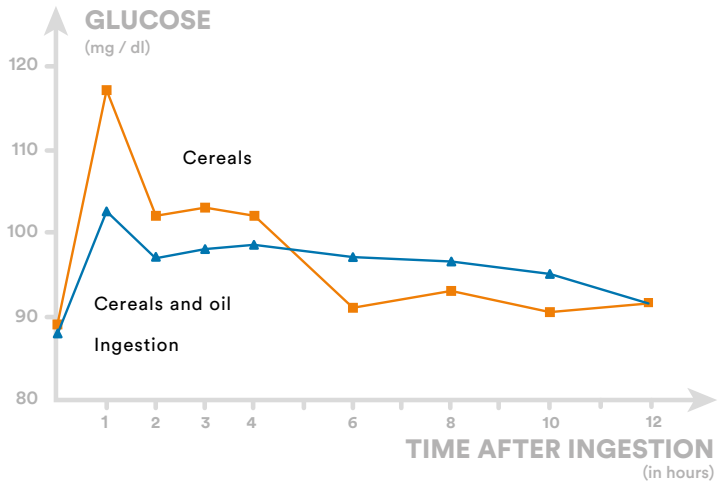
Therefore, to obtain an overall positive effect on health, **it is important to provide at least as much Omega-3 as Omega-6 in the total ration.**

GLYCAEMIC INDEX

Providing lipids **reduces the glycaemic index** of the ration (see the graph) in several ways:

- For a given energy value, the incorporation of lipids **reduces the cereal part of the ration;**
- The increase in energy density due to the oil **reduces the size of the meal**. Oil therefore affects the transit and the glycemic response by a decrease of the glycemic index.

THE GLYCAEMIC RESPONSE AFTER INGESTION OF THE SAME CEREAL RATION WITH OUR WITHOUT ADDED VEGETABLE OIL
(source: Pagan et al. 1999)



Providing fats and oils is interesting for horses suffering from pathological conditions related to and/or aggravated by high glycaemic indexes: obesity, behavioural problems, chronic myopathies, gastric ulcers, Cushing's disease, equine metabolic syndrome and laminitis.

Oils and fats represent a less versatile energy source than starch.

SUPPLY RECOMMENDATIONS

Wolter (1999) recommends ceilings on the lipid content in a ration to maximums of:
- **5 - 6% for racehorses;**
- **8 - 10%** for **endurance horses** or those suffering from **metabolic disorders directly related to carbohydrates ("tying-up").**

As regards to providing vegetable oil (OMEGA OIL) in addition to the concentrate ration, we recommend adding **10 to 20ml per 100kg of bodyweight at each feed.** It should be introduced **progressively**, on average over 4 to 14 days.

WHICH FAT SOURCES TO CHOOSE?

CONCENTRATE FEEDS :

Contrary to green forage (grass and luzerne) which contains about twice as many omega-3 as omega-6, **cereals have an excess of omega-6.** Considering the multiple nutritional benefits that omega-3 show, it is to our way of thinking important to **re-establish in the concentrate feeds we manufacture, a ratio of omega-3 to omega-6 that is favourable to the horse's health (greater than or equal to 1).**

To do this, we have chosen to correct the essential fatty acid unbalance in cereals by adding extruded linseed which is rich in natural omega-3 (linolenic acid). This is one of the reasons for which our pelleted feeds carry the "Bleu-Blanc-Cœur" label. This label promotes a healthy and balanced feed that favours animals health and well-being, whilst preserving ours and our planet's ones !

OIL AS A TOP-DRESSING:

In some situations, it may be necessary to add oil in addition to the concentrate ration. The choice of the oil should be made based upon several criteria.

Firstly, the **levels of en omega-3 and omega-6** must be taken into consideration.
Next, more than any other constituent, oils must be of **irreproachable quality** :

- Extraction : the linseed and maize germ oils that are ingredients in our OMEGA OIL are **first pressed (mechanical)**, and are of **human food quality.** This extraction process does not bring in chemical solvents nor high temperatures, as it is the case during refining. All the oils' nutritional properties are thus conserved. Therefore, the risk of denaturing fatty acids and other natural constituents (natural vitamin E, phytosterols, etc.) is minimised;
- Preservation, storage : it is advisable to store oils away from light and air in hermetic containers. It is also preferable to add anti-oxidants to protect unsaturated fatty acids from oxidation (denaturation).

If these conditions are not respected, the oils are likely to become rancid (denaturation of unsaturated fatty acids) and may become **very toxic for the organism.**

Finally, we advise against feeding **fats high in saturated fatty acids** such as palm and copra oils, whose nutritional interest is limited. In addition, they contribute to "clogging-up" the body when they are consumed in excess.

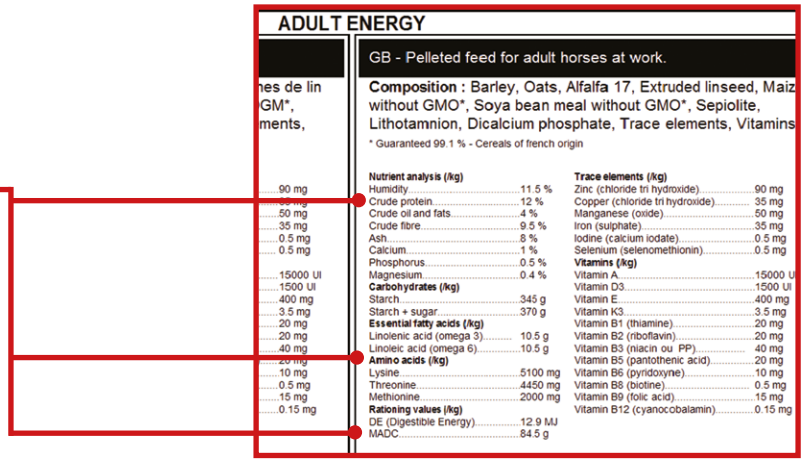
THE NECESSITIES OF ANTIOXIDANT COVER (VITAMIN E)

A supply of lipids in the ration necessitates **higher requirements of antioxidants, notably vitamin E**, even though this fat-soluble vitamin is already partly present in vegetable oils. Indeed, vitamin E acts as a membrane antioxidant. It captures peroxide free radicals produced by the oxidation of unsaturated fatty acids following an oxidative stress.

Thus dietary requirements in antioxidants are related to the **richness in polyunsaturated fatty acids** (PUFAs) and the **endogenic level of vitamin E of oils.** As for Vitamin E, we recommend **0.6 to 0.8mg (or IU) per gram of total PUFAs, or 3mg per gram of acid linolenic** (WOLTER, 1999).

PROTEINS

CRUDE PROTEIN
AMINO-ACIDS
DIGESTIBLE PROTEIN



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DEFINITION

Proteins are nitrogen (N) rich macromolecules composed of one or more amino-acid chains.

NUTRITIONAL INTEREST

Proteins represent **17 to 19% of the horses' weight**, nearly half of this is found in the muscular mass.

Proteins in the organism are **in permanence degraded and replaced**, in consequence, the daily distribution of a feed ration providing a correct supply of protein is needed.

This is of even greater truth because:

- Unlike fats, momentary excess protein at a given moment cannot be stored in specialised tissues for later use;
- Unlike ruminants, it is practically impossible for the horse to count on an eventual production of amino-acids by his digestive microbial flora.

Covering requirements is therefore primordial, above all at the periods in the horses' life when protein synthesis is intensified:
- **The growing foal** increasing his body mass;
- **The broodmare with foal** producing a protein rich milk;
- **The athletic horse**, for whom repeated work sessions result in the development of his muscular mass.

RECOMMENDED REQUIREMENTS

NOTION OF CRUDE PROTEIN AND DIGESTIBLE PROTEIN

The **crude protein content** in a feed must be **digestible** and able to **cover the horses' requirements in essential amino-acids**. This determines the **nitrogenous value**. This value is expressed as the **digestible protein** value in the horse. This parameter tries to take into consideration that non-protein nitrogen (such as ammoniac, ammonium salts, amines etc.) will not be metabolically used by the horse. Certainly it will be absorbed by the digestive tract, however it must be eliminated by the emunctory organs (liver, kidneys etc.), from where there is the risk of overtaxing the organism.

DIGESTIBLE PROTEIN REQUIREMENTS

Requirements are expressed in digestible protein (in g/day) and must be considered in relation to energy needs. To adjust protein levels in the ration we must therefore refer to the **protein to energy ratio** as much as to the quantity of digestible protein provided by the ration.

In the table below, are the recommendations depending on the physiological stage.

SOURCE: WOLTER, 1999 AND INRA, 2012		RATIO DIGESTIBLE PROTEIN/UFC* (in g/UFC)
Adult	Maintenance	≥ 70
	In work	≥ 70
Mares	Gestation 0 - 5 months	≥ 70
	Gestation 6 - 8 months	≥ 80
	Gestation 9 - 11 months	≥ 90
	Lactation 1 - 3 months	≥ 100
	Lactation 4 months	≥ 90
	Lactation 5 - 6 months	≥ 80
Youngster	6 - 18 months	≥ 100

***UFC**: In France, energy values for horse feeds are not expressed in Kcal or MJ/kg but in "Unité Fourragère Cheval" (UFC) (Horse Forage Units). This measure is based on the energy value of a kilo of barley, 1 UFC = the energy provided to the horse by 1kg of barley.

INDISPENSABLE AMINO-ACIDS REQUIREMENTS

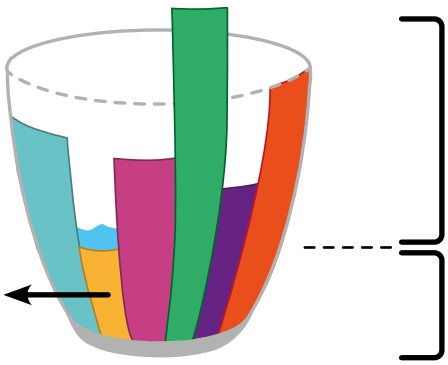
The horse is not **able to synthesise**, or at insufficient speed, the **9 essential amino-acids**: leucine, isoleucine, valine, methionine, phenylalanine, threonine, lysine, tryptophan and histidine. Furthermore, as opposed to ruminants, he is more or less unable to count upon an eventual auto-supplementation of microbial produced nitrogen.

The horse is thus **capable of being deficient in indispensable amino-acids**. That is to say his organism cannot synthesise them. The proteins that intervene in the maintenance of cellular structures, for growth, gestation and lactation will only be synthesised to the level of the dietary supply of these essential amino-acids, and notably the **limiting amino-acid, lysine** (see the diagram) then followed by the others knowing that research led at the University of Florida suggests that the second limiting amino-acid is **threonine**.

ALL AMINO-ACIDS SUPPLIED BY THE HORSES RATION

(Source: Wolter, 1999)

The bucket = the entirety of amino-acids/1 amino-acid = 1 board of the bucket



"Limiting factor" = The most lacking essential amino-acid in the ration **= LYSINE** *= The smallest board of the bucket*

The quantity of **amino-acids of no value** to the organism = Fraction eliminated (urines, sweat etc.) = Overloading the organism

THE WATER LEVEL = The quantity of proteins able to be synthesised by the organism
= The fraction fixed by the organism (maintenance of cellular structures, growth, gestation, lactation etc.)

Lysine requirements have firstly been quantified in the foal. It has been shown that **actively growing youngsters** receiving **lysine deficient rations** had a **slower growth rate** than those nourished with a sufficient quantity of the amino-acid, even if the crude protein content of the two rations was identical.
It is **therefore important to use quality protein sources that are able to fulfill the lysine requirements of the horse**. Detailed below are the recommendations depending on the physiological stage (for a horse with (or expected to reach) an adult weight of 500kg):

SOURCE: INRA, 2012		**LYSINE REQUIREMENTS** (g/day)	**REVERDY RATIONS = LYSINE SUPPLY** (g/day)
Adult	At rest	24	8kg of hay* = **26g**
	Working	31 - 54	5.6kg (8 L) of ADULT ENERGY + 8kg of hay* = **55g**
Mares	Gestation 1 - 8 months	27 - 35	1.4kg (2 L) of BREEDING + 7kg of hay* = **34g**
	Gestation 9 - 11 months	38 - 48	2.8kg (4 L) of BREEDING + 7kg of hay* = **45g**
	Lactation 1 - 3 months	77 - 82	5.6kg (8 L) of BREEDING + 10kg of hay* = **77g**
	Lactation 4 - 6 months	60 - 75	4.2kg (6 L) of BREEDING + 8.5kg of hay* = **61g**
Youngster	6 - 18 months	37 - 49	2.8kg (4 L) of FOAL + 5kg of hay* = **43g**
			2.8kg (4 L) of BREEDING + 5kg of hay* = **38g**

*Normandy meadow hay:
Crude protein = 8%, Lysine = 4.1% of crude protein (INRA 2004)

EXCESS PROTEIN

There is a fairly wide tolerance; however excesses are pointless and even dangerous. **Even if the surplus nitrogen is transformed into good quality microbial proteins by the flora of the large intestine, they will be principally absorbed as ammoniac** which has the principal consequence of overloading the emunctories (liver, kidneys etc.) and could also be accompanied by risks of auto-poisoning.

Consequently, supplying **excess protein** must be **avoided** in the athletic horse as it can be at the origin of:

- **Dehydration**: urea will notably be excreted in sweat and in the urine; this will create an important call for water. It is responsible for an abundant sudation (white foamy sweat) and high urine excretion;
- **Intestinal upsets**: diarrhoea, enterotoxaemia etc.;
- **Behavioural problems**: nervousness, irritability;
- **Perturbations in metabolism of carbohydrates;**
- **An increase in the respiratory frequency during exertion;**
- **Irritation of the respiratory tract** due to ammonia volatilisation from urine in the stable atmosphere.

In the same way, distribution of non-protein nitrogen sources such as **young spring grass** must be limited in order to only to not overload the emunctories, they can be at the origin of diarrhoeas at turn-out (see in the section dedicated to “fibres”).

WHICH PROTEIN SOURCES TO CHOOSE?

Numerous protein sources are used in horse nutrition, such as lucerne (alfalfa), milk proteins, oil cakes (soya, oil seed rape, etc.), or even mediocre by-products (millings, corn gluten feed, brewer's grains etc.).

To compensate for cereals being relatively poor in lysine (see table opposite), high quality protein sources must be used if one wants to compensate for the deficiency in cereals and limit the production of nitrogenous waste prejudicial to the body . In practical terms, the proteins of high nutritional value to the horse notably show high proportions of digestible protein and lysine in relation to the total protein level.

Thus we have made the choice to incorporate the **best protein sources on the market: milk proteins and non-genetically modified soya bean meal** (See table).

	CRUDE PROTEIN	DIGESTIBLE PROTEIN		LYSINE
	%	g/kg	% CRUDE PROTEIN	% CRUDE PROTEIN
Common wheat	10.5	74	70.3	**2.9**
Sunflower meal	33.5	245	73.2	**3.5**
Barley	10.1	71	70.7	**3.8**
Common wheat bran	14.8	106	71.7	**3.9**
Linseed	22.6	170	75.2	**3.9**
1st cut Normandy meadow hay	2.3	13	57	**4.1**
Oats	9.8	69	70.2	**4.2**
Lucerne (alfalfa) 17-18% dry matter	15.9	94	59.4	**4.5**
Oil seed rape meal	33.7	254	75.3	**5.3**
Soya-bean meal 48	45.3	383	84.5	**6.1**
Skimmed milk powder	34.3	NP	NP	**7.9**

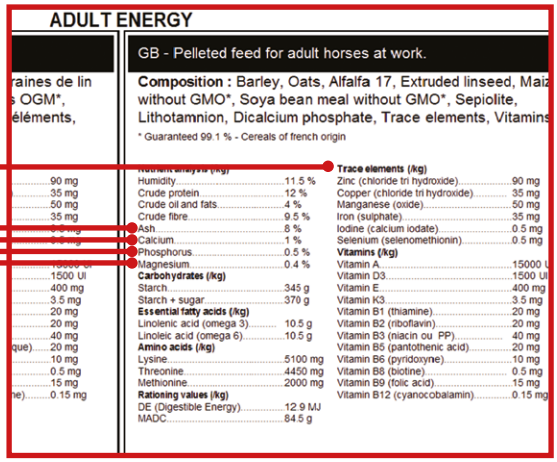
NP = Not provided.
Crude protein, digestible protein and lysine levels for different raw ingredients (source: inra 2004 and inra 2012)

TO SUM UP

CRUDE PROTEIN = DIGESTIBLE PROTEIN + METABOLIC WASTE
The quality of a protein source is provided by the **ratio digestible/crude protein** and the quantity of essential amino-acids, notably lysine, for a given quantity of crude protein.
Therefore these two parameters are objective indicators of protein quality, upon which we must rely to judge the quality of a protein source.

MINERALS

ASH
CALCIUM
PHOSPHORUS
MAGNESIUM
TRACE ELEMENTS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The REVERDY range proposes feeds offering **an optimal coverage of requirements** of all these elements, regardless of the age or the activity of your horse.

CALCIUM AND PHOSPHORUS

PRINCIPAL FUNCTIONS

These two elements have a particular involvement in the **development** and **strength of the skeleton**. Furthermore calcium plays a fundamental and varied role in the organism outside of the bones (cell membrane permeability, muscular contraction, neuromuscular stimulation, blood coagulation, enzyme activation etc.), whilst phosphorus is necessary for energy transfer (ATP), for the synthesis of phospholipids or even nucleic acids that make up DNA.

RECOMMENDATIONS

The following three rules must be followed for good bone mineralisation:

- Sufficient supplies of assimilated calcium and phosphorus;
- Correctly adjusted phosphorus/calcium ratio around **1.5 for maintenance and breeding**, around **1.8 for growth and work;**
- A satisfactory supply of vitamin D, without excess.

The calcium to phosphorus ratio of the entire ration (hay + concentrate feed) is a criterion to be systematically verified in order to prevent the appearance of bone ailments. In every case it must always stay above 1 to avoid sensibility to fractures yet lower than 3 because above this, the assimilation of trace elements (iron, copper etc.) is hampered.

PHOSPHORUS/CALCIUM UNBALANCE

A relative excess of phosphorus compared to calcium due to the **important use of cereal straights** (notably the traditional use of an exclusively oat diet) and/or the use of milling by-products (wheat bran) which contain the aggravating factor of the organic form of phosphorus (phytic acid), is liable to generate a type of secondary hyperparathyroidism (NSH) more commonly known as Big head or Bran disease (there is a thickening of the head). Bones become demineralised making the skeleton fragile, painful, susceptible to splints, deformities, fractures etc.

Unfortunately even if this problem has been known for centuries, it stays no less frequent and dangerous in the horse.

MAGNESIUM

PRINCIPAL FUNCTIONS

This is a major element intervening in most physiological functions: it participates in the metabolism of carbohydrates, lipids, and proteins, boosts the immune system, eases inflammatory and allergic reactions, plays a role in the correct functioning of the neuromuscular and osteoarticular systems and acts as a sedative of the nervous system, the central (like calcium) and also the periphery (the opposite of calcium).

RECOMMENDATIONS

The recommended daily requirements for a horse with an estimated mature adult bodyweight of 500kg are on average **10g a day** no matter what the physiological stage (maintenance, growth, breeding or work) but it should be known that requirements can reach **20g a day in horses undertaking very hard work**.

DEFICIENCY RISKS

Magnesium deficiency is rare, as forage (with the exception of young grass), provides plenty. However requirements are increased in the following cases:

- **Excess calcium in the ration**, as this decreases magnesium absorption in the small intestine;
- **Nitrogen rich diets**, because magnesium counteracts (thwarts) the toxicity of ammoniac in the blood;
- **Fat enriched diets**, notably in saturated fats as these are favourable to the intra–digestive formation of insoluble and indigestible magnesium “soaps”.

ZINC

PRINCIPAL FUNCTIONS

Zinc is present in the body associated with a number of enzymes which have an important role concerning:
- **Bone formation**: protection against osteoarticular problems;
- **Reproduction;**
- **The immune system;**
- **Healthy integuments** (skin etc.);
- **Excellent quality hoof growth** in synergy with copper and vitamins A and H (biotin).

RECOMMENDATIONS

Recommended daily requirements vary from **40 to 80mg/kg of dry matter (total ration) per day** depending on the physiological stage, knowing that growing youngsters have the highest requirements.
Furthermore, it is important to take into account the **Zinc/Copper ratio which is optimal at around 2.5 – 3**.

DEFICIENCY RISKS

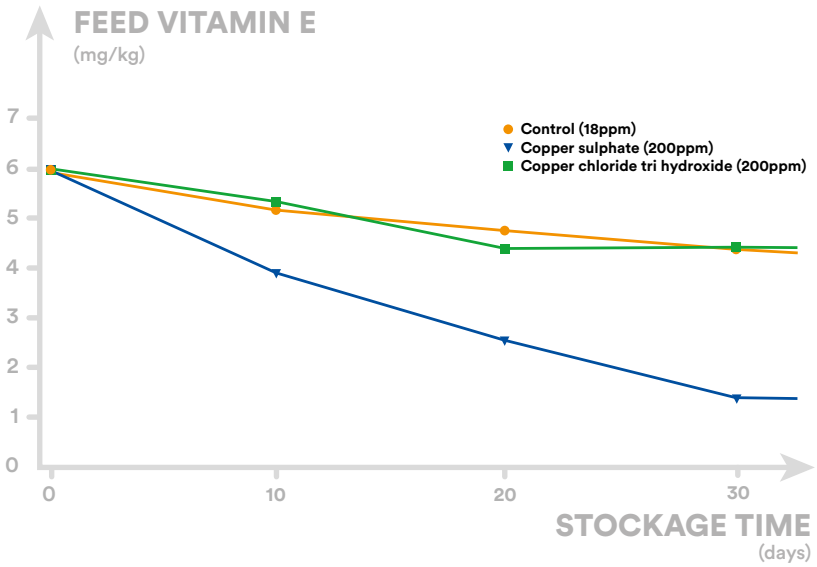
Forage provides an insufficient supply of zinc (1st cut meadow hay = approximately 20mg/kg dry matter), the **risk of deficiency is high**. Consequently, the feed distributed must contain a sufficient amount of this element, above all for growing youngsters but also for broodmares at the end of gestation. In fact during this period, the foetus stores zinc (as he also does for copper, manganese and iron) in his liver which he will then use during the first months of his life. This strategy of storage compensates for the lack of this element in maternal milk. Thus correctly fulfilling the requirements of broodmares at the end of gestation contributes to a better prevention of osteochondrosis in the future foal.

ABOUT THE WAY IN WHICH WE PROVIDE COPPER AND ZINC

In REVERDY feeds the trace elements copper and zinc are provided in **"hydroxide" form**. These two elements are carried within a crystalline matrix structure, which confers **reliable stability**. In this way, the copper and the zinc are not in a free state as is the case when they are found in sulphate form (the traditional way of supplying these elements). Therefore unable to carry out their pro-oxidant effect within the feed, the "hydroxide" forms allow optimum vitamin preservation.

EVOLUTION OF THE VITAMIN E LEVEL OF THE FEED DEPENDING ON THE COPPER SOURCE USED

(Source: Lu et al. 2010)

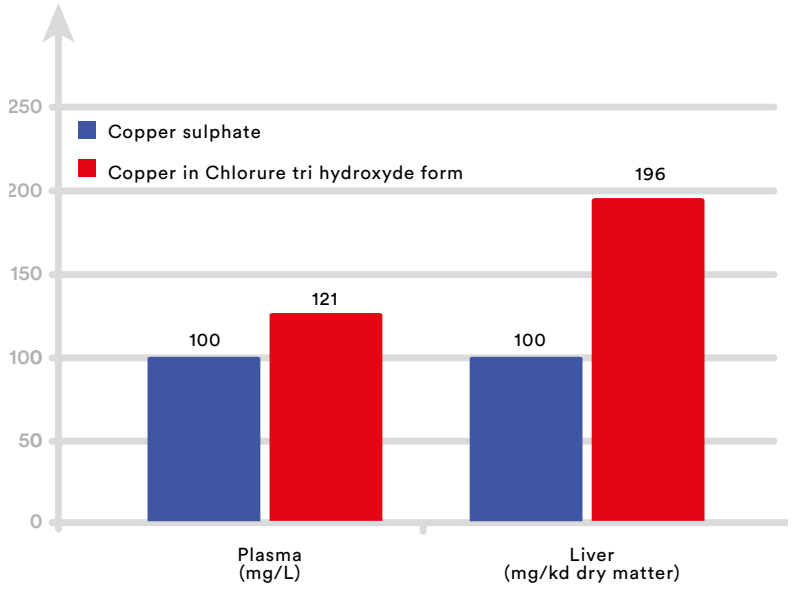


Furthermore, copper and zinc when in chloride tri hydroxide form offer **improved bio-availability** and are therefore more efficiently absorbed in the small intestine. Studies, Spears et al., (2004) for copper, and Shaeffer et al., (2006) for zinc have shown that:

- **Blood levels (plasma)** of these two elements are **increased** on average by **15 to 20%** in comparison to sulphate forms;
- The copper and zinc are **more effectively stored in organs such as the liver**, where concentrations are **approximately multiplied by 2.** This superior storage is of notable interest in the gestating mare and more particularly in the foetus whose in-utero storage in the liver allows it to cover its requirements during the first few weeks of life.

PLASMA AND HEPATIC COPPER LEVELS

(Source: Spears et al, 2004))



Source: ORFFA

COPPER

PRINCIPAL FUNCTIONS

Copper holds an important role at many different levels in the body:
- **Bone development and strength** = “bone glue”;
- **Prevention of osteochondrosis;**
- **An anti-anaemic factor;**
- **Pigmentation of dark hair;**
- **Development** (growth) **of integuments** (hair, hoof wall);
- **Synthesis of elastin fibres** (an neighbouring substance to collagen) on which the mechanical properties of large blood vessels, tendons, etc. depend.

RECOMMENDATIONS

Recommended daily requirements vary from **10 to 30mg/kg of dry matter (total ration) per day** depending on the physiological stage and knowing that growing youngsters have the highest requirements.
Furthermore, it is important to take into account the **Zinc/Copper** ratio which **is optimal at around 2.5 – 3**.

DEFICIENCY RISKS

Forage provides an insufficient supply of copper (1st cut meadow hay = approximately 5mg/kg dry matter), the **risk of deficiency is high**. Consequently, the feed distributed must contain sufficient amounts of this element, above all for growing youngsters but also for broodmares at the end of gestation. In fact during this period, the foetus stores copper (as he also does for zinc, manganese and iron) in his liver which he will then use during the first months of his life. This strategy of storage compensates for the lack of this element in maternal milk. Thus correctly fulfilling the requirements of broodmares at the end of gestation contributes to a better prevention of osteochondrosis in the future foal.

MANGANESE

PRINCIPAL FUNCTIONS

Manganese (Mn) has an essential role in:
- **Carbohydrate and lipid metabolism;**
- The synthesis of chondroitin sulphate, necessary for **cartilage formation.**
- **Fertility.**

RECOMMENDATIONS

Recommendations for daily requirements are identical to those of zinc and vary from **40 to 80mg/kg of dry matter (total ration) per day** depending on the physiological stage, knowing that growing youngsters have the highest requirements.

DEFICIENCY RISKS

Manganese is present at good levels in forage (1st cut meadow hay = approximately 150mg/kg dry matter). However its intestinal absorption can be hindered by an excess of calcium. Nevertheless, whilst it has been clearly recognised in other mammals, **deficiency has not been observed in the horse**.

IRON

PRINCIPAL FUNCTIONS

Iron (Fe) is the element the most frequently **associated with muscular effort**. Given that it enters into the composition of haemoglobin it contributes to the **transport of oxygen** throughout the body via the red blood cells and plays a major role in **cellular respiration***, which is primordial for muscular effort.

RECOMMENDATIONS

Recommendations for daily requirements vary from **40 to 50mg/kg of dry matter (total ration) per day**.

DEFICIENCY RISKS

Forages are generally **very rich in iron** (1kg of dehydrated grass = 525mg of iron! ; INRA, 2004). **The eventuality of deficiency is excluded**.
An iron deficiency leads to anaemia (a decrease in the concentration of haemoglobin in the blood). **However the opposite is not true, that is to say that anaemia is only rarely a synonym of iron deficiency!** Indeed, anaemia is most often secondary, due to chronic inflammation or a quietly evolving infection rather than a lack of iron. In fact true anaemia is rare in the athletic horse, except for those horses:

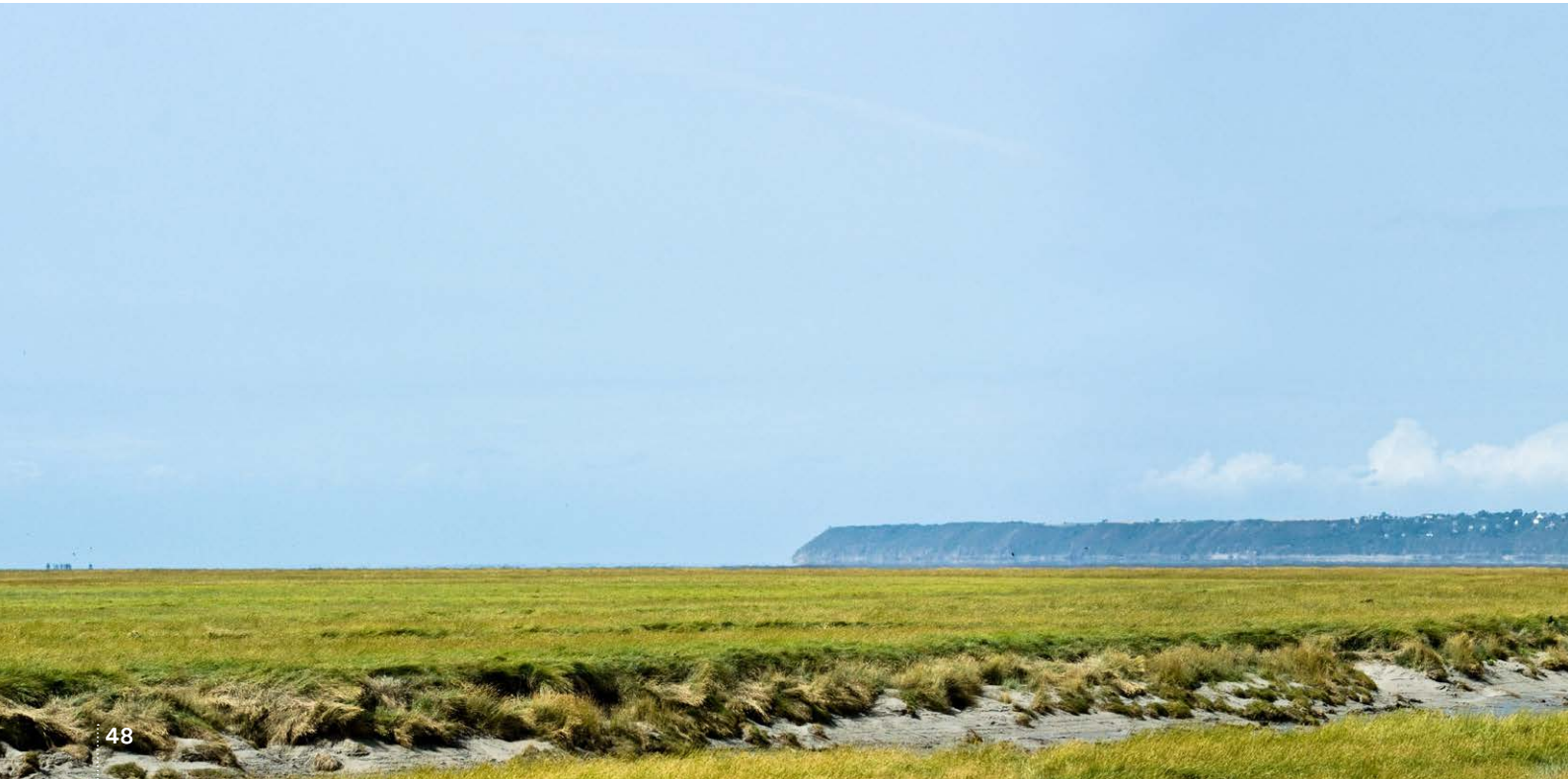
- Carrying a heavy parasite burden.
- Suffering from blood loss caused by gastric ulcers.
- Suffering from pulmonary haemorrhaging induced by violent efforts.

EXCESS SUPPLY

A bigger worry in competition horses is **excesses resulting from an abusive supplementation in iron** in the vain hope of increasing the number of red blood cells to increase the level of sporting performance.
This practice is not justified ifor horses. Effectively, Lawrence et al. (1987) did not succeed in proving an increase in the levels of haemoglobin, haematocrit, or blood iron in horses supplemented with high doses of iron.
Finally, high iron supplementation can have **harmful consequences**:

- Affecting **the availability of other minerals** present in the ration such as zinc, copper or manganese;
- Accelerating **metabolic use of vitamin E** and in this way predisposing the horse to muscle injuries (pro-oxidant action of iron);
- Exposing the horse to a **drop in immunity** (aggravated by the conditioned deficiencies in zinc and vitamin E) and thus favouring all infectious complications.

*Cellular respiration: Chemical reaction which provides the energy needed to enable the cells to function.



IODINE

PRINCIPAL FUNCTIONS

This element enters into the composition of thyroxin (T4) and triiodothyronine (T3), two hormones having powerful effects on the health of the horse. Amongst their actions they contribute to:

- **Thermal regulation** (importance of iodine at birth);
- **Nutriment use** by the different cells of the body;
- **Growth**, as they participate in the construction and mineralisation of the bone framework;
- **Reproduction.**

RECOMMENDATIONS

Recommendations for daily requirements vary from **0.1 to 0.3mg/kg of dry matter (total ration) per day**, it should be known that iodine requirements evolve in parallel to the secretion of thyroxin which **increases with the intensity of the metabolism** and when it is necessary to **fight the cold** (maintain body temperature).

DEFICIENCY RISKS

The risk of deficiency is quite rare (1st cut meadow hay = 0.1 to 0.3mg/kg dry matter) except if the ration contains substances having an anti- thyroid effect, notably present in cabbages or oil seed rape.
As a general rule, **providing iodine in the ration is advised**, especially in broodmares at the end of pregnancy, this is to avoid exposing the new-born foal to the following problems:

- **Death at birth**, or **very weak** foals unable to stand;
- **Goitre** (increase in the size of the thyroid gland);
- A **dull** and **staring coat.**

Finally, it would seem that iodine deficiency shows itself by **fertility problems in mares**. A study (Kruzkova, 1968) showed that broodmares suffering from anovulation (no ovulation) responded favourably to iodine supplementation.

EXCESS SUPPLY

The horse is **extremely sensitive to** excess dietary iodine. The maximum acceptable dose recommended by the NRC (1980) is **5 ppm**, which is the equivalent of **50mg of iodine per day** for the average horse eating 10kg dry matter.

Thus an overconsumption of iodine by the pregnant mare increases the risk of thyroid dysfunction in the new-born foal : weakness, muscular immaturity, contracted tendons and skeletal abnormalities have been described in several studies.

SELENIUM

PRINCIPAL FUNCTIONS

Selenium is a **powerful antioxidant**. It has an important role in:
- The maintenance of **healthy cell membranes;**
- **Growth**, by contributing to **ossification**, either directly, and indirectly by reinforcing the synthesis of thyroxin;
- **Reproduction;**
- The **immune response**, notably concerning the quantity of antibodies (IgG) present in maternal milk.

Selenium (with vitamin E) protects all the cells and in particular:
- **Red blood cells**: reduces the risks of haemolysis (cell destruction);
- **The capillaries**: prevents micro haemorrhages and oedemas;
- **The parenchyma** of the different organs such as the liver, pancreas etc.;
- **Muscle**: Reduces the risks of "tying-up".

RECOMMENDATIONS

Recommendations for daily requirements are identical to those of iodine and vary from **0.1 to 0.3mg/kg of dry matter (total ration) per day**. The supply of selenium must be optimal especially when the ration is rich in polyunsaturated fatty acids (provided by oils) as the latter are very sensitive to oxidation.

SELENIUM DEFICIENCY

Forages tend to be poor in selenium (<0.1mg/kg dry matter), so **deficiency is possible** and can lead to:

- A **myopathy** (muscle disease = "white muscle disease") in **foals under the mother** causing weakness in movements, feeding and swallowing difficulties, respiratory distress and weakened cardiac functioning;
- **Tissue lesions** which can not only be **muscular** but also **respiratory** in the athletic horse.

EXCESS SUPPLY

Toxicity appears from **3 ppm** which equates to **30mg of selenium a day** for an average horse eating 10kg of dry matter. This is a very low dose; however the security coefficient (useful dose/toxic dose) is about 10, in other words similar to the other trace elements.

SUMMARY OF RECOMMENDED DAILY PROVISION OF TRACE ELEMENTS

(Source: Kentucky Equine Research)

INMG/KG OF DRY MATTER IN THE TOTAL RATION (CONCENTRATE FEED + HAY)	MAINTENANCE	BROODMARES		GROWING YOUNGSTERS	HORSES IN WORK
		GESTATION	LACTATION		
Zinc	40 - 50	50 - 60	40 - 50	60 - 80	40 - 60
Copper	10 - 15	15 - 25	10 - 15	20 - 30	10 - 15
Manganese	40 - 50	40 - 60	40 - 50	60 - 80	40 - 60
Iron	40	40 - 50			
Iodine	0.1 - 0.2	0.15 - 0.3	0.15 - 0.25		
Selenium	0.1 - 0.3	0.2 - 0.3			

ABOUT ORGANIC SELENIUM

● FORMS IN WHICH SELENIUM CAN BE PROVIDED

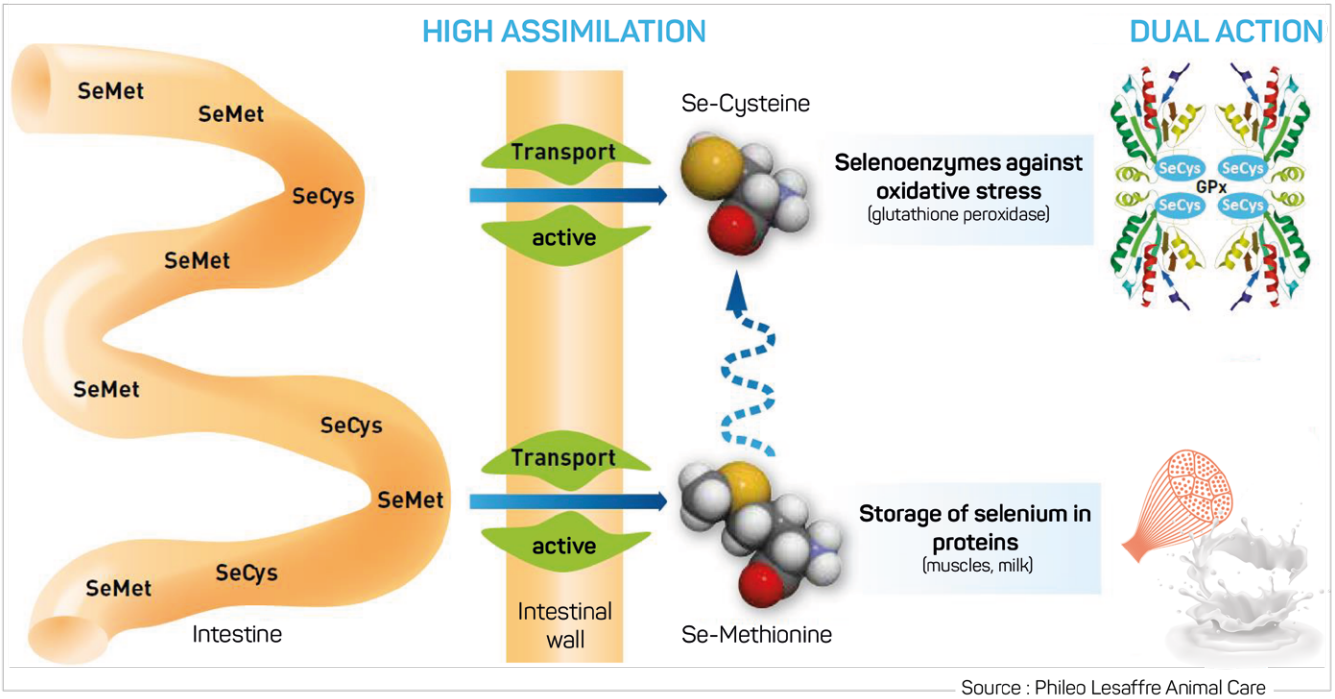
As previously explained, selenium is a powerful antioxidant playing a major role in protecting the organism. Therefore, it is essential to optimally fulfill requirements of the horse.

In feeds, selenium is generally provided in one of two forms:

- In a free state in the inorganic form via sodium selenite. However, selenium is little available in this form;

- Via selenium enriched yeasts ("selenized yeast"). In this case, the sodium selenite is previously incorporated into live yeast cultures (saccharomyces cerevisiae) which will capture the selenium, integrating it into the organic amino-acids : principally methionine, but also cysteine. These organic forms are better assimilated, used and stored than the selenite form (inorganic).

THE ASSIMILATION AND EFFECT OF ORGANIC SELENIUMS DERIVED FROM SELENIZED YEASTS



Source : Phileo Lesaffre Animal Care

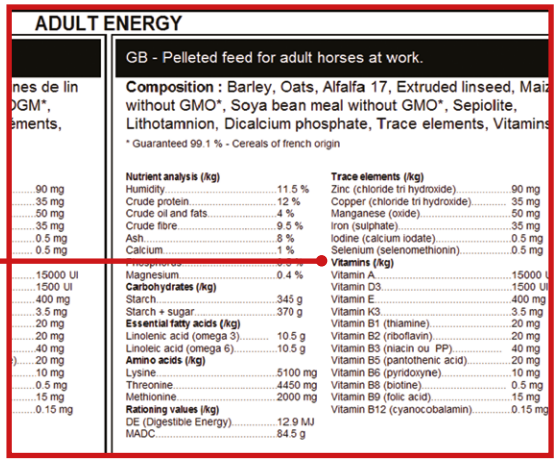
● THE ADVANTAGES OF SUPPLEMENTING WITH L-SELEOMETHIONINE

L-selenomethionine represents a durable form for storing selenium once incorporated into the body's proteins. If the animal has to face severe oxidative stress (intense muscular effort, infection, etc.), selenium stored in the form of L-selenomethionine can be called upon and integrate selenoenzymes, such as glutathione peroxidase (GPx), as L-selenocysteine. GPx is a fundamental enzyme of the antioxidant chain that allows free radicals to be neutralized. Its action is complementary to SOD and vitamins E and C.

As the main constituent of GPx, L-cysteine provided by selenized yeasts is more likely to directly enter the body's anti-oxidant pool following its assimilation.

Finally, providing an organic selenium is of interest in broodmares as this form is transferred more efficiently to colostrum and milk. Thus, as an anti-oxidant, it contributes to better health of the foal under the mother (fighting against infection, preventing acquired myopathies such as "white muscle disease" etc.).

VITAMINS


ADULT ENERGY

GB - Pelleted feed for adult horses at work.

Composition : Barley, Oats, Alfalfa 17, Extruded linseed, Maiz without GMO*, Soya bean meal without GMO*, Sepiolite, Lithotamnion, Dicalcium phosphate, Trace elements, Vitamins

* Guaranteed 99.1 % - Cereals of french origin

Nutrient analysis (/kg)	
Humidity	11.5 %
Crude protein	12 %
Crude oil and fats	4 %
Crude fibre	9.5 %
Ash	8 %
Calcium	1 %
Magnesium	0.4 %
Carbohydrates (/kg)	
Starch	345 g
Starch + sugar	370 g
Essential fatty acids (/kg)	
Linolenic acid (omega 3)	10.5 g
Linoleic acid (omega 6)	10.5 g
Amino acids (/kg)	
Lysine	5100 mg
Threonine	4450 mg
Methionine	2000 mg
Rationing values (/kg)	
DE (Digestible Energy)	12.9 MJ
MADC	84.5 g

Trace elements (/kg)	
Zinc (chloride tri hydroxide)	90 mg
Copper (chloride tri hydroxide)	35 mg
Manganese (oxide)	50 mg
Iron (sulphate)	35 mg
Iodine (calcium iodate)	0.5 mg
Selenium (selenomethionin)	0.5 mg
Vitamins (/kg)	
Vitamin A	15000 UI
Vitamin D3	1500 UI
Vitamin E	400 mg
Vitamin K3	3.5 mg
Vitamin B1 (thiamine)	20 mg
Vitamin B2 (riboflavin)	20 mg
Vitamin B3 (niacin ou PP)	40 mg
Vitamin B5 (pantothenic acid)	20 mg
Vitamin B6 (pyridoxyne)	10 mg
Vitamin B8 (biotine)	0.5 mg
Vitamin B9 (folic acid)	15 mg
Vitamin B12 (cyanocobalamin)	0.15 mg

The REVERDY range proposes feeds offering an **optimal coverage of requirements** of all these elements, no matter what the age or activity of your horse.

VITAMIN A

PRINCIPAL FUNCTION

Contributes to the **synthesis of proteins** (with zinc) and intervenes in:
- Production of **enzymes, hormones, immunoglobulins**;
- All tissue development, in particular **skeletal**, thus its action on growth in the young;
- **Reproduction**, in both the male and the female;
- **Fight against infection**, by contributing to **healthy epitheliums**;
- **Sight**.

SOURCES

Green forage is an excellent source of ß-carotenes, precursors of vitamin A. However, **deficiency** in ß-carotenes is frequent **at the end of winter** because of:
- Deterioration of hay during storage;
- Exhaustion of the hepatic (liver) reserves.

Carrots are also rich in ß-carotenes and can be distributed at the end of the winter without worry of hypervitaminosis.

RECOMMENDATIONS

Reinforced supplementation is indicated if we wish to:
- Improve **stallion** and **broodmare fertility**;
- Obtain optimal growth in **foals and young horses**.

Complementation is recommended at the end of winter for horses not receiving concentrate feeds with correct levels of this vitamin. However, excess vitamin A (over 100 times requirements) is both **inutile** and **dangerous**.

USEFUL TO KNOW
The vitamins incorporated into REVERDY feeds are, in the vast majority, of European origin (or even french). They offer superior stability and sanitary guarantees.

VITAMIN D

PRINCIPAL FUNCTIONS

Principally participates in bone **mineralisation**, because of its role in regulating the phosphocalcic balance.

SOURCES

Vitamin D is present in **sun dried hay**. Furthermore, it can be **synthesised by the skin** when exposed to the ultra-violet rays of sunlight. In absence of excellent hay, and exposure to direct sunlight on the horse, including vitamin D in the ration is essential.

RECOMMENDATIONS

Vitamin D must be supplied moderately and conjointly with sufficient and balanced quantities of calcium and phosphorus.
For **horses in training, supply must be reinforced** because:

- They are **confined** to stables for long periods of the day;
- **Their skeletal structures** are confronted to daily stress.

Overdosing with vitamin D (regular doses of 10 to 100 times the daily requirements) is particularly **harmful**.

VITAMIN E

PRINCIPAL FUNCTIONS

The **major biological antioxidant** and as such it:

- Ensures **the protection of cell membranes** rich in polyunsaturated fatty acids. In this way, along with selenium, which could play the first role, vitamin E contributes to maintain **muscle integrity**;
- Prevents lipid reserves from oxidising.
- Intervenes in **reproduction**.
  - By protecting vitamin A and essential fatty acids;
  - Hoffman and al.(1999) reported an increase blood antibody concentration (IgG) in broodmares who had received supplementation with high doses of vitamin E. After birth, the foals born from these mares also had superior blood antibody levels (IgG).

SOURCES

Vitamin E is found in **young grass** and **fresh vegetable oils**.

RECOMMENDATIONS

Vitamin E requirements increase when the ration is enriched with unsaturated fatty acids (oils) and when work increases.
Vitamin E requirements are **reduced by the presence of selenium**.

VITAMIN K

PRINCIPAL FUNCTIONS

Vitamin K plays a role in:
- Blood coagulation.
- Bone calcification.

SOURCES

Abundant **digestive synthesis** by the gut micro-organisms allows sufficient supply, this is coupled with relatively high levels found in **forage**.

RECOMMENDATIONS

Under normal conditions, **deficiency is not a problem**. However, intensive work may weaken the gut micro-organisms and disrupt the digestive synthesis of vitamin K.
A complementation of **1-2mg/100kg live weight** per day is recommended in horses undertaking heavy intensive work.
Abusive supplementation with vitamin K in the hope of preventing exercise induced pulmonary haemorrhages reveals being **ineffective** and **very dangerous** because it can expose the horse to serious kidney damage (acute nephritis).

THE B GROUP VITAMINS

PRINCIPAL FUNCTIONS

- Vitamin B1 (thiamine)
  Essential for the metabolism of carbohydrates and important for:
  - Sprints: it intervenes in the combustion of carbohydrates in the muscles;
  - Healthy functioning of the nervous system and nerve cell communication.
- Vitamin B2 (riboflavin)
  Activates the catabolism (transformation) of lactic acid (as does zinc) and takes part in the metabolism of carbohydrates and lipids.
- Vitamin B3 (PP or niacin)
  Intervenes in energy metabolism.
- Vitamin B5 (pantothenic acid)
  Participates in the renewal of epitheliums and integuments. It favours wound healing and hair growth.
- Vitamin B6 (pyridoxine)
  Intervenes in the metabolism of amino-acids and proteins, and notably, has an anti-anaemic role.
- Vitamin B8 (H or biotin)
  - At doses of 10 to 30mg a day over a period of 6 to 10 months it improves the growth rate and strength of the hoof wall.
  - At lower doses intervenes in the metabolism of carbohydrates.
- Vitamin B9 (folic acid or Anti-anaemic)
  Favours regeneration and maturing of red blood cells.
- Vitamin B12 (cyanocobalamin)
  Participates in the formation of red blood cells, and so, just like vitamins B6 and B9 helps protect against anaemia. Overdosing is inutile.

SOURCES

The B group vitamins are present in **green forage**, **cereals**, and **probiotics**, they are also synthesised by the **gut micro-organisms**.

RECOMMENDATIONS

For adult horses consuming plenty of good quality forage, there is generally **a sufficient supply provided by the micro-organisms in the caecum and the colon**. However, taking into consideration the many roles played by the B group vitamins in muscular effort, the **requirements of horses in heavy training/work may be increased**, even more so as the gut micro-organisms are weakened by the intensity of the work. Providing **too much vitamin B is not a worry**, the limit being more an economic one.

VITAMIN C

PRINCIPAL FUNCTIONS

Vitamin C is a water soluble vitamin which participates in hundreds of processes in the body. Among its' principal functions, it notably intervenes in:

- **Collagen** synthesis;
- Formation of **red blood cells**;
- Maintaining **immunity**;
- The healing of **wounds**.

Vitamin C **also increases iron uptake** from dietary sources. Finally, as a **major antioxidant**, it plays a very important role in the fight against free radicals by **participating in the recycling of vitamin E**.

SOURCES

Vitamin C is **naturally synthesised by the liver of the horse**.

RECOMMENDATIONS

Unlike man, the horse is able, to synthesise his own vitamin C and cover his maintenance requirements. However, considering the multiple implications of vitamin C in the metabolism, **supplementing horses in intense work and training is recommended**, even more so as the requirements related to effort can be accumulated and the flora weakened by work intensity.

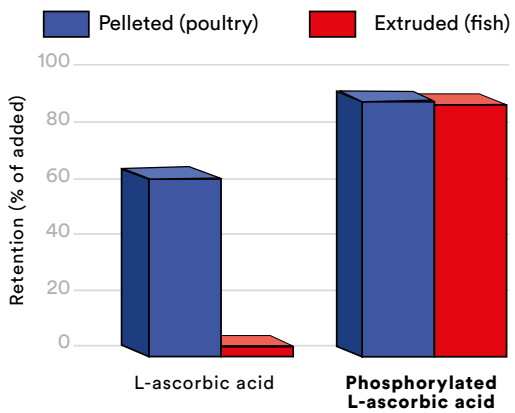
PROTECTED VITAMIN C

The simplest and most common type of vitamin C used is L-ascorbic acid. Unfortunately, this molecule is very fragile and degraded considerably during feed manufacturing and storage processes.
For this reason, **we have selected a protected, thus very stable form of vitamin C: phosphorylated L-ascorbic acid**.

The active part of this molecule is stabilised (esterified with a phosphate group) and is only reactivated after the vitamin C is absorbed and metabolised within the organism.

The best fulfilment of daily requirements for horses in intensive work is ensured by using this form of protected vitamin C associated with the incorporation of optimum levels into our feeds (1000mg/kg).

STABILITY OF STANDARD VITAMIN C (L-ascorbic acid) AND PROTECTED (phosphorylated L-ascorbic acid) DEPENDING ON FEED MANUFACTURING PROCESSES
(source. DSM Nutritional products)

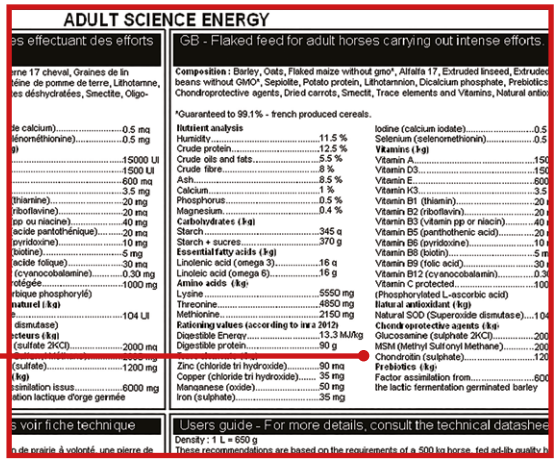


RECOMMENDED DAILY VITAMIN REQUIREMENTS
(sources DSM 2016 recommandations)

/100KGKG OF LIVE WEIGHT PER DAY	GROWING YOUNGSTERS	LEISURE HORSES	RACEHORSES	BREEDING STOCK
Vitamin A IU	10 000 – 12 000	6 364 – 8 182	11 818 – 14 545	11 818 – 14 545
Vitamin D IU	2 000 – 2 200	636 – 818	1 182 – 1 455	1 182 – 1 455
Vitamin Emg	100 – 220	100 – 200	200 – 600	200 – 600
Vitamin Kmg	2.4 – 4.8	1.1 – 2.2	1.1 – 2.2	1.1 – 2.2
Vitamin B1 (Thiamine)mg	10 – 12	7.3 – 12	12.7 – 20	12.7 – 20
Vitamin B2 (Riboflavin)mg	6 – 8	5.5 – 8	9.1 – 13.6	9.1 – 13.6
Vitamin B3 (Niacin)mg	10 – 20	10 – 15.5	20 – 40	20 – 40
Vitamin B5 (Pantothenic acid)mg	10 – 16	8.2 – 11.8	9.1 – 16	9.1 – 16
Vitamin B6 (Pyridoxine)mg	6 – 8	4.5 – 6.4	7.3 – 10	7.3 – 10
Vitamin B8 (Biotin)mg	0.8 – 1.2	2.7 – 3.6*	2.7 – 3.6*	2.7 – 5.5*
Vitamin B9 (Folic acid)mg	2.4 – 9.6	1.1 – 4.4	1.1 – 4.4	1.1 – 4.4
Vitamin B12 (Cyanocobalamin)mg	0.06 – 0.12	0.03 – 0.06	0.03 – 0.1	0.03 – 0.1
Vitamin C (L-acorbic acid)mg	110 – 220	-	200 – 400	200 – 400

*Recommended dose on a 6 months cure to improve the quality of the hoof wall

SPECIFIC NUTRIMENTS


ADULT SCIENCE ENERGY

GB - Flaked feed for adult horses carrying out intense efforts.

Users guide - For more details, consult the technical datashee

ASSIMILATION FACTORS

DEFINITION

Assimilation factors stem from the transformation of barley grains by germination and lactic ferments from 8 strains of micro-organisms (lactobacillus and lactic streptococcus).

PROPERTIES

As a herbivore, the horse shelters a fibrolytic (= cellulolytic) flora in his large intestine which breaks down fibre into energy-giving nutrients. To maintain his digestive health and for effective digestion of fibre it is essential to respect the balance between the fibrolytic flora and the other types of flora.

Assimilation factors act as prebiotics, that is to say they favour the development and activity of the intestinal bacteria beneficial to the health of the horse.

Thus, when added daily at effective doses to the horses' ration, the microbial activity of deteriorating fibrous constituents in the large intestine is significantly increased. In the horse, this stimulation of cellulolytic activity contributes to a **better use of fibres and to maintaining the balance between the different floras**.

The benefits of this type of supplementing in breeding have been studied. It has been shown that assimilation factors allow:

- **Optimisation of the implantation and activity of the digestive flora in the foal**. Indeed, when bacterial assimilation factors are given to the broodmare around the time of foaling, during the first five days of life **the digestive micro-flora in the large intestine of the foal is active and established faster**. The precocity and quality of microbial colonisation in the digestive tract by the new-born animals' indigenous micro-flora, conditions the quality of the barrier effect of this flora against pathogenic micro-organisms;

- **Optimal foal growth and nutritional recuperation by the broodmare**. Clinical studies on the ground and under controlled conditions confirm the beneficial effects of assimilation factors on **post-partum weight recovery by the broodmare and to weight gain in the foal under the mother**. This last point can be explained by improved milk production in the mare (quantity and/or quality).

More generally, assimilation factors are recommended for:

- Increasing feed digestibility **during periods of accrued energetic demand**: growth, lactation, stallions at stud, training, etc.;

- Favouring **recuperation of body condition** during convalescence;

- Securing or restoring the balance between the different floras during **periods of stress**: weaning, turnout to grass, preparation for the sale ring, feeding transitions, competition, transport, etc.;

- Favouring the implantation of the digestive micro-flora in the **foal during the neonatal period**.

RECOMMENDATIONS

For a 500kg horse, distributing **between 10,000 and 30,000mg per day** of assimilation factors is recommended.

SUPEROXYDE DISMUTASE

During moderate to intense muscular effort, consumption of oxygen significantly increases leading to energy being provided aerobically which allows the effort to be continued. **Equally this accrued use of oxygen leads to a large increase in the production of pro-oxidising free radicals**, firstly representing a direct threat to muscle cells, and then to the entire organism. Consequently, we can easily understand that **in horses carrying out intense efforts, it is judicious to increase anti-oxidant supplementation with the aim of neutralising these free radicals**.

DEFINITION

Superoxide dismutase (SOD) is a fundamental enzyme in the struggle against oxidative stress and naturally produced by the organism. It is of interest having a **complimentary action to other commonly used antioxidants (selenium, vitamins E and C)**.

The SOD incorporated into our feeds is **100% natural**: extracted from the flesh and juice of a particular variety of melon that is naturally rich in antioxidants (it also contains catalase). It is supplied **in a coated form** which confers stability during the manufacturing of feeds and which also protects it from gastric acidity.

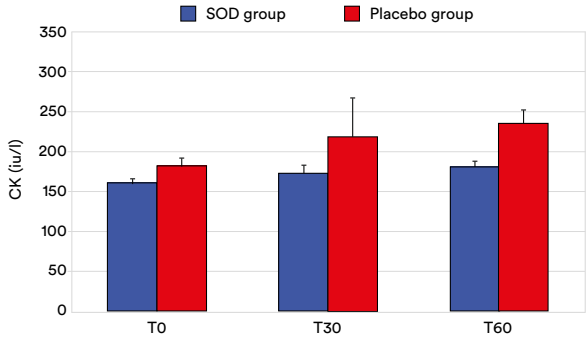
PROPERTIES

The interest of supplementing with SOD in racehorses was notably proved by C. NOTIN and al. In the results of a scientific study published in 2010 and titled “Oral supplementation with SOD in Standardbred trotters in training: a double-blind placebo-controlled study”. The results suggested that **providing oral SOD may protect red blood cells from haemolysis (destruction) and limit the increase in muscle enzymes (creatine kinase, CK) in the blood** (cf. figures below).

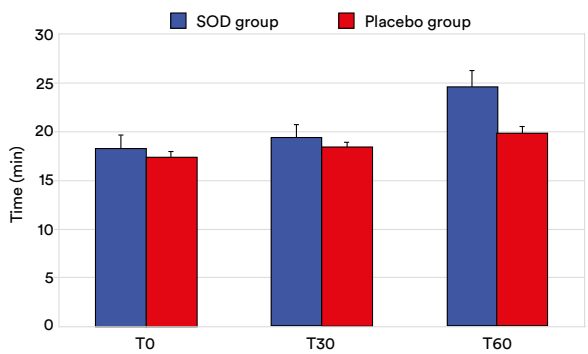
RECOMMENDATIONS

For a 500kg horse, distributing **between 260 and 520 IU per day** of SOD is recommended.

Evolution of the resting plasma creatine kinase activity in the SOD group and placebo group before supplementation (T0) and 30 (T30) and 60 (T60) days after supplementation
(source. C. NOTIN et al., 2010)



Evolution of plasma resistance to haemolysis in the SOD group and placebo group before supplementation (T0) and 30 (T30) and 60 (T60) days after oral supplementation
(source. C. NOTIN et al., 2010)



CHONDROPROTECTIVE AGENTS

The three chondroprotective agents incorporated into our feeds count amongst the most frequently employed in human health. Their effectiveness has been scientifically validated by numerous clinical studies.

DEFINITION

Chondroprotective agents are substances used with the aim of **protecting the cartilage** of articulations and are principally indicated in the **prevention and treatment of arthritis**.

PROPERTIES

Chondroitin is a constituent of proteoglycans whose role is to maintain correct **hydration of cartilage and bones.** Furthermore, it directly protects cartilage cells from enzymatic reactions and free radicals.

Glucosamine is the precursor of many of the constituents of proteoglycans and of hyaluronic acid. In cartilage, hyaluronic acid is bound with proteoglycans and forms aggregates which assure good hydration of this tissue. In the synovial fluid of joints, hyaluronic acid takes a **role of lubricant and chondroprotective agent**.

MSM is also endowed with chondroprotective properties. In addition it is a **source of organic sulphur indispensable to the synthesis of collagen**, an abundant cartilage protein, that bestows hydration, resistance, elasticity and suppleness properties.

RECOMMENDATIONS

MG/100KG LW/PER DAY	DAILY RECOMMENDATIONS
Chondroitin sulphate	200 - 1,200
Glucosamine sulphate 2KCl	1,000 - 2,000
MSM	800 - 4,000

NB: It is recommended to use marine chondroitin sulphate (and not bovine, poultry or porcine).

GLUTAMINE

DEFINITION

Glutamine is one of the 20 natural amino-acids.

PROPERTIES

Glutamine represents an **important energy source for fast renewing cells**. It operates at many levels:

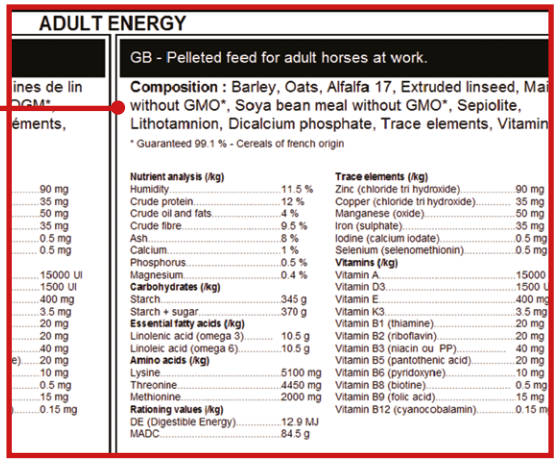
- **Protection and regeneration of the walls of the digestive system**. For example, it takes part in maintaining the integrity of the gastric mucosa and helps heal ulcerous lesions;
- Supports the **immune defences**;
- Installing a **beneficial digestive flora**;
- **Hepatic protection and regeneration**: improves detoxifications, and prevention of steatosis (excessive fat).

RECOMMENDATIONS

For a 500kg horse, distributing **between 10,000 and 15,000mg per day** of glutamine is recommended.

RAW INGREDIENTS

BY REVERDY EQUINE NUTRITION



ADULT ENERGY

GB - Pelleted feed for adult horses at work.

Composition : Barley, Oats, Alfalfa 17, Extruded linseed, Mai
without GMO*, Soya bean meal without GMO*, Sepiolite,
Lithotamnion, Dicalcium phosphate, Trace elements, Vitamin

* Guaranteed 99.1 % - Cereals of french origin

Nutrient analysis (/kg)	
Humidity	11.5 %
Crude protein	12 %
Crude oil and fats	4 %
Crude fibre	9.5 %
Ash	8 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.4 %
Carbohydrates (/kg)	
Starch	345 g
Starch + sugar	370 g
Essential fatty acids (/kg)	
Linolenic acid (omega 3)	10.5 g
Linoleic acid (omega 6)	10.5 g
Amino acids (/kg)	
Lysine	5100 mg
Threonine	4450 mg
Methionine	2000 mg
Rationing values (/kg)	
DE (Digestible Energy)	12.9 MJ
MADC	84.5 g

Trace elements (/kg)	
Zinc (chloride tri hydroxide)	90 mg
Copper (chloride tri hydroxide)	35 mg
Manganese (oxide)	50 mg
Iron (sulphate)	35 mg
Iodine (calcium iodate)	0.5 mg
Selenium (selenomethionin)	0.5 mg
Vitamins (/kg)	
Vitamin A	15000
Vitamin D3	1500 U
Vitamin E	400 mg
Vitamin K3	3.5 mg
Vitamin B1 (thiamine)	20 mg
Vitamin B2 (riboflavin)	20 mg
Vitamin B3 (niacin ou PP)	40 mg
Vitamin B5 (pantothenic acid)	20 mg
Vitamin B6 (pyridoxyne)	10 mg
Vitamin B8 (biotine)	0.5 mg
Vitamin B9 (folic acid)	15 mg
Vitamin B12 (cyanocobalamin)	0.15 m

The choice of the raw ingredients used to compose our feeds is above all based on QUALITY. As our desire is to produce healthy feeds for your horse, this is a coherent thought process. The first objective is to provide the horse with all necessary nutriments throughout his life, while preserving his gut micro-organisms and limiting the production of metabolic waste (lactic acid, urea, etc.) that can overload the organism (liver, kidneys, etc.).

BARLEY AND OATS

WHY?

In France, barley and oats, associated with forage are recognised as being **the basis upon which horses are fed**. These cereals are **rich in starch**, an essential nutriment for the metabolism of energy in the horse (see the chapter concerning "Starch"). Furthermore, the characteristics of their starches (amount in the grain and digestibility) complement each other.

OATS

A **soft grain** that has a relatively **high oil content** (5% crude), and more precisely, rich in Omega-6, an essential fatty acid favouring skin integrity and a shiny coat. Oats are fairly **rich in cellulose** (12% crude) and **contain relatively little starch** (36% crude), although it is highly digestible. To sum up, oats expose less to overfeeding and cereal indigestions, which can lead to complications in the large intestine (digestive acidosis, etc.) than with other cereals. However, the very high digestibility of oat starch confers a **high glycaemic index**. In consequence, oats must be fed in moderation, otherwise the horse can be exposed to **pathological states related to and/or aggravated by a high glycaemic index**: gastric ulcers, laminitis, tying up, obesity, behavioural problems (excitability, etc.), hormonal problems (equine metabolic syndrome, Cushing's disease, etc.), osteo-articular problems during growth (OCD, etc.), etc.

BARLEY

This has always been the basis upon which horses have been fed in Middle Eastern and North African countries; the vigour of Arabian horses cannot be denied.
Barley is a hard grain, relatively low in fibre (4.5% crude). In parallel, it is essential to provide large amounts of forage (hay, straw etc.). It is rich in slow releasing starch (52% crude) which explains why its glycaemic index is lower than that of oats. If a suitable amount is given per feed (no more than 1kg of barley per feed for a horse of 500kg), barley can provide sufficient carbohydrates for energy production without perturbing the digestive system and the metabolism of the horse in its entirety.

CHARACTERISTICS OF BARLEY AND OATS USED

All the cereals we use are French, and we favor those produced locally.
This has many advantages:

- It offers **better quality and sanitary guarantees** compared to the use of cereals imported from Eastern Europe for example.
- It contributes to **sustainable development** by limiting transport by lorry;
- It **supports French agriculture** (as every other french raw ingredients we use).

Cereals are selected according to strict specificatious. They must especially reach a minimum specific weight* and the humidity level must remain below a treshold value.

* Specific weight = cereal density=the weight (kg) of a hectolitre (1 hectolitre = 100 litres).
So for example, if the specific weight = 70, 1 hectolitre = 70kg thus 1 litre = 700 grammes.

MAIZE

WHY?

Used since a long time in America where it produces excellent results, maize is a **hard grain, low in cellulose** (2% crude) but **very rich in starch** (64% crude) of which the digestibility is intermediary compared to barley and oats. Maize is also **very high in energy** and of interest for horses in work. Nevertheless, it must be used in moderation; otherwise we expose our horses to digestive and metabolic complications.

CHARACTERISTICS OF MAIZE USED

We use **French produced, non-genetically modified** (guaranteed to 99.1 %) **maize**. Furthermore, we select **late varieties** which contain a larger amount of digestible starch.

WAXY FLAKED MAIZE

WHY?

Flaking consists of flattening and steam cooking the grains which leads to a hydration and a partial pre-digestion of the starch (= gelatinisation). This **increases the digestibility of the starch** which is **interesting in certain cases** (see the chapter concerning “Starch”).

CHARACTERISTICS OF WAXY FLAKED MAIZE USED

We use **French produced, non-genetically modified** (guaranteed to 99.1 %) maize. We select Waxy variety, which starch is naturally very digestible because deprived of amylose.

ALFALFA 17 (HORSE)

WHY?

Alfalfa is an interesting forage, it **complements cereals**. Being **rich in fibres, quality proteins** (high levels of essential amino-acids) and in **calcium**, alfalfa makes up for the deficiencies found in cereals. In addition, because of its **high intrinsic tampon ability** (capacity for neutralising acid), it can seriously limit the risks of acidification of the digestives contents (above all in the stomach) that can be caused by cereals.
Note: We advise against the feeding of alfalfa/lucerne hay alongside our feeds as they already contain a certain amount of alfalfa.

CHARACTERISTICS OF ALFALFA USED

We use **French produced** alfalfa. Its **guaranteed crude protein level is 17% of dry matter**. It is a dehydrated alfalfa made especially for horses, guaranteeing negative anti-doping control with regard to common naturally occurring prohibited feed substances of which morphine derivatives are part.

EXTRUDED LINSEED

WHY?

Linseed is a **valuable source of fats and oils** (32% crude) of which over half are from the **Omega-3** family. Thus its use in horse nutrition guarantees a balanced supply of essential fatty acids (Omega-3/Omega-6 ratio), the assurance of a healthy diet. Thermal extrusion is a succession of important compressions and decompressions of the seeds which are brutally raised to a high temperature over a very short space of time. This procedure has many advantages:

- **Liberating the oils** contained within the seeds' cells leads to a better assimilation by the organism.
- **Cooking the proteins improves their digestibility** whilst preserving them, thus better use by the animal.
- **Neutralises anti-nutritional factors** (cyanogenic components) and oxidants (lipases and lipoxydases) allows the animal to consume them safely.

CHARACTERISTICS OF LINSEED GRAINS USED

We use linseed produced in **France** and in the **United Kingdom**. It is treated in a factory located in western France holding the "**Bleu, Blanc, Coeur**" ("Blue, white, heart") **label**: this label brings to the fore the use of Omega-3 sources in animal diets.
The linseed is thematically treated using a **patented process**, seed by seed.

SOYA BEAN MEAL

WHY?

Soya bean meal is a **concentrated protein** stemming from the de-oiled soya-bean. Because of its **richness in essential amino-acids**, notably lysine and threonine it is one of the best plant protein sources on the market. Consequently, it compensates for **the deficit of essential amino-acids in cereals**; this is of major importance in not only the athletic horse but equally in growing youngsters and lactating mares whose digestible protein requirements are significantly increased.

CHARACTERISTICS OF SOYA BEAN MEAL USED

The soya bean meal we use is French. It is produced in a factory based in western france. It is **non-genetically modified** (guaranteed to 99.1 %) with a guaranteed crude protein and fat level of 48%.

EXTRUDED SOYA BEANS

WHY?

Just like soya bean meal, the whole grain is an **important source of proteins** (35% crude), **rich in essential amino-acids**, notably lysine and threonine. By undergoing an extrusion process, the proteins in the beans are **more digestible** and so better assimilated by the organism. Furthermore, the soya beans **conserve all their fats and oils** (20% crude). Compared to refined soya oil (see the chapter concerning "By-products"), extrusion is a procedure that conserves the nutritional qualities of oils whilst releasing them from cells of the beans, allowing better use of them by the organism. Also soya beans contain **high levels of Omega-6**. They are thus of interest by being **complementary to linseed**.

Finally, extrusion neutralises the anti-nutritional factors (antitrypsic factors) and oxidants (lipases and lipoxydases) naturally present in the beans permitting the animal to safely consume them.

CHARACTERISTICS OF SOYA-BEANS USED

We use **French grown, non–genetically modified** soya-beans (guaranteed to 99.1 %). They are processed in a factory located in western France and are thematically treated using a patented process, bean by bean.

SKIMMED MILK POWDER

WHY?

Skimmed milk is the **best protein source** used in our feeds (extremely rich in essential amino-acids). It is also a **good source of lactose**. Thus its use is of great interest for **young growing foals**, permitting coverage **of their high protein requirements** and in the transition from maternal milk to vegetable dietary sources.
The use of skimmed milk is also interesting for **increasing muscular mass**, not only in the young growing horse but also in the adult horse.

CHARACTERISTICS OF SKIMMED MILK USED

We used skimmed milk produced in **western France**, it is of "food" quality, which means that it is fit for human consumption.

DRIED CHICORY PULP

WHY?

Dried chicory pulp is rich in fructo-oligo-saccharides (FOS), choice prebiotics, favourable to healthy gut micro-organisms. They assure therefore good digestive health which directly influences the overall health and performances of the animal.
Chicory pulp is also rich in quality soluble fibres. These fibres reinforce the security of the digestive system and provide an alternative energy source to carbohydrates and lipids.

CHARACTERISTICS OF DRIED CHICORY PULP USED

We use France and Belgium chicory pulp. It is produced by **drying at low temperature** which strongly limits denaturalization of the pulp.

DRIED CARROTS

WHY?

Carrots are **very appetising**, encouraging eager consumption of the feed. This is a very important point for those horses in very hard work that are fussy feeders, or in the horse convalescing after surgery. Furthermore, their **richness in soluble fibres** assures good digestive health.
Finally, carrots also represent an important source of beta-carotenes, precursors of vitamin A.

CHARACTERISTICS OF DEHYDRATED CARROTS USED

The carrots we have selected are grown in **France and Poland.** They are washed and cut into cubes before being dehydrated. Just like all of our raw ingredients, they are recognised by GMP+ certification.

GMP+ CERTIFICATION

GMP+ certification (Good Manufacturing Practices) guarantees the feed safety of animal feeds at every stage of the production chain. Both our horse feed factory and our premixes, feed supplement, and vitamin & mineral supplement producing laboratory have been **certified by the scheme since 2015.**

The GMP+ certification rules define the good manufacturing practices to be respected at every stage of the production chain. **The standard requirements will very often exceed French regulation** (ex: the maximum permitted limit of certain substances).

Each year, we are audited by an independent certification body (CERTIS) in charge of ensuring that the GMP+ standard's requirements are respected. Our entire quality system comes under review: the compliance of our suppliers, our formulas, our labelling, the production facilities (checking of maintenance and cleaning routines), production monitoring, the control of taking and storing samples from each incoming ingredient and every outgoing feed, the verification of laboratory tests, of our traceability system (from the arrival of ingredients until the delivery of the finished product to our clients), as well as ancillary activities (storage, transport).
GMP+ certification is therefore a guarantee of the safety and quality of commercialised feeds and supplements.

RAW INGREDIENTS NOT USED

BY REVERDY EQUINE NUTRITION

THE PROBLEM

In the food industry, cereal grains undergo multiple treatments before being used in the human diet as flour (wheat, rye, etc.), starch (maize), beer (barley), etc.
In parallel from "noble" products, different **"waste", by-products and declassed raw ingredients** (example: mediocre wheat) result from these operations. Their nutritive value is very variable.
This **"waste"** cannot be used in the human diet. **Animal nutrition is therefore an** interesting **exit route** for the cereal industry, which valorises and justifies their usage by sometimes questionnable arguments.
As for the equine industry, contrary to animals that have a production (litres of milk produced, carcass weight etc.), **it is not as easy to be aware of the real impact of nutrition in the horse**.
The **principal indicator used by horse owners is body condition**. This criterion is **not at all a measure of the quality of a feed**, on the contrary. To understand this, you only have to observe the growing obesity issues in the human population, especially amond the disadvantaged social classes who eats cheap food.

A horse is not livestock to be fattened, but an athlete, or a future athlete.
The problematic is different.

The **QUALITY** of a feed must be evaluated using **objective indicators** of the horses' **health**:

- The way they maintain their racing and sporting performances throughout the season, year after year;
- Their veterinary records (known health problems, etc.);
- Their blood tests;
- Etc.

However, **as that the majority of horse owners still consider that a feed is of quality if it maintains their horses' body condition, many approximations are made.**

WHEAT

The use of wheat to feed horses is possible, providing that it is of good quality and only a small quantity is incorporated into the feed. However, the wheat available for animal nutrition is very often of poor quality (rejected from human consumption) and if included in too large an amount (figuring in one of the first positions on the list of ingredients), we risk the appearance of health problems related to with the characteristics of this cereal:

- The **high gluten content** increases the risk of **obstructing the digestive tract** of the horse (oesophagus blockage etc.) and even digestive intolerance to gluten;
- **The important quantity of very fermentable starch** leads to gastric fermentations (microbial) which favour the appearance or aggravation of **gastric ulcers**;
- The high digestibility of wheat starch triggers an important production of insulin which can be at the origin of harmful disturbances for the horse: behavioural problems (excitement), the muscular metabolism (tying-up) and osteo-articular (disrupted growth), etc.

For all of these reasons, we have chosen not to use this cereal.

CEREAL BY-PRODUCTS

BRAN, TEGUMENTS, MIDDLING'S, PODS...

Bran is a co-product from the transformation of wheat grains, mainly constituted from the envelopes (teguments) and particles of grain from which the major part of the flour has been removed.
Middling's are co-products from the transformation of wheat grains, starch fractions and husks, of which the proportions are bigger or smaller depending on their origin (white millings, etc.).
As for **pods**, **husks** and **teguments**, they are the envelopes of the cereal or grain.

All these co-products are **very rich in phosphorus** and notably in **phytate phosphorus** (for example: wheat bran = 1% of phosphorus of which 80% is phytate phosphorus) **which perturbs the assimilation of calcium and trace elements**.
Furthermore, these fragments of cereal envelopes contain a more or less large quantity of **starch** (20% starch in wheat bran!) which is **directly exposed to air**. Because of the **important water retaining capacity** of the fibres they contain, there is a high risk of them becoming **rancid**, **fermenting and developing mould**.
Finally, whilst in the field, the seed envelopes are susceptible to collect heavy metals and pesticides.

SPENT GRAIN

Wet brewer's grains from brewery or distillery run the risk of **spoiling quickly**. It is therefore better to exclude them from horses' diet. They are close to bran by their cellulose content but are richer in proteins, even if they are of **poor quality**.

MAIZE GLUTEN MEAL

This is a co-product from the extraction of starch from maize, which is defined as a low quality protein concentrate (60% crude protein, poor in lysine).
Furthermore, the high gluten content increases the risks of **digestive intolerance**.

LACTOSERUM

Lactoserum is a dehydrated co-product from cheese making. It is also called "whey", and is obtained after the caseins, which represent 80% of proteins in cows' milk, have coagulated. It is thus **principally composed of lactose** (sugars: 60 to 70% crude) and is **considerably less rich in protein than skimmed milk** (3.5 times less).
Its **use for foals** therefore contributes more their **fattening** (lactose concentrate) than to the correct progress of their osteoarticular development (low protein content).

SUGAR BEET

MOLASSES FROM SUGAR BEET

Molasses is co-product from the crystallization of beet sugar. It has **binding properties**, that is to say it helps to hold feeds together. However, it also agglomerates dust in the production line, which is far from being ideal from the health aspect.
Furthermore, by increasing appetency, it can hide the taste of unappetising raw ingredients. Also, **"the very high appetency of molasses should certainly not be a pretext to feed your horse with bad quality raw ingredients" (Wolter, 1999)**.
As it is composed of fast sugars it has a high glycaemic index, which makes it a potentially **ulcerogenic and disruptive ofthe glycaemia ingredient.**

SUGAR BEET PULP

Sugar beet pulp is a dehydrated co-product from sugar production obtained after extraction of the juice from the sugar beet roots.
"It must be of perfect quality to enter into the diet of the horse, and then is **only suited to rustic breeds**" (Wolter 1999).
Indeed, if badly stored, the high water retaining capacity increases the risk of it becoming **rancid, fermenting** and **becoming mouldy**.

VEGETABLE OILS

SATURATED OILS (PALM, COPRA, ETC.)

These are rich in **saturated fatty acids**. For example, palm oil is richer in saturated fatty acids than pork fat!
Saturated fatty acids contribute to **"clogging up the organism"** as the body prefers to store them.
In humans, they are responsible for high cholesterol levels and are implicated in heart diseases.

SOYA OIL

Soya oil is the **most widely produced oil in the world**. Even if it does have a certain nutritional interest, the manner in which it is extracted has dissuaded us from using it. Extraction is maximised by subjecting it to numerous pressings at **high temperatures** and using **different solvents**, the oil produced in this way is then refined.
Finally, the oil obtained is very often of bad quality: the fatty acids carry a strong risk of being denatured and becoming **harmful for the organism**.

READ A LABEL

How to know if a feed correctly meets the nutritional demands of your horse?

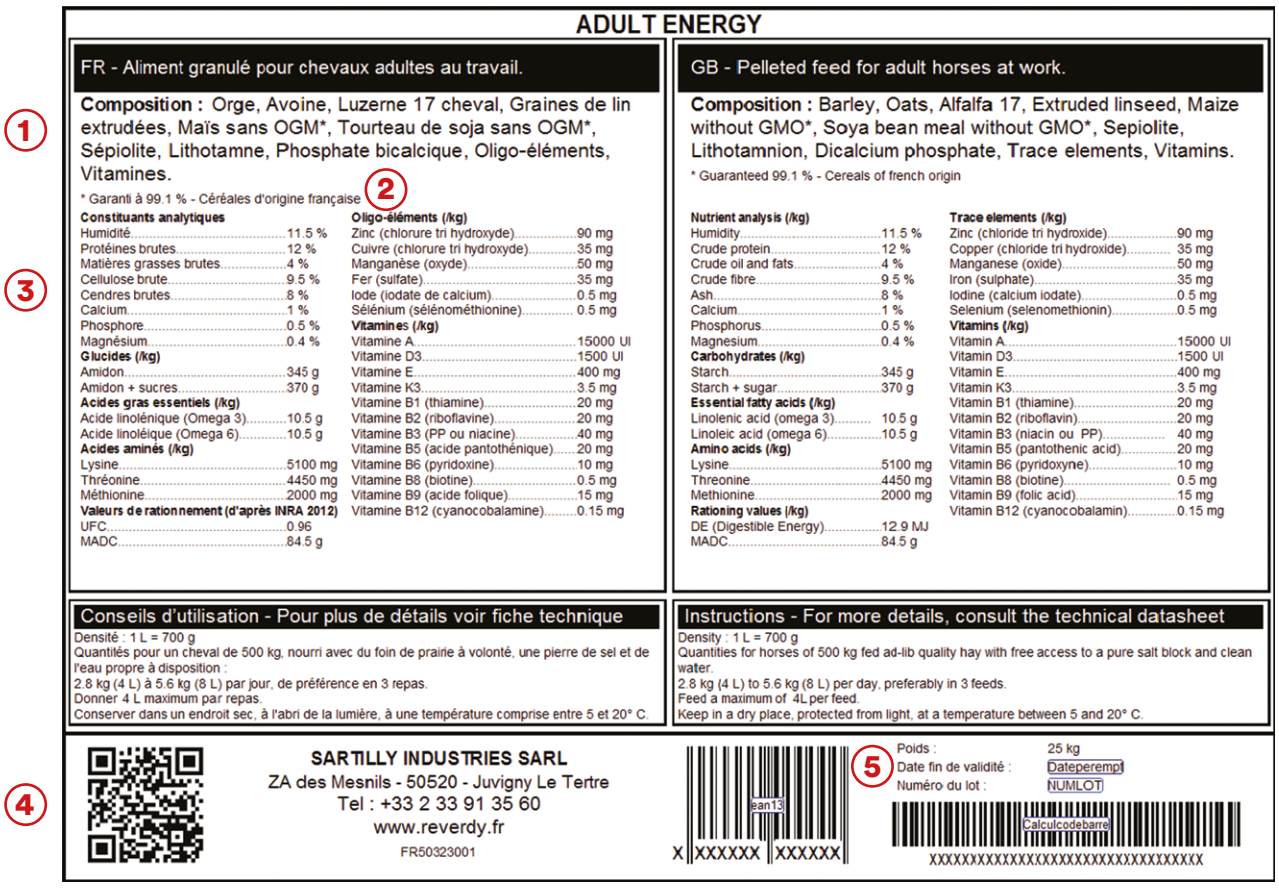
INFORMATION SUPPLIED BY LABELS

COMPOSITION

Ingredients are listed by their **decreasing level of incorporation** (the most to the least).
In consequence it is recommended to avoid a diet made up of raw ingredients and/or by-products which we have previously mentioned, above all if they are featured in the first lines.

ANALYTICAL CONSTITUENTS

Only the display of certain constituents is obligatory: **crude protein, crude oils and fats, crude cellulose (fibre)** and **crude ash**. Mentioning other values is optional (except for particular cases) and engages the manufacturers' responsibility as to the indicated values.
Whilst **the display of the analytical constituents is obligatory, it actually provides us with little information on the quality of the ingredients**. Effectively, the same value for a given constituent can be obtained by using a by-product or a noble raw ingredient. For example, distillers' spent grains, dehydrated co-products from the fabrication of ethanol contain the same quantity of crude protein as skimmed milk powder, that is to say 34% crude. However, the quality of the proteins is far from being identical.
To be aware of the true nutritional value of a feed, we must use the levels of essential nutriments: starch, Omega-3 and 6, lysine, etc.
To demonstrate, we have created a feed (fictive and non-commercialised) based upon by-products and declassed raw ingredients ("BY-PRODUCT" FORMULA) of which the obligatory analytical values are identical to ADULT ENERGY (refer to the labels on page 76).



ADULT ENERGY

FR - Aliment granulé pour chevaux adultes au travail.

Composition : Orge, Avoine, Luzerne 17 cheval, Graines de lin extrudées, Maïs sans OGM*, Tourteau de soja sans OGM*, Sépiolite, Lithotamne, Phosphate bicalcique, Oligo-éléments, Vitamines.

* Garanti à 99.1 % - Céréales d'origine française

Constituants analytiques	
Humidité	11.5 %
Protéines brutes	12 %
Matières grasses brutes	4 %
Cellulose brute	9.5 %
Cendres brutes	8 %
Calcium	1 %
Phosphore	0.5 %
Magnésium	0.4 %
Glucides (/kg)	
Amidon	345 g
Amidon + sucres	370 g
Acides gras essentiels (/kg)	
Acide linolénique (Omega 3)	10.5 g
Acide linoléique (Omega 6)	10.5 g
Acides aminés (/kg)	
Lysine	5100 mg
Thréonine	4450 mg
Méthionine	2000 mg
Valeurs de rationnement (d'après INRA 2012)	
UFC	0.96
MADC	84.5 g

Oligo-éléments (/kg)	
Zinc (chlorure tri hydroxyde)	90 mg
Cuivre (chlorure tri hydroxyde)	35 mg
Manganèse (oxyde)	50 mg
Fer (sulfate)	35 mg
Iode (iodate de calcium)	0.5 mg
Sélénium (sélénométhionine)	0.5 mg
Vitamines (/kg)	
Vitamine A	15000 UI
Vitamine D3	1500 UI
Vitamine E	400 mg
Vitamine K3	3.5 mg
Vitamine B1 (thiamine)	20 mg
Vitamine B2 (riboflavine)	20 mg
Vitamine B3 (PP ou niacine)	40 mg
Vitamine B5 (acide pantothénique)	20 mg
Vitamine B6 (pyridoxine)	10 mg
Vitamine B8 (biotine)	0.5 mg
Vitamine B9 (acide folique)	15 mg
Vitamine B12 (cyanocobalamine)	0.15 mg

GB - Pelleted feed for adult horses at work.

Composition : Barley, Oats, Alfalfa 17, Extruded linseed, Maize without GMO*, Soya bean meal without GMO*, Sepiolite, Lithotamnion, Dicalcium phosphate, Trace elements, Vitamins.

* Guaranteed 99.1 % - Cereals of french origin

Nutrient analysis (/kg)	
Humidity	11.5 %
Crude protein	12 %
Crude oil and fats	4 %
Crude fibre	9.5 %
Ash	8 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.4 %
Carbohydrates (/kg)	
Starch	345 g
Starch + sugar	370 g
Essential fatty acids (/kg)	
Linolenic acid (omega 3)	10.5 g
Linoleic acid (omega 6)	10.5 g
Amino acids (/kg)	
Lysine	5100 mg
Threonine	4450 mg
Methionine	2000 mg
Rationing values (/kg)	
DE (Digestible Energy)	12.9 MJ
MADC	84.5 g

Trace elements (/kg)	
Zinc (chloride tri hydroxide)	90 mg
Copper (chloride tri hydroxide)	35 mg
Manganese (oxide)	50 mg
Iron (sulphate)	35 mg
Iodine (calcium iodate)	0.5 mg
Selenium (selenomethionin)	0.5 mg
Vitamins (/kg)	
Vitamin A	15000 UI
Vitamin D3	1500 UI
Vitamin E	400 mg
Vitamin K3	3.5 mg
Vitamin B1 (thiamine)	20 mg
Vitamin B2 (riboflavin)	20 mg
Vitamin B3 (niacin ou PP)	40 mg
Vitamin B5 (pantothenic acid)	20 mg
Vitamin B6 (pyridoxyne)	10 mg
Vitamin B8 (biotine)	0.5 mg
Vitamin B9 (folic acid)	15 mg
Vitamin B12 (cyanocobalamin)	0.15 mg

Conseils d'utilisation - Pour plus de détails voir fiche technique

Densité : 1 L = 700 g
Quantités pour un cheval de 500 kg, nourri avec du foin de prairie à volonté, une pierre de sel et de l'eau propre à disposition :
2.8 kg (4 L) à 5.6 kg (8 L) par jour, de préférence en 3 repas.
Donner 4 L maximum par repas.
Conserver dans un endroit sec, à l'abri de la lumière, à une température comprise entre 5 et 20° C.

Instructions - For more details, consult the technical datasheet

Density : 1 L = 700 g
Quantities for horses of 500 kg fed ad-lib quality hay with free access to a pure salt block and clean water.
2.8 kg (4 L) to 5.6 kg (8 L) per day, preferably in 3 feeds.
Feed a maximum of 4L per feed.
Keep in a dry place, protected from light, at a temperature between 5 and 20° C.

SARTILLY INDUSTRIES SARL
ZA des Mesnils - 50520 - Juvigny Le Tertre
Tel : +33 2 33 91 35 60
www.reverdy.fr
FR50323001

ean13
X XXXXXX XXXXXX

Poids : 25 kg
Date fin de validité : Dateperempt
Numéro du lot : NUMLOT
Calculcodebarre
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

1

Very important

Ingredients are listed by their decreasing level of incorporation (from the greatest amount to the least).
Reverdy feeds contain NO BY-PRODUCTS.

2

Our commitment towards quality at every level:

- A careful following of our raw ingredients.
- A certified manufacturing process.

3

- The quality of our nutriments is regularly verified by independent laboratories.
- The values are guaranteed from certified suppliers.

4

QR Code

Read using your smartphone to directly access the technical data sheet for that feed.

5

An irreproachable traceability, from the arrival of raw ingredients until delivery to our customers.

COMPARATIVE STUDY OF TWO FEEDS

HUMIDITY

Providing it does not exceed 14% crude, it is not obligatory to display the humidity level. However this value is important as it translates the foods' aptitude for preservation. **The higher the feeds humidity, the lower the keeping potential.**

CARBOHYDRATES

The "BY-PRODUCT FORMULA" is composed of wheat starch (contained in the wheat grains and in the bran), very fermentative and digestible. Furthermore, because of the addition of molasses, it contains 2.5 times as many simple sugars as ADULT ENERGY. To sum up, this feed is **rich in fast** and moderately fast **sugars** which are:

- **Very fermentative**, which increases the risks of appearance of gastric ulcers.
- **Highly digestible**, providing a high glycaemic index, from which there is a non-negligible risk of the following health problems

appearing: **tying-up, behavioural problems (excitability, etc.), hormonal problems (equine metabolic syndrome, Cushing's disease, etc.), laminitis, osteo-articular problems (OCD, etc.)**. Furthermore, the massive arrival of sugar in the bloodstream after the meal will lead to the storing of sugars. **This storage will take the form of fat** giving the horse corpulence.

A deception, because the horse looks normal, but it results more in the clogging of its organism rather than in its good health.

On the other hand, ADULT ENERGY is mainly composed by barley starch, slow releasing and not as prone to ferment. It is associated with maize and oat starches which are more digestible but are present in smaller quantities. As for simple sugars, it contains only those naturally present in the raw ingredients. To sum up, ADULT ENERGY principally provides slow releasing sugars, protecting carbohydrate metabolism, whilst favouring the storage of energy into the muscles. It is therefore more **favourable to performance and limits a surcharge in fat**, ensuing a more harmonious morphology.

PROTEINS

The principal protein sources of the "BY-PRODUCT" FORMULA are, in decreasing order: wheat bran, maize gluten meal and distillers spent grains. Although the crude protein content is identical to ADULT ENERGY, this feed contains **30% less lysine and 25% less threonine**. So, even with an identical crude protein content to ADULT ENERGY, 5.5kg of this feed + 8kg of ordinary hay **does not cover the daily requirements in lysine and threonine for a 500kg adult horse in very hard work**: It provides 46.5g of lysine for a daily requirement of 54g (INRA 2012). Furthermore, given that protein synthesis is carried out to the extent of lysine supply, as lysine is the most limiting amino acid (see the chapter "proteins", the diagram of the bucket), the use of other amino acids cannot be fully optimised. **They must be eliminated by the emunctory organs (liver, intestines, kidneys, skin, etc.) which, yet again, burdens the organism.**

Regarding ADULT ENERGY, the principal protein sources are, by decreasing order: alfalfa 17 (horse), soya bean meal 48 and extruded linseed. This association creates a feed containing **good quality protein**. Indeed, the **lysine content** is satisfactory compared to the crude level of proteins. Feeding 5.5 kg of ADULT ENERGY + 8kg of ordinary **hay meets the lysine requirements of a 500kg adult horse in very hard work**: supplies 54.5g of lysine for a daily requirement of 54g.

LIPIDS

Only 24% of the total fat and oil content of the "BY-PRODUCT FORMULA" are Omega-3 and Omega-6, the greater part of the rest is made up of saturated fatty acids found in palm oil. Furthermore, the Omega3/Omega-6 ratio is equal to 0.1. To sum up, the fats and oils contained within this feed are **unfavourable to the good health of the organism**. Effectively:

- The part Omega-3 + Omega-6 is insufficient.
- The Omega-3/Omega-6 ratio is too low, the objective is to be higher than 1.
- The feed is **high in saturated fatty acids**, which are stored in priority, facilitating corpulence.

Concerning ADULT ENERGY, Omega-3 and Omega-6 represent 55% of the total fat and oil content, thus more than a half. In addition, the Omega-3/Omega-6 ratio equals 1.1. To sum up, the fats and oils contained within this feed **favour the good health of the organism** (immunity, fertility, regulation of inflammation, etc.). Effectively:

- Omega-3 + Omega-6 make up a big part of the crude oil and fat content.
- The Omega-3/Omega-6 ratio is greater than 1 thanks to the extruded linseed.
- This feed is **low in saturated fatty acids**.

MINERALS

The "BY-PRODUCT FORMULA" is mainly composed from cereal envelopes, **rich in phytate phosphorus**. For example, wheat bran contains 3 times the phosphorus and 4.5 times the phytate phosphorus of barley or oats. Phytate phosphorus limits calcium and trace element absorption.
In consequence, horses that eat the "BY-PRODUCT FORMULA" can be susceptible to suffer from **assimilation deficiencies** of some minerals although the feed itself provides satisfactory quantities.

TO SUM UP

A healthy and balanced diet provides all the nutriments indispensable to the correct functioning of the organism whilst limiting clogging-up (liver, kidneys, intestines etc.). Thus favouring performance and allowing your horse to maintain his good health over the long term.

TO SUM UP

There can be the same quantity of proteins, lipids and carbohydrates
but **there is a real difference in the quality of raw ingredients**

PROTEINS	
"BY-PRODUCT FORMULA"	**"ADULT ENERGY FORMULA"**
Wheat bran	Alfalfa 17 (horse)
Maize gluten meal	French soya bean meal without GMO* (*<0,1 %)
Distillers spent grains	"Bleu Blanc Cœur" extruded linseed

Optimal daily requirement of lysine (for a 500kg adult horse in work) = 54g

For 5.5kg of feed + 8kg of hay/day:	
46.5g	**54.5g**

In the "by-product formula" there is 30 % less lysine and 25 % less threonine

LIPIDS	
"BY-PRODUCT FORMULA"	**"ADULT ENERGY FORMULA"**
Omega-3 & 6 = 27.5% of fat content The rest is palm oil!	Omega-3 & 6 = 55% of fat content

Goal: Omega-3/Omega-6 ratio ≥ 1

0.1	**1.1**

✓ High in saturated fatty acids
✓ Promotes corpulence
✓ Horse looks normal but:
CLOGGING OF ITS ORGANISM

≠

✓ Low in saturated fatty acids
✓ Favours the good health of the organism (immunity, fertility, regulation of inflammation)

CARBOHYDRATES	
"BY-PRODUCT FORMULA"	**"ADULT ENERGY FORMULA"**
Wheat starch =>Highly digestible thus very easily fermented in the stomach	Barley starch
	Maize and oat starches =>Easily digested but present in smaller quantities
Addition of MOLASSES = SUGAR => 3 times as much sugar as Adult Energy	No simple sugars

SIMPLE SUGARS (FAST):

- ✓ Increases the risk of the appearance of gastric ulcers
- ✓ Very digestible = high glycaemic index => "tying-up", behavioural problems (nervousness/excitement), hormonal problems, etc.
- ✓ The storage will take the form of fat => obesity

≠

COMPLEX SUGARS (SLOW):

- ✓ Favourable to performance
- ✓ Limits a surcharge in fat

COMPARISON WITH THE HUMAN DIET:

A hamburger, pizza or hotdog can contain the same amount of protein, fat and energy as a plate of fish, olive oil, brown rice and green beans.

Two different diets, two different effects on our organism and our health...

A comparison with human diet is presented next page.

FLAKES:

> Increase digestibility thus glycaemic index of cereals.

TOO MANY FLAKES :

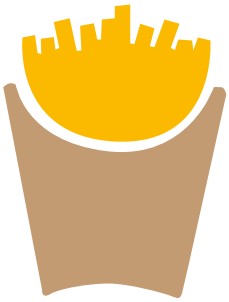
- Obesity;
- Development of gastric ulcers;
- Behavioural problems;
- Muscular problems;
- Metabolic problems.

For breeding, as they favour the development of osteoarticular disorders in young horses, **we strongly advise against the feeding of flakes !** (broodmares in gestation and growing youngsters).

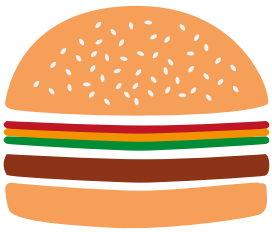
We recommend feeding flakes in moderation, only in specific situations. (ex: horses in hard work which have high energy requirements)

If we compare a horse's diet with a humans.
"By-Product" formula = "Fast Food" meal
Adult Energy formula = "Healthy" meal

"FAST FOOD" MEAL



100g of chips



Burger

Caramel ice cream

=

Calories: **880Kcal**

Fats: **33g**

Proteins : **24g**

"BY-PRODUCT" FORMULA

COMPOSITION

Wheat, Wheat bran, Buckwheat hulls, Molasses, Dehydrated sugar beet pulp, Distillers spent grains, Lithothamnion, Palm oil, Sepiolite, Maize gluten meal, Dicalcium phosphate, Trace elements, Vitamins.

ANALYTIC CONSTITUANTS

Humidity	12.5%
Crude Protein	**12%**
Crude fats and oils	**4%**
Crude fibre	**9.5%**
Crude Ash	**9%**
Calcium	1%
Phosphorus	0.5%

CARBOHYDRATES/KG

Starch	290g
Starch and sugars	350g

ESSENTIEL FATTY ACIDS/KG

Acid Linolenic (Omega-3)	1g
Acid Linoleic (Omega-6)	10g

AMINO ACIDS/KG

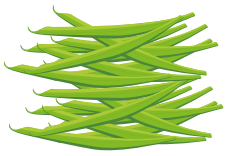
Lysine	3,650mg
Threonine	3,350mg
Methionine	1,950mg

A “Fast Food” Meal contains the same quantity of Fats (33 g) and Proteins (24 g) than a balanced meal.
However, how many athletes would choose the first meal?

“HEALTHY” MEAL

80g of mackerel

100g of brown rice



100g of green beans

1 spoon of nut oil (10g)

2 spoons of sour cream

1 apple

=

Calories: **605Kcal**

Fats: **33g**

Proteins : **24g**

ADULT ENERGY FORMULA

COMPOSITION

Barley, Oats, Alfalfa 17 (horse), Maize without GMO*, TRADI-LIN extruded linseed, French soya bean meal without GMO*, Sepiolite, Lithothamnion, Dicalcium phosphate, Sodium Chloride, Trace elements and Vitamins.
* Guaranteed to 99.1% - French produced cereals

ANALYTIC CONSTITUANTS

Humidity	11.5%
Crude Protein	**12%**
Crude fats and oils	**4%**
Crude fibre	**9.5%**
Crude Ash	**9%**
Calcium	1%
Phosphorus	0.5%

CARBOHYDRATES/KG

Starch	340g
Starch and sugars	360g

ESSENTIEL FATTY ACIDS/KG

Acid Linolenic (Omega-3)	10.5g
Acid Linoleic (Omega-6)	10.5g

AMINO ACIDS /K

Lysine	5,150mg
Threonine	4,500mg
Methionine	2,000mg

Conclusion

To conclude, when understanding horse nutrition, the origins of the horse have to be taken into consideration: the horse is a herbivore, living in symbiosis with a microbial flora which allows him to digest cellulose. He evolved over millions of years on huge grassy plains, eating small but frequent fibre rich meals. In the wild, the horse was prey, escaping through flight, hence his exceptional athletic abilities.

Man then tamed him, using him in different ways and turning him into his companion. In any event, we have considerably changed his lifestyle. For example, sometimes horses may be confined to their stables up to 23 hours a day when originally, a horses' lifestyle was synonymous with continual movement. These "new" living conditions are often the source of a number of stressful situations from which the horse cannot flee. We know that, unfortunately, it is not easy to leave the horse outdoors throughout the year. However, it is within everyone's reach to respect his status as a herbivore and to "feed his flora" by providing forage at will. By doing this, we guarantee a healthy digestion, mind-set and thus proper functioning of his entire organism. **Consequently, providing forage at will must be the first point to be considered when discussing horse nutrition and this, well before concentrate feeds!**

Nowadays, the horse is considered an athlete, able to take part in a number of disciplines : jumping, racing, etc. He must therefore be fed as such in order to be able to fully show his potential. Also, as you will have become aware of through this guide, we do our utmost to provide all the essential nutrients absent or deficient in forage, in order to meet his requirements as an athlete. We use the best ingredients on the market, those best suited to horses. Indeed, the elaboration of our feeds is based on the traditional feeding practises of man over centuries, without by-products derived from the agri-food industry, and also making use of recent scientific data. For this reason, we can call our nutritional concept "traditional next generation".

Finally, if you must remember only one clear message on the subject of industrial feeds, this is it : "read the labels!".

BIBLIOGRAPHY

AAEP, Joint health supplements: information and how to read a product label, http://www.aaep.org/.

Akay V., Jackson J. A., Effects of nutridense and waxy corn hybrids on the rumen fermentation, digestibility and lactational performance of dairy cows, J. Dairy Sci. 2001 ; 84 : 1698 – 1706.

Allain P., « Les médicaments » 3ème édition, mise à jour Août 2008.

Benamou-Smith A., Syndrome métabolique équin : état des lieux et éléments de comparaison avec l'homme, 2007 ; Vol. 39 : n° 154, 37-41.

Capitain et al., Croissance et développement du poulain, CEREOPA, Paris, 1976.

Caure S. et Lebreton P., Ostéochondrose chez le trotteur au sevrage et corrélation avec divers paramètres, Pratique Vétérinaire Equine, 2004 ; Vol. 36, n°142.

Couroucé-Malblanc A., **Deniau V.** et coll., L'entraînement, la prophylaxie et le traitement des myopathies d'exercice, Pratique Vétérinaire Equne, 2009 ; Vol. 41 : n°161, 41-49.

Crandell K.M., Vitamin requirements in the horse, World Equine Veterinary Review, 2000 ; Vol. 5/8 : 15-20.

Cuddeford D., Starch digestion in the horse. In: Proc. 9th Equine Nutr. Conf. Feed Manufacturers. Kentucky Equine Research Inc., Lexington KY, 1999 ; 129.

Dill S.G., Rebhun W.C., White muscle disease in foals, Comp. Cont. 1985 ; Ed.7: 627.

DSM, Nutritional products, Stabilité de la vitamine C, Dossier technique.

DSM, Vitamin Supplementation Guidelines 2016 for animal nutrition.

Essen B., **Lindholm A.**, Muscle fibre characteristics of active and inactive Standardbred horses, Equine Veterinary Journal, 1985 ; Vol. 17, Issue 6 : 434-438.

Faubladier et al., Bacterial carbohydrate degrading capacity in foal feces: changes from birth to preweaning and impact of a maternal supplementation with fermented feed products. Br J Nutr. Doi:10.1017/S0007114512006162, 2013.

Faubladier et al., Effet d'une supplémentation prébiotique (technologie FAP) sur le poids et l'écosystème fécal de la jument et répercussions sur la croissance du poulain. Journées annuelles de l'Association Française des Vétérinaires Equins de France, Lyon, France (Poster), 2011.

Geor R.J., Harris P.A., Coenen M., Equine applied and clinical nutrition : Health, Welfare and Performance, Saunders, Elsevier, 2013.

Goachet A.G., L'alimentation du cheval d'endurance : présentation ACA Bretagne, AGRO SUP Dijon, 2010.

Graham P.M., Ott. E.A., Brendemuhl J.H., TenBroek S.H., The effect of supplemental lysine and threonine on growth and development of yearling horses, J. Anim. Sci., 1994 ; 72 : 380-386.

Hoffman R.M., Morgan K.L., Lynch M.P., Zinn S.A., Faustman C., Harris P.A., Dietary vitamin E supplemented in the periparturient period influences immunoglobulins in equine colostrum and passive transfer in foals, Proc. 16th Equine Nutr. Physiol. Soc. Symp. 96.

Hoekstra, K.E., K. Newman, M.A.P. Kennedy and J.D. Pagan. Effect of corn processing on glycemic response in horses. In: Proc. 16th Equine Nutr. and Physiol. Soc. Symp., 1999 ; 144-148.

Holden R. J., Schizophrenia, suicide and the serotonin story. Med Hypotheses, 1995 ; 44: 5, 379-91.

Huntington P.J., Pagan J.D, Forages: The foundation for gastrointestinal health, Proc 14th Asian Assoc Animal Prod. Animal Science Congress, 359 -364.

Janicki K.M., Lawrence L.M., Barnes T., O'Connor C.I., The effect of dietary selenium source and level on broodmares and their foals. Proceedings of the KER Nutrition Conference for Feed Manufacturers, Lexington, KY, 2000.

Jansson, A., Sandin, A. & Lindberg, J. Digestive and metabolic effects of altering feeding frequency in athletic horses. Equine Comp. Exerc. Physiol. 3, 83–91 2006).

Jevardat de Fombelle A., Etude de l'effet de l'origine botanique de l'amidon sur sa digestibilité antécaecale chez le cheval, Thèse, Institut National Agronomique de Paris – Grignon, 2003.

Julliand V., Impact of nutrition on the microflora of the gastro-intestinal tract in horses. In: Applied Equine Nutrition, edited by A. Lindner, Wageningen Academic Pub., 2005.

Laude et al., Evaluation de l'intérêt d'une supplémentation en EQUIPROCESS (FAP) sur la reprise de poids de la jument poulinière en postpartum, Journées annuelles de l'Association Française des Vétérinaires Equins de France. Bordeaux, France (Poster), 2010.

Lallemand, Animal Nutrition, Melofeed, natural properties of bone, Proc. 10th Equine Nutr. Physiol. Soc. Symp., 1987.

Lawrence L. M., Feeding more and getting less: effects of high grain intakes on digestive capacity and gastrointestinal health of performance horses, University of Kentucky, Lexington, Kentucky, 2002.

Lawrence L.M., Ott E.A., Asquith R.L., Miller G.J., Influence of dietar y iron on growth, tissue mineral composition, apparent phosphorus absorption and chemical properties of bone, Proc. 10th Equine Nutr. Physiol. Soc. Symp., 1987.

Lizardo R., Perez-Vendrell A., Ballet N., Auclair E., Brufau J., Influence de la source et du niveau de sélénium des régimes sur les performances zootechniques et sur la teneur en sélénium de la viande chez le porc, Journées Recherche Porcine, 2009 ; 41.**Lu et al.**, Effect of dietary supplementation with copper sulfate or tribasic copper chloride on the growth performance, liver copper concentrations of broilersfed in floor pens, and stabilities of vitamin E and phytase in feeds, Biol. Trace Elem. Res., 2010 ; 138 (1-3) : 181-189.

McKenzie E.M., Valberg S.J, Pagan J. D., Nutritional management of exertional rhabdomyolysis. In: E. Robinson (Ed.) Current Therapy in Equine Medicine 5, 2003.

Métayer N., Lhôte M., Bahr A., Cohen N. D., Kim I., Roussel A. J. and Julliand V., Meal size and starch content affect gastric emptying in horses, Equine Veterinary Journal, 2004 ; 36 (5) : 436-440.

Meyer, H., Coenen M., Gurer C., Investigations of saliva production and chewing in horses fed various feeds, In: Proc. Equine Nutri. Physiol. Soc., 1985 ; 38-41.

Nadeau J., Andrews F., Mathew A., Argenzio R., Blackford J., Sohtell M., Saxton A., Evaluation of diet as a cause of gastric ulcers in horses. American Journal of Veterinary Research, 2000 ; 61 : 784– 790.

Notin C. and al., Oral supplementation with superoxide dismutase in Standardbred trotters in training: a double-blind placebo-controlled study, Equine vet. J., 2010, 42 (Suppl. 38), 375-381.

ORFFA, Excential Selenium 4000, nouvelle génération de sélénium organique, Dossier technique.

Pagan J. D., Energetics : choosing the appropriate fuel for the performance horse, In: Proc. 17th Equine Nutr. and Physiol. Soc. Symp., 2010.

Pagan J. D., Geor R.J., Caddel S.E, Pryor P.B., Hoekstra K.E., The relationship between glycemic index response and the incidence of OCD in Thoroughbred weanlings : a fiel study, In : Proc. Amer. Assn. Equine Practnr., 2001 ; 47: 322-325.

Pagan J.D., Micromineral requirements in horses. In: J.D. Pagan and R.J. Geor (Ed.) Advances in Equine Nutrition II, 2001 ; 317-327. Nottingham University Press. Nottingham, United Kingdom.

Pagan, J.D., Forages for horses: More than just filler, In: J.D. Pagan (Ed.) Advances in Equine Nutrition, 1998 ; 13-28. Nottingham University Press. Nottingham, United Kingdom.

Pagan, J.D., Carbohydrates in equine nutrition. In: J.D. Pagan (Ed.) Advances in Equine Nutrition, 1998 ; 29-41. Nottingham University Press. Nottingham, United Kingdom.

Pagan, J.D., Energy and the performance horse. In: J.D. Pagan (Ed.) Advances in Equine Nutrition, 1998 ; 141-148. Nottingham University Press. Nottingham, United Kingdom.

Pavlata L., Illek J., Pechovà A., Blood and tissue selenium concentrations in calves treated with inorganic or organic selenium compounds – a comparison, Acta Vet. Brno 2001 ; 70 : 19-26.

Pratt-Phillips, S. et al. The Effect of Feeding Two or Three Meals Per Day of Either Low or High Nonstructural Carbohydrate Concentrates on Postprandial Glucose and Insulin Concentrations in Horses. J. Equine Vet. Sci. 34, 1251–1256 (2014).

Robles, M. Influence du métabolisme maternel sur la fonction placentaire et la santé du poulain. (Thèse de doctorat, Université Paris-Saclay - AgroParisTech, 2017).

Robles, M. et al. Maternal obesity increases insulin resistance, low-grade inflammation and osteochondrosis lesions in foals and yearlings until 18 months of age. PLoS One 13, (2018).

Sauvant D., Perez J.M., Tran G., coord., Tables de composition et de valeur nutritive des matières premières destinées aux animaux d'élevage, 2è édition revue et corrigée, Editions INRA, 2004.

Shaeffer, G. L., Evaluation of basic zinc chloride as a zinc source for cattle, MS Thesis. North Carolina State University. Raleigh, NC, 2006.

Snow D.H., Valberg S.J., Muscle anatomy : adaptations to exercise and training. In : The athletic horse : principles and practice of equine sports medicine, New York, 1994 ; 145-179.

Spears et al., Bioavailability of copper from tribasic copper chloride and copper sulfate in growing cattle, Anim. Feed Sci. Technol., 2004 ; 116 : 1-13.

Steelman, S., Michael-Eller, E., Gibbs, P. & Potter, G. Meal size and feeding frequency influence serum leptin concentration in yearling horses. J. Anim. Sci. 84, 2391 (2006).

Vahabzadeh, A, Boutelle M.G., Fillenz M., Effects of changes in rat brain glucose on serotonergic and noradrenergic neurons. Eur J. Neurosci., 1995 ; 7: 2, 175-179

Valberg S. J., The management of tying-up in sport horses : challenges and successes, In: Proc. 17th Equine Nutr. and Physiol. Soc. Symp., 2010.

Vitasod, la SOD superoxyde dismutase, disponible sur http://www.vitasod.fr/sod-superoxyde-dismutase/

Wolter R., Alimentation du cheval, Editions France Agricole, 2è édition, 1999.

GASTRIC ULCERS in the athletic horse

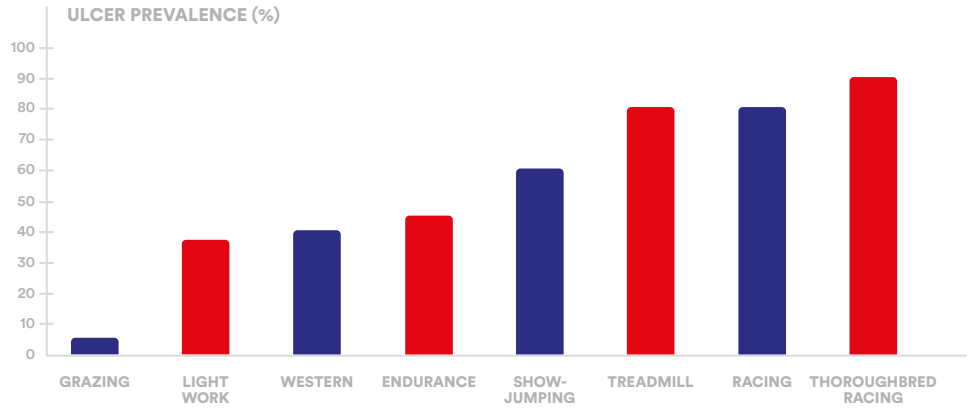
Man imposes living conditions on the horse that can have a negative impact on his health by using him for racing or other equestrian sports. The digestive sphere being the Achilles heel of equines, it is often here that the first disorders appear. Amongst the digestive disorders observed in horses in training, gastric ulcers hold the first place.

I. PREVALENCE

Whilst gastric ulcers are observed in 5% of horses at grass or at rest, up to 93% of racehorses suffer from this pathology during training[1].

The relationship between exercise and gastric-intestinal function is the subject of more and more research given that poor performance caused by ulcers, and their impact on well-being, are of non-negligible economic importance.

PREVALENCE OF GASTRIC ULCERS DEPENDING ON THE DISCIPLINE (1)



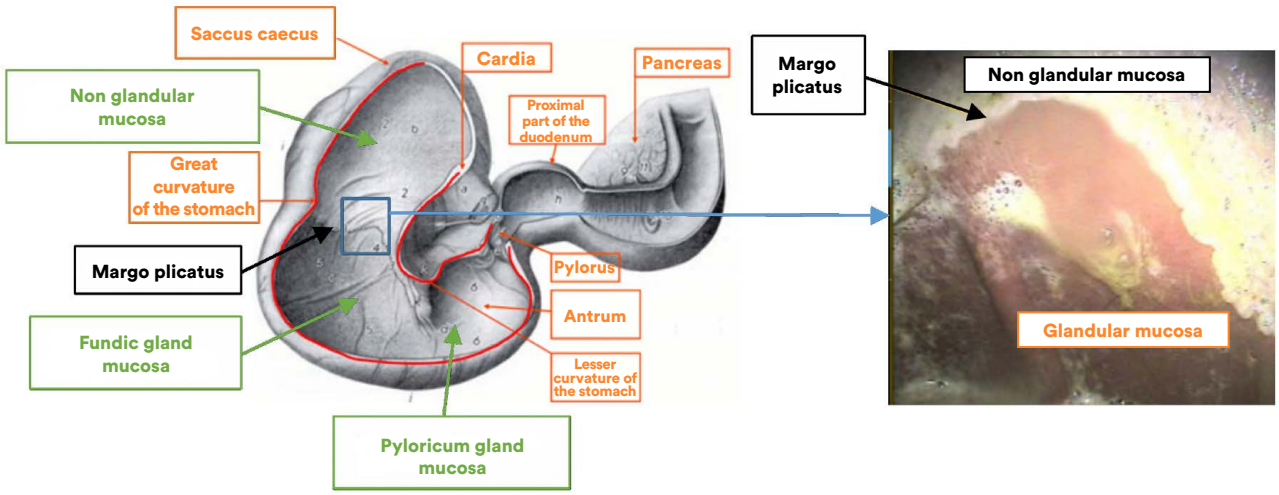
II. ANATOMY OF THE STOMACH

The stomach of the horse is divided into two distinct regions:

- The non-glandular squamous region, white in colour. It is located at the top (proximal) of the stomach and represents about a third of the organ. The squamous mucosa has a stratified epithelium composed of 4 layers of cells, similar, on a histological basis to the oesophagus. The most superficial layer has a keratinized surface;

- The glandular region, pink in colour with a shiny aspect. It represents the remaining two-thirds of the stomach. As indicated by its name, this part has a mucosa that secretes. It is composed of cells secreting mucus and bicarbonates as well as gastric glands housing different cell types.
  Each type of cells produces one of the following compounds: pepsinogen, hydrochloric acid, histamine or gastrin.

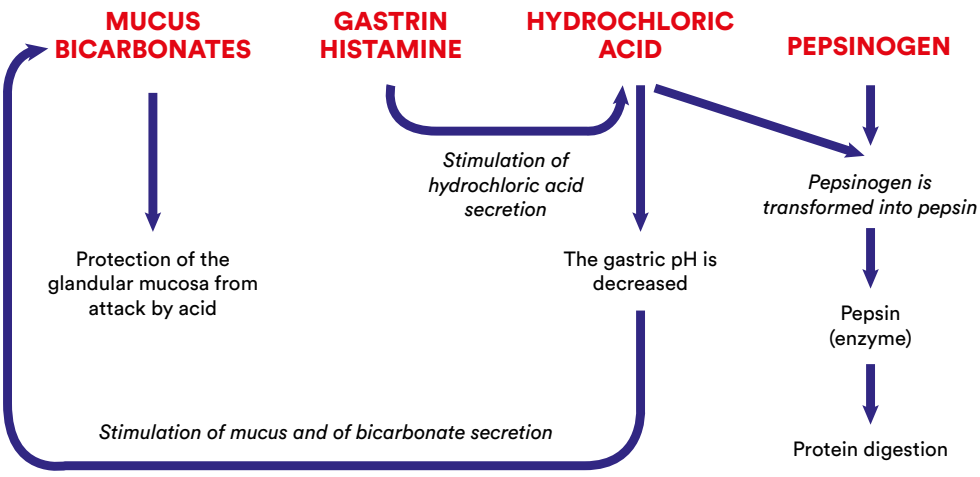
These two parts are separated by a demarcation line that can be seen by the naked eye: the margo plicatus[1].



III. PHYSIOLOGY OF GASTRIC SECRETIONS

Only the glandular mucosa is composed from cells secreting substances whose role is described below:

In the horse, acid is continuously secreted, even when the stomach is empty. The pH of the gastric contents, which are permanently acid, show however a gradient from the top (proximal) towards the bottom (distal), the lowest pH is found in the distal region[1].



IV. DEFENCE MECHANISMS OF THE GASTRIC MUCOSA

1. GLANDULAR MUCOSA

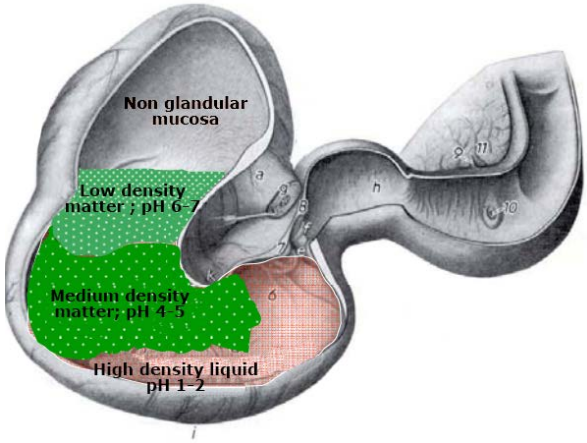
As can be seen on the below diagram, the glandular mucosa is permanently exposed to acid stomach contents. However, it possesses a number of protection mechanisms that preserve integrity[2]:

- Mucus and bicarbonate secretions form a protective film on the surface of the mucosa. This barrier allows the acid secretions and pepsinogen to pass only one way and thus obtain a neutral pH under the protective layer. This mucus and bicarbonate production is principally induced by prostaglandin E2 (PGE2). This locally acting hormone exerts a positive action on vasodilatation and has the direct effect of inhibiting acid secretion;

- Rapid cell renewal;

- The mucosa is highly vascularised which permits a supply of nutritive substances, oxygen and reparation factors.

CHARACTERISTICS (DENSITY AND PH) OF STRATIFIED GASTRIC CONTENT, IN NORMAL CONDITIONS[1]



2. NON GLANDULAR SQUAMOUS MUCOSA[2]

On the other hand, until proved to the contrary, the squamous mucosa is not protected by a film of mucus. Maintaining integrity is principally dependant on limited exposure to the acid contents of the stomach. The cells present at the surface of the mucosa renew rapidly and are keratinized. When the squamous region is subjected to aggression by the acid contents of the stomach the keratin layer thickens. Nevertheless, these protection mechanisms are quickly exceeded when faced with excessive exposition to acid contents.

NB: Two recent studies carried out on deceased horses have shown the existence of a layer of mucus on the surface of the squamous mucosa. However, this interesting discovery must still be confirmed in live subjects.

When the mucosa is damaged, EGF (Epidermal Growth Factor) receptors appear, who, once stimulated, contribute to inhibiting acid secretion and stimulating the regeneration and protection of the mucosa.

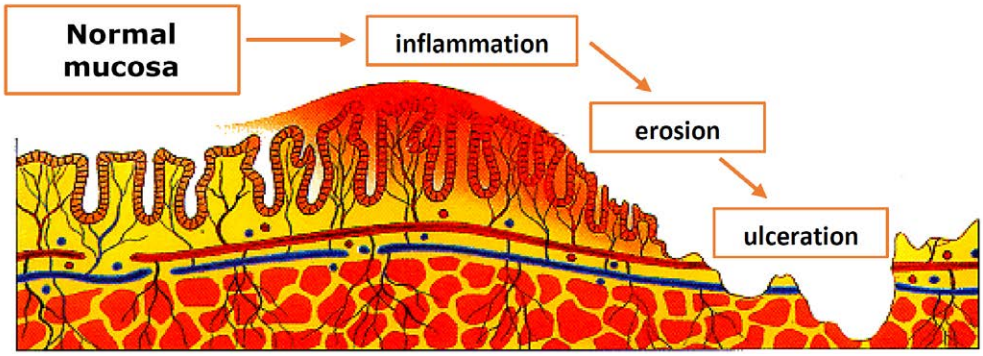
Finally, must be added to these protection mechanisms of the squamous and glandular mucosa, the production of saliva, secreted in the oral cavity during mastication. It contains an important quantity of bicarbonates that once in the stomach contribute to neutralising acid secretions.

V. EQUINE GASTRIC ULCER SYNDROME

1. DEFINITION

Equine gastric ulcer syndrome (EGUS) gathers together different disorders which accompany erosions or ulcers of the mucosa of the stomach, oesophagus or the first part of the small intestine (duodenum)[2]. To start with, the lesions are characterised by a local inflammation (erythema) or a thickening of the squamous epithelium (hyperkeratosis) without rupture in the integrity of the surface epithelium. However, they can progress to more or less superficial erosion of the mucosa epithelium, and even penetrate more deeply. Thus, when all the cellular layers of the epithelium are affected and the lesions reach the underlying loose connective tissue, called the lamina propria, we talk about ulcers[3].

THE DIFFERENT STAGES OF EQUINE GASTRIC ULCER SYNDROME (EGUS)[3]



2. THE DIFFERENT TYPES OF ULCERS

EGUS gathers different types of lesions, classified depending on their localisation[2]:

- Primary squamous lesions, which above all affect adult horses in intensive training, without any discrimination regarding age, breed or sex;

- Glandular lesions and/or primary proximal duodenal mucosa lesions, as the result of an alteration or a failure of the protection mechanisms of the glandular mucosa. The toxicity of non steroidal anti-inflammatory drugs (NSAIDs) is implicated, in particular in the case of individual sensibility or overdosing. The lesions being in preference localised in the pylorus region;

- Secondary squamous lesions, above all seen in the foal (under the mother or shortly after weaning) following a gastric-duodenal ulcerous condition;

- Primary lesions of the cardial glandular mucosa (under the margo plicatus), met with in the new born subjected to intense stress following a severe infection or trauma.

Thus, principally met with in the horse athlete are primary squamous lesions.

VI. PRIMARY SQUAMOUS ULCEROUS DISEASE

1. CLINICAL SYMPTOMS

A wide range of clinical signs is associated with gastric ulcers [1,2]:

- **Fickle appetite**: slow eating, selective or reduced appetite
- **Reduced drinking**;
- **Reduced overall condition**: weight loss, staring coat;
- **Intolerance to effort, under performing**;
- **Behavioural changes**: lack of enthusiasm when exercised, handling and training difficulties;
- **Low-grade colics**, notably after feeds.

Clinical symptoms associated with pain can also be observed in the case of acute lesions. This pain is notably provoked by mechanical stimulation applied to the damaged mucosa (such as the arrival of water or feed, or during an increase in the intra-abdominal pressure).

If the presence of clinical signs orientates diagnosis, the absence of symptoms cannot on the other hand allow the hypothesis of gastric ulceration to be excluded. Indeed, some animals can have ulcers without showing any clinical signs, which is why EGUS is often under diagnosed[4].

The majority of primary squamous lesions are situated at the level of the margo plicatus, on the lesser curvature of the stomach, where the squamous mucosa finds itself the most easily exposed to acid contents, even in animals at rest.

A scoring system proposed in 1999 allows lesions to be classified on a scale of 0 to 4:

SCORING SYSTEM FOR GASTRIC-INTESTINAL ULCERS IN THE HORSE (2)

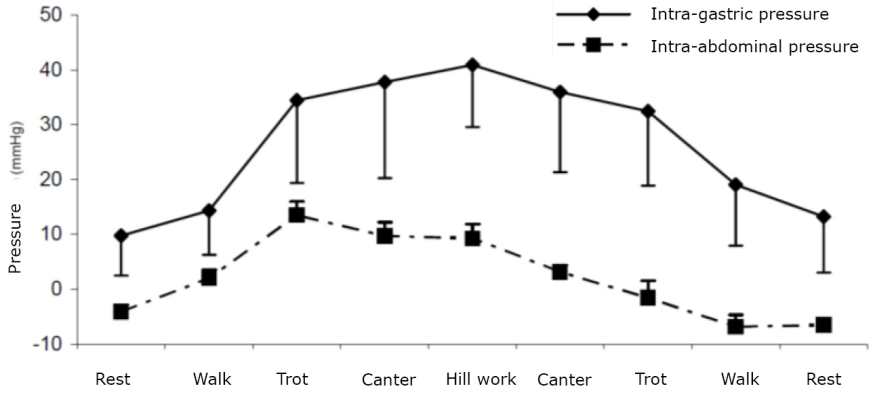
SCORE	DESCRIPTION
0	The epithelium is intact and the mucous membrane does not appear hyperemic (red) nor hyperkeratoic (yellow in the squamous region)
1	The mucosa is intact, but certain regions are red or hyperkeratoic (scaly)
2	Lesions are shallow and isolated or multi-focal
3	Lesions are severe, isolated, multi-focal or widespread and superficial
4	Lesions are widespread, with areas of deep ulceration

2. CAUSES FOR THE APPEARANCE OF ULCERS OF THE SQUAMOUS MUCOSA (NON-GLANDULAR)

a - Exercise

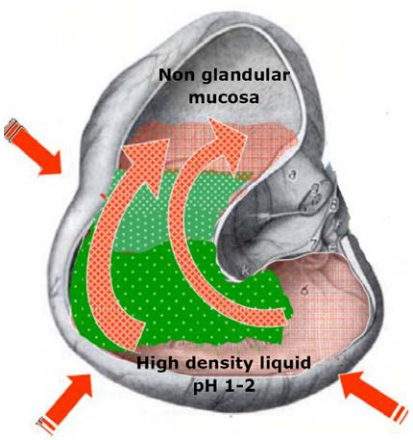
Primary squamous disorders are above all seen in the adult horse in training. During exertion, excessive exposure by the squamous mucosa to the contents is, by a purely mechanical phenomena, responsible for the formation of squamous ulcers. Indeed, when the horses moves at a faster pace than walk, the abdominal muscles contract and increase the intra-abdominal pressure, which is responsible for an increase in the pressure inside the stomach (experimentally proven, cf. the diagram next page)[2].

THE EFFECT OF EXERCISE ON INTER-GASTRIC AND INTRA-ABDOMINAL PRESSURES[2]



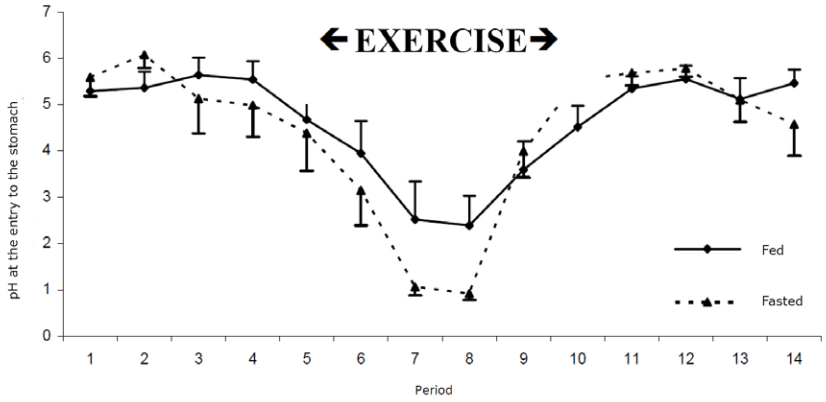
The pressure exerted on the walls of the stomach is at the root of a rise of the gastric contents towards the proximal region (top) of the stomach, thus modifying the normal stratification of the gastric contents (cf. the diagram below). The acid secretions and enzymes then damage the non-glandular mucosa, devoid of a protective barrier.

ABNORMAL STRATIFICATION OF THE GASTRIC CONTENTS FOLLOWING ABDOMINAL MUSCULAR CONTRACTIONS[1]



This hypothesis is supported by the fact that during exertion (trot, canter), the pH measured at the entrance to the stomach is significantly lower (it can reach 1.0) than when the horse is halted or at walk (where it is between 5.0 and 6.0). It should be noted that this drop in pH is even larger when the horse has a completely empty stomach (see the diagram on the next page).

VARIATION IN THE PH AT THE ENTRY TO THE STOMACH DEPENDING ON EXERCISE, IN HORSES FED BEFOREHAND OR FASTED[2]



The squamous portion of the stomach thus finds itself excessively exposed to the gastric contents. In particular the squamous mucosa close to the margo plicatus situated at the length of the lesser curvature, is more or less constantly exposed to the gastric contents, sometimes even at rest because of the anatomical disposition.

To sum up, exercise is therefore directly responsible, by a purely mechanical effect, to the squamous mucosa being excessively exposed to the acid stomach contents. Also certain persons also put forward other situations that cause the horse to contract his abdominal musculature during prolonged periods (stressful environment, wind sucking) as being able to lead to a rise in the acid contents onto the squamous mucosa[5].

Furthermore, exercise also indirectly favours the appearance of squamous ulcers. Indeed, it has been proven that hydrochloric acid production is greater in horses in training than those at rest.

On the other hand, during punctual exercise, we observe a decrease in blood flow to the stomach mucosa. Blood is directed in preference towards muscles to the detriment of other organs. Also this drop in blood flow to the gastric mucosa rends it more vulnerable to factors of aggression.

b - Feeding

In competition horses, highly digestible and therefore quickly fermented carbohydrates (cereal flakes, wheat, oats) are often fed in large quantities. The latter are easily fermented by the flora of the stomach into volatile fatty acids and lead to a drop in the gastric pH. In an acid environment, the volatile fatty acids can easily penetrate into the cells of the mucosa even if they are not in any way damaged. Thus they acidify the cell contents bringing about necrosis (death of the cell), leading to an ulcer[6].

Equally of importance are methods of feeding. In his natural state, that is to say grazing, the horse does not completely fill his stomach, so the greater part of the squamous mucosa is never exposed to the acid and corrosive contents[7]. On the other hand, current feeding practices do not always go in this direction:

- Concentrate meals are often very few in number (2 or 3 a day) and are in consequence more voluminous: the stomach is therefore fuller, and consequently, the squamous mucous membrane risks being more easily exposed to the corrosive and acid contents[7]. Furthermore, it has been proven that the more voluminous and low in fibre the feed, the longer it will stay in the stomach[2]. Whilst eating large, high starch, low fibre concentrate feeds, the stomach becomes over full, intense volatile fatty acid producing bacterial fermentations take place and emptying of the gastric contents is retarded. The result is a prolonged contact with the very acid gastric contents by the squamous mucosa. All conditions are bought together for the formation of squamous ulcers;

- If hay is not made available between feeds, prolonged periods of fasting can occur, notably at night. Fasting leads to a rapid drop in the gastric pH and to prolonged exposure to acid contents by the squamous mucosa. Indeed, the continuous acid secretion of acid must be permanently neutralised by bicarbonate rich saliva and by the intrinsic buffer ability of fibre rich forage, and regarding “legume” hays (alfalfa), in calcium and in proteins. So, when forage is lacking, the continuous acidity produced in the stomach is not buffered from where there is a sharp drop in pH and ulcers are formed in a few days at the squamous mucosa level[1]. Furthermore, the stomach being empty is likely to favour a gastric-duodenal reflux containing biliary acids which, associated with hydrochloric acid are very corrosive to the non glandular mucosa.

These problems due to fasting are, in the majority, seen in stabled horses or during transport over a long distance. In this case, the long intervals between feeding favours gastric acidity. In the same way, horses turned out into sand or earth paddocks, without access to any source of forage for a good number of hours, are equally exposed to this problem.

3. PREVENTION

The objective is to fight against favouring elements by providing environmental and feeding solutions.

a - Avoid periods without food

The best way to do this is to provide hay at will, including at night. Indeed, if a horse hasn’t got hay available during the night (frequent in yards where the last hay feed is distributed around 4 to 5pm), he is quite likely to be without food for 12 hours, so half a day! To make sure this type of situation doesn’t arise, it is advisable to make hay available in a haynet (hung outside the stable), or a Hayball ND. It is equally possible to use a Haybar ND which can be installed in the corner of the stable.

HAYBALL

HAYBAR

b - Feed a concentrate ration that limits the acidification of the gastric contents.

In the performance horse, distributing cereals is unavoidable. However, depending on the type of starch they contain, these cereals are more or less liable to acidify the gastric contents.

Therefore, if we wish to minimise this phenomena, it is recommended to feed:

- Either a ration composed of a moderate quantity of slow releasing starch (barley) associated with a very small fraction of highly digestible, so easily fermented starch (flaked cereals, oats);
- Or a ration composed from a small quantity of very easily digested starch (oats), mixed with raw ingredients possessing important buffer qualities such as alfalfa (lucerne)[8]. The latter possesses a strong buffer effect due to its' high levels of calcium, protein and fibre. However, it is not advisable to feed alfalfa hay ad-lib, otherwise we risk upsetting the calcium to phosphorus ratio in the overall ration, and provide excess protein, with all the harmful consequences that this can have in the horse at work (hepatic overload, excessive sweating, dehydration, etc.).

The opposite, rations composed exclusively from oats or containing important quantities of wheat, flaked cereals and molasses are totally inadvisable, being very ulcerogenic.

Next, providing fats and oils is interesting, as they participate in preventing ulcers in many different ways:

- Lipids are above all very high in energy. They increase the energy density of the ration and therefore allow provision of sufficient energy in a limited volume of feed. Thus, for a given energy value, incorporating lipids allows for a reduction in the cereal portion of the ration;
- By covering the mucous membrane, providing oil reinforces the protective barrier against attack from acid. Furthermore, if they are rich in essential fatty acids, that is to say in linolenic acid (Omega-3) and in Linoleic acid (Omega-6), the oil also plays a part in the nutrition of the cell membranes of the gastric wall;
- Linoleic acid (Omega-6) contained in corn (maize) oil (REVERDY OMEGA OIL contains 40%) or in extruded soya beans, is a precursor of arachidonic acid, a component from which E2 prostaglandins are synthesised.

In this way, as was proved by a study undertaken by Cargile *et al.*[9], providing 20ml/100kg/day of maize oil rich in Omega-6 (or 50ml/100kg/day of REVERDY OMEGA OIL) allows an increase in stomach prostaglandins PGE2, the principal inductive agent for the production of mucus and of bicarbonates at a glandular level and also contributes to inhibiting acid secretion.

Finally, associated with a well balanced concentrate ration, the use of REVERDY CARE is of interest to limit the acidification of the gastric contents:
- The clays it contains participate in neutralising acid secretions in the stomach;
- The prebiotics contribute to limiting undesirable, volatile fatty acid and lactic acid producing, bacterial fermentations.

Furthermore, the clays plays a part in protecting the gastric mucosa.

c - Avoid the stomach becoming overfull and shorten the time the feed spends in the stomach

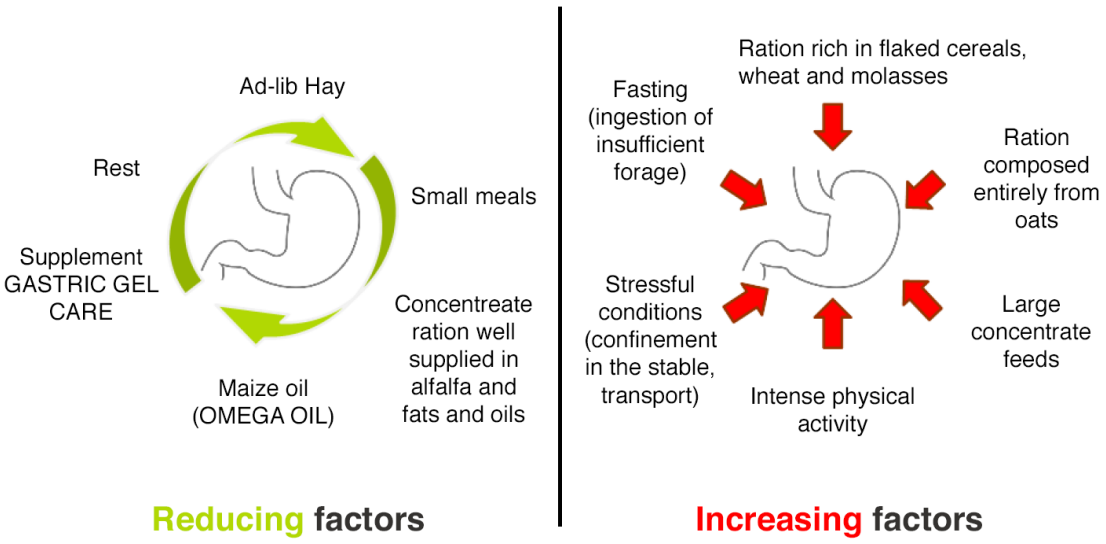
It is advisable to fraction the daily ration the maximum possible in order to feed a little each time. Feeding 3 times a day is the strict minimum in the sporting horse, knowing that the ideal is to feed via an automatic feed distributor able to provide up to 10 to 12 small feeds a day.

d - Protect the squamous mucosa against acid projections that occur during physical effort

For this, it is advisable not to work a horse on an empty stomach. Consuming forage before work, which, in addition to its intrinsic qualities, leads to twice the saliva production than an equal quantity of a concentrate feed[8], allows effective buffering of the gastric contents acidity. In the same way, just before entering the track or the arena, administering a syringe of REVERDY GASTRIC GELhelps protect the squamous mucosa from acid projections.
Indeed, when they arrive in the stomach, the aluminium phosphate and the aloe vera from which this nutritional supplement is composed will on one hand cover a part of the squamous mucous membrane and on the other settle on the surface of the gastric contents. Thus, these two digestive protectors will be projected during effort with the gastric contents onto the squamous mucosa. Because of their covering ability and cytoprotective action, they contribute to protecting the non-glandular portion of the stomach from attack by acid.

Associated with these feeding measures, turnout in lightly grassed paddocks equipped with hay racks contributes to reducing the stress of being confined to the stable which increases the risk of the onset of gastric ulcers. However, completely bare sand or earth paddocks, lacking a system for forage distribution, are more harmful than beneficial for gastric disorders. Time spent in this type of paddock will be imposed fasting time for the horse.

RISK OF INJURY OF SQUAMOUS MUCOSA



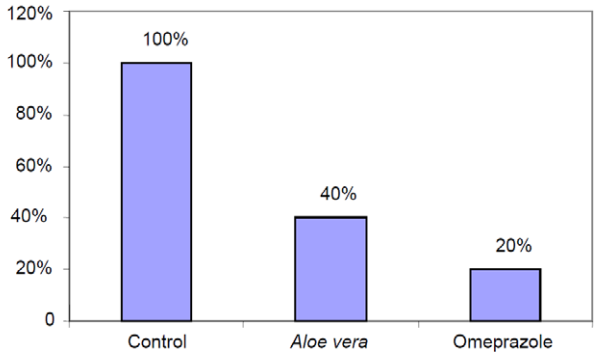
4. TREATMENT

Treatment for gastric ulcers must eliminate the clinical symptoms, promote healing, prevent recurrence and complications. It is essentially based on the use of inhibitors of the proton pump (omeprazole, lansoprazole) specifically stopping the secretion of hydrochloric acid. This family of molecules joins in a covalent fashion to this pump and for the entire lifespan of the cell. As long as the cell does not synthesise new pumps, acid secretion cannot resume. This explains why a single daily dose of proton inhibitors is sufficient[10].

Associated with this medical treatment, applying the measures described in Part 3. "Prevention" will help accelerate the healing of non glandular squamous ulcers and then help avoid their recurrence. More particularly, the daily use of GASTRIC GEL will act as reinforcement to the action of omeprazole. It is composed from four active ingredients each with complementary properties:

- Principal ingredient, **aloe vera gel**, contains lectins which inhibit acid secretions of the stomach by acting directly on the parietal cells. The tannins, saponins and flavonoids which it contains can be responsible for its' cytoprotective action and anti-inflammatory properties on digestive mucosa. A study[11] undertaken in rats showed that aloe vera possessed significantly comparative antiulcer activity to the "reference" treatment omeprazole (at a therapeutic dose). On the diagram below, the number of lesions induced by the administration of non-steroidal anti-inflammatory drugs in the control group represents the reference and has the score of 100%. Even if omeprazole remains the most effective treatment with 80% less ulcers, preliminary oral administration of aloe vera is very interesting as 60% less lesions are obtained compared to the control group.

THE EFFECT OF ALOE VERA AND OF OMEPRAZOLE IN PREVENTING ULCERS FOLLOWING THE ADMINISTRATION OF A NON-STEROIDAL ANTI-INFLAMMATORY DRUG, COMPARED TO A CONTROL GROUP[11]



- **Aluminium phosphate** has strong covering ability and lines the gastric mucous membrane. Indeed, it has been scientifically proven that this cytoprotector stimulates the synthesis of endogenous prostaglandins which, in addition to favouring mucus and bicarbonate secretion, reduce acid secretion and increase mucosa blood flow, thus help healing. It also leads to the liberation of sulfhydryl radicals, maintaining the integrity of the mucous membrane[12];

- **Glutamine** represents an important energy source for fast renewing cells, such as the cells in the digestive tract. This amino-acid thus participates in maintaining the integrity of the gastric mucous membrane and helps heal ulcerous lesions;

- Playing the role of prebiotics, **fructo-oligosaccharides (FOS)** contribute to maintaining healthy conditions in the stomach.

TO SUM UP

The use of the horse for racing and equestrian sport, combined with changes in his eating habits, largely explains the high prevalence of gastric ulcers in the athletic horse. This pathology is very problematic because, in addition of undermining the well-being of horses, it is responsible for poor performances which have significant economic repercussions.

Thus the management of gastric ulcers involves the implementation of preventative environmental measures, limiting stressful conditions such as being confined to a stable, and above all nutritional measures. Amongst them, we will note the provision of ad-lib forage, the distribution of small concentrate meals containing generous amounts of alfalfa (lucerne), fats rich in essential acids, and slow releasing starch. The feeding of only moderate, or small quantities of highly digestible starch. The daily ration intake can also be secured by the addition of nutritional supplements like REVERDY CARE and REVERDY GASTRIC GEL.

Finally, it is interesting to note that the bacteria Helicobacter pilori, recognised as being responsible for gastric ulcers in Humans, has, to this day, an undetermined pathogenic role in the horse. Certain persons such as, Scott *et al.*[13], advocate in favour of the existence of a Helicobacter in the horse, but further research needs to be undertaken.

BIBLIOGRAPHY

(1) **Tamzali Y.**, les ulcères gastriques « EGUS », DMV, PhD, Dipl.ECEIM, Médecine Interne Équine Clinique Équine, École Nationale Vétérinaire de Toulouse.

(2) **Marguet Caroline** (2009), Etude de prévalence des ulcères gastriques chez le cheval d'endurance Thesis.

(3) **Dr RIELLE JC.**, Swissweb santé publique, Ulcère gastrique et duodénal, page web: http://www.prevention.ch/ulcere.htm.

(4) **MERIAL**, Groupe Européen d'Experts sur les Ulcères Gastriques, gestion des ulcères gastriques chez le cheval.

(5) **Tamzali Y.**, La contre-performance d'origine digestive: les ulcères gastriques, Médecine interne équine, ENVT.

(6) **Nadeau, J., Andrews, F., Mathew, A., Argenzio, R., Blackford, J., Sohtell, M., Saxton, A.**, 2000. Evaluation of diet as a cause of gastric ulcers in horses. American Journal of Veterinary Research 61, 784–790.

(7) **Doucet M-Y et Vrins A.**, Les ulcères gastriques: physiopathologie, stratégies thérapeutiques et préventives, Département de biomédecine vétérinaire et Département de sciences cliniques, Faculté de médecine vétérinaire, Université de Montréal, C.P. 5000, Saint-Hyacinthe, Québec, Canada, J2S 7C6.

(8) **Smyth GB, Young DW, Hammond LS**. Effects of diet and feeding on postprandial serum gastrin and insulin concentration in adult horses. Equine Vet J 1989; 7 (suppl): 56-59.

(9) **Cargile J.L., Burrow, J.A., Kim, I., Cohen, N.D. and Merritt A.M.** 2004. Effect of Dietary Corn Oil Supplementation on Equine Gastric Fluid Acid, Sodium, and Prostaglandin E2 Content before and during Pentagastrin Infusion. J. Vet. Intern. Med. 18: 545-549.

(10) **Tamzali Y.**, Comment prévenir et traiter les ulcères gastriques chez le cheval sportif, Médecine interne équine, ENVT.

(11) **Sai Krishna Borra, Radha Krishna Lagisetty and Gowrinath Reddy Mallela**, Antiulcer effect of Aloe Vera in non-steroidal antiinflammatory drug induced peptic ulcers in rats, Department of Pharmacology, Kamineni Institute of Medical Sciences, Narketpally, Nalgonda District, Andhra Pradesh, India, 1 September 2011.

(12) **Duchateau A., Thiefin G., Varin-Bischoff S., Garbe E., Zeitoun P.**, Prevention by aluminium phosphate of gastric lesions induced by ethanol in the rat: role of endogenous prostaglandins and sulfhydryls, Laboratory of Cellular Digestive Morphology, University of Medicine, Reims, France, Histology and histopathology (Impact Factor: 2.24). 02/1990; 5(1):89-94.

(13) **Scott Dr, Marcus Ea, Shirazi-Bee-Chey SP et coll**. Evidence of Helicobacter infection in the horse. Dans: Proceedings of the 101 st Gen. Mtg. Am. Soc. Microbiol. Abstr. 2001;101: D-30.

COLIC: SYMPTOMS, CAUSES, RISK FACTORS, AND POST-OPERATIVE RE-FEEDING

A horse that rolls, kicks the ground and looks round at the flank etc. These symptoms, well known to riders, are closely watched for. It should be said that " colic", a word that gathers together every type of abdominal pain, is the dread of every horse owner, and for good reason : This disease is the biggest cause of mortality in the horse[1].

The horse, possessing a unique digestive system, is of particular risk from suffering from colic. The pain can be caused by an infection, or be related directly to the horse (his age, breed…), but also may be linked to his lifestyle. It is therefore possible to minimize the risk of your horse developing colic by controlling, for example, his feeding, watering and housing.

This article aims to explain what colic is, present the environmental risk factors that you can control to optimise your horses' health. Finally, a non-exhaustive presentation of post-colic (with or without surgery) re-feeding plans is proposed.

POINTS TO REMEMBER

The word "colic" regroups every type of abdominal pain that may be confronted by the horse. There are true colics, that is to say, affecting the digestive organs, and "false colics", caused by diseases affecting the urinogenital systems, circulatory system, muscles (azoturia/tying-up), movement (laminitis) or even the respiratory system.
In the large majority of cases, colic symptoms are related to a digestive blockage. This blockage may be caused by an obstruction of extremely fibrous foods like straw, wood chips/shavings, sand, enteroliths, lipoma, parasites, or by strangulation of a section of the gut. The symptoms of colic can also be related to a massive build up of gas in the caecum/large colon, following the ingestion of a too large quantity of fermentable sugars (starch and/or fructans). Ulcers affecting the stomach and /or the small intestine can also be at the root of colic symptoms and can become chronic. Ponies are more susceptible to suffering from colics due to lipomas whilst horses have an increased risk of suffering from colics related to gut displacement. It is possible to limit the risks by respecting simple health and feeding rules:
» Ad-lib clean water at a temperate temperature in the stable and paddock at all times. In the same manner, when travelling, stopping at regular intervals to offer water to the horse so he is able to remain hydrated can reduce the risk of travel related colics;
» Feed a minimum of 1.5kg of good quality hay (not mouldy) for each 100kg of live-weight (body-weight) a day;
» Split the daily concentrate ration into as many feeds as possible, 150g of starch for 100kg of live-weight and 400g of food per 100kg of live-weight per meal must not be exceeded. It is also recommended to not exceed 5kg of concentrate feed per day for a 500kg horse;
» When there is a change in hay and/or concentrate feed, a gradual transition over about 10 days is advised;
» Horses who are turned out in a paddock at least 3 times a week have less risk of suffering colic than those who remain stabled;
» Finally, teeth should be checked regularly, and animals wormed following a programme recommended by your vet.

Reintroducing feed to the horse after digestive surgery must be carefully monitored in order to limit postoperative complications and optimise the animal's recovery. As far as possible, the horse should be started with small quantities of forage as soon as is feasible. He can, when his state of health stabilises, be given a low starch concentrate feed.

I. COLIC: SYMPTOMS AND CAUSES

1. SYMPTOMS

A grid of symptoms has been developed, which also allows the pain intensity from which the horse is suffering to be identified on a scale of 1 to 5[2] :

Stage	Pain intensity	» Symptoms
1	Absent	» None
2	Light	» Lack of appetite » Occasional pawing at the ground » Looking at the flank » Posturing as if to urinate » Laying down for longer than normal » Backs into a corner against a wall or a separation » Curling the upper lip » Playing with water without drinking
3	Moderate	» Agitation, restlessness » Gathers himself up as though about to lay down » Kicking at the abdomen with a hind leg » Laying on his side on the ground » Rolling » Adopts a “sitting dog” position » Groaning
4	Severe	» Sweating » Violent rolling » Throwing himself to the floor » Previous symptoms expressed violently
5	Depression	» Depressed state

On seeing these symptoms, a vet should be contacted who will also examine:

» The heart rate, which increases according to the pain. This is a good indicator as to the seriousness of the colic;

» The respiration rate, which is also a good indicator of pain;

» The colour of the mucous membranes, which are naturally pink. In cases of colic they can be a dirty bright red, or even show cyanosis;

» Pinch test to check for dehydration;

» Intestinal noises, which are fewer and even absent in most colics, but can be greater in the case of diarrhoeas;

» Body temperature, which can give information on a possible inflammatory/infectious cause, or if the animal is in shock.

The vet will also carry out a rectal examination which will allow him to more precisely evaluate the cause of this pain. This complete examination (which can be associated with other tests and examinations, such as a blood count or even nasogastric intubation) will allow a diagnosis in order to treat the horse. Depending on the cause and the severity of symptoms, the horse can be treated on the spot, or must be taken to a veterinary clinic and/or undergo surgery.

2. THE HORSE’S DIGESTIVE SYSTEM

The horse has a unique digestive system:

» A small stomach (about 18L, that is to say 9% of the total digestive tract), which only 2/3 fills and which must empty 6 to 8 times a day. Thus, food generally stays a very little time in the stomach which has only a moderate action on digestion.

The small intestine is the major site of digestion, but it is capacity to digest starch is limited and can be exceeded by the ingestion of too many cereals (in general when the quantity of starch exceeds 150g per 100kg live-weight per meal or when the amount of compound feed exceeds 400g per 100kg live-weight per meal). The large intestine, comprised of the colon and the caecum, a pocket situated at the entry to the colon, is the seat of microbial digestion which breaks down fibre from forage that is non-digestible in the small intestine. If starch is not entirely digested in the small intestine, it passes into the large intestine where it will be fermented, which can disturb the intestinal microbiota (for further information, consult the article “STARCH” and the information sheet “STARCH AND COLICS”)

3. THE PRINCIPAL CAUSES OF COLIC

The causes of colic are multiple, they can be infectious, inflammatory, parasitic, dietary or even anatomic. Every cause does not carry the same prognostic nor is as easy to treat. Certain colics will pass with anti-spasmodic drugs, whilst others require emergency surgery. Here are the principal causes, but others also do exist.

Stomach

Pains in the stomach can be linked to an impaction, which is an accumulation of dried food in the stomach which then doesn’t empty. The impaction is generally related to foods **that swell-up or solidify (sugar-beet pulp, sand, poor forage, straw) or excessive** or **too rapid ingestion of pelleted/cubed feeds.** Gastric ulcers can also lead to colic symptoms, in general chronic but sometimes acute when the stomach fails to empty.

Small intestine

Pain in the small intestine can be caused by obstructions which prevent feeds from continuing their passage through the digestive tract. This can be related to the ingestion of **difficult to digest bedding (an accumulation of fibre)** to the displacement of other organs blocking the progression of food through the digestive tract (for example the colon is poorly fixed and so subject to displacements), to **parasites**, or tumours (such as lipomas, benign fatty tumours). Ulcers in the small intestine can also slow the intestinal transit and cause an obstruction. The small intestine itself can also enter an opening in the abdomen and become trapped (at the navel for the umbilical hernia, in the scrotum for the inguinal hernia, or even in the foramen epiploic), twist on its self (volvulus) or become strangled by the colon.

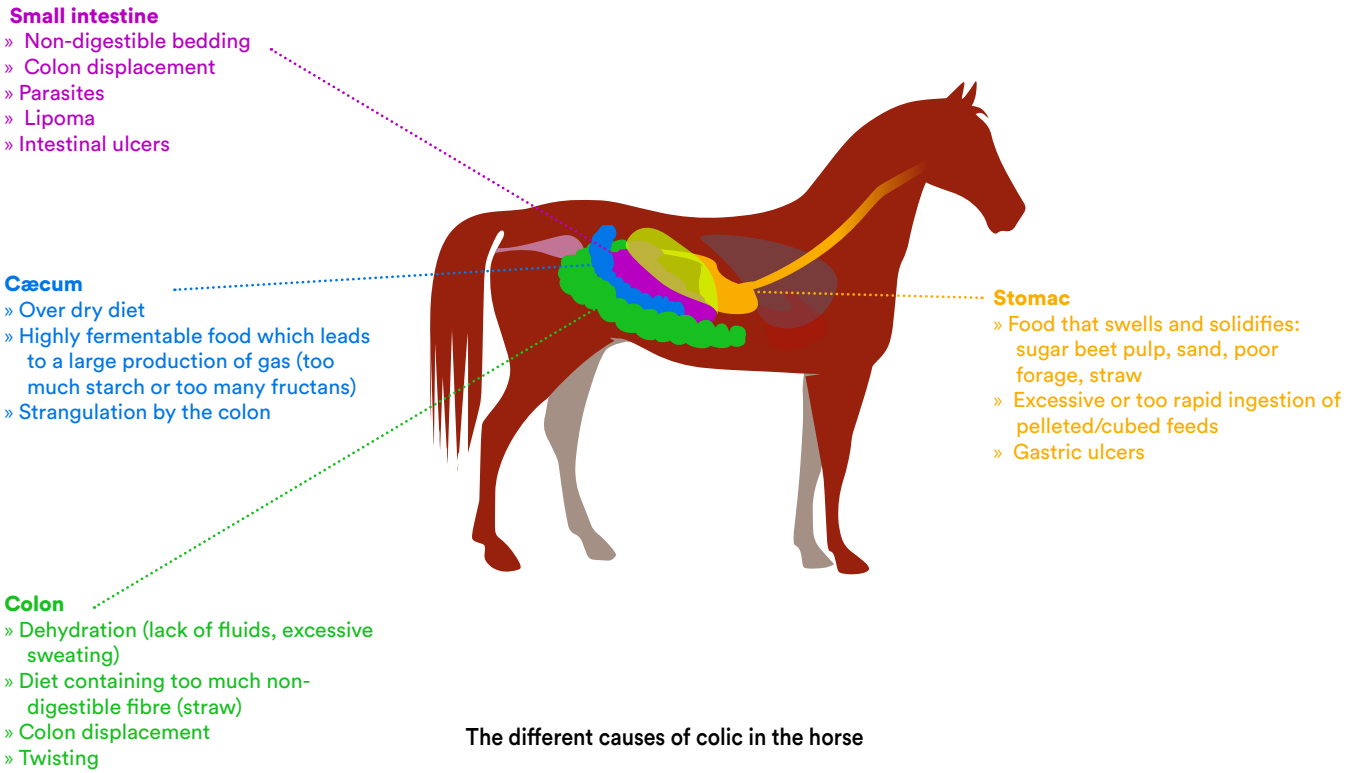
Cæcum

Pain in the caecum can be linked to an obstruction caused by **over dry food**, or even to distension by gas if **the food is easily fermented** and undigested by the small intestine. For example, when there is too large a quantity of starch (>150g of starch/100kg live-weight per meal), the small intestine's starch digestion ability will be exceeded, undigested starch will therefore pass into, and be fermented by, the caecum and colon. In the same manner, too many fructans (be wary of spring grass), non-digestible by the small intestine, will also be fermented in the caecum. These fermentations will lead to a large, painful, amount of gas being produced, as well as the production of lactic acid, which will bring about a drop in the pH, detrimental to the working and survival of intestinal cells and the intestinal microbiota. The caecum can also find itself strangled by the colon.

Colon

An impacted colon is the most frequent cause of colic[3]: a plug forms and the contents can no longer move. This can be connected to **dehydration** (not drinking enough, exercise that is too strenuous) or even a **food too rich in non-digestible fibre** (for example colics caused by straw). The colon, poorly fixed, can also displace itself and position itself badly (we talk about nephrosplenic entrapment, or left dorsal displacement, when the colon displaces to the left, between the spleen and abdominal wall). The colon can also twist on itself, from 180 to 720° (volvulus). The formation of enteroliths, stones composed from struvite crystals, in the colon can equally lead to colic symptoms. Enteroliths are principally observed in horses living in arid areas, as well as in horses who ingest large amounts of luzerne[4].

"False colics" also exist, related to diseases of the urinogenital system,
circulatory system, muscles (tying-up, laminitis) or even respiratory system. These diseases can manifest the same symptoms as digestive colics.



The different causes of colic in the horse

THE SPECIAL CASE OF THE FOAL:

It can happen that the foal shows signs of colic very rapidly after birth. The most common causes of these symptoms are:

» Meconium impaction. The meconium is the equivalent of the "first droppings", it is dark brown and of a firm consistency. The meconium must normally be passed in the hours following birth. Expulsion is generally complete after 24 hours but may take up to 48 hours;
» Enterocolitis, which is characterised by diarrhoeas caused by infection. Diarrhoea in the foal is classically observed in 70 to 80% of foals in the first weeks following birth (generally during the foal heat). In this case it is a short lasting and self-resolving diarrhoea. However, the diarrhoea can also be caused by infection: pain can therefore be intense and mortality high;
» Hernias, which correspond to a part of the small intestine incarcerating within an abdominal opening (for example, umbilical hernia). The digestive hernia maybe external (umbilical hernia) or internal (foramen epiploic). In the second case it is therefore not visible. This can lead to pain associated with an obstruction;
» The presence of urine within the abdomen, which can be caused by a ruptured bladder. The foal will have abdominal pain and swelling;
» Twisting of the small intestine (volvulus). Volvulus of the small intestine is the principal cause of abdominal surgery in the foal. Pain is generally progressive and intense and not relieved by pain-killing drugs.

Other, less common problems, such as the absence of intestinal motility, obstruction of the stomach, small intestine intussusception (that is to say the intestine slides over itself, causing an obstruction), volvulus of the large colon, colon displacement or gastric ulcers can also be at the root of colic symptoms seen in the foal.

II. WHAT ARE THE RISK FACTORS ?

Digestive colics are multifactorial diseases. This means that a large number of risk factors can influence their development. This makes it difficult to estimate the risk factors directly related to the horses (for example, breed, age, sex) as these factors often merge with other environmental factors: for example, the breed is often associated with a discipline and living conditions. Numerous studies have examined this subject. The major findings are presented here, and take into consideration the principal limits associated with each factor, as the cause and effect relationships have not always been elucidated.

1. FACTORS RELATED TO THE HORSE

The breed of the horse

Study findings are contradictory. A single breed would not seem to be more at risk than another, but rather the way he is kept (lifestyle) would be the cause of a higher risk. However, the breed would seem to have an influence over the type of colic affecting the horse. Indeed, ponies would be more at risk of developing problems in the small intestine (related or not to lipoma development) as well as colitis[3] (inflammation of the colon), while riding horse types would be more at risk of showing left and right colon displacements[3,5] and draft types, of presenting colon displacements and problems in the caecum[3]. Hence, the metabolism, but also the size of horse, influence the causes of colic.

The age of the horse

Even if these observations are not systematic, a number of studies observed an increase in the risk of colic in older horses[3,6–11] : from the age of 10[6,10] or 20[8,11] years of age, depending on the study. Furthermore, the risk of requiring surgical intervention for colic is greater in horses over 15 years of age[12].
To conclude, the older horse would seem to be more at risk and must therefore be more closely watched.

The horse's sex

The sex of the horse does not have an affect on the risk of suffering colic[3,6–9,11,13,14]. Nevertheless, mares who foal are at greater risk[13,15]. It has moreover been demonstrated that in broodmares who colic just after foaling, the intestinal microbiota (= flora) has already altered 10 days before colic occurs. Indeed, the proportion of commensal bacteria (beneficial bacteria) is reduced, while that of bacteria that can become pathological under certain conditions, is increased[16].
Thus the intestinal microbiota would also seem to play a big role in the development of colic: whether it is the cause of colic symptoms or an early indicator of a future bout, it is not to be neglected.

Stereotypical behaviours (vices)

Horses who crib-bite or wind-suck are at more risk of suffering from colic[8,17–21]. The cause and effect relationships between stereotypical behaviours and colic have not yet been elucidated. However, horses showing these behaviours would seem to have a slower intestinal transit[22], which would explain this increase in cases of colic amongst these animals. In horses that wind-suck, the actual swallowing of air has not been associated with colic[23]. The development of stereotypical behaviours would also be an indicator of the animal's way of life. In this respect, the fact that the horse has this behaviour can also be associated with feeding practices, housing, etc. also shown to be in favour of colic developing, as explained below.

2. RISK FACTORS LINKED TO THE HORSE'S WAY OF LIFE

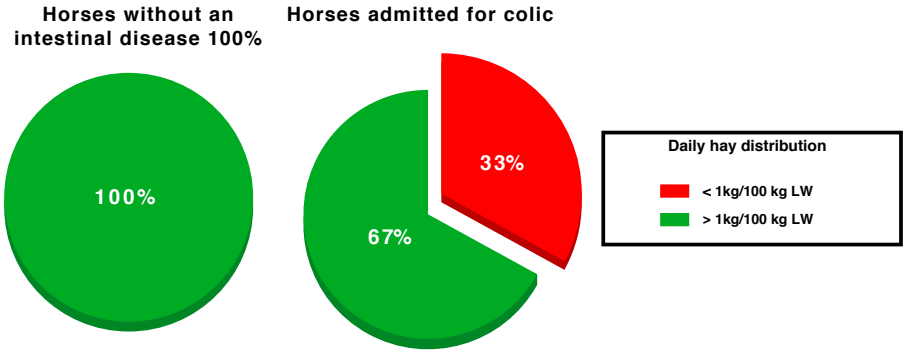
Watering

Horses without access to water at all times in their stable, field or paddock are more at risk of suffering from colic[7,10,24]. This effect is all the more important as the age of the horse increases[7]. Furthermore, the prevalence of colic increases during, or following travelling[25], notably if the journey lasts more than 24 hours[17]. This will be in part related to the fact that travelling long distances leads to horses becoming dehydrated, by the absence of, or insufficient water, the stress and sometimes the heat. **It is thus primordial to offer your horse, free easy access to clean, temperate water, no matter the season.**

Feeding

Hay: The quantity of hay offered is essential to limiting the risk of colic. A study undertaken between 2013 and 2017 at the Centre Hospitalier Universitaire Vétérinaire at Ghent (Belgium) demonstrated that 33% of horses that were admitted for colic received less than 1kg of hay per 100kg live-weight per day against 0% for those horses without digestive problems[26]. Epidemiological research, carried out in Sweden in 2017, also showed that for each extrakg of hay distributed per 100kg live-weight, the risk of colic was divided by three [27].

Hay quality and in particular forage hygiene, for example the absence of contamination by bacteria or mould, is also primordial. Indeed, horses eating poor unhygienic hay have more risk of colic[24]. In the same manner, horses who ate hay directly from the bale also showed a higher risk. This would seem to be related to a greater presence of "foreign bodies" (for example, nets/string left on the bale), as well as the lesser hygienic quality of bales exposed to conditions favourable to the development of mould[28]. **Hay quality is very important, its' storage and distribution must be carefully monitored.**



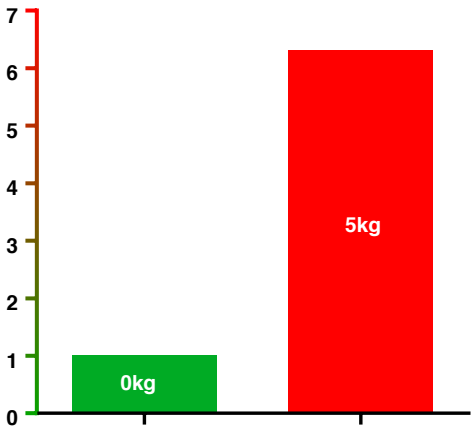
Horses admitted to the Ghent veterinary hospital for colic were receiving less hay than horses admitted for non-intestinal causes

Concentrate feeds: Concentrate feeds lead to an increase in the risk of colic when they are fed in too large a quantity and bolted (eaten too quickly)[9,17,24,28,29]: horses that ingest more than 2.5kg of concentrate feed daily show a five-fold increase in the risk of suffering from colic[29], and this risk rises as the quantity of concentrate food increases. Indeed, horses ingesting more than 5kg of concentrates a day are 6 times more at risk of colic[29]. Increasing the number of meals from 2 to 3 when the horse is eating more than 5kg of concentrate feed per day does not reduce the risk of colic as the quantity of concentrate feed consumed per meal remains high[29]. Eating oversized meals can lead to compaction, but equally swelling of the caecum as a result of excess fermentation. Indeed, starch undigested in the small intestine will enter the large intestine, where it will ferment, this can disturb the intestinal microbiota and thus equally causing gas to be produced and bloating to occur. **As a reminder, 150g of starch, and 400g of feed/100kg of live-weight per meal should not be exceeded. For horses subject to gastric ulcers, we must remember that it is advisable to not exceed 100g of starch per 100kg live-weight per meal** *For further information, consult the information sheet "STARCH AND ULCERS".*

In addition, feeding large quantities of concentrate feeds is often associated with a lack of forage[27]. No scientific study has examined the effects of the quality of raw ingredients used in concentrate feeds.

To conclude, to reduce the risk of colic, it is best to give small meals of concentrate feeds, thus allowing optimum digestion. The actual type of concentrate feed will not have any real incidence on the risk of colic, and access to water, exercise and the horse's environment, also play a part in how concentrate feeds are digested.

Risk of colic depending on the quantity of concentrate feed distributed daily



Distributing more than 5kg of concentrate feed a day multiplies the risk of colic by 6.

Fruit and vegetables: Giving your horse fruit and vegetables reduces the horse's risk of colic[21]. In this case, the carrot is more appropriate than the apple, which can ferment in the large intestine and cause digestive disorders if consumed in too large a quantity. Carrots are of interest as they have a very high water content (about 80-90%), they are also a good source of carotenes (transformed into vitamin A by the organism). Carrots are also composed of insoluble (predominantly) and soluble (between 2 and 8%) fibres as well as soluble sugars (between 2 and 8%).

Dietary transitions: Sudden changes of feed without a period of transition is also a risk factor in the development of colic : Changing the type of concentrate feed but also the type of forage leads to a rise in the risk of colic in the 14 day period following the change, and especially within the first 7 days[17,28]. Abrupt changes of feed can disturb the intestinal microbiota and so also the digestion in general. **When a change of food is needed a progressive transition must be programmed (about 10 days), whether it be for concentrate feeds or forage.**

Housing

Horses stabled for over 13 hours a day are more at risk from colic than horses who are turned out daily (field or paddock with ad-lib water) for at least 11 hours[6,17,21,28].
Horses who live out or who are turned out at least 3 times a week have less risk of colic than horses who never get turned out during the week, and more so if they have not had access to pasture in the 6 months preceding colic[17]. **To conclude, the horse needs sufficient, clean and regular water, good quality hay in sufficient quantity (a minimum of 1.5kg for 100kg live-weight), small fractioned meals of concentrate feeds (a maximum of 150g of starch and 400g of feed/100kg live-weight per meal), a well as regular turnout in order to limit boredom and permit regular and slow ingestion of fibre. It must be ensured that as to a great an extent as possible that the same foods are fed, at fixed times, and if there is a need to change, to programme a progressive transition between the old and the new food.**

3. RISK FACTORS RELATED TO THE CARE OF THE HORSE

Dental health

It is important to ensure the horse has regular dental care. Horses with dental problems are more at risk of suffering from colic[20,21,30]. In the same manner, the number of colic cases drop when dental care increases[17]. Horses that show "quidding", that is to say, dropping partially chewed food, so having trouble chewing their food are also more at risk from colic[15]. In the aged horse, dental problems are more frequent and partly explains why this population is more at risk than others. Dental problems lead to difficulty chewing food which will therefore be swallowed unaltered, less well broken down but also less humidified by saliva, and so able to cause compaction and even excessive fermentation. **Regular dental care of the horse is paramount in order to reduce the occurrence of colic but also to permit the horse optimum digestion and assimilation of food.**

Parasites

Regular worming is associated with a reduction in cases of colic[7,10,17,31]. However, recent worming, possibly tied to taking into consideration signs of parasitism (weight-loss, pot belly, itching, diarrhoea, etc.) is associated with an increase in the risk of colic[10,17,24]. In the second case, colic can be the result of a large number of parasites killed by the wormer being released into the intestines which can cause, for example, intestinal obstructions. **Following a regular worming programme established by a vet in order to limit colics of parasitic origin is therefore important.**

III. HOW TO FEED A HORSE FOLLOWING COLIC ?

1. RE-FEEDING THE HORSE AFTER COLIC NOT REQUIRING SURGERY

It is advised to withdraw water and food during colic, that is until the episode has finished and clinical parameters have returned to normal. For the following few days, feeding concentrate feeds is not advised in order to limit production of gases in the large intestine, especially if the colic was caused by the ingestion of too much fermentable sugars.
With the aim of rebalancing the intestinal microbiota, which may have been disturbed by the colic episode[16], giving a pre-pro-postbiotic supplement after the colic is advocated.

2. RE-FEEDING THE HORSE AFTER DIGESTIVE SURGERY

Following digestive surgery, re-feeding must be carefully followed. Indeed, the choice of method of re-feeding can have an influence over recovery and the chances of the horse's post-operative survival. Rapidly after surgery (6-12 hours), it is common to give the horse only water and/or IV fluids and electrolytes. However, if the delay between the surgery and re-feeding the animal is too long it can lead to increased post-operative complications, such as post-operative paralytic ileus (an arrest or slowing of the intestinal transit during an abnormal lapse of time). There is in fact a positive correlation between the parameters of serum biochemical indicators of negative energy balance and post-operative complications in the horse, in the same manner as seen in man. Thus, rapid re-feeding after surgery, in order to limit the massive use of tissue energy reserves by the animal leads to a reduction in the risks of post-operative complications.

How to feed the horse after surgery in this case?

Rapidly after surgery, feeding the horse with a ration providing slightly less energy than his requirements for maintenance is recommended (about 75% of maintenance requirements)[32]. This corresponds to about 2.9 UFC (Horse forage units) per 100kg of live-weight to the power of 0.75. Protein requirements are approximately 0.92g of crude protein/kg/live-weight during this period[33]. Restricting energy just after surgery allows the risks associated with over-nutrition such as hyperglycaemia and septic shock to be limited. If the horse shows an absence of gastric reflux, good intestinal motility and an appetite, voluntary parenteral (oral) re-feeding is advised. **The horse must receive small amounts (between 0.1 and 0.2% of live-weight) of good quality forage 4 to 6 times a day, which will gradually increase day after day[32].**

Thus in practice we recommend feeding 1.2% of the horse's live-weight (body weight) in good quality hay, over 4 to 6 meals a day.

At the end of 2 to 4 days depending on the horse's state of health, the energy value of the diet will be progressively increased to reach the horse's true maintenance requirements, approximately 3.8 UFC (Horse Forage Units) per 100kg live-weight to the power of 0.75. Protein requirements are around 1.25g of crude protein/kg/live-weight[33]. **Once the state of health is stabilised, a specific concentrate feed, suited to post-operative re-feeding, low in fermentable sugar (in particular starch), containing good quality protein and rich in omega-3 fatty acids can be given in addition to forage.**

In practice, we recommend distributing 1.2% of the horse's live-weight in good quality hay, and 0.4L (350g) for each 100kg of live-weight of the concentrate feed Reverdy POST OP, these quantities should be divided between 4 to 6 feeds daily, without ever exceeding 0.2L of concentrate feed for every 100kg of live-weight per meal.

Administering probiotic supplements (*Lactobacillus plantarum, L. casei, L. acidophilus, Streptococcus faecium ou L. acidophilus, S. faecium, Bifidobacterium thermophilum et B. longun*) during the 7 days following digestive surgery has not been shown to have any affect on the prevalence of diarrhoea, the quantity of salmonella in the droppings, the duration of antibiotic treatment and hospitalisation[34]. However no research has been undertaken on the use of pre or postbiotics, and data concerning the evolution of the intestinal microbiota after surgery following the quality of post-operative recovery is lacking.

CONCLUSION,
What should be done to reduce the risk of colic ?

1. Know your horse: is your horse at risk or not from colic, certain types of colic, or will not easily support surgery (is he a big horse, cribs or wind-sucks, an aged horse, a new-born foal, a brood mare, is often colicky...)? Knowing him means being able to take precautions in his lifestyle that will reduce the risks but equally allow quick action if the first symptoms arise.
2. In every case, give the horse the possibility of being able to drink enough clean and temperate water at every moment of the day, feed good quality clean hay, divide the concentrate ration into a number of small meals, also give him the opportunity of being turned out in order to reduce boredom and permit slow and regular ingestion of fibre (roughage). In addition, aim to avoid the ingestion of too many, or too much, little or non-digestible foods such as straw, shavings or sand.
3. Worm your horse in accordance with your vet's recommendations and organise regular dental care (of even greater importance if your your horse is aged).

BIBLIOGRAPHY

1. Leblond, A., Leblond, L., Sabatier, P. & Sasco, A. Epidémiologie descriptive des causes de la mort chez le cheval: résultats d'une enquête effectuée auprès de vétérinaires praticiens francophones. Annales de Médecine Vétérinaire 145, (2001).

2. Gluntz, X. Examen clinique du cheval en coliques. Prat. vérétinaire équine 145, (2005).

3. Dunkel, B., Buonpane, A. & Chang, Y. Differences in gastrointestinal lesions in different horse types. Vet. Rec. 181, 291 (2017).

4. Quéré, E. Etude des facteurs de risque des entérolithes chez les chevaux au sénégal. (Ecole Nationale Vétérinaire d'Alfort, 2017).

5. Lindegaard, C., Ekstrøm, C., Wulf, S., Vendelbo, J. & Andersen, P. Nephrosplenic entrapment of the large colon in 142 horses (2000-2009): Analysis of factors associated with decision of treatment and short-term survival. Equine Vet. J. 43, 63–68 (2011).

6. Egenvall, A., Penell, J., Bonnett, B., Blix, J. & Pringle, J. Demographics and costs of colic in Swedish horses. J. Vet. Intern. Med. 22, 1029–1037 (2008).

7. Reeves, M., Salman, M. & Smith, G. Risk factors for equine acute abdominal disease (colic) : Results from a multi-center case-control study. Prev. Vet. Med. 26, 285–301 (1996).

8. Malamed, R., Berger, J., Bain, M., Kass, P. & Spier, S. Retrospective evaluation of crib-biting and wind sucking behaviours and owner-perceived behavioural traits as riskfactors for colic in horses. Equine Vet. J. 42, 686–692 (2010).

9. Reeves, M., Gay, J., Hilbert, B. & Morris, R. Association of age, sex and breed factors in acute equine colic: A retrospective study of 320 cases admitted to a veterinary teaching hospital in the U.S.A. Prev. Vet. Med. 7, 149–160 (1989).

10. Cohen, N., Gibbs, P. & Woods, A. Dietary and other management factors associated with colic in horses. J. Am. Vet. Med. Assoc. 215, 53–60 (1999).

11. Silva, A. & Furr, M. Diagnoses, clinical pathology findings, and treatment outcome of geriatric horses: 345 cases (2006–2010). J. Am. Vet. Med. Assoc. 243, 1762–1768 (2013).

12. Proudman, C. A two year, prospective survey of equine colic in general practice. Equine Vet. J. 24, 90–93 (1992).

13. Kaneene, J. et al. Risk factors for colic in the Michigan (USA) equine population. Prev. Vet. Med. 30, 23–36 (1997).

14. Traub-Dargatz, J. et al. Estimate of the national incidence of and operation-level risk factors for colic among horses in the United States, spring 1998 to spring 1999. J. Am. Vet. Med. Assoc. 219, 67–71 (2001).

Suthers, J., Pinchbeck, G., Proudman, C. & Archer, D. Risk factors for large colon volvulus in the UK. Equine Vet. J. 45, 558–563 (2013).

15. Weese, J. et al. Changes in the faecal microbiota of mares precede the development of post partum colic. Equine Vet. J. 47, 641–649 (2015).

16. Hillyer, M. et al. Case control study to identify risk factors for simple colonic obstruction and distension colic in horses. Equine Vet. J. 34, 455–463 (2002).

17. Archer, D. C., Pinchbeck, G. L., French, N. P. & Proudman, C. J. Risk factors for epiploic foramen entrapment colic: An international study. Equine Vet. J. 40, 224–230 (2008).

18. Salem, S. E., Scantlebury, C. E., Ezzat, E., Abdelaal, A. M. & Archer, D. C. Colic in a working horse population in Egypt: Prevalence and risk factors. Equine Vet. J. 49, 201–206 (2017).

19. Scantlebury, C. E., Archer, D. C., Proudman, C. J. & Pinchbeck, G. L. Recurrent colic in the horse: Incidence and risk factors for recurrence in the general practice population. Equine Vet. J. 43, 81–88 (2011).

20. Scantlebury, C. E., Archer, D. C., Proudman, C. J. & Pinchbeck, G. L. Management and horse-level risk factors for recurrent colic in the UK general equine practice population. Equine Vet. J. 47, 202–206 (2015).

21. McGreevy, P. D., Webster, A. J. & Nicol, C. J. Study of the behaviour, digestive efficiency and gut transit times of crib-biting horses. Vet. Rec. 148, 592–596 (2001).

22. McGreevy, P., Richardson, J., Nicol, C. & Lane, J. Radiographic and endoscopic study of horses performing an oral based stereotypy. Equine Vet. J. 27, 92–95 (1995).

23. Kaya, G., Sommerfeld-Stur, I. & Iben, C. Risk factors of colic in horses in Austria. J. Anim. Physiol. Anim. Nutr. (Berl). 93, 339–349 (2009).

24. Padalino, B. et al. Health problems and risk factors associated with long haul transport of horses in Australia. Animals 5, 1296–1310 (2015).

25. Galinelli, N., Wambacq, W. & Hesta, M. Descriptive statistical analysis of cases referred to the Equine Nutrition Service at Ghent University. in 9th European Workshop on Equine Nutrition 38 (2018).

26. Lindroth, K. & Müller, C. Nutrition-related risk factors of colic in horses. in 8th European Equine Health & Nutrition Congress 109 (2017).

27. Hudson, J. M., Cohen, N. D., Gibbs, P. G. & Thompson, J. A. Feeding practices associated with colic in horses. J. Am. Vet. Med. Assoc. 219, 1419–25 (2001).

28. Tinker, M. K. et al. Prospective study of equine colic risk factors. Equine Vet. J. 29, 454–458 (1997).

29. Sawesi, O. & Milad, A. Risk Factors Associated with Impaction Colic in Horses at North Western Area of Libya. J. Vet. Adv. 5, 1064 (2015).

30. Little, D. & Blikslager, A. T. Factors associated with development of ileal impaction in horses with surgical colic: 78 cases (1986-2000). Equine Vet. J. 34, 464–468 (2002).

31. Geor, R. J. How to feed horses recovering from colic. Proc. 53rd Annu. Conv. Am. Assoc. Equine Pract. Orlando, Florida, USA, 1-5 December, 2007 196–201 (2007).

32. NRC. Nutrient Requirements of Horses - Sixth revised edition. (National Academies Press, 2007). doi:10.17226/11653.

33. Parraga, M. E., Spier, S. J., Thurmond, M. & Hirsh, D. A clinical trial of probiotic administration for prevention of Salmonella shedding in the postoperative period in horses with colic. J. Vet. Intern. Med. 11, 36–41 (1997).

“TYING-UP”

Known under various names, equine rhabdomyolysis syndrome (ERS), exertional rhabdomyolysis (ER), exertional myopathy, Monday morning disease, tying-up or set fast, this is a disease of the muscular system which occurs during exercise. It can be sporadic or reoccurring.

I. CLINICAL SIGNS

A horse falling victim to a myopathy during exercise will suddenly shorten his stride, stiffen, then show difficulty moving. If he is forced to continue his effort he will start to sweat profusely, his respiratory (and cardiac) rate will increase and he will finish by becoming totally blocked, the spasms of the dorsal and hind quarter muscles being so painful he will be unable to take another step. He shows signs of discomfort that can be confounded with those of colic.

Furthermore, the destruction of muscular cells leads to the liberation of myoglobin (a protein permitting the transport, and storage of oxygen in the muscle cells) into the blood. This protein is then eliminated in the urine, colouring it dark brown (like coffee).

Finally, a blood test will reveal an increase in muscular enzymes (CK or creatine kinase, LDH or lactate deshydrogenase and AST or aspartate aminotransferase) which will confirm diagnosis.

Even if the clinical signs are similar, there exists many types of exertional myopathy.

II. DIFFERENT TYPES OF EXERTIONAL RHABDOMYOLYSIS

1. SPORADIC

Sporadic types arise without the horse having a particular genetic predisposition. They generally occur during unsuited periods of exercise:

- A return to work after one or more rest days without reducing concentrate feed (thus the name “Monday morning disease”);
- Exercise too severe (too long or too fast) for the physical condition of the horse;
- Prolonged effort (endurance) in extreme climatic conditions (high temperatures and humidity) leading to severe dehydration and electrolytic imbalanc;.
- Intensive exercise whilst the horse is sick: lameness, fever, viral respiratory infection (Equine herpes virus or flu).
- Over training.

Furthermore, certain feeding imbalances favour the onset of sporadic “tying-up”:

- Excess energy provided in the form of cereals (even if starch is not the primary cause of “tying-up”) notably during rest days;
- Antioxidant deficiencies (vitamin E, selenium, etc.);
- Electrolyte deficiencies (sodium, chloride potassium, magnesium);
- Imbalanced calcium to phosphorus ratio.

Even dehydration can be at the origin of sporadic myopathies. We can observe this situation in winter, when temperatures are around or below 0°C . In this case, water is very cold which puts horses off drinking leading to dehydration. Automatic drinkers can even freeze if they are not heated or insulated. Horses may be totally deprived of water for one or more days if this goes unnoticed. In this case, a good number of horses on the yard may fall victim to exertional myopathy.

2. CHRONIC FORMS

When horses have recurrent episodes we talk about chronic exertional rhabdomyolysis. They are due to hereditary genetic abnormalities and met with in certain breeds and even in certain bloodlines.

Even if there are many types of chronic myopathies, we will only look at the type best known in France - recurrent exertional rhabdomyolysis (RER), (other types, such as Polysaccharide storage myopathy (PSSM) being more rare in this country).

Recurrent exertional rhabdomyolysis (RER), is met with principally in thoroughbreds, trotters and arabs. The exact cause is not known. It was thought for a long time that the increase in lactic acid during muscular effort could be at the root of these chronic myopathies. However, recent experimental studies have shown that muscular lactate concentrations were low at the offset of RER in predisposed horses. The symptoms are often appearing 15 to 30 minutes after moderate effort (aerobic). The most probable hypothesis is an anomaly of the intra cellular calcium regulation responsible for muscular contraction. This results in a dysfunction of the contraction/relaxation cycles. Thus, during exercise (mainly long and slow), this anomaly can explain the occurrence of excessive muscular contractions, leading to the destruction of the affected cells and the neighbouring ones if the effort is not immediately stopped.

In practice, we observe that:

- Females are more affected (67% of females versus 33% of males) and, in particular, 2 year olds in training. Even though it has not been scientifically proven, many trainers have observed more frequent cases of myopathies when fillies are in season;
- Nervous/stressed horses have 5 times more chance of suffering from RER;
- Horses having a predisposition to RER have four times more chance of a myopathy when lame;
- Horses suffering from RER have more chance of a myopathy when they are very fit.

Furthermore, a diet too rich in starch and sugars is likely to trigger a myopathy in a predisposed horse. A meal too rich in starch and sugar leads to a large absorption of glucose in the blood stream (principally from the digestion of starch or sugar by-products such as molasses). This triggers a more or less marked secretion of insulin depending on the horse (notably greater in fit horses). This hormone, whose role is to permit glucose to enter the cells, also increases the production of a neurotransmitter the serotonin in the central nervous system. It has been proven that a hyperserotonemia (an excess of cerebral serotonin) shows itself by physical and mental hyperactivity, disorganised behaviour and mood change.

To sum up, in those horses predisposed to RER, ingesting a feed too rich in starch and sugar will be at the root of behavioural troubles (nervousness, excitement, stress, etc.) which then has repercussions at a peripheral level, leading to malfunctioning of muscular contractions responsible for bouts of myopathies.

III. WHAT TO DO WHEN FACED WITH "TYING-UP"

When a horses shows all the clinical signs of a myopathy, the first thing to do is to stop exercise immediately and to move the horse the minimum possible! If the horse is far from the stables he must be brought back in a lorry or trailer.

Whilst waiting for the vet, offering him a drink and putting a rug on are recommended.
Once arrived, the vet may put in to place a treatment based on rehydration, pain relief, reducing anxiety and the muscular spasms, improving the peripheral blood supply and supporting renal and hepatic functioning.

After suffering a myopathy episode, it is not recommended leaving the horse stabled for long periods. Indeed prolonged stabling can favour the onset of a new episode when work is resumed. Thus, resuming light activity 24 hours to a few days after an attack (depending on the type and severity of the myopathy) is recommended. The horse can first be walked in hand for a few minutes once or twice a day in a calm environment, then turned out daily in a small paddock for a good many hours. It is important that periods of stabling do not exceed 12 hours. Concerning feeding, only feeding hay to the horse during a few days is recommended.

The return to work will vary depending if the horse has had the sporadic type or suffers from a chronic form of myopathy:

- **Sporadic forms**: a return to training is not possible until the clinical signs have disappeared and the muscular enzymes (principally the CK) have returned to their normal levels. The return to work must be gradual and controlled, notably by a regular monitoring of the muscular enzymes;
- **Chronic forms**: the muscular lesions being moderate and recurrent, it is best to put the horse back into work rapidly as soon as the clinical signs cease. The aim is to return to a daily work routine. Ideally the daily exercise in the first three weeks will be on the lunge. During this period, the objective is to progress from sessions in walk lasting few minutes, to sessions of 30 minutes in walk and trot without a new episode occuring. Unless a new episode arises during this period it is not necessary to re-control the CK during the first month. Driven or ridden work can then be resumed in a progressive manner.

IV. PREVALENCE OF "TYING-UP"

1. SURROUNDINGS

As stress, excitement and nervousness have all been implicated in the onset of episodes of myopathies, every effort must be taken to ensure horses stay calm and relaxed. For those horses predisposed to chronic myopathies, it is advisable to stable them next to quiet horses in a calm part of the yard. A daily routine where they are fed and worked (always by the same rider) first and at fixed times is very often an effective means of managing the most sensitive horses.

2. EXERCISE

Firstly, in order to prevent the onset of "tying-up", it is advisable to **avoid rest days, in the stable without exercise**. Indeed it has been proven that levels of CK are higher following exercise the day after a rest day.

Secondly, during work it is advisable to:

- Warm-up properly;
- Allow the horse to loosen up and relax during the session;
- Cool-down actively after intensive efforts (at a brisk active walk or a slow trot);
- Use an exercise sheet (at least at the start of a work session) to cover the back of predisposed horses during cold weather.

More specifically, jockeys riding thoroughbreds predisposed to myopathies should avoid "fighting" with their mounts in order to keep to a moderate pace, it is often at this occasion that the onset of a myopathy is seen. In trotters that have a tendency to "tying-up", the start of an episode is generally seen after 15 to 30 minutes work at below maximum speed. Thus, rather than working for long periods of time it is preferable to use interval training for predisposed subjects.

3. WATERING

A horse at rest generally drinks between 20 and 40L of water a day in a temperate climate. A horse weighing 500kg, worked during hot and humid weather may drink up to 90L per day! Consequently **it is primordial that horses have permanent access to temperate good quality water**.

About watering methods. Buckets are the best means of controlling the quantity and quality of the water drunk. If for practical reasons the yard is equipped with automatic drinkers, checks should be made to ensure that the water distributed is satisfactory, with sufficient pressure, and in a clean drinker (not contaminated by muck, straw, or bird droppings). **Particular attention must be paid in winter as soon as temperatures drop**. If the water is too cold the horse will reduce his intake and can become dehydrated. At the extreme, if water pipes freeze, and it is not noticed, horses can be deprived of water for a day or more. In this case a number of horses on the yard may fall victim to an episode of tying-up.

4. FEEDING

Rigorous feeding management is indispensable if we wish to avoid the onset of “tying-up”.

a - Forage

Forage plays a primordial role in managing the psychological well being of nervous and stressed horses. Above all, it is **an occupational and calming element** for stabled horses. Ideally a horse should be able to consume meadow hay (not lucerne hay) at will. Furthermore, hay is a **significant energy source**. Indeed, 2kg of good hay provides as much energy as 1kg of barley. So, providing a sufficient quantity of hay allows us to reduce the cereal contribution and thus the starch in the concentrate ration.

b - Concentrate ration

From a general viewpoint, the energy supplied in the daily ration must be divided between a **moderate quantity of cereals, fats and oils, and fibre**. Furthermore, it must not exceed the daily energy requirements of the horse. Particular attention must be made on rest days without exercise. In this case, it is advised to reduce the concentrate ration by 30 to 50%. **For horses predisposed to chronic forms, it is imperative to reduce starch and sugars** in the concentrate ration.

It is inadvisable to provide molasses and sources of rapidly digested starch (ex. wheat, oats, flaked cereals, etc.) : Energy must be chiefly provided by oils/fats, fibre and a small quantity of slowly digested starch (ex. barley). ADULT SPECIFIC ENERGY is a suitable feed in this case. It contains:

- A small amount of slowly digested starch from barley, thus the take up of glucose into the blood stream is low, provoking only a moderate secretion of insulin. The risk of behavioural troubles appearing and the disturbance of muscular contractions is therefore greatly limited;

- Extruded linseed, both the oil and the seeds which are rich in Omega-3, and also extruded soya beans rich in Omega-6. Fats and oils provide on average three times more energy than cereals. **They represent a very interesting alternative to starch**. Lipids reduce the absorption peak of glucose seen 1 to 2 hours in the blood after the ingestion of a cereal feed. **Oils and fats therefore have a "calming" effect**. Finally, the high level of essential fatty acids in ADULT SPECIFIC ENERGY is beneficial to maintaining the fluidity and integrity of the membranes in muscle cells.

- Soluble and insoluble fibres, notably provided by lucerne (alfalfa), extruded linseed and chicory pulp. These are slowly fermented in the large intestine into volatile fatty acids which are then transformed into glucose in the liver. Providing fibres therefore allows progressively supply glucose throughout the day without disturbing the glycaemia (blood sugar level).

c - Supplements

They can be provided via the feed or by nutritional supplements.

ANTIOXIDANTS

First of all, rations rich in oils and fats require a sufficient supply of antioxidants, notably vitamin E. Next, in order to ensure **optimal protection of cell membranes**, the daily ration must be well supplied with antioxidants, the principal two being vitamin E and selenium.

Furthermore, it is possible to provide other antioxidants which complete the action of vitamin E and selenium. For example, in addition to optimal doses of vitamin E and organic selenium, the feeds in our range intended for horses in very hard work (ADULT MIX ENERGY, ADULT SCIENCE ENERGY and ADULT SPECIFIC ENERGY for horses predisposed to myopathies) provide also at optimal levels, stable forms of vitamin C and natural superoxide dismutase (SOD) extracted from a particular variety of melon.

In case of traditional feeding (straights), or if the concentrate feed provides insufficient vitamin E, it is possible to provide it separately via REVERDY NATURAL E. This supplement contains natural vitamin E which is better absorbed and more effective than the synthetic form (but it is more fragile, so difficult to incorporate into feeds).

ELECTROLYTES AND MINERALS

In order to assure optimal functioning of the neuromuscular system, it is essential to cover all the horses' requirements in macro elements. Thus:

- Providing a **salt block** associated with a feed enriched in salt fulfils the daily requirements of chloride and sodium ions;
- Providing meadow hay allows a sufficient supply of potassium and is equally a source of magnesium, the latter being of primary importance in managing tying-up. Indeed, it acts as a sedative (tranquilliser) of the central and peripheral nervous system; It therefore has calming properties and participates in muscle relaxation (the opposite of calcium). It is interesting to reinforce the supply provided by forage by providing a feed enriched in magnesium.
- Calcium requirements are covered by a concentrate feed enriched in this element provided in a Ca/P ratio close to 2.

However, **during efforts leading to abundant sweating** (intense effort, during a long period, in very hot weather, etc.), **it is advisable to punctually reinforce the daily supply of certain macro elements by distributing suitable supplements such as REVERDY ELECTROLYTES**. Given after an effort, this supplement compensates for the loss of the three principal electrolytes eliminated by sweating (chloride, sodium and potassium).

TO SUM-UP

Preventing “tying-up” passes by strict management of the surroundings, training, watering and feeding. As for reoccurring exertional rhabdomyolysis (RER), putting into place a routine, which has the aim of limiting stress in predisposed horses is fundamental. Next, in addition to the normal feeding precautions (ad-lib hay, temperate clean water, electrolytes, antioxidants, etc.), horses subject to myopathies should be fed with a feed such as ADULT SPECIFIC ENERGY, poor in starch and high in oils/fats and fibre. If all these measures are respected there is no reason to condemn a horse predisposed to reoccurring exertional rhabdomyolysis (RER).

BIBLIOGRAPHY

Couroucé-Malblanc A., Deniau V et coll., L’entraînement, la prophylaxie et le traitement des myopathies d’exercice, Pratique Vétérinaire Equine, 2009 ; Vol.41: n°161, 41-49.

Finno C. J., McKenzie E., Valberg S. J. et Pagan J., Effect of fitness on glucose, insulin and cortisol responses to diets varying in starch and fat content in Thoroughbred horses with recurrent exertional rhabdomyolysis, Equine Vet. Journal, Novembre 2010 ; 38: 323-328.

Huntington P. and Valberg S., Fit to be tied: part one, EQUINEWS, 2 mars 2011.

Huntington P. and Valberg S., Fit to be tied: part two, EQUINEWS, 7 mars 2011.

Kentucky Equine Research staff, Feeding and managing to reduce Recurrent Exertional Rhabdomyolysis in horses, EQUINEWS, 27 décembre 2013.

Kentucky Equine Research staff, Can high-fat or Low-starch diets minimize muscle cramping in horses, EQUINEWS, 5 juin 2014.

Virevialle H., Myosite d’effort: adapter le traitement à chaque cas, La dépêche vétérinaire, Décembre 2007 ; Cahier pratique n°5.

Valberg S. J., The management ot tying-up in sport horses: challenges and successes, In: Proc. 17Th, Equine Nutr. and Physiol. Soc. Symp., 2010.

MOVEMENT IN THE HORSE: why and how to supplement?

Equestrian sports allow horses to fully demonstrate their exceptional athletic ability. Whether they have to go through a showjumping course, cover dozen of kilometre at a fast pace, use all their flexibility during a dressage test, or even pull a carriage, their locomotory system is put under pressure.
Every rider concerned about sparing his horse in the long term has to pay special attention to the health of his horse's locomotory system and more particularly to his joints.
The aim of this article is to provide concrete answers about how to supplement your horse if you wish to:
- Prevent joint problems;
- Manage painful mobility diseases that are susceptible to becoming chronic and thus jeopardising the well-being, and ultimately the sporting career of your companion.

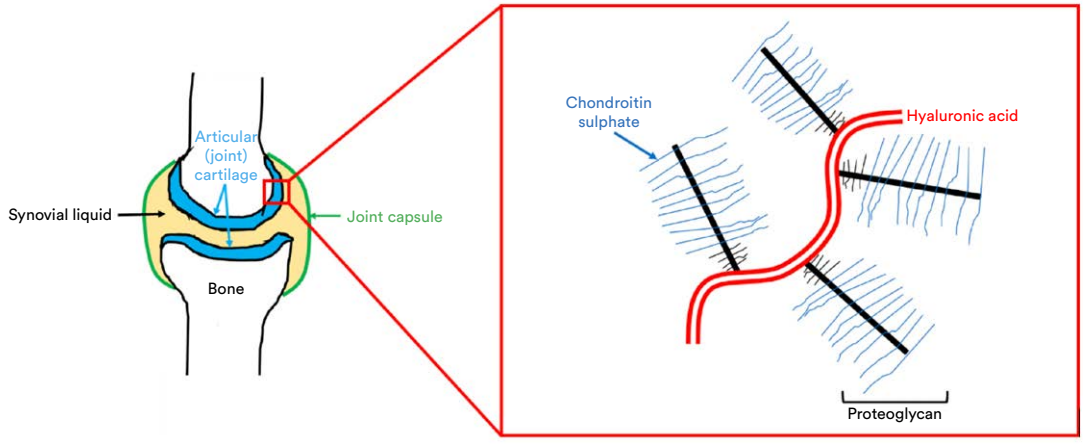
I. COMPOSITION OF AN ARTICULATION (JOINT)

An articulation, or joint, refers to the meeting place of two or more bones. The articulation also consists of:
- Ligaments connecting the bones;
- A joint capsule delimiting a cavity filled with synovial fluid, a lubricating liquid which facilitates movements;
- Cartilage.

Articular cartilage is situated on the surface of bones within joints. It has a dual function: it allows the two extremities to slide smoothly over each other and also to absorb repeated impacts between the bones during movement. Its' resilience and elasticity thus directly condition the fluidity of movements. Furthermore, cartilage bathes in a liquid called, the synovial liquid, which nourishes and lubricates the joint.
Articular cartilage is composed of cartilage cells (called "chondrocytes") that synthesize the constituents of cartilage: the **collagen fibres** (type II), which form a strong matrix trapping the **proteoglycans** fixed to the **hyaluronic acid**. Their primary role is to hold water, principal component of articular cartilage which gives its elastic characteristics.

More precisely, proteoglycans are made in part from **chondroitin sulphate**. As for glucosamine, it is synthesized from glucose in the cartilage cells. It is the precursor of a number of the constituents of proteoglycans (including chondroitin sulphate) and hyaluronic acid. Finally, **sulphur** plays a central role in the functioning of cartilage: it is essential to the synthesis of collagen, hyaluronic acid and of chondroitin sulphate. Sulphur is also needed for normal cell functioning.

DIAGRAM OF AN ARTICULATION – CARTILAGE MATRIX COMPONANTS



CHONDROPROTECTIVE AGENTS: feed supplements for joint health

A number of supplements are used by human, the horse and domestic animals for maintaining optimum articular health, relieving pain in the case of degenerative diseases such as osteoarthritis, or improve post-operative articular recovery. They are called chondroprotective agents as they have a role in cartilage protection (the word “chondral” is the adjective used in medicine to designate cartilage).

Amongst the different ingredients available on the market, it is important to employ those whose effectiveness has been scientifically proven, and to use them at the recommended doses:

- Natural components of cartilage such as **chondroitin sulphate**, **glucosamine**, **hyaluronic acid** and **collagen**;
- Methylsulfonylmethane (MSM), a source of sulphur;
- **Avocado/soybean** unsaponifiables (ASU).

Furthermore, the origin and the composition of chondroprotective agents employed is important. For example, there exists two different forms of glucosamine: glucosamine sulphate and glucosamine hydrochloride. A study showed that in the horse, the sulphate form is better absorbed than the hydrochloride form[1].

Finally, we should be aware that until now, no side effects of chondroprotective agents have been brought to light in their use in the horse in the medium term (up to 6 months). However, no studies have been undertaken in gestating mares. In consequence, in this precise situation, we recommend that you consult your vet who will be able to advise you after weighing up the benefits /risks of such supplementation for the health of the mare and foal.

II. IN WHAT SITUATIONS IS SUPPLEMENTATION USEFUL?

1. OSTEOARTHRITIS

WHAT IS OSTEOARTHRITIS?

Osteoarthritis is the most widespread articular disease. It can occur at any age even if the risk of it appearing increases as the horse ages.

It is a chronic and painful joint disease which leads to lameness in horses. It is characterised by a deterioration of the cartilage which loses elasticity and thickness. The pain is referred to as mechanical because it is triggered by the use of the arthritic joint, and relieved by rest.

During flare-ups of osteoarthritis, the affected joints can show inflammation with articular swelling and heat. The pain takes on an inflammatory character.

The reasons behind the appearance of osteoarthritis are multiple: trauma, morphological anomalies or even infections in the joints. It should be underlined that the principal risk factor for osteoarthritis is ageing, probably due to a drop in the production of the components that give cartilage cells their elastic properties.

Finally, more often than not, osteoarthritis worsens as the thickness of the cartilage diminishes.

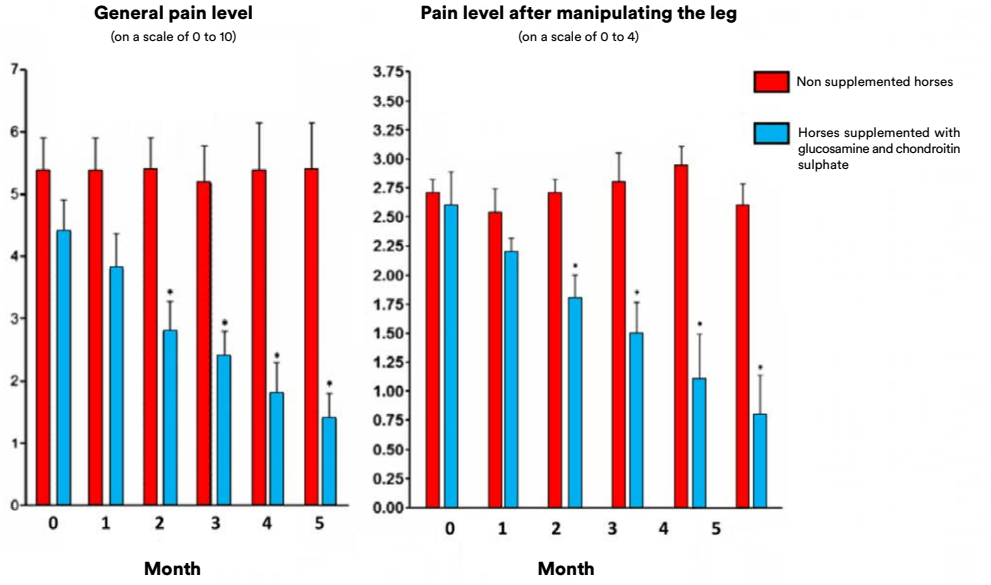
HOW TO SUPPLEMENT THE HORSE SUFFERING FROM OSTEOARTHRITIS?

Management of the disease must first start by putting into place a treatment whose aim is to protect the remaining joint cartilage. For this reason, supplementing with chondroprotective agents is of interest as they can have a beneficial effect on slowing the progress of the disease. Indeed, it has been shown that supplementing glucosamine/chondroitin sulphate combinations along with with ASU reduces inflammation and deterioration of cartilage composants[2,7].

Improvement in cartilage health is reflected by a gradual decrease in mechanical pain and so therefore an improvement in mobility. For example, supplementing with glucosamine and chondroitin sulphate reduces signs of (mechanical) pain in arthritic horses[8]. It should be noted however that pain decreases gradually as the months during which the horses are supplemented pass: in the study shown below, it really starts to be observed after 2 months of supplemetation.

PAIN WHILST WALKING AND TROTTING PROGRESSIVELY DIMINISHES IN HORSES SUFFERING FROM OSTEOARTHRITIS WHO ARE SUPPLEMENTED WITH GLUCOSAMINE CHONDROITIN SULPHAT

(source Gupta et al., 2009)[8]



In the event of active inflammation (acute arthritis), characterised by articular heat and swelling along with more pronounced lameness than usual (caused by inflammatory pain), supplementing with chondroprotective agents is not enough to quickly halt the inflammatory process. In this case, it is preferable to seek a medical treatment based on non-steroidal anti-inflammatory drugs (NSAID). Indeed, the latter allow the inflammation to be stopped, with the effect of quickly relieving pain and protecting the articular surfaces likely to suffer deterioration during a prolonged inflammatory state. However, resorting to the use of NSAIDs should be intermittent as their long term administration can contribute to accelerating the evolution of osteoarthritis[9].

Remember: Daily supplementation with chondroprotective agents improves joint comfort in horses suffering from osteoarthritis and helps to slow the disease.

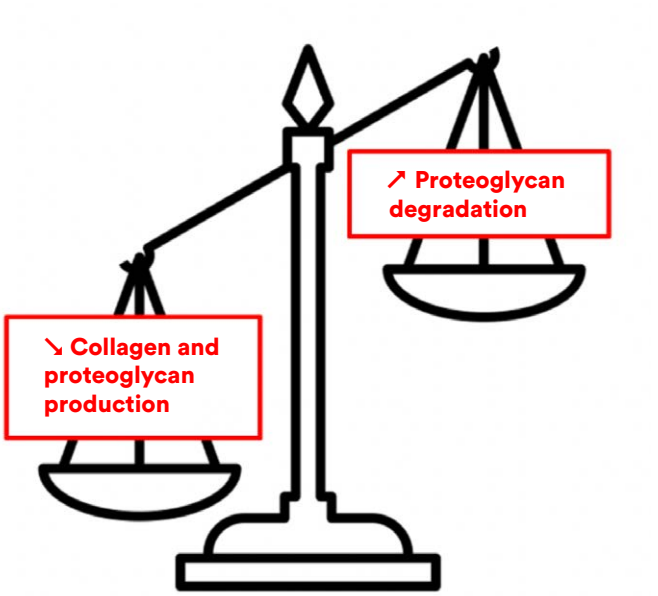
REVERDY TIP

In arthritic horses, we recommend giving one dose of REVERDY FLEXY a day for 1 month, and then continue by giving ½ a dose per day.

THE SPECIFIC CASE OF THE AGED HORSE

With age, the speed at which collagen and water holding proteoglycans degrade finishes by overtaking the speed at which they are produced. Therefore cartilage becomes less elastic and more brittle, hence the appearance of stiffness and joint pain. After a while, cartilage is prone to thinning and cracking, which will result in the development of osteoarthritis.

IN AGEING CARTILAGE, THE BALANCE BETWEEN PRODUCTION AND DEGRADATION IS BROKEN



However, it is possible to delay this degenerative phenomena by supplementing the aged horse with chondroprotective agents. Indeed, it has been shown that supplementation with chondroitin, glucosamine and N-acetyl-D-glucosamine (another form of glucosamine) improves mobility in horses aged over 15 years old.: range of joint motion, length of stride, swing duration and stance duration[10].

Remember: supplementing the aged horse with chondroprotective agents helps improve their articular comfort. It should be noted that horses whom are no longer ridden due to their age should be able to freely walk around each day in order to minimise joint stiffness.

REVERDY TIP

In the aged horse, we recommend giving one daily dose of REVERDY FLEXY for 1 month then continue by giving ½ a dose a day.

2. JOINT SURGERY: WHY AND HOW TO SUPPLEMENT AFTER SURGERY?

Whether it is to remove a fragment of cartilage or for other reasons, joint surgery remains an invasive surgical technique, which can potentially lead to lesions of the capsule and the articular surfaces.

A chondroprotective agent based supplementation after surgery can be useful to help post-operative recovery. For example, a study showed that oral supplementation with hyaluronic acid in yearlings, after surgery for removing cartilage fragments in the hock, reduced post-operative articular swelling[11].

Furthermore, a second study showed that the use of avocado and soya oil extracts (ASU) also improved post-operative recovery by:

- An anti-inflammatory and protective effect on cartilage;
- Better healing of the synovial membrane (part of the articular capsule) that was perforated during the intervention (arthroscopy)[3].

It is important to note that the benefits observed due to supplementation with avocado and soya oil extracts were greater than those obtained with certain injectable veterinary preparations (glycosaminoglycan polysulphate or hyaluronic acid based), tested according to the same type of study.

Remember: Supplementing orally with hyaluronic acid and above all avocado and soya oil extracts improves post-operative recovery in joints.

REVERDY TIP

After joint surgery, we recommend giving one dose of REVERDY SUPER FLEXY per day for two months, then continue chondroprotective agent supplementation with ½ a dose of REVERDY FLEXY per day.

3. HOW CAN YOU KEEP YOUR HORSES JOINTS IN GOOD HEALTH?

Even if young and healthy, the horse can be confronted by situations that challenge his joints: heavy work, competition, working on hard ground or even breaking-in can cause micro-lesions that can lead to the development of articular inflammation.

A study showed that supplementing for about 3 months with glucosamine and chondroitin sulphate before experimental induction of articular inflammation reduced the production of factors implicated in cartilage degeneration in young horses[12]. In the same manner, a second study showed supplementing with glucosamine, chondroitin sulphate, MSM and hyaluronic acid approximately 1 month before the development of inflammation reduced the inflammatory reaction within the joint.

Finally, it also has been shown that supplementing with glucosamine and chondroitin for 6 years permitted a decrease in the frequency of intra-articular injections (following the detection of pain by a vet) each year in show-jumping and eventing horses.

Remember: Preventative supplementation with chondroprotective agents helps to safeguard joint health.

REVERDY TIP

We recommend giving ½ a dose of REVERDY FLEXY for 1 to 3 months before an event that can challenge joints (breaking-in, competition, etc.). This supplementation can be continued throughout the risk period.

PRESENTATION OF REVERDY FLEXY AND SUPER FLEXY

SITUATION	PRODUCT	DOSE AND PERIOD
Osteoarthritis	FLEXY	1 dose/day during 1 month then ½ dose/day
Old age	FLEXY	1 dose/day during 1 month then ½ dose/day
Post-operative (articular)	SUPER FLEXY followed by FLEXY	1 dose/day during 2 month ½ dose/day
Prevention	FLEXY	½ dose/day during 1 - 3 months

BIBLIOGRAPHY

(1) **M. Meulyzer, P. Vachon, F. Beaudry, T. Vinardell, H. Richardy, G. Beauchamp et S. Laverty** (2008). Comparison of pharmacokinetics of glucosamine and synovial fluid levels following administration of glucosamine sulphate or glucosamine hydrochloride. Osteoarthritis and cartilage 16:973-979.

(2) **J. Dechant, G. Baxter, D. Frisbie, G. Trotter et C. McIlwraith** (2005). Effects of glucosamine hydrochloride and chondroitin sulphate, alone and in combination, on normal and interleukin-1 conditioned equine articular cartilage explant metabolism. Equine Veterinary Journal 37(3):227-231.

(3) **C. Kawcak, D. Frisbie, C. McIlwraith, N. Werpy et R. Park** (2007). Evaluation of avocado and soybean unsaponifable extracts for treatment of horses with experimentally induced osteoarthritis. American Journal of Veterinary Research 68(6):598-604**.**

(4) **R. Murray, V. Walker, C. Tranquille, J. Spear et V. Adams** (2017). A randomized blinded crossover clinical trial to determine the effect of an oral joint supplement on equine limb kinematics, orthopedic, physiotherapy, and handler evaluation scores. Journal of Equine Veterinary Science 50:121-128.

(5) **M.Orth, L.Peters et J.Hawkins** (2002). Inhibition of articular cartilage degradation by glucosamine-HCl and chondroitin sulphate. Equine Veterinary Journal, Supplement 34:224-229.

(6) **J. Fenton, K. Chlebek-Brown, J. Caron, M. Orth** (2002). Effect of glucosamine on interleukin-1-conditioned articular cartilage. Equine Veterinary Journal, Supplement 34:219-223.

(7) **E. Secor, M. Grzanna, A. Rashmir-Raven, C. Frondoza** (2018). Chondrocyte production of pro-inflammatory chemokine MCP-1 (CCL-2) and prostaglandin E-2 is inhibited by avocado/soybean unsaponifiables, glucosamine, chondroitin sSulfate combination. Pharmacology & Pharmacy 9:10-26.

(8) **R. Gupta, T. Canerdy, P. Skaggs, R. Burke, K. Wegford, J. Goad, K. Rohde, D. Barnett, W. DeWees, M. Bagchi et D. Bagchi** (2009). Therapeutic efficacy of undernatured type-II collagen (UC-II) in comparison to glucosamine and chondroitin in arthritic horses. Journal of Veterinary Pharmacology and Therapeutics 32:577-584.

(9) **R A. Hauser (**2010). The acceleration of articular cartilage degeneration in osteoarthritis by nonsteroidal anti-inflammatory drugs. Journal of Prolotherapy 2(1):305-322.

(10) **R. Forsyth, C. Brigden et A. Northrop** (2006). Double blind investigation of the effects of oral supplementation of combined glucosamine hydrochloride (GHCL) and chondroitin sulphate (CS) on stride characteristics of veteran horses. Equine Veterinary Journal, Supplement 36:622-625.

(11) **B. Bergin, S. Pierce, L. Bramlage et A. Stromberg** (2006). Oral hyaluronan gel reduces post operative tarsocrural effusion in the yearling Thoroughbred. Equine Veterinary Journal, 38(4):375-378.

(12) **J. Leatherwood, K. Gehl, J. Coverdale, C. Arnold, R. Rabareiner, K. Walter et E. Lamprecht** (2016). Influence of oral glucosamine supplementation in young horses challenged with intra-articular lipopolysaccharide. Journal of Animal Science 94(8):3294-3302.

(13) E. **Van de Water, M. Oosterlinck, M. Dumoulin, N. Korthagen, P. Van Weeren, J. Van den Broek, H. Everts, F. Pille et D. Van Doorn** (2017). The preventive effects of two nutraceuticals on experimentally induced acute synovitis. Equine Veterinary Journal, 49(4):532-538.

(14) **M. Rodgers** (2006). Effects of oral glucosamine and chondroitin sulfates supplementation on frequency of intra-articular therapy of the horse tarsus. The International Journal of Applied Research in Veterinary Medicine 4(2):155-162.

The interest of hay steamers in preventing and managing respiratory diseases

I. THE HORSE,

an animal sensitive to bacteria, mould and dust present in conserved forage

A healthy adult horse weighing 500kg consumes about 10 to 13kg dry matter (DM) a day, of which, 2/3 should be forage (necessary to cover daily requirements in fibres). Thus, a stabled horse in work must eat 8 to 10kg of hay a day.

In addition to being beneficial to the digestive system (buffer effect in the stomach, bulk to favour a healthy transit and maintain a beneficial digestive flora) and important to the mental well being (occupation), hay represents a non negligible energy source.

Nevertheless, **bad quality hay is likely to lead to various health problems in the horse, notably in the respiratory system**[1]. Indeed, inhalation of dust from hay containing bacterial endotoxins, fungal spores, dust mites, pollens and other inorganic debris, can be at the root of hypersensitivity reactions, that is to say an exaggerated immune response towards these foreign substances, able to induce tissues and inflammatory lesions in the respiratory tract.

In the horse we principally observe two types[2]:

- **Inflammatory Airway Disease (IAD)** more often met with in young horses in training. It is characterised by intolerance to effort with a drop in performance commonly accompanied by coughing and discharge;
- **Recurrent Airway Obstruction (RAO)**, “heaves”, “broken wind” or “emphysema” appearing mainly in stabled, adult horses aged 7 and over. This reversible inflammatory obstruction of the lung branches is characterised by intolerance to effort, coughing and even respiratory distress, flared nostrils, expiratory dyspnoea with the appearance of a “heave line” reflecting the important abdominal efforts during expiration and sometimes an increase in the respiratory rate.

In the athletic horse, disturbance of gaseous exchanges in the lungs and in particular of the pulmonary alveoli is one of the major causes (along with locomotive problems) of poor performance. Thus it is primordial to accord great importance to the sanitary quality of forage, more so considering the majority of horses in work live in the confined atmosphere of their stable.

To reduce dust, hay is often soaked. However, this technique can have undesirable effects (changes in nutritive values and palatability) and does nothing to improve the sanitary quality of hay. Indeed, it is preferable to resort to the use of forage purifiers such as those proposed by the HAYGAIN company.

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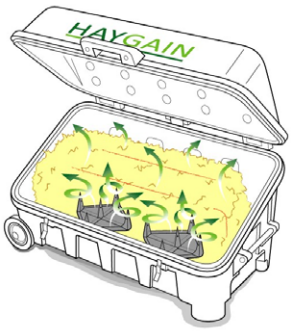
II. HAYGAIN HAY STEAMERS

a - How they work

HAYGAIN hay steamers are made up of different components:

- **A double insulated chest holds the steam**, thus a temperature greater than 100°C can be reached and maintained;



- **A steam generator**, also double skinned and insulated, composed of a stainless steel 8L water heater using an element (for the HG-1000 et HG-600 models) having the cawpability to produce steam for about 2 hours. It is equipped with an alarm and safety thermal protection in case of lack of water (dry run);

- **Distribution manifolds** in the base of the chest. These are made up of aluminium plates which hold heat under the bale and lead to a temperature rise within the chest. Furthermore, these plates have perforated spikes which inject steam directly into the centre of the bale which is then pushed outwards towards the edges of the bale thus ensuring total steam absorption.

A steam cycle lasts about 50 minutes. There is minimal condensation due to the thermal efficiency of this procedure making the HAYGAIN easy to maintain[3].

HAYGAIN is available in three models, each with a smaller or larger capacity. They are all guaranteed for a year.

b - Usage

For the user, operating is simple. Follow these steps:

1) Fill the generator (using a watering can for example) by unscrewing the filler cap which is found on the front.
2) Place the hay bale in the chest and properly shut the lid.
3) Start steaming by pressing the start button on the generator.
4) Unload the forage.

III. A SOLUTION IN THE PREVENTION AND MANAGEMENT OF RESPIRATORY DISEASES

1. DUST-FREE FORAGE

Hay can be dusty, that is to say, contains high levels of breathable particles, for many different reasons: baling whilst moist, leading to heating during storage, cut too short, inclusion of soil particles (earth etc.), cut late, containing plants in flower, presence of mould, so containing spores, etc. The effect of the HAYGAIN steaming process on the number of breathable particles (diameter inferior of 5µm) has been studied[4].

METHOD

8 hay samples were taken from four different zones in Great Britain (GB). Each sample was divided into three and each part treated differently:

- 50 minute cycle in a HAYGAIN 1000 then the hay shaken;
- 50 minute cycle in a HAYGAIN 1000 then left for 24 hours before being shaken;
- No passage in the HAYGAIN 1000 and only shaken (control).

Each of the 5kg samples was vigorously shaken in a rotating agitator for 3 minutes.

RESULTS

The control samples (who were not treated in the steamer) had variable levels of breathable particles: in addition to the reasons cited above, these fluctuations can be explained by variations in humidity during harvesting and climatic conditions during storage. Some contained few dust particles (10,000 particles with a diameter inferior of 5µm/kg hay and litre of air) whilst others liberated many (more than 50,000 particles with a diameter inferior of 5µm/kg hay and litre of air). On the other hand, those samples treated in the HAYGAIN saw their level of breathable particles drop sharply:

- A drop of 94% in those analysed immediately after treatment in the HAYGAIN compared to the control sample;
- A drop of 79% for the samples analysed 24 hours after treatment.

TO SUM UP

Treating hay with a HAYGAIN is an effective method to reduce the number of breathable particles (diameter inferior of 5µm) for at least 24 hours after steaming.

2. PURIFIED FORAGE

The effectiveness of HAYGAIN hay steamers on the total number of bacteria, yeast and mould has also been studied[5].

Experiment n°1

METHOD

A count of microbial colonies was carried out on samples from hay bales from 5 different regions of GB. Each sample was divided into two: one part treated by the HAYGAIN 1000 steamer for 50 minutes whilst the other was not and represented the control sample. Colony numbers were counted in each sample, whether treated or not by the hay steamer.

RESULTS

After steaming in the HAYGAIN 1000, bacterial contamination was reduced on average by 86% and no yeast or fungal colonies were detectable.

MICRO-ORGANISM (CFU*/g)	NON-STEAMED (DRY)	STEAMED
Bacteria	381,573	4,453
Fungi	185,000,000	0
Yeast	6,893,333	0

***CFU = Colony forming units**

A second experiment led in 2012 confirmed these results. It showed that steaming hay using a HAYGAIN 600 (a smaller model) led to a 99% reduction in bacterial and mould colonies[6].

Experiment n°2

A similar experiment was carried out on haylage[7]. In general, this type of forage has better nutritional values and lower dust levels than hay. However, because of higher humidity, haylage must be rapidly consumed after opening (on average within 5 days). In fact, once the protective film is removed, contact with air, and in particular oxygen, leads to the rapid development of bacteria and mould.

METHOD

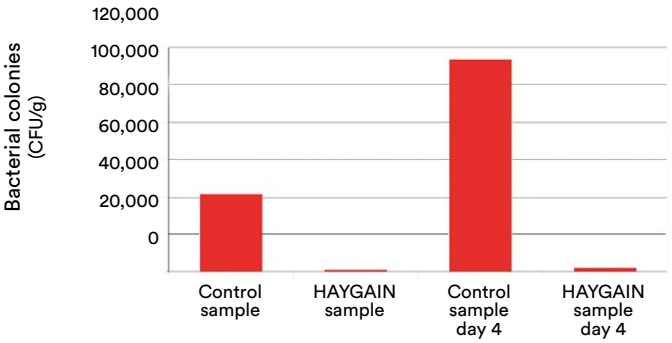
5 bales of rye-grass haylage were randomly chosen on an English farm. Each bale was divided into 4 equal parts:

- Part n°1 being tested the same day;
- Part n°2 was tested 4 days after opening the bales;
- Part n°3 was steamed in a HAYGAIN 600 the same day and tested immediately afterwards;
- Part n°4 was steamed in a HAYGAIN 600 the same day and tested 4 days after opening.

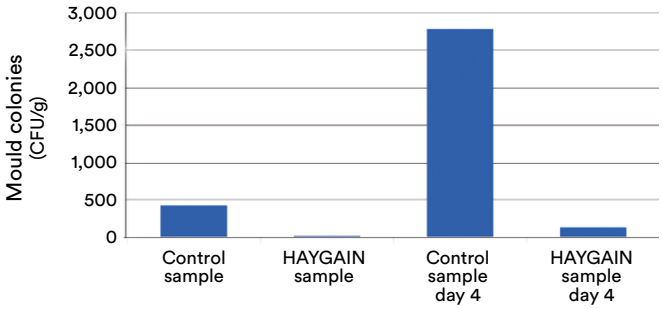
RESULTS

After steaming, analysis carried out the same day showed 99% reduction in the number of microbial colonies (bacteria and mould) compared to the non-steamed sample. After 4 days exposure to air, the haylage treated by the HAYGAIN 600 still showed a 99% reduction in bacterial colonies and 70% in mould, which remains satisfactory. On the other hand, analysis carried out 4 days after opening on the non-steamed haylage sample showed an important increase in the number of microbial colonies (x2.75 for bacteria and x6.5 for fungus). All the results are presented in the graphs below[7].

Number of **bacterial colonies** at day 0 and day 4 following the opening of a haylage bale, with or without treatment by HAYGAIN



Number of **mould colonies** at day 0 and day 4 following the opening of a haylage bale, with or without treatment by HAYGAIN



CONCLUSION OF EXPERIMENTS 1 AND 2

Treating forage by HAYGAIN permits a near complete elimination of bacteria and mould.

Indeed it seems logical to think that the use of HAYGAIN machines should limit the onset of respiratory problems due to allergens in hay, notably in those horses suffering from chronic problems such as “heaves” or “emphysema”.

Experiment n°3

To validate this hypothesis, a study was led in 2012 on 6 horses suffering from RAO[8].

METHOD

6 horses suffering from RAO but in remission (attenuated symptoms) were divided into two groups: a control group fed on ad-lib standard lucerne hay and a group eating the same hay steamed in a HAYGAIN 1000. During the 10 days study, the horses underwent different examinations:

- On days 1, 5 and 10: respiratory tract endoscopy, evaluation of mucus production and measure of the intrapleural pressure;
- On days 1 and 10: bronchoaveolar lavage (cytology of fluids from the respiratory tract).

RESULTS

Horses consuming non steamed hay showed an aggravation of the clinical symptoms of RAO between the first and 10th day of the experiment, whilst the parameters of the horses eating steamed hay remained unchanged during the study.

CONCLUSION

In addition to being useful in prevention, HAYGAIN hay steamers allow effective management of horses suffering from respiratory diseases, notably reoccurring forms such as RAO.

IV. UNCHANGED NUTRITIONAL QUALITY AND IMPROVED PALATABILITY

1. CONSERVED NUTRITIONAL VALUES

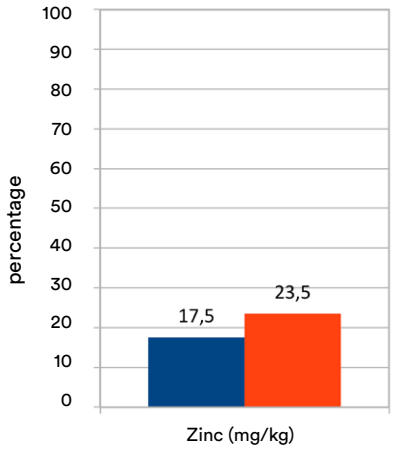
Soaking hay induces a drop in nutritional quality. Regarding treatment by HAYGAIN, a study was carried out on 30 hay bales[9].

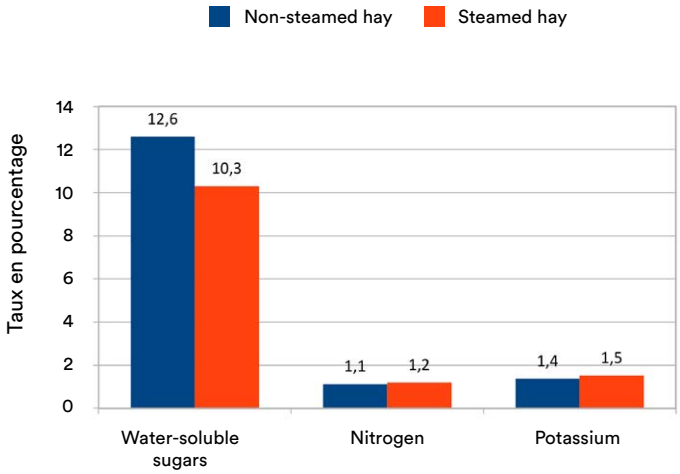
METHOD

2 samples were extracted from each bale, taking each time hay from 5 different places in the bale. One sample from each bale underwent steaming treatment in the HAYGAIN. Then, each sample, whether it had been treated in the HAYGAIN or not, was analysed in order to establish nutrient levels.

RESULTS

No significant difference was found in calcium, magnesium, sodium, phosphorus, copper, manganese and iron. Levels of nitrogen, potassium and zinc were slightly increased. Only the level of soluble sugars decreased by 2.3%. This small decrease can be considered beneficial as very high levels of sugar in hay are harmful for horses (risk of laminitis, obesity, etc.).





CONCLUSION

Treatment with the HAYGAIN does not alter nutritive values in forage.

2. UNMODIFIED DIGESTIBILITY

Steam treatments increase the digestibility of forage. Therefore the evolution of forage degradability after treatment by HAYGAIN has been studied *in vitro*.

METHOD

6 hay samples were collected. Three of them underwent steaming in the HAYGAIN for 50 minutes[10]. The 6 samples were then fermented in vitro using horse faeces as microbiological inoculum. After an incubation period of 65 hours at 37°C, the volume and pressure of gas was measured.

RESULTS

No significant difference between the samples was found whether treated or not by the HAYGAIN.

CONCLUSION

The steaming procedure does not improve forage digestibility.

3. IMPROVED PALATABILITY

In order to study the palatability of hay after steaming, a study was undertaken in 6 ponies[11].

METHOD

Hay samples were treated in three different ways:

- Hay soaked in water;
- Steamed hay using a HAYGAIN;
- Dry hay (no treatment, control).

1kg of each sample was given to the ponies for an hour: The hay was placed on the ground at three different positions in the stable, the ponies also had water available. In order to eliminate any positional preferences, the experiment was repeated three times for each pony, changing the position of the hay samples every time. The amount of dry matter consumed during an hour as well as the first choice of forage to be consumed during the first five minutes were recorded.

RESULTS

Hay treated by HAYGAIN is consumed in significantly larger quantity than the two other samples, and is eaten first by the ponies during the first five minutes.

CONCLUSION

The HAYGAIN steaming procedure therefore improves hay palatability.

TO SUM UP

Different scientific studies carried out on HAYGAIN hay steamers have proven that these machines reduce the number of breathable particles in hay, and also destroy bacteria, mould spores and dust mites in dehydrated or wrapped forage. Thus, thanks to the easily and simply operated steaming system, we obtain clean, dust free, rehydrated and palatable hay, whilst conserving nutritional qualities. The interest of these machines in preventing and managing respiratory diseases related to forage allergens is therefore evident. Consequently, knowing that respiratory diseases represent a major cause of poor performance and are favoured by stabling, daily treatment of forage by HAYGAIN hay steamers is recommended, for predisposed horses at the very least.

BIBLIOGRAPHY

(1) **Oke S.** (2010). The equine respiratory system. In The horse, article #24958.

(2) **Mesnil C, Bureau F., Lekeux P.** (2006), Tableau clinique et mécanismes physiopathologiques des principales maladies inflammatoires chroniques des voies respiratoires du cheval, Ann. Méd. Vét., 150, 227- 240.

(3) **HAYGAIN**, purificateur de foin, En ligne. http://www.haygain.fr/the-solution.php. Consulté le 1er décembre 2014.

(4) **Stockdale, C and Moore-Colyer, M.J.S** (2010) Steaming hay for horses: The effect of three different treatments on the respirable particle numbers in hay treated in the Haygain steamer. European Workshop for Equine Nutrition, Cirencester, Sept 2010. The Impact of nutrition on the health and welfare of horses. EAAP publication No. 128. Ed Ellis, A., Longland, A.C., Coenen, M and Miraglia, N. p 136-138.

(5) **James, R. and Moore-Colyer, M.J.S.** (2010) The effect of steam treatment on the total viable count, mould and yeast numbers in hay using the Haygain steamer European Workshop for Equine Nutrition, Cirencester, Sept 2010. The Impact of nutrition on the health and welfare of horses. EAAP publication No. 128. Ed Ellis, A., Longland, A.C., Coenen, M and Miraglia, N.p 128-132.

(6) **Moore-Colyer, M.J.S and Fillery, B.G.** (2012) The Effect of three different treatments on the respirable particle content, total viable count and mould concentrations in hay for horses. 6 th European Workshop for Equine Nutrition, Lisbon, Portugal, June. 101-106.

(7) **Leggatt, P.** (2012) A comparison of the total viable count, fungi and yeast concentrations in fresh haylage and haylage steamed for 50 minutes in the Haygain steamer - HG 600. BSc thesis, Royal Agricultural College Cirencester 2012.

(8) **Blumerich, C.A., Buechner-Maxwell, V.A., Scrratt, W.K., Wilson, K.E., Ricco, C., Becvarova, I., Hodgson, J. and Were, S.** (2012) Comparison of airway response of Recurrent Airway Obstruction affected horses fed steamed versus noon-steamed hay. Proceedings of the Annual ACVIM Conference, 2012.

(9) **James, R.** Nutrient content of 30 different samples of dry hay and hay steamed for 50 minutes in the Haygain steamer (MSc thesis, Royal Agricultural College).

(10) In vitro fermentation of dry hay and hay steamed for 50 minutes in the HG1000 Haygain steamer.

(11) **Moore-Colyer, M.J.S. and Payne, V.** (2012) Palatability and ingestion behaviour of 6 polo ponies offered a choice of dry, soaked and steamed hay for 1 hour on three separate occasions. Advances in Animal Biosciences. Healthy Food from Healthy Animals. Vol 3 part 1. 127

IMMUNITY
beta-glucans and performance

I. IMMUNITY

The immune system, represented by white blood cells, defends the organism by fighting pathogens such as bacteria, viruses, fungi and parasites.

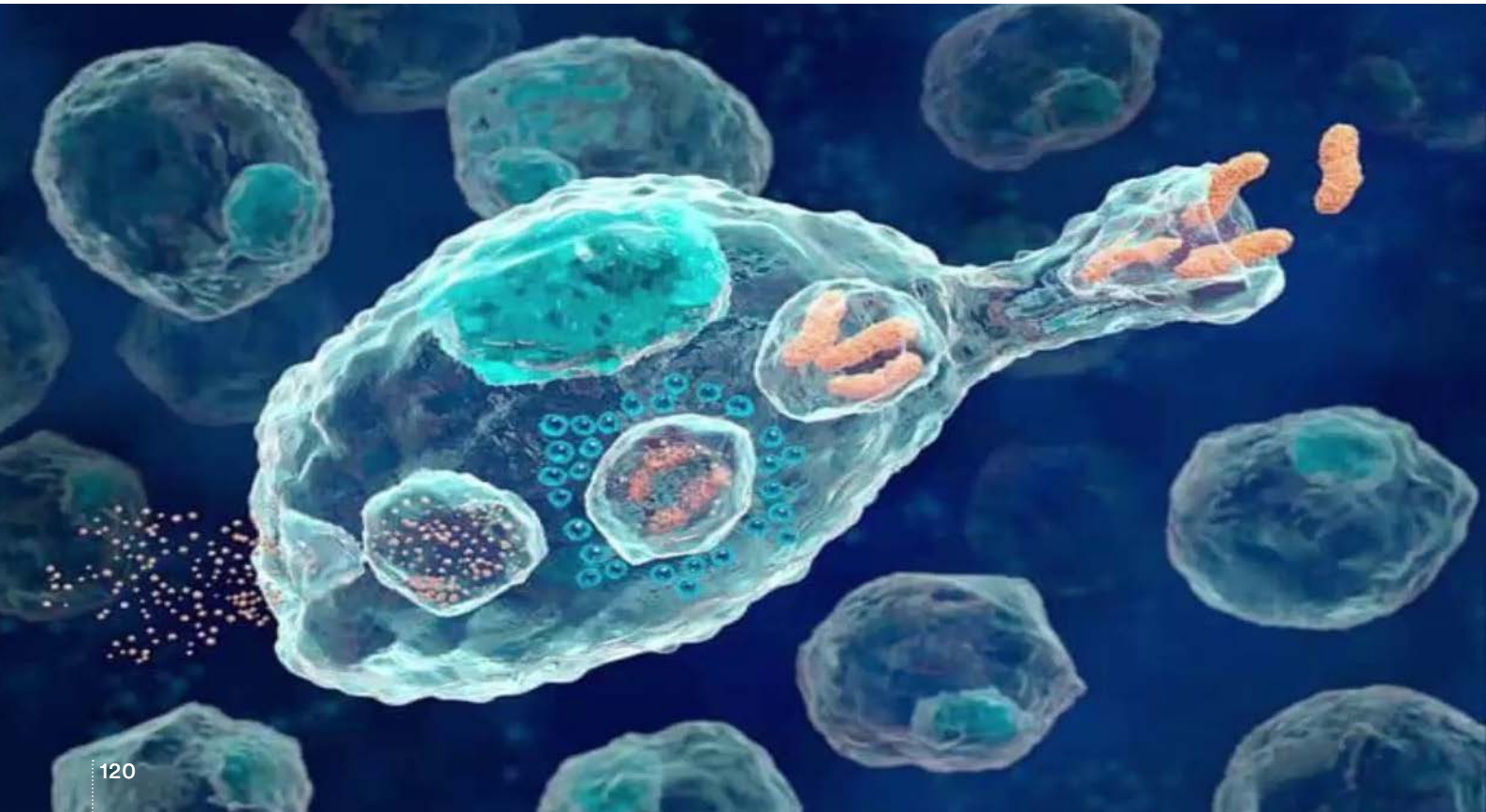
Two types of response enter into play:

- **The innate, or natural immune response** which is immediate. This represents the **first line of defence** against infectious agents. If the latter manage to cross the physical barriers represented by skin and mucous membranes, they are recognised by **phagocytic cells** such as macrophages (from blood monocytes) and polynuclear neutrophils which phagocyte ("eat") them, thus destroying them. These immune cells will then be at the origin of the "**warning signal**" responsible for triggering an inflammatory response at the spot where the pathogen was recognised. Following the recognition of infectious agents by phagocytic cells, the latter will secrete soluble substances called **cytokines**, notably at the origin of vasodilatation, then recruit other phagocytic cells. Some of these will then activate the adaptive immunity cells, the lymphocytes, by showing them antigens from the infectious agents;

- **The adaptive (or specific) immune response** which comes later. It represents the **second line of defence** against infectious agents. It is characterised by the participation of **T and B lymphocytes**. A prior activation phase before any action of lymphocytes is essential. This activation starts either by direct contact with the pathogenic agent (for the B lymphocytes), or via the appearance of a pathogenic antigen by cells presenting antigens such as phagocytic cells taking part in the innate immune reaction.

It should be noted that a type of T-leucocyte (helper or inducer) plays a fundamental role in activating other leucocytes that will directly fight against infectious agents:
- B lymphocytes, responsible for humoral immunity, by producing specific antibodies against the infectious agent;
- Cytotoxic T lymphocytes, responsible for cell immunity, that act by releasing granules containing cytotoxins which attack the membranes and DNA of infected cells, leading to their death.

PHAGOCYTOSIS OF A BACTERIA BY A MACROPHAGE



II. TRAINING AND IMMUNITY

A horse will only perform well if he is in good health. The general health of the horse reflects the functioning of his immune system which is really put to the test in the athletic horse. Indeed, **intense physical exercise is perceived as stress by the organism**, which will secrete during this type of effort, stress hormones such as cortisol or catecholamines (adrenaline, etc.).

These substances have an **inhibiting effect on the immune system** (called an immunosuppressive effect). The amount, as well as the length of time these stress hormones are secreted will have a direct consequence on the immunosuppressive period, a period during which the immune system is lacking, rendering the body more fragile and sensitive to various infections (bacterial, viral, etc.).The link between a drop in immunity and muscular effort was demonstrated in the study made by Ingrid Waldschmidt (CIRALE-ENVA) called « Impact de l'effort et de l'entraînement sur la réponse immunitaire du trotteur français » ("The impact of effort and training on immunological reactions in French trotters" - December 2013) . Her work showed that **training, even moderate, had a long-lasting negative effect on innate respiratory immunity**, principally on anti-viral immunity.

Therefore, this can explain why, in addition to the fact they run a higher risk of being exposed to viruses (being in contact with numerous other horses), **horses in training are more prone to catching viral respiratory infections**.

Considering that respiratory problems represent the second cause of poor performance after locomotory problems in racehorses, and that they are in relation to a drop in innate immunity, **support for the immune system would seem essential during periods of training and competition in the horse**.

III. THE INTEREST OF BETA-GLUCANS

a - Definition

Beta - (1,3/1,6) - glucans are extracts from the cell walls of bakers yeast (saccharomyces cerevisae) whose **immunity stimulating properties have been recognised for approximately the last ten years**. They have been the subject of hundreds of articles showing that beta glucans induce an intensified immune reaction.

b - How they work

The powerful immunity stimulating effect of beta glucans from bakers yeast is due to **their special molecular structure able to activate specific receptors** present on the surface of macrophage cell membranes. The activation of macrophages by beta-glucans increases their phagocytosis ability and leads to a modulation in their production of cytokines intervening in innate (immediate) and adaptive (specific) immunity by participating in lymphocyte activation.

MOLECULAR STRUCTURE OF BETA - (1,3/1,6) - GLUCANS

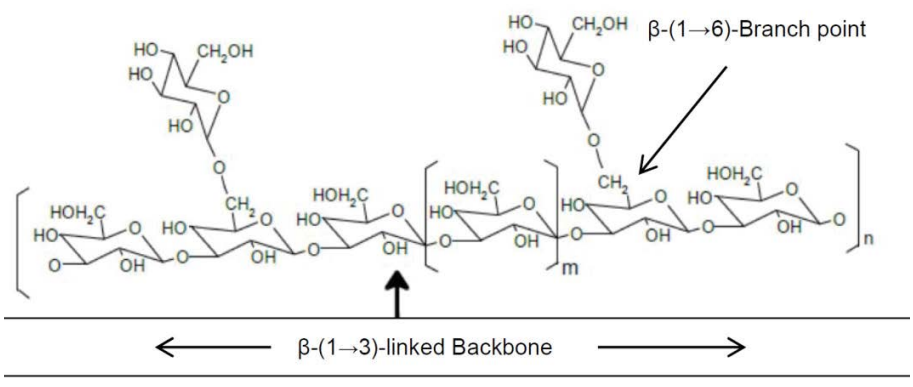


Illustration 1

c - Proven immunostimulating properties

Every study presented below was carried out using identical preparations of beta-glucans (from the same manufacturer) to those contained in our feed supplement **IMMUNE** (REVERDY). Furthermore, it is important to note that the method of administration was always oral.

ACTIVATION OF INNATE IMMUNITY

Studies carried out by Vaclav Vetvicka and coll. on healthy adult dogs (2014) as well as on healthy weaned piglets (2014) notably showed after 14 – 16 days of oral supplementation with beta-glucans (15mg/kg LW/day):

- **An improvement in phagocytosis activity by monocytes** (circulating macrophages) and of polynuclear neutrophils.

The effect of supplementing with beta-glucans on phagocytosis activity of blood monocytes and neutrophils in piglets

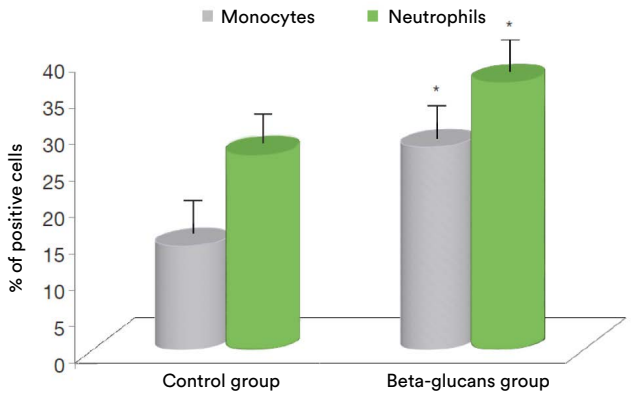


Illustration 2

The effect of supplementing with beta-glucans on phagocytosis activity of blood monocytes and neutrophils in healthy adult dogs

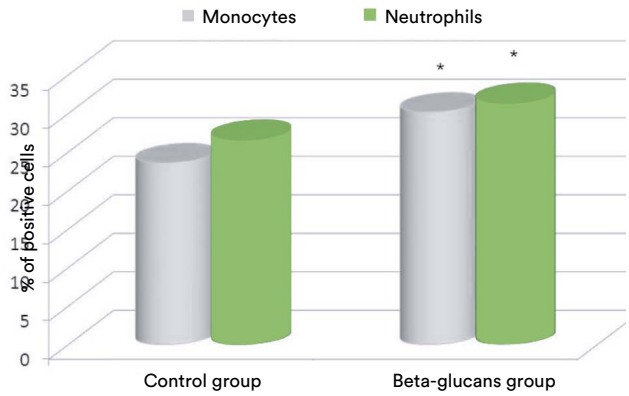


Illustration 3

*represents significant differences between the control and test groups (p<0.05)

- **Increased production of interleukin 2** by phagocytic cells, cytokine which stimulates lymphocyte proliferation (leukocytotrophic hormone) and notably takes part in T inducer leucocyte activation.

The effect of supplementing with beta-glucans on serum levels of interleukin 2 (IL-2) in piglets

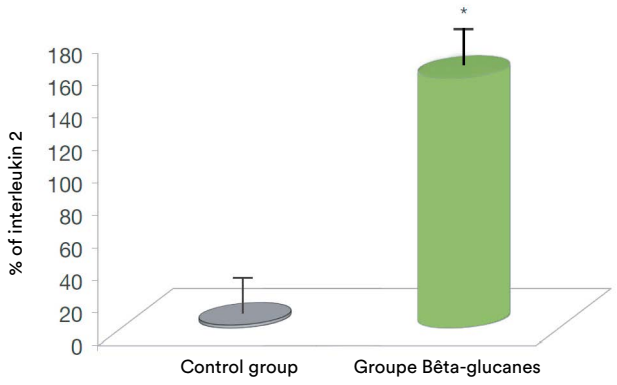


Illustration 4

The effect of supplementing with beta-glucans on serum levels of interleukin 2 (IL-2) in healthy adult dogs

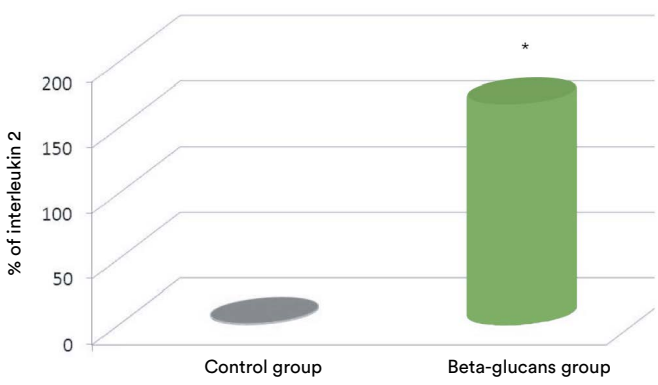


Illustration 5

*represents significant differences between the control and test groups (p<0.05)

ACTIVATION OF THE ADAPTIVE (SPECIFIC) IMMUNITY

The study by Doctor (veterinary medicine) Claire Leleu (Equi-Test) et coll. (2014) carried out on French trotter racehorses in training, showed that oral supplementation with beta-glucans at a rate of 5g/day that is, 10mg/kg LW/day for 90 days, significantly improved response to vaccination in supplemented horses compared to the control group.
The methodology is presented below.

EXPERIMENTAL METHODOLY

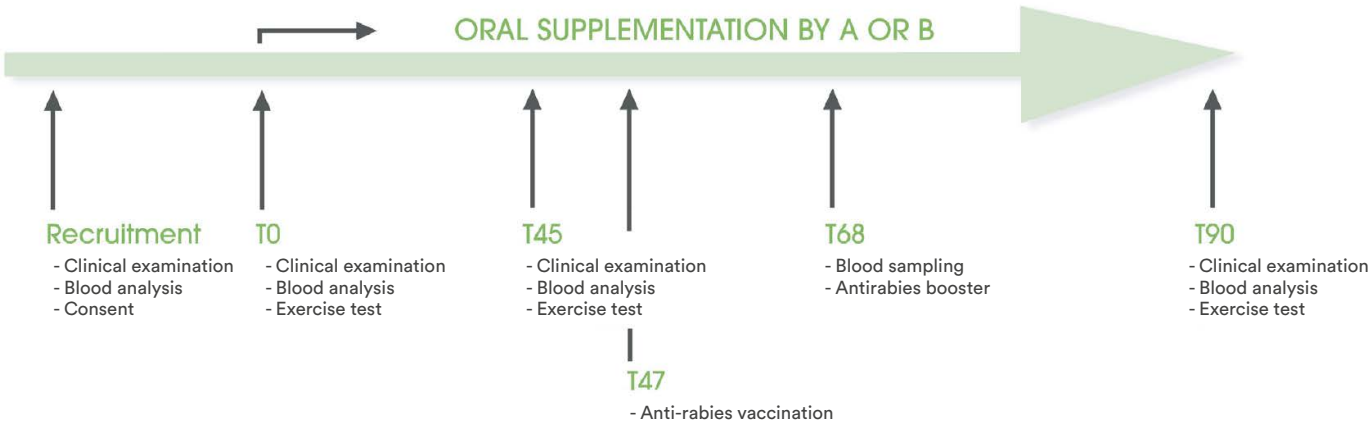


Illustration 6

THE EFFECT OF SUPPLEMENTATION WITH BETA-GLUCANS ON SERUM LEVELS OF ANTI-RABIES ANTIBODIES (UI/ml)

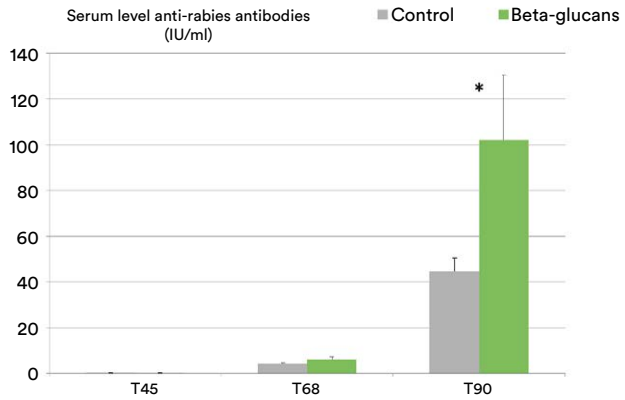


Illustration 7

*represents significant differences between the control and test groups (p<0.05)

This study confirmed that beta-glucans possess **strong B lymphocyte immunostimulating properties**.

This activation of the adaptive immunity is interpreted by an increased production of specific antibodies (against rabies in the study) following the intrusion of infectious agents into the body (in this case, fragments of the rabies virus in the vaccine).

d - The effect of supplementing with beta-glucans on athletic performance

The study undertaken by Claire Leleu et coll. (2014) also contained a section centred on performance based on three exercise tests carried out during the supplementation period. (at day 0, day 45 and day 90). During the exercise test carried out at day 45 of supplementation, the authors were able to observe a tendency of **improved performance in supplemented horses**.

More precisely, the cardiac capability (velocity for a heart rate of 200 beats/minutes (V200)) and aerobic (velocity for a lactate concentration of 4mmol/L (VLA4)) tended to be higher in those horses supplemented in beta-glucans.

EFFECT OF SUPPLEMENTING WITH BETA-GLUCANS ON CARDIAC CAPACITY (V200) IN HORSES

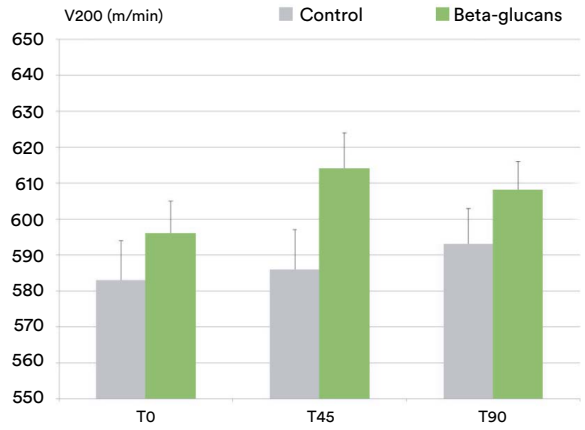


Illustration 8

e - Absence of side effects

Finally, the study carried out by Claire Leleu et coll. (2014) showed that supplementation with beta-glucans (identical to those in the supplement IMMUNE), at a level of **5g/day for 3 months was without danger to horses** in so far as they had no negative impact on any haematology or clinical chemistry parameters, nor on any physiological readings taken during the exercise tests.

EFFECT OF SUPPLEMENTING WITH BETA-GLUCANS ON AEROBIC CAPACITY (VLA4) IN HORSES

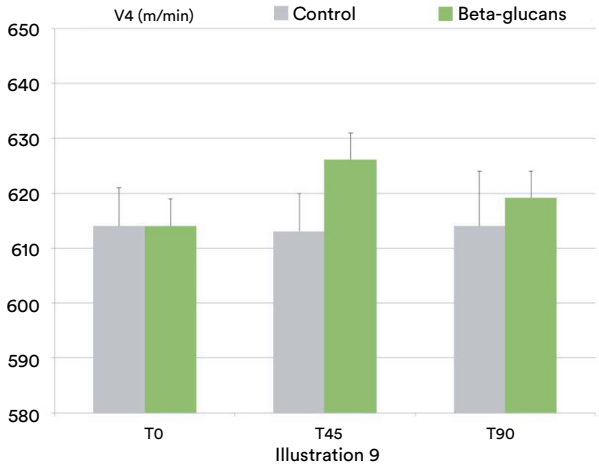


Illustration 9

TO SUM UP

To conclude, training, even moderate, has harmful long-lasting repercussions on the immune system, notably on the respiratory tract.

Respiratory problems represent the second cause of under-performance in race-horses and are related to a drop in local immunity. Consequently, supplementing with beta-glucans, whose immunostimulating properties have been proven in the athletic horse, is recommended during periods of training and competition.

In this way, the use of **REVERDY IMMUNE helps support the immune system in the athletic horse with positive repercussions on sporting performance**.

BIBLIOGRAPHY

Leleu C. and al., Immune effects and safety of an oral beta-1,3/1,6-glucans derived from yeast in racehorses.

Nutra News, Le bêta-(1,3/1,6)-glucane, un très puissant stimulant du système immunitaire, nutranews.org, 01/02/2008.

Paap P., Race horses perform better with beta-glucans, Allaboutfeed Volume 22, No. 6, p 500-502, 2014.

Simon M., les réponses immunitaires, Cours-pharmacie.com, 07/09/2009.

Vetvicka V. and al., B(1,3/1,6)-D-glucans modulate immune status in pigs: potential importance for efficiency of commercial farming, Annals of Translational Medicine, Volume 2, No. 2: 16, February 2014.

Vetvicka, V. and al., B(1,3/1,6)-D-glucans modulate immune status and blood glucose levels in dogs. British Journal of Pharmaceutical research, Issue 4(8), pp. 981-991, 2014.

Waldschmidt I., Impact de l'effort et de l'entraînement sur la réponse immunitaire du Trotteur français, Equ'idée, Article 1, Décembre 2013.

SOURCES

- **Illustration 1**: http://www.lookfordiagnosis.com
- **Illustration 2, 3, 4, 5**: Vetvicka et coll., 2014
- **Illustration 6, 7, 8, 9:** Leleu C. et coll., 2014

Food allergies: Blood test reliability?

With the arrival of spring, the appearance of multiple allergens such as pollens, biting insects, dust mites, etc., can trigger allergic reactions in some horses, symptoms often manifesting on a cutaneous and respiratory level. When such signs appear, horse owners will generally call their vet who may recommend a blood test in the hope of identifying precisely the responsible allergen.

The frequent outcome of a blood test requested following the appearance of respiratory problems is that the laboratory carrying out analysis will conclude that a food allergy is the cause. It then follows that the complete diet of the horse is called into question with the supposed allergens being suppressed.

It also happens that at the end of these tests, horses are declared allergic to all the feed allergens tested ! Consequently, this type of situation can lead us to question the reliability of these blood tests. Knowing that in humans, about 50 to 60% of individuals are said to be allergic, when the reality is that they are not (we talk about “false positives“)[1]. It is legitimate to ask if this is not also true for tests developed for use in the horse. If this is the case, what tests can we carry out to know if a horse is really suffering from a food allergy ?

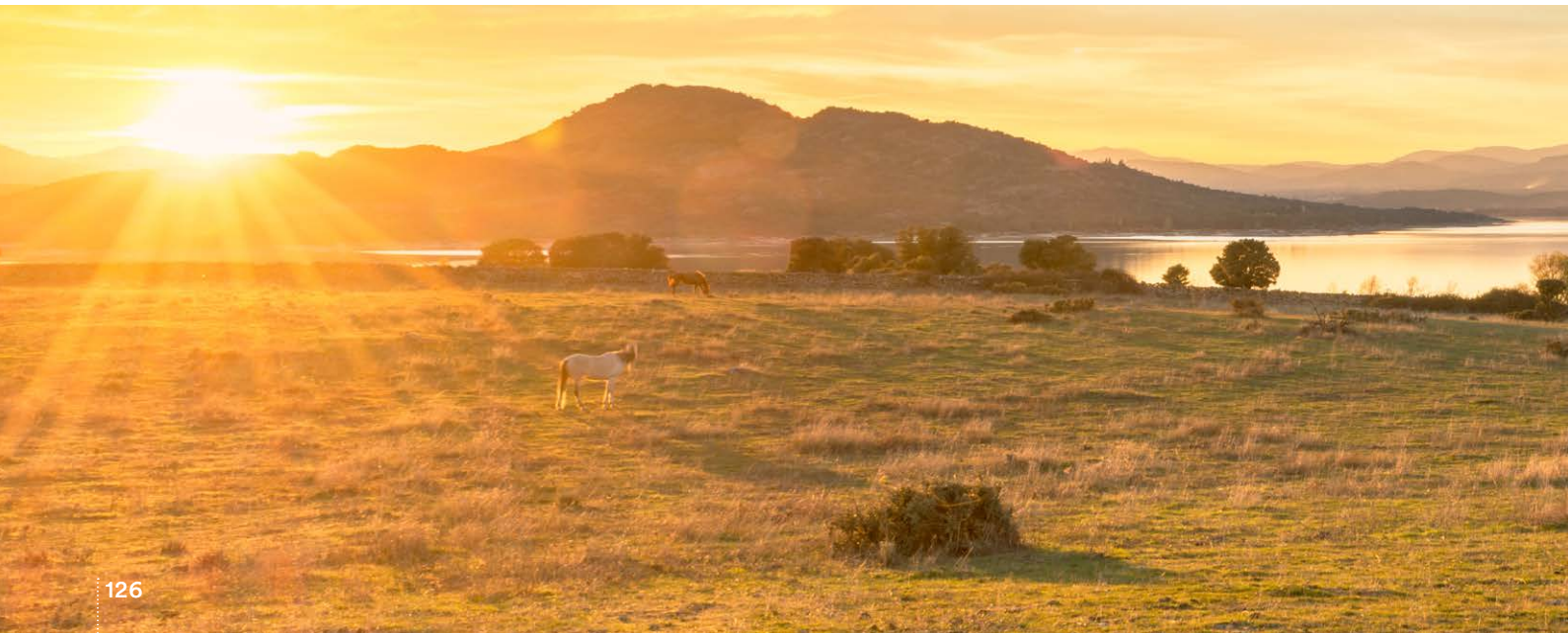
I. DEFINITION AND MECHANISMS OF ALLERGIC REACTIONS

Generally, an allergic reaction corresponds to a hypersensitivity of immunological origin, provoking symptoms that are reproducible, objective, initiated by exposure to a stimuli which, at the same dose, provokes no reaction in a healthy individual. (definition of the “International Task Force on Canine Atopic Dermatitis”).

More precisely, a food allergy is characterised by an abnormal immune reaction following the ingestion of a food containing one or more antigens (molecules recognised by antibodies or cells of the immune system) called allergens. These latter are responsible for this excessive immune reaction. The symptoms are systematically reproducible following each new exposure to the allergen[1].

Allergens are antigens capable of inducing an allergic reaction in genetically predisposed individuals who find themselves in an opportune environment[4]. The allergens are able to enter the animals body by four routes:

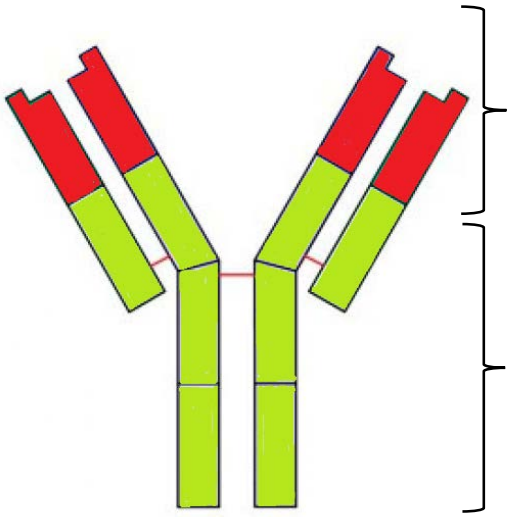
- **Inhalation**: via the respiratory system;
- **Ingestion**: via the mouth and digestive system;
- **Injection**: via the skin from an insect bite or a needle;
- **Contact**: via the skin[2].



In the case of a food allergy, the main entry route for the allergen is obviously ingestion[2].

Allergic reactions bring into play different hypersensitivity mechanisms (classified into four types by Gell and Coombs), even if it is principally the type I reaction (HSI) which is triggered. This hypersensitivity implies a specific recognition of the antigen by the immune system, more precisely by antibodies: type E immunoglobulins (see below diagram), from where it is also obtains the name of IgE dependant allergy. The symptoms rapidly appear after contact with the allergen, we also call it immediate hypersensitivity[5].

SIMPLIFIED STRUCTURE OF AN IMMUNOGLOBULIN (ANTIBODY)



Variable region Fab which fixes to allergen

Constant region Fc which fixed on the receptors of mast cells and polynuclear cells

The immunoglobulins present two fragments (see the above diagram): a constant fragment F with which they fix onto mast cell receptors and polynuclear basophils, and a Fab region, which binds itself to the allergen. We talk about specific IgE because this Fab region is specific to one allergen. However, if two allergens possess closely neighbouring forms, these are able to be recognised by the same IgE antibody.

Type I hypersensitivity takes place in two stages:

- **1st stage, known as sensitisation, without clinical sign**s: this can last a few weeks to a few years. Antigen presenting cells (called dendritic cells), present in the tissues on the frontier between the outside and inside environment of the organism (skin, respiratory and digestive mucosa,), continuously capture penetrating antigens. Once the antigens are interned, dendritic cells migrate towards the lymph nodes finishing their maturing. They then interact with T lymphocytes and also B lymphocytes via T-helper lymphocytes. The B lymphocytes develop into plasmocytes and will produce a large number of IgE.

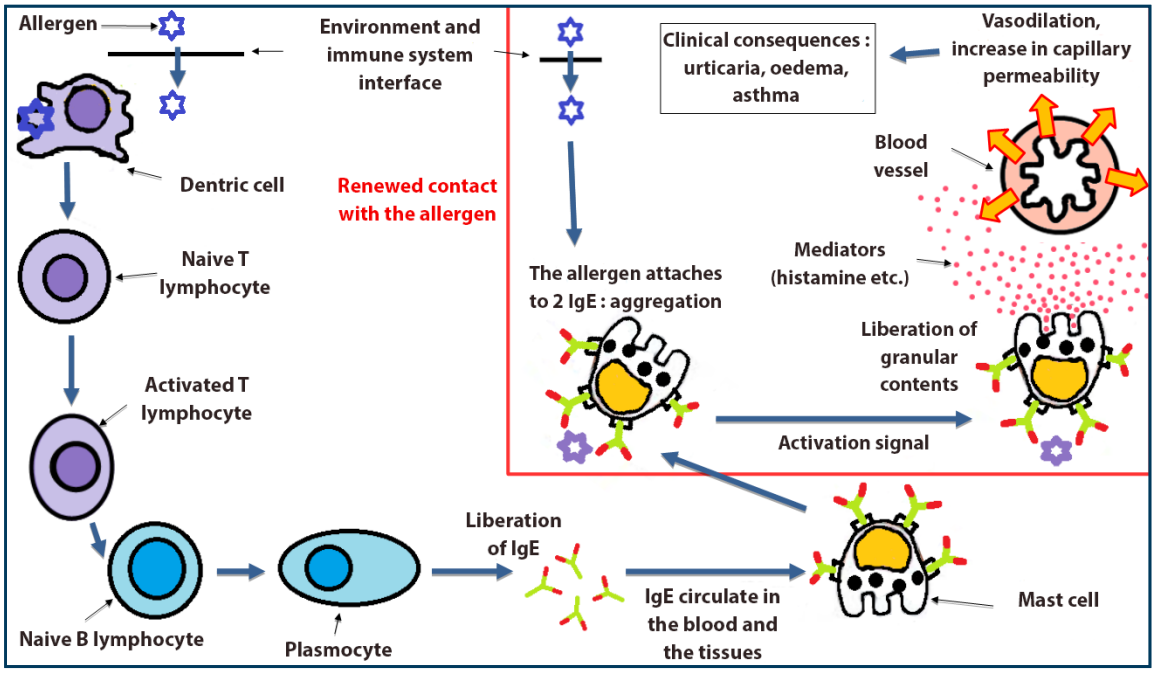
These immunoglobulins will then circulate in the blood and the tissues, either in a free state or fixed to the surface of mast cells and polynuclear basophils. The IgE are able to last many months on the surface of cells but only a few days in a free state in the blood[5]. Everybody synthesises IgE, type I hypersensitivity being a normal protective immune reaction against foreign elements. However, allergic individuals differentiate from healthy individuals on an immunological plan because they produce them in an exaggerated manner.

- **2nd stage, the effector stage**: in the case of re-exposure to the allergen, the recognition of the latter by IgE situated on the surface of mast calls or to a lesser degree by basophils, leads to an activation in cascade by these cells. However, this activation necessitates the allergen being bivalent, that is to say that it is capable of attaching to two neighbouring IgE at the same time. This phenomena is called "aggregation" of IgE by the allergen. It brings about a modification in the structure and function of the cell membrane, leading to an activation signal at the origin of degranulation episode, that is to say the release of secretory granules (contained within the mast cells and basophils) into the extracellular medium.

These vesicles are limited by a cytoplasmic membrane containing the numerous mediators preformed in the immediate phase, notably proteases and histamine (chemical mediator, that is to say a molecule capable of activating cells possessing the specific receptor of histamine).

Histamine diffuses across the tissues and attaches to its' receptors: it causes vasodilation and an increase in capillary permeability, leading to the appearance of visible clinical signs (urticaria etc.). As for proteases, they initiate inflammation and local tissue damage. Symptoms generally appear in 10 to 20 minutes[5].

THE DIFFERENT STAGES OF TYPE I HYPERSENSITIVITY[5]



II. PREVALENCE AND CLINICAL SIGNS OF TRUE FOOD ALLERGIES

Even though the prevalence of food allergies is not exactly known in the horse, it is estimated to be low[2,3,4].

As for clinical signs, horses can react differently to a same allergen. Some can show symptoms of the upper respiratory tract (nasal discharge, sneezing, tears or even head-shaking) while others will suffer skin problems:

- Pruritis (itching) often leading to a alopcia (loss of hair exposing the skin), even wounds when the itchiness is important and chronic;
- Urticaria (sudden appearance of numerous oedematous raised patches over a bigger or smaller expanse, also called “nettle rash” or “hives”).

Also, in some horses, allergic symptoms can appear on a digestive level: drop in appetite, diarrhoea and even colics. Given that numerous pathogenic agents can be responsible for these symptoms, making a careful differentiated diagnosis is advisable. Finally, to slightly further complicate matters, horses can very often be allergic to more than one allergen![2]

III. RELIABILITY OF COMMERCIAL BLOOD TESTS

ELISA (Enzyme Linked Immunosorbent Assay) serological tests, carried out on blood samples are presented by laboratories that market them as being a recognised alternative to skin prick tests in allergy diagnosis. These costly tests classify allergic components into 2 groups: the aeroallergens (inhaled into the respiratory tract) and the trophallergens (ingested into the digestive tract).

The principle of these immuno-enzymatic tests rests on dosing allergen-specific E immunoglobulins (IgE) present in the serum (a part of the blood) of the animal.

In practice, these tests are very easily carried out. The vet takes a small blood sample (a fewml) from the horse showing clinical symptoms consistent with an allergic reaction. Next, on returning to his clinic he centrifuges the sample and extracts the serum which he injects into another sample tube. The latter then only has to be sent to the laboratory for analysis.

Seeing the ease of carrying out these analyses, it is tempting to fall back on them as soon as an allergy is suspected. However it has been proven in man and in other animal species that in the case of feed allergies, that these tests are unreliable[6, 7]. In equines, a study[1] published in 2014 came to the same conclusions.

STUDY[1]: "A COMMERCIALLY AVAILABLE IMMUNOGLOBULIN E-BASED TEST FOR FOOD ALLERGY GIVES INCONSISTENT RESULTS IN HEALTHY PONIES"

MATERIALS AND METHODS

The study was undertaken on 17 Shetland ponies. After a 14 days' adaptation period, 2 experimental phases were carried out:

- **Phase I**: Two blood tests were carried out aimed at measuring specific IgE food allergens (soya, maize, molasses, wheat, sugar-beet, oats, alfalfa, rye, carob and barley). One the first day and the other 14 days later, the day before the start of phase II;

- **Phase II**: Following the results of blood test number1 of phase I, the ponies considered "positive" to one or more food allergens started provocation trials on day 1 of phase II. Each pony that had tested positive received 100g of the presumed allergen twice a day for two weeks, in addition to the base diet.

The ponies that had tested positive to more than one allergen underwent more than one provocation test (one per allergen) separated by a weeks rest (without any provocation) during which the ponies only consumed the base ration (hay + vitamin and mineral supplement).

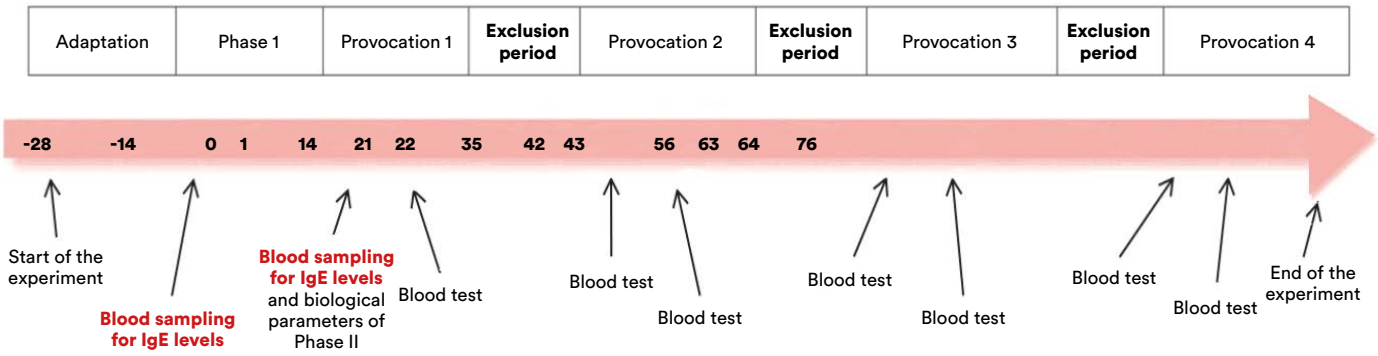
During the phase II, the animals were followed in two ways:

- **Clinical examination**: before and 30 minutes after the first feed of phase II, then every hour for 12h, then every 3h for the next 36 hours, and finally 3 times daily for 10 days. The parameters monitored were the following: heart rate, respiratory rate, temperature, presence of urticaria, signs of itching (skin lesions, etc.), colic and diarrhoea;

- **Laboratory parameters**: the first day of phase II, before the feed, and at 6 and 12h after, urea, lactate, haematocrit. The following day, 1h after the feed, analysis for an acute inflammatory phase protein the SAA (serum amyloid A).

RESULTS

The results of the two blood tests carried out during phase I are presented in the table on the right:



Blood test n°1: 6 ponies out of 17 (35%) were tested positive, and three of them for more than one allergen.
Blood test n°2: 7 ponies out of 17 (41%) tested positive, knowing that for each subject, a single allergen was held responsible.

In all, 10 ponies out of 17 (59%) reacted positively to at least one of the food allergens tested. Out of these 10 “positive” subjects, only 3 of them were “positive” during the 2 tests, knowing that only a single pony (n°13) reacted twice to the same allergen (rye). Finally, only 7 ponies out of 17 (41%) were had no reaction to the 2 tests.

Concerning the 6 ponies that were « positive » during the first blood test, during phase II the following observations were taken:

- **Clinical parameters**: no sign of allergy was observed; only two ponies showed dropping of a slightly abnormal consistency (3.5/5 instead of 4/5 for the other ponies);
- **Blood parameters**: only pony n°13 saw his level of serum amyloid A(SAA)* increase (93,2mg/l) during the provocation test with rye.

*SAA is an acute inflammation protein, produced in the main by the liver. It is used as an allergy marker in human asthma sufferers. However, the pertinence of this marker has not yet been tested in horses.

Pony	Test n°1	Test n°2
1	-	-
2	+ (maize)	-
3	-	-
4	-	-
5	-	-
6	-	-
7	-	+ (rye)
8	+ (soya)	+ (wheat)
9	-	+ (wheat)
12	+ (sugar beet, oats, maize, alfalfa	+ (soya)
11	-	-
12	+ (oats, sugar beet)	-
13	+ (alfalfa, rye, sugar beet)	+ (rye)
14	-	+ (rye)
15	-	+ (molasses)
16	+ (rye)	-
17	-	-

DISCUSSION

The results of the study showed that a commercially available IgE based food allergy detection test did not produce consistent results in healthy ponies.
Indeed, many inconsistencies were observed in the results of the 2 blood tests:

- 41% (7/17) of ponies were tested "positive" to one or more allergens in test n°1 but did not react during test n°2 or inversely;
- Concerning the 3 ponies that reacted to both tests, the suspected allergens were different in each test. Only the results of pony n°13 were consistent for 1 of the 3 allergens detected during test n°1 that was also found in test n°2 (rye).

Furthermore, none of the 6 ponies declared "positive" following blood test n°1 developed clinical signs in favour of an eventual allergy during the provocation trials of phase II.

Concerning pony n°13, even if he showed no clinical signs of a feed allergy, he was twice tested positive to rye. Furthermore, during the phase II provocation test with rye, blood analysis carried out 1 hour after the feed on the second day showed a moderate rise in the acute inflammation phase protein SAA. This increase, judged as moderate by the authors, is nevertheless an indication of the presence of an inflammatory stimuli.
However, even if the results of tests carried out on this pony seem consistent (with the exception of the lack of specificity of blood test 1 of Phase I), the authors of the study do not commit themselves as to the existence of a possible hypersensitivity to rye by pony n°13.

Concerning the method of analysis, the authors of the study were unable to obtain more information on the exact mechanism of the test used. They did not know therefore either the threshold of IgE from which the pony was considered positive, nor the type of antibody used in the detection of IgE in the animals' blood. In consequence, they are not able to offer the exact reason for these inconsistent results. However, the results of this study confirm yet again that commercially available blood tests are not scientifically valid and are not able to be considered as a reliable diagnosis method for food allergies.

Such inconsistencies have also been observed in other IgE detection tests: intradermal tests or ELISA, used with the aim of detecting skin allergies in horses but also in food allergy detection tests in cats, dogs and humans.

CONCLUSION

The authors conclude that an IgE based food allergy test provided inconsistent results in healthy ponies. These erroneous results from this commercially available test could lead to inappropriate and unnecessary changes in the feed ration when eliminating the presumed allergen.

The conclusions of this study confirmed those of Wagner (2009), that there exists no scientific publication that validates the use of blood tests in determining food allergies[8].

Thus, although these tests are very easy to carry out, they are unreliable. The number of false positives generated by them is important: numerous are the individuals that present high levels of IgE without showing any clinical signs of food allergy.

The large number of false positives, is able to be explained in different ways:

- No relation between the level of blood antibodies and those in target organs has been shown up to now[9];
- Depending on the season, the level of IgE increases in a significant way in healthy horses[10];
- It is not obligatory for individuals presenting high levels of IgE to show clinical signs of allergy, and in consequence they are not necessarily allergic[11];
- The quality of allergens used: for the equine species, no standardisation of allergens has been made[9];
- The same IgE can bind to different antigens if the latter presents a similar or closely neighbouring structure. We talk about a cross reactivity. Therefore with today's techniques, when a level of IgE is high, it is impossible to say if the immunoglobulins are binding to to "targeted" allergen or to a similar molecule to the latter[11].

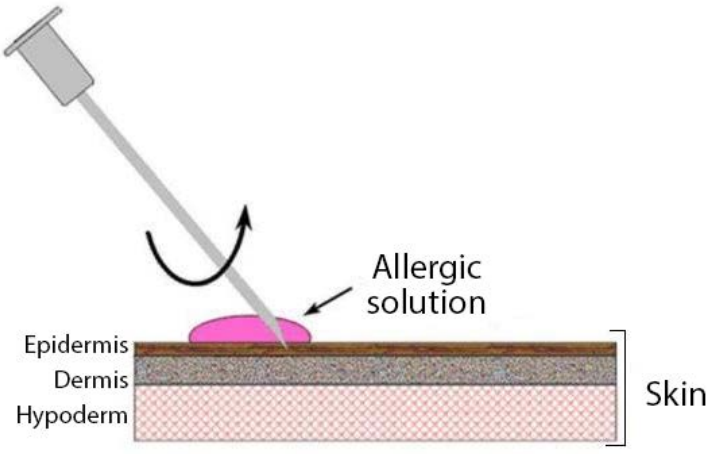
In consequence, these blood tests only allow the detection of IgE production, but in no case the diagnosis of a food allergy.

IV. WHAT TEST TO CARRY OUT TO KNOW IF A HORSE IS ALLERGIC ?

1. INTRADERMAL TEST

Skin tests using intradermal reactions allow a localised recreation of a type I hypersensitive reaction. The suspected allergen (or allergens), as well as a negative control (often a glycerine solution) and a positive control (codeine and/or histamine) are injected intradermally. The negative control eliminates a friction allergy whilst the second control, meant to provoke a localised reaction, ensures that the animal is not or no longer under the effect of anti-allergic medications that were perhaps administered prior to the test[6]. If the cutaneous mast cells are sensitised to one or more of the injected allergens, degranulation occurs and localised symptoms appear (erythema, papule) in 10 to 20 minute[6].

CUTANEOUS TEST TECHNIQUE[13]



The test is read therefore by comparison with the positive and negative control sites 15 to 30 minutes after the different injections to detect an eventual immediate hypersensitivity then at 24 hours for delayed hypersensitivity. So that the tests can be interpreted, the negative control must correspond to a erythematous papule less than 5mm in diameter whilst the positive control must show a diameter greater than 1cm. Generally a test is considered positive if there is erythema and if the diameter of the reaction is superior or equal to the average of the two control sites[6].

Even if intradermal reaction skin tests are more reliable than blood tests, the risk of obtaining false positives and false negatives stays nevertheless high. Therefore they do not allow a definite diagnosis of food allergy.

CUTANEOUS TEST ON A HORSE[14]

2. EXCLUSION/REINTRODUCTION TEST

This test is the simplest and most reliable because it provides a direct relation between the allergen and the clinical signs. It is considered as the reference test in man, cats and dogs[1]. When we suspect a food allergy in a horse showing clinical signs compatible with the latter, the exclusion test consists of removing one ingredient at a time from the horses' ration until the disappearance of symptoms is observed. Indeed, if the animal gets better with no treatment (in a few days to 2 -3 weeks), it is logical to think that the last ingredient removed possibly contained the allergen responsible for the clinical signs. Also, after the exclusion phase comes the reintroduction phase: the last ingredient to be excluded (probably containing the allergen) is reintroduced into the ration. The rapid reappearance of symptoms following this reintroduction provides the proof that the horse is allergic to this ingredient[6].

NB: Other tests are available for horses, such as basophil degranulation tests, or lymphoblastic transformation test. Nevertheless, their reliability has not been shown[6].

V. TREATMENT

In the case of a true food allergy, the first stage of treatment consists of eliminating the allergen from the ration.

Once the allergen has been identified, then eliminated and the clinical signs of allergy have disappeared, the vet may propose an allergen-specific immunotherapy, also called desensitisation or anti-allergen vaccination. The aim of this therapy is to progressively accustom the organism to the allergen in question in order that it develops tolerance towards the latter. An injectable preparation ("vaccine") made from the selected allergen is injected in increasing doses and at regular intervals under the skin of the animal, the objective being to develop a tolerance towards the allergen. It should be noted that desensitisation is mainly used in horses suffering from skin or respiratory problems[15].

The addition of Omega-3 in the ration (by using REVERDY feeds or via REVERDY OMEGA OIL) can influence the immune response, and in consequence reduces the clinical signs of allergy[16]. Indeed, they notably act on leukotrienes and cytokines, mediators present in the secreting granules of mast cells and basophils which are liberated in case of contact by these cells with the allergen and at the root of certain clinical signs of allergy.

TO SUM UP

A number of scientific studies have proved that blood tests for food allergies based on IgE levels produce incoherent results. Thus, their lack of reliability can lead to inappropriate and unnecessary changes in the feed ration.
Consequently, when a feed allergy is suspected, it is preferable to make use of exclusion/reintroduction tests which are less costly and more reliable.

BIBLIOGRAPHY

(1) **Dupont, S., A. De Spiegeleer, D.J. Liu, L. Lefère, D.A. Van Doorn et M. Hesta**, A commercially available immunoglobulin E-based test for food allergy gives inconsistent results in healthy ponies, Equine Veterinary Journal, 2014, DOI 10,1111/evj.12369.

(2) **Burke D.J.**, Food allergy in horses – nothing to sneeze at !!, Tribute Equine Nutrition/Kalmbach Feeds, Inc.

(3) **Kentucky Equine Research staff**, Food allergy testing in horses, EQUINEWS, 3 Novembre 2014.

(4) **Waldridge B.**, Food allergy in horses, Kentucky Equine Research.

(5) **Hoarau C., Abuaf N., Bérard F., Bienvenu J., Chollet-Martin S., Nicolas J.F, Vitte J.**, Physiopathologie de l'hypersensibilité immédiate (HSI), association des collèges des enseignants d'immunologies.

(6) **Bertholdy Thomas**, Etude de l'atopie chez les équidés: étude comparative de son traitement chez l'homme et chez le cheval, thèse, janvier 2005.

(7) Pearls and pitfalls of allergy diagnostic testing. Ann Allergy Asthma Immunology, Cox.

(8) **Wagner B.**, IgE in horses: occurrence in health and disease, Veterinary Immunology and Immunopathology, Volume 132, Issue 1, 2009, Pages 21–30.

(9) **Guilford W.G., Jones B.R., Markwell P.J., Arthur D.G., Collett M.G., Harte J.G.**, Food sensitivity in cats with chronic idiopathic gastrointestinal problems, Journal of Veterinary Internal Medicine, 2001, 15, 7-13.

(10) **Wilkolel PM, Pomorski ZJ, Szczepanik MP, Adamek L, Pluta M, Taszkum I, Golynski M, Rozwod A, Sitkowski W**, Assessment of serum levels of allergen-specific immunoglobulin E in different seasons and breeds in healthy horses, Journal of Veterinary Science, 2014, 17(2):331-7.

(11) **Haute Autorité de Santé (HAS)**, Indications du dosage des IgE spécifiques dans le diagnostic et le suivi des maladies allergiques, Mai 2005.

(12) **Moneret-Vautrin DA, Kanny G, Halpern G**, Detection of antifood IgE by in vitro tests and diagnosis of food allergy.

(13) **Le Prick Test**, En ligne: http://tpe-pricktest. e-monsite.com/pages/deroulement-duprick-test.html.

(14) **Animogen**, Santé: les allergies chez les chevaux (causes, symptômes, traitements, limites), En ligne: http://www.animogen.com/2015/02/10/sante-les-allergies-chezles-chevaux-causes-symptomes-traitementslimites/.

(15) **Laboklin Labor Klinische Diagnostik**, L'immunothérapie spécifique (désensibilisation) chez le cheval, En ligne: http://www.laboklin.com/pdf/fr/rat_tat/Immuntherapie-pferd-FR.pdf.

(16) **Grimm H, Mayer K, Mayser P, Eigenbrodt E**, Regulatory potential of n-3 fatty acids in immunological and inflammatory processes, British Journal of Nutrition, 87, Suppl. 1, S59-S67, 2002.

A NEW CASE OF TOXIN INDUCED HEPATIC PROBLEMS?

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After detecting a hepatic abnormality, usually by measuring specific liver enzymes, determining the aetiology is always complex. Mostly, after having eliminated metabolic and infectious (virus, bacteria or parasites) possibilities, dietary causes, and therefore the toxin (poison) one is regularly explored. In the latter case, the problem is mostly double: sampling methodology and analytical aspects. Over the last few years, the arrival on the market of new analytical technologies have permitted new approaches to screening rather than targeted ones.

This presentation intends to expose the discovery of a molecule responsible for liver problems and related to the presence of red fescue.

I. BACKGROUND

In a training yard (Y1), certain horses showed elevated liver enzyme counts from 2010 onwards. Using diet analysis and implementing exclusion diets, the hay was incriminated. Forage analysis excluded mycotoxins as a cause. Despite having removed a number of ragwort, meadow vetchling and vetch plants growing on part of the fields the problem reappeared at the end of 2012.

At the same period a similar problem occurred on a large Normandy stud farm (F2), notably in yearlings, although they were without symptoms. A number of investigations on feed and possible infections were undertaken to find a cause and did not allow a precise aetiology even if there was a leaning towards the feed.

At the beginning of the summer in 2013, a botanical inventory on F2 showed a wide scale presence of a dense grass sward, unusual in the floristic of Lower Normandy stud farms. This same grass was found in a more diffuse way in one of the fields used to make hay for Y1. This grass was identified as being red fescue. Fescues are known to host endophytic fungi. Fescues like their endophytics can produce different toxins notably alkaloids. The best known are responsible for problems during gestation and the neonatal period in the equine species.

II. METHOD

After drying and grinding the hay and fresh grasses were extracted before being injected into the LC/MS-QTOF. The serums were themselves directly injected. This equipment measures the time of flight of molecules and from this time, calculates the precise mass and deduces the empirical formula.

Comparisons between the formulas and the mass of ragwort alkaloids as well as the main alkaloids of fescue endophytics (loline, hordenine…) were carried out.

Mycological searches were also carried out on samples of red fescue. The molecule was also looked for in colonies of fungi.

III. RESULTS AND FOLLOWING UP OF CASES

In our case, analysis using the LC/MS-QTOF permitted the identification of a molecule with the formula $C_{18}H_{28}N_2O_6$. This formula corresponds to 130 molecules identified in different data bases but none of them suggested being potentially pathogenic. The empirical formula perhaps corresponding to an alkaloid formula.

This molecule is almost systematically found in samples of red fescue collected from the two structures as well as in the serum of horses having grazed in paddocks contaminated by red fescue or in hay made in these paddocks. $C_{18}H_{28}N_2O_6$ was also found to be present in hay bought from a merchant in order to complete the requirements at F2.

Control feeds based on red fescue and exclusion diets also served to show a rapid elevation in liver enzymes (particularly GLDH), as well as the appearance (2 to 5 days), and the rapid disappearance of the molecule if the contaminated feed was withdrawn. Liver biopsies were carried out for histological analysis. No profound and irreversible lesions could be detected. Test groups of yearlings were also formed in order to evaluate all the paddocks, at the same time a floristic inventory of the fields took place.

The majority of red fescue samples led to the identification of fungi. However from isolated colonies the molecule was unable to be identified. This does not allow to exclude that one or more of these fungi are responsible for the production of the toxin. Indeed in-vitro growth conditions are in no way comparable to conditions on the ground (hydrometric, temperature, stress, etc.). It is interesting to note that most of the time the molecule became practically undetectable after the first frosts (to be confirmed).

At Y1, the situation was managed by reorganising hay making with an agreement with the farmer who made it. Only forage produced in fields without fescue was used for feeding horses.

On F2, every animal was transferred to another farm abroad. A number of trials in the fields and paddocks were carried out: grazing by cattle, by sheep, spreading Bordeaux mixture. None of them eliminated the molecule nor the presence of fescue. In order to avoid massive use of herbicide on the stud farm, mechanical treatment - discs, burying, then reseeding with seed mixes tested as being exempt of the molecule – was undertaken. Tests with the yearling groups were done and showed effectiveness. The paddock borders were also treated in the same manner.

In addition to these two cases, the incriminating molecule has been found in a number of structures in the West of France, belonging to both one-horse owners and professionals. It was notably detected in forage fed to animals in a pre-training centre. The latter showing very elevated liver enzyme levels upon their arrival at their training yard. It was proved that the hay at the pre-training centre came from a forage merchant who had previously supplied F2 and in which the molecule had been identified.

TO SUM UP

When a number of liver problems are detected on the same yard, looking for the toxic molecule related to red fescue must now become part of the differential diagnosis. It can complement searches for other toxic molecules such as alkaloids from ragwort or the mycotoxins traditionally looked for. Normalisation of hepatic parameters, notably GLDH is rapid after with drawing the incriminated forage (fresh grass, hay.). This normalisation confirms itself by recent group winners who were amongst horses bred and raised during the acute crisis at F2.

Work carried out, notably at F2 showed that amongst the non-chemical treatments, only mechanical treatment and reseeding with seeds controlled as being exempt from endophytics including the unidentified molecule eliminated the molecule from fields and paddocks (biochemical tests and tests using batches of yearlings).

MARE FERTILITY

Reproduction is a “luxury” function. It is only assured if other requirements notably those of maintaining vital functions are covered and if the animal is in good health. Thus, first affected by any feeding error, reproduction is also the last to benefit from appropriate correction. We can then understand all the importance of feeding a balanced diet, supplying not only correct amounts of energy and protein, but also vitamins and trace elements.

I. ENERGY SUPPLY AND BODY CONDITION

Body condition is a good indicator of the animals health. Therefore, it must be evaluated with precision and adjusted in an optimal way. It has been shown that overweight or underweight mares are less fertile.

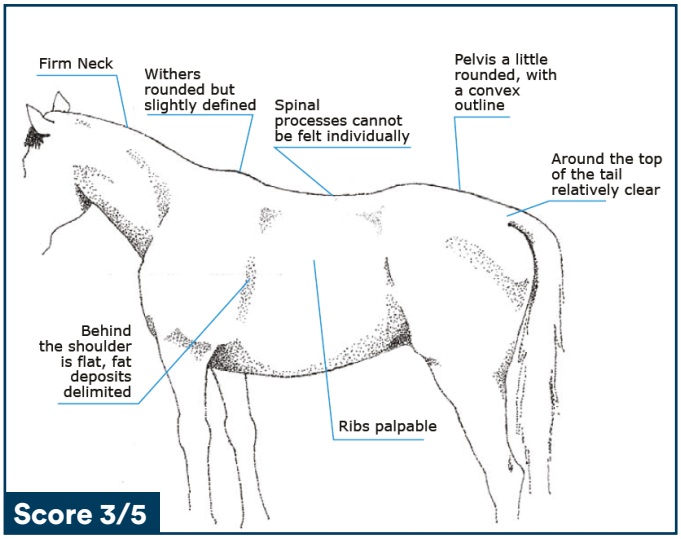
There exists principally two systems of condition scoring for horses:

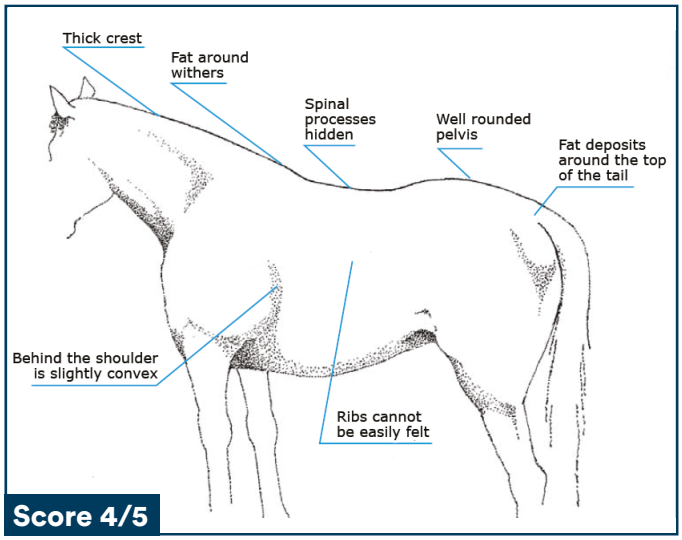
- That of Caroll and Huntington (used in France) which attributes a score of between 0 to 5;
- That of Henneke (Anglo-Saxon method), whose scores range from 1 to 9.

These two methods are based on evaluating adipose deposits (fat) by palpation at certain precise spots backed up by visual assessment.

Scientific studies have shown that **the best fertility levels are seen in mares showing a condition score of between 3 and 4 (out of 5)** for the French system, or between 5 and 7 (out of 9) if we refer to the Anglo-Saxon method. The characteristics relating to body condition scores of 3 and 4 are described opposite:

CHARACTERISTICS OF DESIRED BODY CONDITION SCORES
(Source: Institut de l’élevage)





Normally ovulation takes place between the fifth and seventh day in the 21-day cycle. However, when mares are too fat or too thin, the progression of cycles may be disrupted. In these two extreme cases, **fertility problems will be linked to a disturbance in insulin secretion** (glycaemia regulating hormone secreted by the pancreas) which will be insufficient in underweight mares and in excess in the case of them being overweight.

Insulin directly stimulates the cells that produce sexual hormones in the brain as well as in the ovaries. Thus:

- Whilst overweight, important secretions of insulin caused by the ingestion of a concentrate ration with a high glycaemic index, that is to say rich in carbohydrates (starch, simple sugars), may notably lead to, directly and/or indirectly, an exaggerated production of androgens by the ovaries which will prevent the correct progression of the cycle and inhibit ovulation;

- In mares who have insufficient body condition, the ingestion of a low energy ration with a low glycaemic index (poor in cereals) leads to limited insulin secretion. Now, the latter notably stimulates the production of leptin, favouring the liberation of sexual hormones by the brain.

In consequence, low circulating levels of leptin hamper the correct progression of the cycle up to ovulation.
Finally, diversifying energy sources by **substituting some cereals with fats and oils presents a number of interests**.

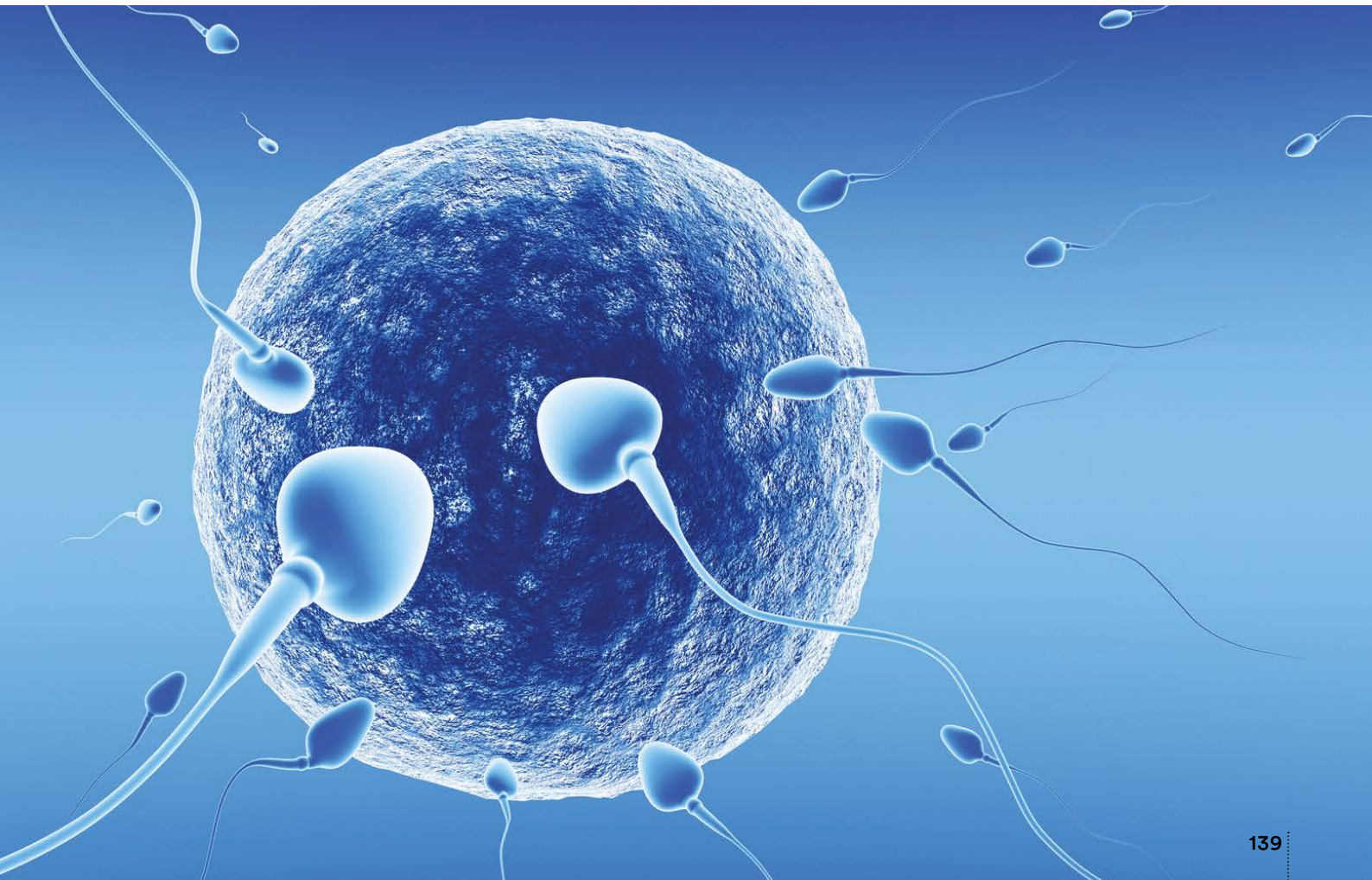
-To start with, lipids allow the maintenance of sufficient body condition as they are very high in energy, and without over-stimulating insulin secretion;

- Next, choosing fats and oils rich in essential fatty acids, notably Omega-3, is beneficial to maintaining good fertility in mares.

In effect, metabolising essential fatty acids leads to the synthesis of different compounds, amongst them prostaglandins, which are considered "local" hormones having a brief but very powerful action. **Omega-3 are the most interesting because, unlike Omega-6s, they only generate prostaglandins beneficial to the organism**. These latter notably allow an increase in blood flow in the uterus and obtain larger corpus luteum, these two parameters being fundamental in the establishment of gestation and foetus development.

Essential fatty acids cannot be produced by the organism, therefore they must be provided in the diet. As cereals contain excess Omega-6s and are nearly devoid of Omega-3, it is important to re-establish in the ration an Omega-3/ Omega-6 ratio that is beneficial to the organism (a voluntary reversal) superior or equal to 1. To do this, **all feeds in the REVERDY range contain important quantities of extruded linseed, rich in linolenic acid (natural Omega-3)**, therefore complementary to cereals.

It should be noted that our top of the range feeds contain in addition to extruded linseed, first pressed linseed oil, which can also be incorporated separately (in a mix with maize germ oil) via the supplement REVERDY OMEGA OIL.



II. PROTEIN SUPPLIES

A ration deficient in protein inhibits the production of sexual hormones in the brain. The opposite, a diet providing surplus nitrogen will lower fertility in many ways.

Firstly, it leads to a hepatorenal overload which predisposes to a hormonal unbalance by hindering the catabolism of sexual hormones. Equally, it can lead to a "poisoning" of the organism by nitrogenous waste (urea, ammonia, etc.). Early spring turn out which leads to the ingestion of young grass rich in non protein nitrogen can, when consumed in excess, be responsible for a nitrogenous overload, at the origin of case of anestrus observed in some mares during this period. Furthermore, ammonia and its metabolites are toxic for gametes (sperm and ovules) and embryos and can destroy the ciliary process necessary to transport the ovule in the genital tract. Lastly, an excess of urea is able to modify the uterine pH rendering the environment unfavourable to the implantation of an embryo.

TO SUM UP

In order to avoid any surplus or deficiency in protein during the winter months, it is advisable to distribute ordinary meadow hay (between 8 to 10% protein perkg of dry matter) to barren brood mares associated with a concentrate feed containing a moderate level of quality protein. For example, ADULT, or ADULT ENERGY are perfectly suitable if the forage fed fulfils the criteria mentioned above.

III. DIETARY VITAMIN AND MINERAL SUPPLIES

Firstly, deficiencies in certain macro-elements can induce fertility problems. For example, **phosphorus plays an important role** in the synthesis of sexual hormones: a deficiency in this element can lead to problems with ovulation as well as longer periods of time between heats (which may even go as far as their absence, which is called anestrus). The diet must also provide sufficient trace elements, notably copper, manganese and zinc.

A lack of the latter lengthens the duration of cycles, so ovulation is less frequent. Selenium is a powerful antioxidant. It has an important role in the functioning of the immune system responsible for protecting the organism, including the reproductive system. Therefore a drop in immunity is likely to reduce fertility and even be at the root of abortions. All nutriments that favour the immune system allow fertility improvement in the mare.

Next, unlike vitamin K and the hydro-soluble B and C group vitamins, **the liposoluble vitamins A, D and E are not synthesised by the digestive flora and must be provided in the ration**. It has been shown that a deficiency in vitamin A or E leads to reproductive disorders. As antioxidants, these vitamins play an important part in stimulating the immune system and therefore in the protection of cells, notably ovules and sperm. They integrate into the lipid part of membranes stabilising and protecting from toxic components such as free radicals, heavy metals, etc.

Moreover vitamin E intervenes in the synthesis of sexual hormones and permits an increase in uterine blood flow and the thickness of the endometrium (mucous membrane). As for vitamin A, it stimulates the appearance of heat, participates in the development of progesterone (steroid hormone implicated in the ovarian cycle) and, since it preserves epithelium integrity, it also facilitates ovulation and then the implantation of the embryo. Vitamin A can be supplied directly in the diet or through its precursor beta carotene.

Beta carotene is known as the precursor of vitamin A. However its involvement in improving fertility is more complex. It is equally an antioxidant which protects cells from attack by pro-oxidant free radicals and reinforces the immune system. In the mare, ingested beta-carotene penetrates into the follicle (vesicle containing the ovule which it liberates at ovulation) where it takes part in the synthesis of vitamin A and oestrogens, hormones synthesised in large quantity at the moment of heat. **Beta-carotene therefore improves the quality and the maturity of follicles**. Following ovulation, it assures the correct functioning of the corpus luteum within which it participates in the synthesis of progesterone. **It contributes in this way to maintaining gestation**.

Beta carotene is therefore beneficial to fertility. Amongst the positive effects, we can cite: more visible heats, a reduced number of ovarian cysts, improved conception rate, a reduction in embryo mortality, less retained placentas, etc. Furthermore, as precursor of vitamin A we can also attribute to it a number of the benefits related to supplementation in this vitamin (protecting mucous membranes etc.).

The daily requirements vary between 500mg to 1,000mg per day depending upon the type of forage consumed. Grass being naturally rich in beta-carotene (about 250mg/kg dry matter), mares who are eating enough need only receive minimal supplementation. On the other hand, when we wish to bring forward the start of reproduction, supplementing with beta-carotene becomes essential. During the winter months, barren mares do not have (or have only very limited) access to grass. They only eat hay which contains a lot less (about 25mg/kg dry matter), as beta-carotene deteriorating quickly during storage.

Finally, supplying sufficient feed, or a vitamin and mineral supplement from the REVERDY range fulfils the daily requirements in vitamins and minerals for barren brood mares.

However if we wish to put every chance on our side, it is recommended to reinforce the supply of these nutriments by distributing nutritional supplements such as:

- **REVERDY NATURAL E** which provides natural vitamin E, very effective and optimally dosed;

- **REVERDY CAROTENE** which contains chelated trace elements which are very easily assimilated and stored by the organism, vitamins A and E and also a high dose of beta-carotene, responsible for the characteristic red colour of the pellets in this supplement. Thus giving a daily measure of REVERDY CAROTENE optimally fulfils the daily requirements in these nutriments that are indispensable to good mare fertility.

IV. LIGHT THERAPY

Feeding is not the only factor to influence mare fertility. **Sexual activity in the mare varies according to the season**. Ovarian activity is important from April to October and more erratic from October to March. Mares often experience a period of seasonal anestrus during this period. This seasonal difference is notably explained by a variation in the photoperiod (the connection between the duration of day and the duration of night) and exterior temperatures.

Amongst these changes, **the length of the day and in particular the amount of daily light holds a preponderant place in the seasonal sexual activity mechanism**. The eye captures light and transmits this information to the brain, which in function of the luminosity received, secretes a more or less important quantity of melatonin, a hormone which inhibits the production of sexual hormones. So, whilst the days get shorter, the amount of melatonin increases (and vice-versa) wich inhibites the production of sexual hormones. This is why from October to March, a drop in sexual activity with the absence of visible heats (seasonal anestrus) is generally observed.

Also, **in order to favour the early return of ovarian activity at the start of the season, it is possible to artificially lengthen the duration of day in winter. The aim is to artificially reproduce a total of 14.5 hours of "sunlight" in a day**, a duration which represents the critical threshold under which mares switch to short days (autumn/winter), and in consequence stop ovarian activity. In concrete terms, during winter, sunlight stretches globally from 8.30am to 5pm, a duration of 8.5 hours. In consequence, artificial lighting in the stable (using an ordinary or a low energy light bulb) for 6 hours allows the attainment of 14.5 hours of daily sunlight. It should be noted that this period of artificial lighting can be in one or two periods. For example, once from 5pm to 11pm, or from 2.30am to 8.30am, or in two periods from 5.30am to 8.30am then from 5pm to 8pm.

To be effective, it is advisable to put this mechanism into place after the mares have acquired a short day rhythm, so at the earliest the 1st December. Next, the treatment should be continued for at least 35 consecutive days. The result will be the appearance of normal heats in treated mares with every chance that they will be served 70 days after the start of treatment, so towards the end of February if they have been exposed to this extra light from the beginning of December.

Notes:
Scientific research led in 2012 by Walsh et al. have made known the minimal luminosity to be applied to one eye in order to reduce melatonin production and therefore stimulate the early return to sexual activity at the beginning of the year. The results of this research has been used by Dr Barbara Murphy and her team who developed in 2013 a mask similar to a closed hood but with only one blinker equipped with a device producing a temporized blue light on a single eye.

Equilume Light Mask®

Lastly, as soon as exposure to artificial lighting is imposed upon the mares it may in theory be carried out in the paddock or in the stable. Nevertheless, **we recommend the stable, not only for the practical advantages of this option** (less powerful lamp required to light up the limited space, easier access to an electric supply, etc.), **stabling the mares at night protects them from the cold in winter**. Thus, they require less energy to keep warm, which translates notably by more easily maintained body condition and by a shorter, less thick winter coat. Ideally, they should wear a rug whilst out in the paddock during the day. In this manner they will be better prepared for the reproductive season, which remember, is a luxury function.

TO SUM UP

Diet plays a fundamental role in mare fertility. The daily ration must cover in an optimal way the daily requirements in energy, protein, vitamins and minerals, without excess or deficiency. It is also necessary to ensure that the mares receive hay and concentrate feeds of quality, irreproachable from a sanitary point of view, the presence of mycotoxins can for example disturb the correct progression of cycles. Furthermore if we wish to put all the odds on our side, supplies of trace elements, vitamins and other nutriments that favour fertility such as beta-carotene can be reinforced by the addition of a nutritional supplement such as REVERDY CAROTENE. Conjointly, light therapy in the stable during the winter months will increase the chances of success. Finally, every effort must be made to limit stress in the animals, this latter inhibits the production of sexual hormones in the brain. For example, during the management of mares living in a herd, the establishing of hierarchy can be disturbing to the dominated mares who then meet with problems when put into reproduction.

BIBLIOGRAPHY

Equine Disease Quarterly, Mobile Blue Light Therapy for Broodmares, 12 octobre 2012 .

Filteau V., Caldwell V., Fertilité et alimentation chez la vache laitière.

Foote C. E., Beta-Carotene's Effect on Mare Reproduction, Equine Consulting Services.

Hines, K. K., S. L. Hodge, J. L. Kreider, G. D. Potter and P. G. Harms. 1987. Relationship between body condition and levels of serum luteinizing hormone in postpartum mares. Theriogenology 28:815–825.

Hopkins J, Researchers Unravel Clues to Infertility Among Obese Woman, Johns Hopkins children's center, 7 septembre 2010.

Institut de l'Élevage, Notation de l'état corporel des chevaux de selle et de sport, Guide pratique, Octobre 1997.

Kentucky Equine Research staff, Effect of Supplementation on Stallion Fertility, EQUINEWS, 22 février 2013.

Kentucky Equine Research staff, Horse Weight, Other Factors Affect Mare Fertility, EQUINEWS, 3 mars 2014

Kentucky Equine Research staff, Omega-3 Fatty acids for horses, EQUINEWS, 27 octobre 2006.

Kentucky Equine Research staff, Optimal Body Condition Scores for Breeding Mares, EQUINEWS, 4 novembre 2003.

Horse Sense: The Guide to Horse Care in Australia and New Zealand, Par Peter Huntington, Jane Myers, Elizabeth Owens.

Miraglia Nicoletta, Martin-Rosset William, Nutrition and Feeding of the Broodmare, EAAP publication No. 120, 20-22 juin 2006.

Petit H.V. and al., Milk production and composition, ovarian function, and prostaglandin secretion of dairy cows fed omega-3 fats, Journal of Dairy Science, Volume 85, Issue 4, April 2002, Pages 889-899.

Pubert Christian, L'activité sexuelle saisonnière chez la jument et le Traitement photo-lumineux, haras de la roseraie.

Puder J., Pralong F., Syndrome des ovaires polykystiques et résistance à l'insuline, Rev Med Suisse, 2009 ; n°198 ; 5: 779-782.

Saldeen P., Saldeen T., Women and omega-3 fatty acids, Obstet Gynecol Surv., Oct 2004, 59 (10): 722-30 ; quiz745-6.

Swinker Ann, Feeding Omega-3 to Horses for Reproduction, Penn State Extension, 14 janvier 2010.

Takasaki A. and al., Endometrial growth and uterine blood flow: a pilot study for improving endometrial thickness in the patients with a thin endometrium, Fertil Steril, Apr 2010 ; 93 (6): 1851-8.

Trujillo E, Broughton K. Ingestion of n-3 polyunsaturated fatty acids and ovulation in rats. J Reprod Fertil 1995;105:197-203.

Walsh C.M., PrendergastR.L. , SheridanJ.T. , Murphy B.A., Blue light from light-emitting diodes directed at a single eye elicits a dose-dependent suppression of melatonin in horses, 2012. The Veterinary Journal.

Wolter, Alimentation du cheval, France Agricole Editions, 1999 - 478 pages.

OSTEOCHONDROSIS

Osteochondrosis is a common disease in young horses. Before the start of work, it is, in most cases, without associated symptoms. In work, symptoms can show as varying degrees of lameness most often accompanied by swellings: Surgery is sometimes necessary in order to resume sporting activity. In addition to the significant cost of operations, osteochondrosis can lead to drops in performance in sport horses and racehorses, and even compromise their sporting career[1-5].

This disease is multifactorial: genetics, feeding of the pregnant mare and the growing foal, the foals' living conditions, exercise, potential injuries etc. All are able to have an influence on it is development. Osteochondrosis is therefore not the result of one single cause. It is important to understand osteoarticular development in order to have a better understanding of how and why this condition develops.

This article aims to present osteoarticular development, the biological origins of osteochondrosis as well as risk factors in the gestating mare and growing foal. This is in order to understand that it is possible to help prevent the development of this disease by managing the environment in which the foal grows and develops, that's to say, right from pregnancy.

POINTS TO REMEMBER

Bones grow by bone tissue replacing growth cartilage at the "growth plates". This can only happen correctly if the cartilage vascularises. Otherwise, residual cartilage softens, can crumble, and even break off. We then talk about osteochondrosis (OCD). **This disorder evolves in the foal/young horse up until the age of 18 months.** Osteochondrosis is multifactorial, stemming from genetics, injury, but equally from the environment in which the foal has grown since being conceived;

» Feeding and the metabolism of the pregnant mare are paramount:
Mares receiving large quantities of digestible starch and sugar rich feeds carry a higher risk of producing foals suffering from osteochondrosis. It is equally the case for mares who are overweight throughout pregnancy;

» The foal's nutrition must be monitored during growth:
Deficiencies in minerals and trace elements can lead to the development of lesions, for example, copper deficiency. Furthermore, an excess of phosphorus compared to calcium is also a factor of risk, surplus calcium is not a cause of any particular problems. An excessively rapid growth rate, combined with a diet containing too much energy, and feeds rich in digestible starch and sugar, contributes to the formation and also continued existence of osteoarticular lesions. It is an excess of energy and not an excess of protein that is one of the factors in the development of the disorder.

For a gestating mare and the growing foal, it is advisable not to exceed 100g of starch per 100kg/live-weight per feed.

I. THE GROWTH OF LONG BONES

There exists a number of different types of bone in the organism: long bones (for example the femur), flat bones (for example the skull), short bones (bones present in joints) and irregular bones (such as vertebrae, the pelvis). We are going to talk about the growth of long bones, as it is their extremities who find themselves within joints affected by osteochondrosis. Bone growth takes place to these extremities. A long bone is made up of:

» A **diaphysis,** situated at the centre of the bone;

» Of two **epiphyses,** that make up the extremities of the bone and which are covered by articular cartilage. It should be noted that bone is vascularised, cartilage isn't;

» Of two **metaphysis** located between the diaphysis and the epiphysis, and which are the seat of growth.

Before birth long bones in the foal are composed uniquely of cartilage. As gestation progresses the centre part of this cartilage calcifies, then ossifies: this is the **primary ossification centre.**
In the metaphysis, two **secondary ossification centres** appear next: the centre is composed of bone and surrounded by a calcified matrix with cartilage (called growth cartilage) all around. At the base of each secondary ossification centre is the **"growth (or "epiphyseal") plate".** As growth progresses, cartilage is replaced by bone, pushing ever further the growth plates. The speed of replacement by bone is faster than that at which cartilage grows, so over time the growth plates become thinner. In the end, all the cartilage in the growth plates will disappear, this is the closure of the growth plates and thus the end of growth.

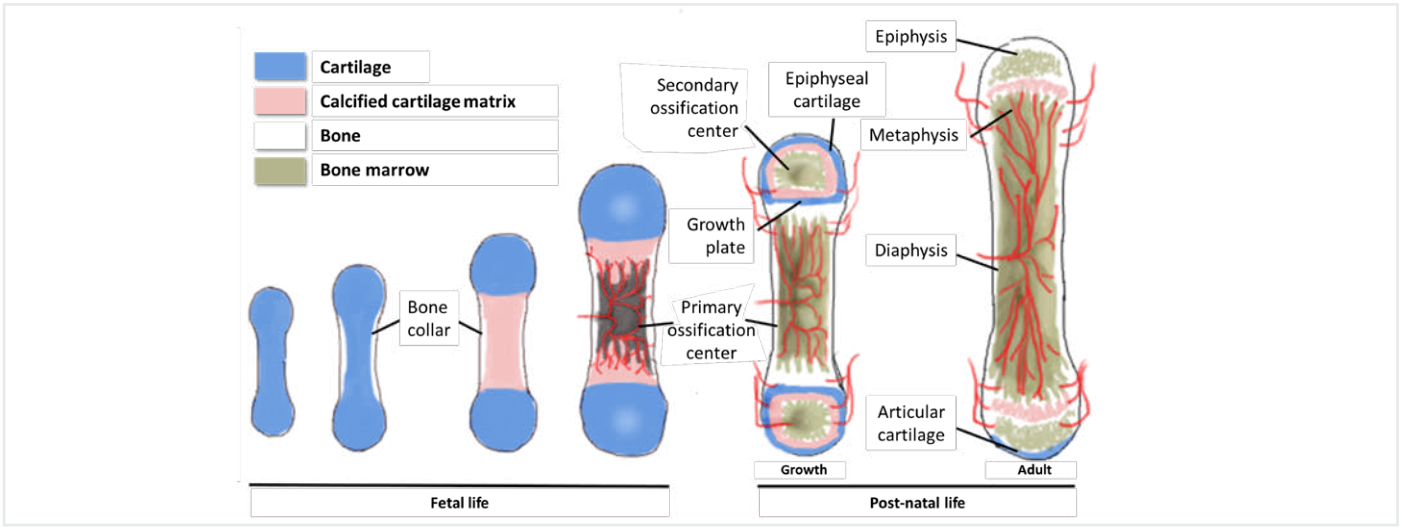
Cells making up cartilage are called chondrocytes. The epiphyseal plate is organised into four different zones:

» A **resting zone,** in which the chondrocytes are inactive;

» A **proliferating zone,** where chondrocytes divide rapidly, forming columns;

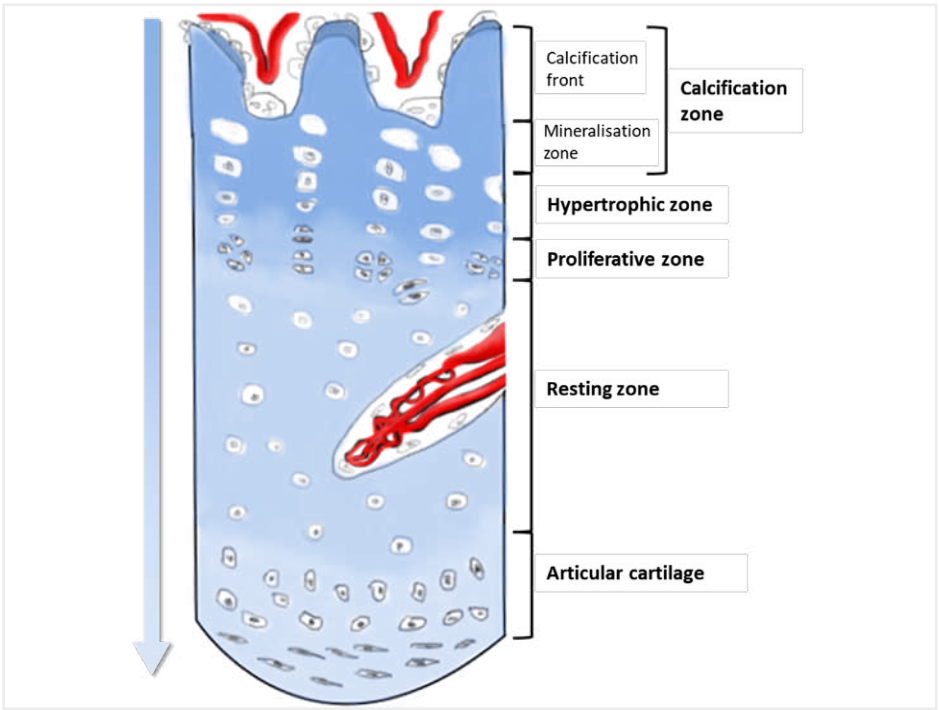
» A **hypertrophic zone,** in which the chondrocytes, now much larger, secrete substances that allow the cartilage to calcify, serving as a matrix for bone cells to form bone;

» Finally, a **calcification zone,** where the chondrocytes die, leaving gaps that allow blood vessels and bone cells (osteocytes) to penetrate into the tissue.



Long bone growth during gestation and after birth(according to Mackie and al., 2011[6] and van Weeren, 2006[7])

Growth cartilage structure
(according to Mackie and al., 20116 et Ytrehus et al., 2007[8])



Chondrocytes (cartilage cells) go through several stages: rest, proliferation, hypertrophy, before dying and leaving gaps that allow blood vessels and bone cells to install, in order to build bone.

II. WHAT IS OSTEOCHONDROSIS ?

Osteochondrosis is a development disorder that evolves in the foal up to the age of 18 months[9]. Lesions may appear and naturally resorb themselves within this time frame. The disorder is defined by a disruption in the maturation of the cartilage involved in bone growth which may lead to the releasing of fragments into the joints[7]. This disorder is not associated with osteoarthritis and is not of inflammatory origin.

Generally, osteochondrosis results from a lack of vascularisation in the growth cartilage situated at the cartilage/bone junction. In this case, cartilage persists as bone cannot form to replace it. Thus, the junction zone between the cartilage and the bone becomes irregular and the cartilage becomes soft and fragile[8-15]. The reason behind this lack of vascularisation has not yet been totally solved. A number of theories have been put forward over many years. Today, the validated hypothesis seems to be the one of the persistence of chondrocytes in the hypertrophic zone and thus the cartilage within the subchondral bone[16]. Furthermore, within lesions, chondrocytes show a break in the balance between deterioration/maintenance factors of the cartilage matrix and vascularisation factors[17]. Thus the cartilage matrix cannot be replaced by the bone matrix, and will not have enough factors to attract blood vessels.

The disorder divides into three stages:

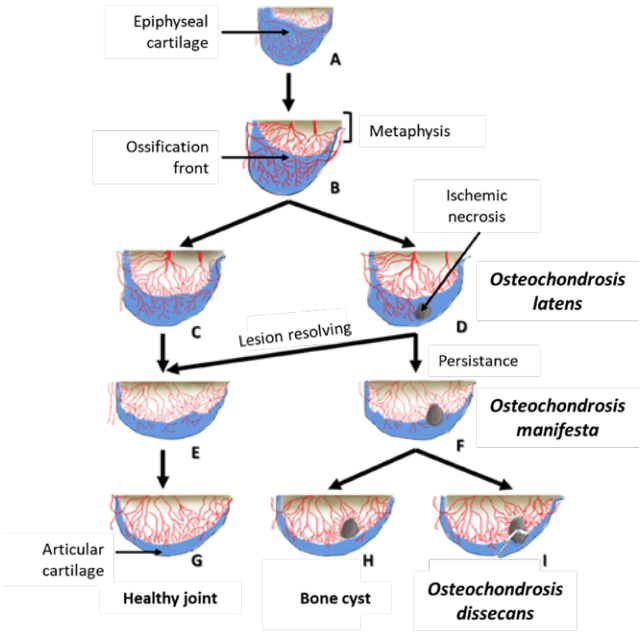
» **Osteochondrosis latens:** there are very small zones without blood vessels in the growth plate, these lesions may regress, even disappear, they are not visible on x-rays;

» **Osteochondrosis manifesta:** cartilage is no longer replaced by bone, it becomes soft and fragile. This can lead to the formation of cracks, zones with a loss of density, or irregularities on the cartilage surface which are visible on x-rays;

» **Osteochondrosis dissecans (OCD) or cyst:** the split/crack is widespread and/or cartilage fragments are released into the joint. Osteochondrosis manifesta can also lead to the forming of a bone cyst, that is to say a liquid filled hole in the bone [7].

If you have known about this disorder for a certain time, you will have heard of “osteochondritis dissecans”. In medicine, the term “itis” means a disease of inflammatory origin. As this is not the case, this name was modified a few years back to osteochondrosis and osteochondritis is no longer used today.

Progression of osteochondrosis lesions in the growing foal (according to Ytrehus and al., 2007[8])



Osteochondrosis is characterised by an absence of vascularisation in the growth cartilage (ischaemic necrosis, D). This may lead to the appearance of cracks (F), of a cyst (H) or fragment (I) in the joint. Due to their evolutive nature, osteochondral lesions may regress (C) or worsen (D) during growth.

III. IS THIS A COMMON DISORDER ?

The prevalence of osteochondrosis depends on the breed and the country studied. Indeed, osteochondrosis is more frequently seen in fast growing breeds such as thoroughbreds, trotters (standardbreds), riding horses, etc. than slow growing breeds such as Icelandic horses, ponies and draft horses.
These differences between breeds can be explained by the fact that in horses a larger number of blood vessels must be incorporated into the cartilage during growth than in ponies. For example, in trotters, growth cartilage is thicker, with a larger number of blood vessels than in the Fjord poney[33]. Therefore, there is a higher risk of vascularisation problems and thus of developing the disorder[15]. Genetics is an important development factor in this condition, especially since it is known that within breeds, certain lines are more affected than others. However it must be noted that heredity varies between breeds and the joints affected too, and it is not the only cause of lesions developing. Environmental factors, right from the start of foetal life, can modify the development of this disorder that is programmed by the genetic patrimony of the foal.

Breed	Horses affected	Bibliography source
Icelandic horses	0%	19,20
Draft horse	5%	21
Thoroughbreds	24% (from 10 to 77%)	22-25
Trotters (Standardbreds)	36% (from 14 to 51%)	23,26-28
Sport horses	42% (from 13 to 70%)	23,29-33

Percentage of horses suffering from osteochondrosis by breed

Hock of a 2 year-old showing a fragment of osteochondrosis (according to Robles, 2017[45])

IV. WHAT ARE THE PREDISPOSING FACTORS IN THE DEVELOPMENT OF OSTEOCHONDROSIS ?

The environmental factors predisposing to the development of osteochondrosis can be divided into three categories:

» Injuries and biomechanical constraints;

» The feeding and metabolism of the mare and foal;

» The foal's living conditions .

The hypothesis of mechanical demands is substantiated by the fact that certain sites in certain joints are more affected than others. Thus, constraints of weight, of pressure, or of friction would be greater at these locations and play a role in the development of the disease by weakening the joint[12].

1. THE PREGNANT MARE'S LIFESTYLE

Osteochondral lesions have been observed in foals just 2 days old[10,15,34,35]. At this age, the foal has not yet spent long enough outside of his dam for the post-natal environment to be the explication for the appearance of lesions. Furthermore, during the final two-thirds of gestation, growth cartilage in the foal undergoes important vascular changes[36], thus this is a particularly critical period in the growth and development of bone.

Mineral balance

Copper is an essential element in osteoarticular development. Supplementing pregnant mares with copper above their requirement levels does not always reduce the incidence of osteochondrosis in foals[37–40]. However, adequate supplementation in copper during the last three months of gestation increases the hepatic stock of copper in the new-born foal[38,39]. Mare's milk being naturally deficient in copper, the foal must be born with a big enough hepatic stock to meet his requirements for growth. Supplementing milking mares with copper does not increase the amount of copper in the milk[41]. It is therefore the mineral balance of the ration and the absence of deficiencies in pregnant mares that seems to have a significant influence over the development of osteochondral lesions in the foal.

Metabolism of sugars and starch

Glucose is a very important source of energy for the organism. The body must have a certain quantity of glucose at its disposal in order to function. However, in a too large quantity glucose is toxic. Thus, the blood sugar level (glycaemia) must be regulated. When the glycaemia increases (after a feed for example), the pancreas produces insulin whose role is to stimulate the storage of glucose in muscle and fatty tissues, thus enabling the glycaemia to return to a normal level.

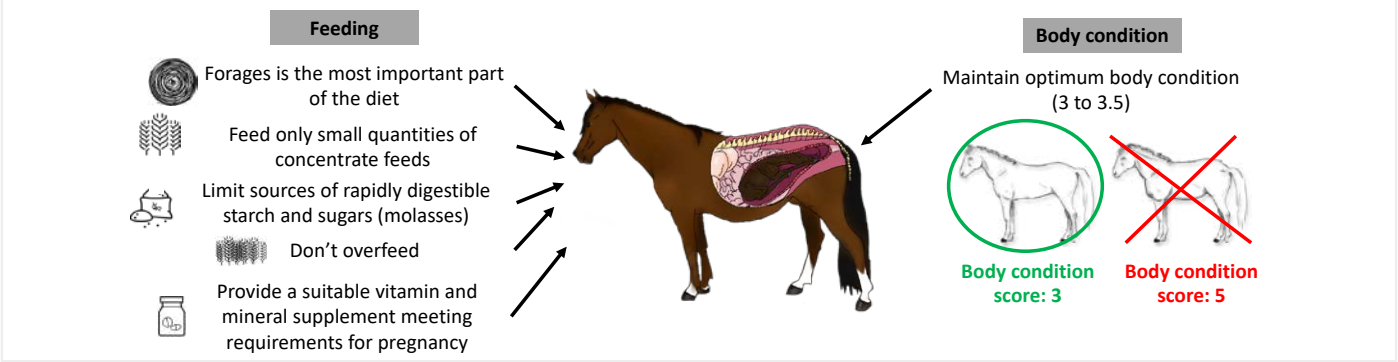
The role played by insulin in chondrocyte growth and bone development is still under discussion. Insulin is considered as a growth factor, notably known for stimulating the multiplication of chondrocytes[33], but also with the ability of modifying the expression of a number of genes. It can in this way, when too much is present, disturb the balance between cartilage persisting and deteriorating and thus bone growth.

Distributing feeds rich in starch feeds to pregnant mares increases the risk of their foals developing osteochondrosis. This risk is even greater if starch in cereals is predigested, having undergone a technological treatment beforehand such as such as flaking, micronising, puffing or extrusion. Furthermore, soluble sugars (such as those in molasses) lead to an even steeper rise in the glycaemia and blood insulin level after the feed. **An increase in insulin production after a feed in the pregnant mare is therefore related to an increase in the number of foals showing osteochondral lesions[30,42,43].** Foetal chondrocytes are particularly sensitive to insulin, thus the time the foal is in utero should not be neglected[44]. Furthermore, mares ingesting more than 200g of starch per 100kg live-weight per day (and so more than 100g/100kg live-weight per feed) produce more foals suffering from osteochondrosis than mares ingesting less than 200g of starch per 100kg live-weight and per day (and thus, less than 100g/100kg live-weight per feed).

The development of resistance to insulin can be caused by the long term consumption of cereals with a high glycemic index and/or disorders such as obesity in the mare. Insulin resistance is notably characterized by a drop in the ability of insulin to stimulate the storing of glucose. Mares who suffer from resistance to insulin, because of obesity or through being fed large amounts of starch during gestation, also produce a greater number of foals suffering from osteochondral lesions[42,45]. Thus, the metabolism of glucose in the gestating mare is an important factor, and its disturbance, as a result of feeding, can alter bone development in foals.

Colostrum

Finally, mares producing a lower quality colostrum at birth, that is to say with **lower level of anti-bodies** (immunoglobulins G), have higher numbers of foals suffering from osteochondral lesions[18,43]. Colostrum quality can be altered by feeding during gestation, and notably by an excessively rich diet with a too high a glycemic index[18,46,47]. The foal is born with limited immune defences. The dam must be able, via milk, to transfer anti-bodies to give the foal protection until his own immune defence system is established. The relationship between poor quality colostrum and osteochondrosis has yet to be explained.

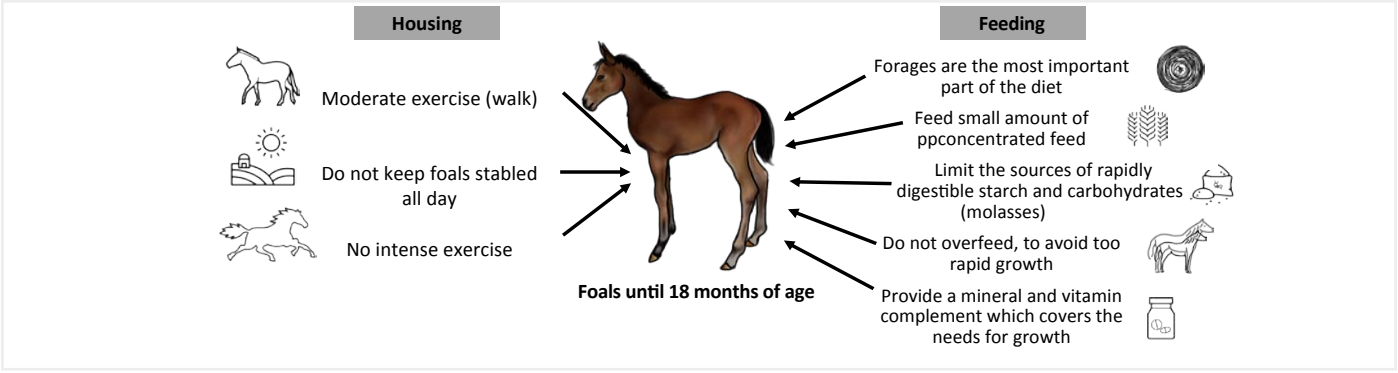


Good management of the pregnant mare limits the development of osteochondrosis in foals

2. THE FOAL'S LIFESTYLE

The foal's living conditions up to the age of 18 months

Foals living out at grass 24/7 are at less risk of developing osteochondrosis than foals out at grass during the day and stabled at night. This is related to the sudden and very large increase in physical activity in foals stabled overnight and thus to an increase in biomechanical constraints and the risk of injuries[47].
However, this has not been observed in every epidemiological study undertaken and should be nuanced in relation to the manner in which foals are turned out, the size of paddock and even herd size[28]. In addition, sustained and controlled exercise (pre-training) during growth is an aggravating factor for existing lesions, all the more so when the osteoarticular system of the youngster isn't ready for hard work.



Factors to be monitored to limit the development of osteochondrosis in foals

In any event, **foals who are able to exercise moderately (walk) on a regular basis are less at risk of developing osteochondral lesions than foals confined to the stable[48,50].** Moreover, cartilage maturation is of particular importance during the first 5 months of the foal's life and may be retarded if the foal remains stabled, and thus can also lead to changes in the development of joints[51].

Nutrition and growth of the foal before 18 months of age

One of the most important factors in bone growth is the balanced provision of minerals. Bones are composed of a protein based matrix, which gives them elastic properties (this allows bones to have a certain ability to deform before breaking), and crystals that are rich in calcium and phosphorus. Certain minerals and trace elements such as copper are also necessary to create elements that make up the protein based matrix.

Hence, **copper deficiency in the growing foal is associated with an increase in osteoarticular lesions[52-54]**. In addition, an excess of phosphorus in relation to calcium in the diets of foals aged between 2 and 6 months old would seem to be related to an increase in the development of osteochondral lesions[56]. Calcium absorption enters into competition with that of phosphorus, **a diet too rich in phosphorus thus leads to poor absorption of calcium** by foals who are unable to use it for bone growth. However, **a diet containing excess calcium will not be prejudicial** to the osteoarticular development of the foal.
Foals that grow too quickly and who are overfed have a greater risk of developing osteochondral lesions[22,23,55–57]. Indeed, overfeeding leads to an altered development of cartilage and thus to poor bone growth in the joints[58]. **Maximum growth does not signify optimal growth as bone cannot simultaneously grow and mineralise correctly.**

Not only is the amount of energy of importance, but also its quality: foals fed with cereals have a greater risk of developing osteochondral lesions and have less chance of recovering from these lesions than those exclusively fed on forage[48]. This relationship becomes all the more evident when cereals fed have a high glycemic index, thus sharply increasing the glycaemia and blood insulin levels in foals after feeds[59,60].

We sometimes hear that the amount of protein fed to foals is a factor to take into consideration in the development of osteochondrosis. If few research projects have studied this subject, one of them has demonstrated that **it is an excess of energy and not an excess of protein that is at the origin of the development of this pathology[58].**

CONCLUSION

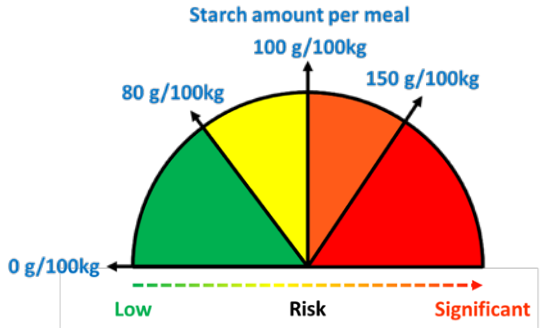
To conclude, osteochondrosis is a disorder with a strong genetic component but is equally heavily dependant on the environment in which the foal finds himself from his moment of conception. Careful management of the pregnant mare and growing foal up to the age of 18 months thus will determine the osteoarticular health of the foal.

It should be known that the early environment in which the foal develops will also programe other aspects of his health at an adult age, such as his growth, his adiposity, his metabolizing of carbohydrates (a role of capital importance in sporting performance), muscular capacity, reproductive capability, or even his behaviour. Therefore, good and careful management of pregnant mares and growing foals helps the genetic potential of the foal to be reached and puts luck on his side.

PRATICAL ADVICE FOR BROODMARES AND FOALS AIMED AT PREVENTING OSTEOCHONDROSIS:

» **Favour the use of forage;**
» **Restrict the amount of sugar and digestible starch in the diet: feed a concentrate ration based on the use of unflaked, unmicronised, non-puffed or non-extruded barley starch, and without added sugar (molasses for example);**
» **Carefully think about the amount of starch fed daily and split the concentrate feed into as many meals possible,**
» **Use a suitable vitamin and mineral supplement;**
» **Do not overfeed, in order to maintain an optimal condition and growth rate.**

In regards to quantities of starch, for a gestating mare we recommend not exceeding 100g of starch per 100kg live-weight per meal. For foals, the maximum quantity of starch not to be exceeded per meal has yet to be determined.



Careful reasoning of the quantity of starch per feed in the mare and foal allows a diminution in the risk of development of osteochondrosis

Translators note: the use of the word "foal" in this article (translated from the French word "poulain"), includes yearlings up to 18 months of age.

BIBLIOGRAPHY

1. Jørgensen, H., Proschowskyt, H., Nne, J., Willebergq, P. & Hesselholt, M. The significance of routine radiographic findings with respect to subsequent racing performance and longevity in Standard bred trotters. Equine Vet. J. 29, 55–59 (1997).

2. Laws, E., Richardson, D., Ross, M. & Moyer, W. Racing performance of Standardbreds after conservative and surgical treatment for tarsocrural osteochondrosis. Equine Vet. J. 25, 199–202 (1993).

3. Robert, C., Valette, J. & Denoix, J. Correlation between routine radiographic findings and early racing career in French Trotters. Equine Vet. J. 36, 473–478 (2006).

4. Kane, A. et al. Radiographic changes in Thoroughbred yearlings . Part 2 : Associations with racing performance. Equine Vet. J. 35, 366–374 (2003).

5. Verwilghen, D. et al. Do developmental orthopaedic disorders influence future jumping performances in Warmblood stallions ? Equine Vet. J. 45, 578–581 (2013).

6. Mackie, E., Tatarczuch, L. & Mirams, M. The skeleton: A multi-functional complex organ. The growth plate chondrocyte and endochondral ossification. J. Endocrinol. 211, 109–121 (2011).

7. Van Weeren, P. Etiology, Diagnosis, and Treatment of OC(D). Clin. Tech. Equine Pract. 5, 248–258 (2006).

8. Ytrehus, B., Carlson, C. & Ekman, S. Etiology and pathogenesis of osteochondrosis. Vet. Pathol. 44, 429–448 (2007).

9. Jacquet, S., Robert, C., Valette, J. & Denoix, J. Evolution of radiological findings detected in the limbs of 321 young horses between the ages of 6 and 18 months. Vet. J. 197, 58–64 (2013).

10. Carlson, C., Cullins, L. & Meuten, D. Osteochondrosis of the articular-epiphyseal cartilage complex in young horses: evidence for a defect in cartilage canal blood supply. Veterinary Pathology 32 641-647 (1995).

11. Jeffcott, L. & Henson, F. Studies on growth cartilage in the horse and their application to aetiopathogenesis of dyschondroplasia (osteochondrosis). Vet. J. 156, 177–192 (1998).

12. Douglas, J. Pathogenesis of osteochondrosis. in Diagnosis and management of lameness in the horse (eds. Ross, M. & Dyson, S.) 617–625 (Saunders, Elsevier, 2011).

13. Kinsley, M., Semevolos, S. & Duesterdieck-Zellmer, K. Wnt/β-catenin signaling of cartilage canal and osteochondral junction chondrocytes and full thickness cartilage in early equine osteochondrosis. J. Orthop. Res. 33, 1433–1438 (2015).

14. Olstad, K., Ekman, S. & Carlson, C. An Update on the pathogenesis of Osteochondrosis. Vet. Pathol. 52, 785–802 (2015).

15. Mirams, M. et al. Altered gene expression in Early Osteochondrosis lesions. J. Orthop. Res. 27, 452–457 (2009).

16. Mirams, M. et al. Identification of novel osteochondrosis - Associated genes. J. Orthop. Res. 34, 404–411 (2016).

17. Hendrickson, E. et al. Comparison of the blood supply to the articular-epiphyseal growth complex in horse vs . pony foals. Equine Vet. J. 47, 326–332 (2015).

18. Robles, M. Influence du métabolisme maternel sur la fonction placentaire et la santé du poulain. (Thèse de doctorat, Université Paris-Saclay - AgroParisTech, 2017).

19. Björnsdóttir, S., Axelsson, M., Eksell, P., Sigurdsson, H. & Carlsten, J. Radiographic and clinical survey of degenerative joint disease in the distal tarsal joints in Icelandic horses. Equine Vet. J. 32, 268–272 (2000).

20. Strand, E., Braathen, L., Hellsten, M., Huse-olsen, L. & Björnsdóttir, S. Radiographic closure time of appendicular growth plates in the Icelandic horse. Acta Vet. Scand. 49, 19 (2007).

21. Riley, C. et al. Osteochondritis dessicans and subchondral cystic lesions in draft horses: A retrospective study. Can. Vet. J. 39, 627–633 (1998).

22. Pagan, J. The incidence of developmental orthopedic disease (DOD) on a Kentucky Thoroughbred farm. Adv. Equine Nutr. 469–475 (1998).

23. Lepeule, J. et al. Association of growth, feeding practices and exercise conditions with the prevalence of Developmental Orthopaedic Disease in limbs of French foals at weaning. Prev. Vet. Med. 89, 167–177 (2009).

24. Combs, T. et al. A Transgenic Mouse with a Deletion in the Collagenous Domain of Adiponectin Displays Elevated Circulating Adiponectin and Improved Insulin Sensitivity. Endocrinology 145, 367–383 (2004).

25. Bastos, L. et al. Incidence of Juvenile Osteochondral conditions in thoroughbred weanlings in the south of Brazil. J. Equine Vet. Sci. (2017). doi:10.1016/j.jevs.2017.02.008.

26. Grøndahl, A. The incidence of osteochondrosis in the tibiotarsal joint of Norwegian Standardbred trotters. J. Equine Vet. Sci. 11, 272–274 (1991).

27. Sandgren, B. Bony fragments in the tarsocrural and metacarpo- or metatarsophalangeal joints in the Standardbred horse - a radiographic survey. Equine Vet. J. 6, 66–70 (1987).

28. Lykkjen, S., Roed, K. & Dolvik, N. Osteochondrosis and osteochondral fragments in Standardbred trotters: Prevalence and relationships. Equine Vet. J. 44, 332–338 (2011).

29. Vander Heyden, L. et al. Prévalence de l'ostéochondrose chez le cheval de sport en Wallonie. Ann. Médecine Vétérinaire 152, 61–70 (2008).

30. Vander Heyden, L. et al. Association of breeding conditions with prevalence of osteochondrosis in foals. Vet. Rec. 172, 68 (2012).

31. Vos, N. et al. Incidence of osteochondrosis (dissecans) in Dutch warmblood horses presented for pre-purchase examination. Ir. Vet. J. 61, 33–37 (2008).

32. Van Grevenhof, E. et al. Prevalence of various radiographic manifestations of osteochondrosis and their correlations between and within joints in Dutch Warmblood horses. Equine Vet. J. 41, 11–16 (2009).

33. Jönsson, L., Dalin, G., Egenvall, A., Roepstorff, L. & Philipsson, J. Equine hospital data as a source for study of prevalence and heritability of osteochondrosis and palmar/plantar osseous fragments of Swedish Warmblood horses. Equine Vet. J. 43, 695–700 (2011).

34. Henson, F., Davies, M. & Jeffcott, L. Equine dyschondroplasia (osteochondrosis)--histological findings and type VI collagen localization. Vet. J. 154, 53–62 (1997).

35. Rejnö, S. & Strömberg, B. Osteochondrosis in the horse. II. Pathology. Acta Radiol. Suppl. 358, 153–78 (1978).

36. Lecocq, M. et al. Cartilage matrix changes in the developing epiphysis : Early events on the pathway to equine osteochondrosis ? Equine Vet. J. 40, 442–454 (2008).

37. Knight, D. et al. The effects of copper supplementation on the prevalence of cartilage lesions in foals. Equine Vet. J. 22, 426–432 (1990).

38. Pearce, S., Grace, N., Wichtel, J., Firth, E. & Fennessy, P. Effect of copper supplementation on copper status of pregnant mares and foals. Equine Vet. J. 30, 200–203 (1998).

39. Pearce, S. G., Firth, E. C., Grace, N. D. & Fennessy, P. F. Effect of copper supplementation on the evidence of developmental orthopaedic disease in pasture-fed New Zealand Thoroughbreds. Equine Vet. J. 30, 211–218 (1998).

40. Winkelsett, S., Vervuert, I., Granel, M. & Borchers, A. Feeding practice in Warmblood mares and foals and the incidence to osteochondrosis. Pferdeheilkunde 21, 124–126 (2003).

41. Kavazis, A., Kivipelto, J. & Ott, E. Supplementation of broodmares with copper, zinc, iron, manganese, cobalt, iodine, and selenium. J. Equine Vet. Sci. 22, 460–464 (2002).

42. Peugnet, P. et al. Effects of moderate amounts of barley in late pregnancy on growth, glucose metabolism and osteoarticular status of pre- weaning horses. PLoS One 10, e0122596 (2015).

43. Caure, S. & Lebreton, P. Ostéochondrose chez le trotteur au sevrage et corrélation avec divers paramètres. Prat. Vétérinaire Equine 36, 47–57 (2004).

44. Henson, F. et al. Effects of insulin and insulin-like growth factors I and II on the growth of equine fetal and neonatal chondrocytes. Equine Vet. J. 29, 441–447 (1997).

45. Robles, M. et al. Maternal obesity increases insulin resistance, low-grade inflammation and osteochondrosis lesions in foals and yearlings until 18 months of age. PLoS One 13, (2018).

46. Thorson, J. et al. Effect of selenium supplementation and plane of nutrition on mares and their foals: Foaling data. J. Anim. Sci. 88, 982–990 (2010).

47. Coverdale, J., Hammer, C. & Walter, K. Nutritional programming and the impact on mare and foal performance. J. Anim. Sci. 93, 3261–3267 (2015).

48. Mendoza, L. et al. Impact of feeding and housing on the development of osteochondrosis in foals — A longitudinal study. Prev. Vet. Med. 127, 10–14 (2016).

49. van Weeren, P. & Barneveld, A. The effect of exercise on the distribution and manifestation of osteochondrotic lesions in the Warmblood foal. Equine Vet. J. Suppl. 31, 16–25 (1999).

50. Lepeule, J. et al. Association of growth, feeding practices and exercise conditions with the severity of the osteoarticular status of limbs in French foals. Vet. J. 197, 65–71 (2013).

51. Brama, P., TeKoppele, J., Bank, R., Barneveld, A. & van Weeren, P. Development of biochemical heterogeneity of articular cartilage: influences of age and exercise. Equine Vet. J. 34, 265–269 (2002).

52. Hildebran, S. & Hunt, J. Copper-responsive epiphytis and tendon contracture in a foal. in The Roles of Amino Acid Chelates in Animal Nutrition (ed. Ashmead, H.) 400–410 (Noyes Publications, 1993).

53. Hurtig, M., Green, S., Dobson, H., Mikuni-Takagaki, Y. & Choi, J. Correlative study of defective cartilage and bone growth in foals fed a low-copper diet. Equine Vet. J. 25, 66–73 (1993).

54. Coskun, A., Ozdemir, O., Erol, M. & Kirbiyik, H. The relationship of copper concentrations in feed and plasma to developmental orthopedic disease in foals. Vet. Arh. 86, 287–294 (2016).

55. Savage, C., McCarthy, R. & Jeffcott, L. Effects of dietary energy and protein induction on dyschondroplasia in foals. Equine Vet. J. Suppl. 16, 74–79 (1993).

56. Savage, C., McCarthy, R. & Jeffcott, L. Effects of dietary phosphorus and calcium on induction of dyschondroplasia in foals. Equine Vet. J. 16, 74–79 (1993).

57. Donabédian, M. et al. Effect of fast vs. moderate growth rate related to nutrient intake on developmental orthopaedic disease in the horse. Anim. Res. 55, 471–486 (2006).

58. Glade, M. & Belling, T. A dietary etiology for osteochondrotic cartilage. J. Equine Vet. Sci. 6, 151–155 (1986).

59. Ralston, S. Hyperglycemia/hyperinsulinemia after feeding a meal of grain to young horses with osteochondritis dissecans (OCD) lesions. Pferdeheilkunde 12, 320–322 (1996).

60. Pagan, J., Geor, R., Caddel, S., Pryor, P. & Hoekstra, K. The Relationship Between Glycemic Response and the Incidence of OCD in Thoroughbred Weanlings: A Field Study. in Proceedings of the 47th AAEP Annual Convention 47, 322–325 (2001).


REVERDY
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WEANING:
an important stage of horses' life

Weaning is a crucial moment occurring during the first months of a foals life. A badly prepared weaning can lead to a "growth crisis " that can have long term repercussions if not followed by "compensatory growth" during the following months.

I. WHEN TO WEAN?

The exact date of weaning depends on each foals' capabilities and progression during his first months of life. Usually, it takes place between 5 and 7 months of age. However, the age of the foal is not the only criteria to be taken into consideration. For example, the foals' weight and the amount of feed being consumed daily are objective indicators to better evaluate the true aptitude of a foal for being deprived of maternal milk. Thus, it is considered that a thoroughbred foal can be weaned at a minimum weight of 225kg and if eating at least 1.5kg of a transitional weaning feed.

II. HOW TO GO ABOUT IT?

The separation of a broodmare from her offspring is likely to cause different stresses that can all affect the foals' growth. It is therefore important that the foal is properly prepared for this determining event in the next months of his life.

a - Choose a weaning method that limits psychological stress

Separation between the mare and foal leads to a psychological stress which will be more or less intense depending on the weaning method. Amongst the known methods, the best is that which suits your set up and which will limit stress and injury to both the foal and mare.

Here are the most frequent:

- **Pasture weaning or interval weaning**: within a herd, minimal psychological stress following the sudden separation between broodmare and foal can be achieved if not all the mares are withdrawn at the same time. On studs using this method, one or two dams of the oldest foals are removed and taken far from the group whilst their foals are at a distance. Other broodmares are then taken out at regular intervals (ex. one a week) or when their foals have attained the desired age. Weaning is immediate, but the foals do not lose all their bearings. Indeed, even if their dam is no longer present, the foals remain within their herd which is not completely de-structured in one blow.

  In this way, in most cases, stress at weaning is limited. Despite this, it is important to watch the foals during the moments following the withdrawal of their dams. This method takes longer, however it is gentler and each foal can be weaned when he has reached the desired age and weight. When pasture weaning is impossible (for example there is only one foal to be weaned), then we can resort to other methods such as abrupt or gradual weaning.

- **Abrupt weaning**: as its name indicates, the mare is withdrawn abruptly. It is possible to substitute the mother by another animal (donkey, pony, gelding, etc.). This is an interesting solution, even if all excessive attachment phenomena which could lead to a new stressful separation situation must be avoided. Thus, it is preferable to leave the foal alone for 24h after withdrawing the mare before introducing any companion.

  When abrupt weaning is practised on a stud where a number of foals are weaned at the same time, they are often stabled in pairs. However, studies have shown statistically higher levels of cortisol (stress hormone) in foals weaned in this way than observed in foals weaned by being stabled alone. It is possible that this difference is related to lack of space and the dominance of one foal over the other.

  The dominant foal may show his stress by aggressive behaviour towards his stable companion who is unable to flee in the confined environment. A study led in 1990 at Rutgers University in New Jersey showed that even if foals weaned

in pairs were calmer (less agitation and neighing), they were more immunodeficient as more stressed, and therefore more susceptible to illness than foals weaned alone. Consequently, if a number of foals are being weaned at the same time, the best solution is place them singly, but in adjacent loose boxes, making sure they can see each other (stable separations with openings).

- **Gradual weaning**: the foal is progressively separated from his dam. When a single foal is being weaned, the easiest and safest way is to place the mare and her foal in a large loose box divided into two by a separation that allows the foal to touch his dam but not to suckle. The mare can be progressively distanced whilst staying on the same yard. This method takes on average 7 to 10 days and is generally accepted by both parties who gradually lose interest in each other.

When a number of foals are being weaned simultaneously, a collective and gradual weaning outside (adjacent field weaning) is possible. The foals are placed together in a small paddock which offers enough space to avoid conflicts. These enclosures are placed adjacent to those of the mares and separated by a fence which does not allow the foals to suckle, although they can see and even touch. As for the mares, they remain in a large paddock that can be increased in size after a few days in order to allow them to progressively move away from the foals paddock, weaning themselves from their foals. Generally, weaning takes a week and doesn't cause a lot of stress or injury.

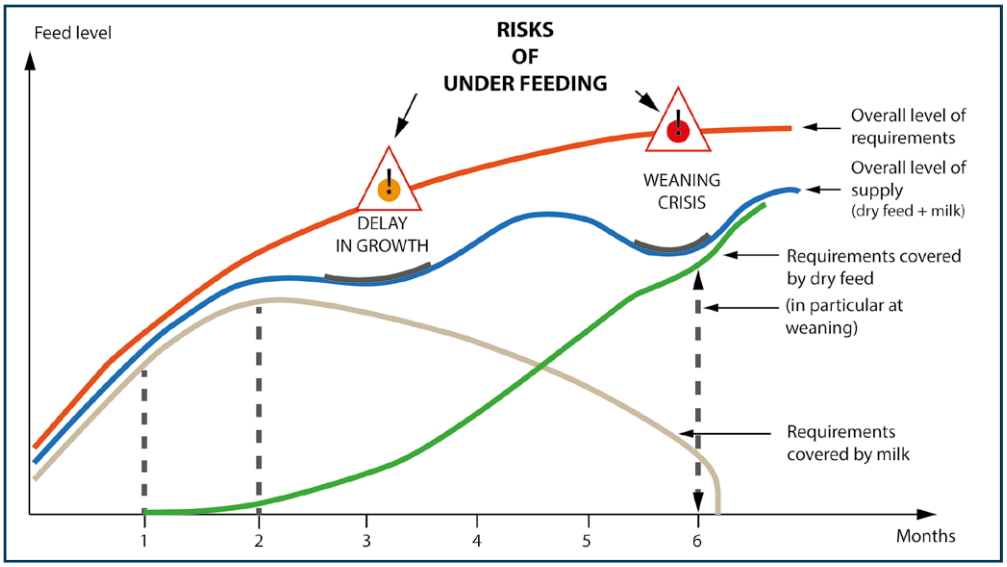
Whatever method is chosen, it is important to manipulate the foal before weaning, accustom him to wearing a head-collar and to being led in-hand. This really facilitates the handling that is required at weaning, if, in addition to the weaning related stress, the latter has never been handled this can prove to be dangerous for both breeder and foal. It should be noted that the earlier this handling takes place (in the days following birth), the easier it is to carry out. In effect it is at this moment that the foal has the least strength and the least risk of injury.

b - Anticipate weaning in order to limit digestive perturbations

From a dietary point of view, weaning corresponds to the stopping of maternal milk and the passage to solid vegetable feedstuffs. Badly prepared, this transition can provoke digestive problems (perturbations of the gut flora with diarrhoea, etc.) which can disturb the correct growth and development of the foal. Consequently, introducing a transitional concentrate feed containing dairy products associated with raw ingredients of vegetable origin, allows the foals' organism to progressively become accustomed to this change of diet.

The feed "FOAL" is particularly suited to this job. It contains skimmed milk powder which notably stands out against whey by its' high level of milk proteins (about three times higher). Like this, associated with non GM (guaranteed to 99.1%) soya vegetable proteins and sources of fats and oils rich in Omega-3 (extruded linseed), it allows to prepare for and gives security to weaning, limiting any growth crisis if correctly fed.

DESIRED EVOLUTION OF FEED LEVELS DURING WEANING IN THE FOAL



FOAL can be introduced a few weeks after birth. The daily feeding of a handful of FOAL from 15 days old in a creep feeder (or a foal park) allows the foal to progressively become accustomed to a solid diet. Well before weaning, this method also anticipates for the drop in maternal milk production that occurs at 3 months thus avoiding the delay in growth with which this can be associated. Finally, towards 5 to 6 months of age, complete weaning from maternal milk can take place when the foal is capable of eating sufficient "FOAL" (2L equal to 1.4kg per day) and forage (hay, grass). Once weaned, it is recommended to continue feeding "FOAL" for at least two months before changing to a 100% vegetable based feed such as BREEDING.

Lastly, FOAL contains bacterial assimilation factors obtained from the lactic fermentation of germinated barley. Given at an effective dosage, these prebiotics help the young flora to establish and contribute to optimal digestion of fibre rich raw ingredients of vegetable origin (concentrates and forage). If the feed being employed is lacking prebiotics or probiotics it is advisable to use REVERDY FLORA. Distribute for a minimum of a week before weaning and during the two weeks following, this feed supplement provides high doses of probiotics (live yeasts) and prebiotics (lactic ferments from germinated barley and fermented organic bread), which contribute to limiting digestive perturbations.

TO SUM UP

Weaning is the major event during the first months of the foals' life. If it is badly prepared, it can lead to delays in growth and development which can compromise the future athletic career of the foal. A bad weaning is even more serious if the young horse is brought into work early and in an intensive fashion. Furthermore, Wolter (1999) stated that, early, and above all badly prepared weaning can in the long term lead to much more insidious problems, notably in future broodmares who ultimately revealed being less fertile, and producing weaker, slower growing foals whose skeletons were less resistant.
It is therefore important that weaning takes places in the best possible conditions. To do this, a number of methods exist, although each of them has its advantages and disadvantages. Whatever the method, the early handling of foals beginning in the first weeks of life, and the feeding of a quality concentrate feed enables the foal to be the best prepared for separation from his dam.

BIBLIOGRAPHY

Brown-Douglas Clarissa Dr., Common methods of weaning horses, EQUINEWS, february 13, 2012

Smith Thomas Heather, Weaning foals, THE HORSE, June, 1st 2005

Wolter R., Alimentation du cheval, Editions France Agricole, 2nd édition, 1999.


ERDY

Reverdy Equine Nutrition range

FEEDS

BALANCERS

VITAMIN AND MINERAL SUPPLEMENTS (CMV)

NUTRITIONAL SUPPLEMENTS

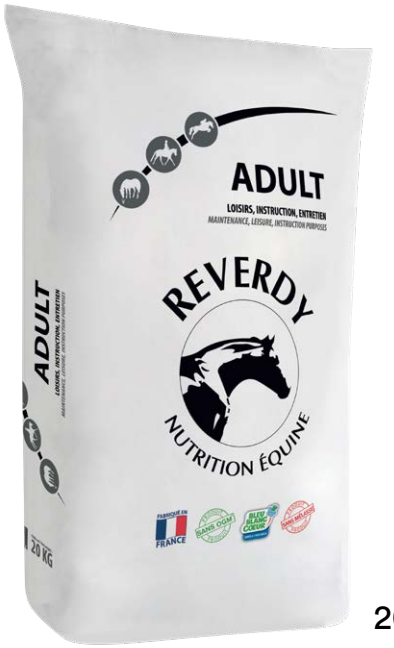
TREATS

ADULT

DESCRIPTION

Pelleted feed for adult horses used at rest or in work.

PRESENTATION



MADE IN FRANCE

PRODUCT GMO FREE* PRODUCT

BLEU BLANC COEUR OMÉGA 3 NATURELS

PRODUCT NO MOLASSES PRODUCT

20 kg

COMPOSITION

Barley, Alfalfa 17 (HORSE), Straw, TRADI-LIN extruded linseed, Soya bean meal without GMO*, Dicalcium phosphate, Sodium chloride, Lithothamnion, Trace elements and Vitamins.

** <0.1% - French produced cereals and soya*

WHY REVERDY ADULT?

- **Barley based**
- **Source of fibres** › to promote good digestive health

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.4 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATION	
		KG	L
Maintenance		1.4 - 2.1	2 - 3
Leisure activities, instruction and trekkings	Moderate workload	2.1 - 3.5	3 - 5
Equestrian sports	Moderate workload	2.8 - 4.2	4 - 6
	Heavy workload	4.2 - 5.6	6 - 8
Breeding	Barren broodmare	1.4 - 2.8	2 - 4
	Stallion (out of breeding season)	1.4 - 4.2	2 - 6

CONDITIONING

	Bag	Container	Vrac
Expiration date :	6 months	4 months	6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	11 %
Crude fats	3 %
Crude fibre	14.5 %
Crude ash	7 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.1 %
Sodium	0.2 %

CARBOHYDRATES/KG

Starch	290 g
Starch + Sugars	315 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	8.5 g
Linoleic acid (Omega 6)	6.5 g

AMINO ACIDS/KG

Lysine	4,400 mg
Threonine	3,950 mg
Methionine	1,700 mg

RATIONING VALUES/KG

UFC	0.8
DE (Digestible Energy)	10.8 MJ
Digestible protein	72 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	67.5 mg
Copper (Chloride tri hydroxide)	26 mg
Manganese (Oxide)	37.5 mg
Iron (Sulphate)	26 mg
Iodine (Calcium iodate)	0.38 mg
Selenium (Organic selenium)	0.38 mg

VITAMINS/KG

Vitamin A	11,250 IU
Vitamin D3	1,125 IU
Vitamin E	300 mg
Vitamin K3	1.5 mg
Vitamin B1 (Thiamin)	15 mg
Vitamin B2 (Riboflavin)	11 mg
Vitamin B3 (PP or Niacin)	26 mg
Vitamin B5 (Pantothenic acid)	11 mg
Vitamin B6 (Pyridoxine)	7.5 mg
Vitamin B8 (Biotin)	0.38 mg
Vitamin B9 (Folic acid)	2.6 mg
Vitamin B12 (Cyanocobalamin)	0.08 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

It is recommended to distribute meals of 1 to 2L and to split the daily ration into balanced meals.

Precautions for use
Do not exceed 3 litres per feed.

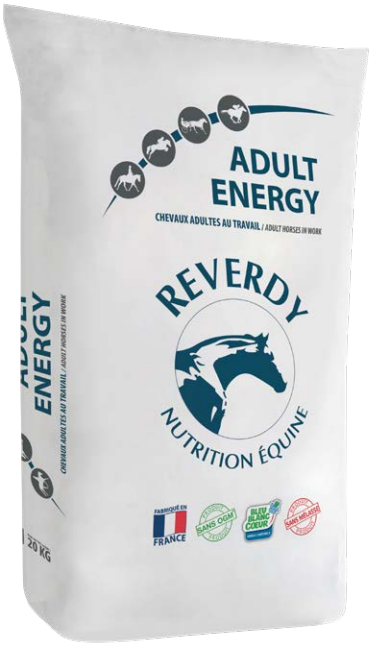
Elaborated and manufactured in our factory.

ADULT ENERGY

DESCRIPTION

Pelleted feed for adult horses in work.

PRESENTATION



MADE IN FRANCE

PRODUCT GMO FREE* PRODUCT

BLEU BLANC COEUR OMÉGA 3 NATURELS

PRODUCT NO MOLASSES PRODUCT

20 kg

COMPOSITION

Barley, Oats, Alfalfa 17 (HORSE), Maize without GMO*, TRADI-LIN extruded linseed, French soya bean meal without GMO*, Sepiolite, Lithothamnion, Dicalcium phosphate, Sodium Chloride, Trace elements and Vitamins.

** <0.1% - French produced cereals and soya*

WHY REVERDY ADULT ENERGY?

- **Suitable for every type of activity**

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.4 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATION	
		KG	L
Equestrian sports	Moderate workload	2.8 - 4.2	4 - 6
	Heavy workload	4.2 - 5.6	6 - 8
Racing (training)	Trotter	4.2 - 5.6	6 - 8
	Thoroughbred	4.9 - 5.6	7 - 8

CONDITIONING

	Bag	Container	Vrac
Expiration date :	6 months	4 months	6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	12 %
Crude fats	4 %
Crude fibre	9.5 %
Crude ash	9 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.4 %
Sodium	0.2 %

CARBOHYDRATES/KG

Starch	340 g
Starch + Sugars	360 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	10.5 g
Linoleic acid (Omega 6)	10.5 g

AMINO ACIDS/ KG

Lysine	5,150 mg
Threonine	4,500 mg
Methionine	2,000 mg

RATIONING VALUES/KG

UFC	0.88
DE (Digestible Energy)	11.9 MJ
Digestible protein	85 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	90 mg
Copper (Chloride tri hydroxide)	35 mg
Manganese (Oxide)	50 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	1,500 IU
Vitamin E	400 mg
Vitamin K3	2 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	0.5 mg
Vitamin B9 (Folic)	3.5 mg
Vitamin B12 (Cyanocobalamin)	0.10 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

It is recommended to distribute meals of 1 to 2L and to split the daily ration into balanced meals.

Precautions for use
Do not exceed 3 litres per feed.

Elaborated and manufactured in our factory.

ADULT ENERGY WITH FLAKES

DESCRIPTION

Pelleted feed with flaked maize for adult horses with high energy requirements or fragile intestinal flora.

PRESENTATION

MADE IN FRANCE

PRODUCT GMO FREE* PRODUCT

BLEU BLANC COEUR OMÉGA 3 NATURELS

PRODUCT NO MOLASSES PRODUCT

20 kg

COMPOSITION

Barley, Oats, Alfalfa 17 (HORSE), WAXY variety flaked maize without GMO*, Maize without GMO*, TRADI-LIN extruded linseed, French soya bean meal without GMO*, Sepiolite, Lithothamnion, Dicalcium phosphate, Sodium Chloride, Trace elements and Vitamins.

* <0.1% - French produced cereals and soya

WHY REVERDY ADULT ENERGY WITH FLAKES?

- **Reinforced energy intake** › highly digestable flaked maize

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.3 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATION	
		KG	L
Racing (training)	Trotter	3.9 - 5.85	6 - 9
	Thoroughbred	4.55 - 5.85	7 - 9
Equestrian sports	Moderate workload	2.6 - 3.9	4 - 6
	Heavy workload	3.9 - 5.2	6 - 8
Reproduction	Stallion (covering)	2.6 - 5.2	4 - 8

CONDITIONING

Expiration date :	Bag	Container	Vrac
	6 months	4 months	6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	11.5 %
Crude fats	4 %
Crude fibre	8.5 %
Crude ash	8 %
Calcium	0.9 %
Phosphorus	0.45 %
Magnesium	0.35 %
Sodium	0.2 %

CARBOHYDRATES/KG

Starch	375 g
Starch + Sugars	400 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	9 g
Linoleic acid (Omega 6)	11 g

AMINO ACIDS/KG

Lysine	4,850 mg
Threonine	4,300 mg
Methionine	1,950 mg

RATIONING VALUES/KG

UFC	0.91
DE (Digestible Energy)	12.2 MJ
Digestible protein	81.5 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	79 mg
Copper (Chloride tri hydroxide)	31 mg
Manganese (Oxide)	44 mg
Iron (Sulphate)	31 mg
Iodine (Calcium iodate)	0.44 mg
Selenium (Organic selenium)	0.44 mg

VITAMINS/KG

Vitamin A	13,000 IU
Vitamin D3	1,300 IU
Vitamin E	350 mg
Vitamin K3	1.8 mg
Vitamin B1 (Thiamin)	17.5 mg
Vitamin B2 (Riboflavin)	13 mg
Vitamin B3 (PP or Niacin)	30 mg
Vitamin B5 (Pantothenic acid)	13 mg
Vitamin B6 (Pyridoxine)	8.8 mg
Vitamin B8 (Biotin)	0.44 mg
Vitamin B9 (Folic acid)	3 mg
Vitamin B12 (Cyanocobalamin)	0.9 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

It is recommended to distribute meals of 1 to 2L and to split the daily ration into balanced meals.

Precautions for use
Do not exceed 3 litres per feed.

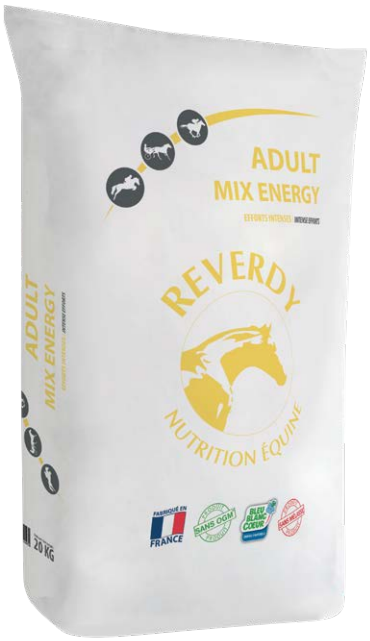
Elaborated and manufactured in our factory.

ADULT MIX ENERGY

DESCRIPTION

Pelleted feed with flaked maize for adult horses undertaking intense efforts.

PRESENTATION



MADE IN FRANCE

PRODUCT GMO FREE* PRODUCT

BLEU BLANC COEUR OMÉGA 3 NATURELS

PRODUCT NO MOLASSES PRODUCT

20 kg

COMPOSITION

Barley, Oats, WAXY variety flaked maize without GMO*, Alfalfa 17 (HORSE), TRADI-LIN extruded linseed, French extruded soya beans without GMO*, Soya bean meal without GMO*, Sepiolite, Lithothamnion, Sodium chloride, Dicalcium phosphate, Prebiotics, Bentonite, Trace elements and Vitamins, Lyophilized melon juice and flesh.

* <0.1% - French produced cereals and soya

WHY REVERDY ADULT MIX ENERGY?

- **Reinforced energy intake ›** increased level of extruded linseed, extruded soya beans, highly digestible flaked maize
- **Muscular protection and development ›** lysine rich proteins, antioxidant complex
- **Digestive security and better valuation of the ration ›** assimilated factors
- **Red blood cell production ›** vitamins B9 and B12

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.3 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATION	
		KG	L
Racing (intensive training)	Trotter	3.9 - 5.85	6 - 9
	Thoroughbred	4.55 - 5.85	7 - 9
Equestrian sports	Very hard work	3.9 - 5.2	6 - 8

CONDITIONING

Expiration date :	Bag	Container	Vrac
	6 months	4 months	6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	12.5 %
Crude fats	5.5 %
Crude fibre	8 %
Crude ash	9.5 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.4 %
Sodium	0.4 %

CARBOHYDRATES/KG

Starch	335 g
Starch + Sugars	360 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	16 g
Linoleic acid (Omega 6)	16 g

AMINO ACIDS/KG

Lysine	5,500 mg
Threonine	4,700 mg
Methionine	2,050 mg

RATIONING VALUES/KG

UFC	0.93
DE (Digestible Energy)	12.7 MJ
Digestible protein	90.5 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	90 mg
Copper (Chloride tri hydroxide)	35 mg
Manganese (Oxide)	50 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	1,500 IU
Vitamin E	600 mg
Vitamin K3	2 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxinx)	10 mg
Vitamin B8 (Biotin)	0.5 mg
Vitamin B9 (Folic acid)	7 mg
Vitamin B12 (Cyanocobalamin)	0.2 mg
Vitamin C protected (Phosphorylated L-ascorbic acid)	1,000 mg

NATURAL ANTIOXIDANT/KG

Melon extract: SOD activity (Superoxide dismutase)	104 IU

POSTBIOTICS/KG

Assimilated factors obtained from the lactic fermentation of germinated barley	6,000 mg

CLAY/KG

Bentonite mg	5,300 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

It is recommended to distribute meals of 1 to 2L and to split the daily ration into balanced meals.

Precautions for use
Do not exceed 3 litres per feed.

SPECIFIC RECOMMENDATIONS

Switch to ADULT ENERGY when work intensity decreases.

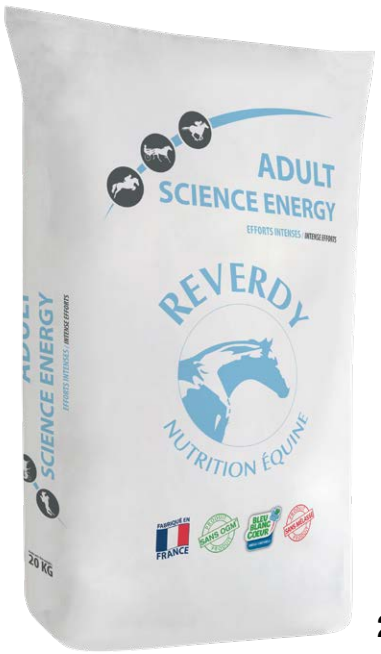
Elaborated and manufactured in our factory.

ADULT SCIENCE ENERGY

DESCRIPTION

Pelleted feed with flaked maize for adult horses undertaking intense efforts.

PRESENTATION



20 kg

COMPOSITION

Barley, Oats, WAXY variety flaked maize without GMO*, Alfalfa 17 (HORSE), TRADI-LIN extruded linseed, Extruded soya beans without GMO*, Soya bean meal without GMO*, Sepiolite, Sodium Chloride, Lithothamnion, Dicalcium phosphate, Postbiotics, Bentonite, Dehydrated carrots, Chondroprotective agents, Trace elements and Vitamins, Lyophilized melon juice and flesh.

** <0.1% - French produced cereals and soya*

WHY REVERDY ADULT SCIENCE ENERGY?

- **Reinforced energy intake** › increased level of extruded linseed, extruded soya beans, highly digestible flaked maize
- **Muscular protection and development** › lysine rich proteins, antioxidant complex
- **Digestive security and better valuation of the ration** › assimilated factors
- **Red blood cell production** › vitamins B9 and B12
- **Articulations (joint) protection and support** › chondroitin, glucosamine, MSM
- **Hooves horn growth and quality** › biotin

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.3 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATION	
		KG	L
Racing (intensive training)	Trotter	3.9 - 5.85	6 - 9
	Thoroughbred	4.55 - 5.85	7 - 9
Equestrian sports	Very hard work	3.9 - 5.2	6 - 8

CONDITIONING

	Bag	Vrac
Expiration date :	6 months	6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	12.5 %
Crude fats	5.5 %
Crude fibre	8 %
Crude ash	9.5 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.4 %
Sodium	0.4 %

CARBOHYDRATES/KG

Starch	330 g
Starch + Sugars	355 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	16 g
Linoleic acid (Omega 6)	16 g

AMINO ACIDS/KG

Lysine	5,500 mg
Threonine	4,700 mg
Methionine	2,050 mg

RATIONING VALUES/KG

UFC	0.93
Digestible protein	90.5 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	90 mg
Copper (Chloride tri hydroxide)	35 mg
Manganese (Oxide)	50 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	1,500 IU
Vitamin E	600 mg
Vitamin K3	2 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	4 mg
Vitamin B9 (Folic acid)	7 mg
Vitamin B12 (Cyanocobalamin)	0.2 mg
Vitamin C protected (Phosphorylated L-ascorbic acid)	1,000 mg

NATURAL ANTIOXIDANT/KG

Melon extract: SOD activity (Superoxide dismutase)	104 IU

CHONDROPROTECTIVE AGENTS/KG

Glucosamine (Sulphate 2 KCl)	2,000 mg
MSM (Methylsulfonylmethane)	2,000 mg
Chondroitin (Sulphate)	400 mg

POSTBIOTICS/KG

Assimilated factors obtained from the lactic fermentation of germinated barley	6,000 mg

CLAY/KG

Bentonite mg	5,000 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

It is recommended to distribute meals of 1 to 2L and to split the daily ration into balanced meals.

Precautions for use
Do not exceed 3 litres per feed.

SPECIFIC RECOMMENDATIONS

Switch to ADULT ENERGY when work intensity decreases.

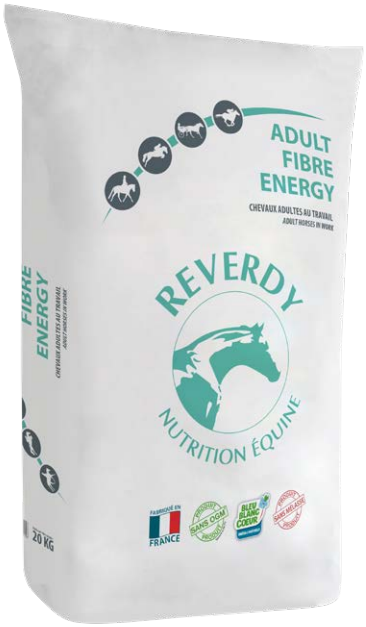
Elaborated and manufactured in our factory.

ADULT FIBRE ENERGY

DESCRIPTION

Pelleted feed for adult in work.

PRESENTATION



20 kg

COMPOSITION

Oats, Alfalfa 17 (HORSE), Barley, Straw, TRADI-LIN extruded linseed, Sepiolite, Potato protein, Dicalcium phosphate, Sodium Chloride, Lithothamnion, Postbiotics, Bentonite, Trace elements and Vitamins.

** French produced cereals*

WHY REVERDY ADULT FIBRE ENERGY?

- **Reinforced energy intake ›** based on oats, high level of extruded linseed
- **Source of fibres ›** to promote good digestive health
- **Digestive security and better valuation of the ration ›** assimilation factors
- **Without soya and maize**

RECOMMENDED DOSES

1 mesure REVERDY (2 L) = 1,4 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATION	
		KG	L
Racing (training)	Trotter	4.2 - 5.6	6 - 8
	Thoroughbred	4.9 - 5.6	7 - 8
Equestrian sports	Moderate workload	2.8 - 4.2	4 - 6
	Heavy workload	4.2 - 5.6	6 - 8

CONDITIONING

Bag

Expiration date : 6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	12 %
Crude fats	5 %
Crude fibre	15 %
Crude ash	9 %
Calcium	0.9 %
Phosphorus	0.45 %
Magnesium	0.4 %
Sodium	0.2 %

CARBOHYDRATES/KG

Starch	240 g
Starch + Sugars	260 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	13 g
Linoleic acid (Omega 6)	11.5 g

AMINO ACIDS/KG

Lysine	5,450 mg
Threonine	4,650 mg
Methionine	2,050 mg

RATIONING VALUES/KG

UFC	0.80
DE (Digestible Energy)	11.1 MJ
Digestible protein	84.5 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	90 mg
Copper (Chloride tri hydroxide)	35 mg
Manganese (Oxide)	50 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	1,500 IU
Vitamin E	400 mg
Vitamin K3	2 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	0.5 mg
Vitamin B9 (Folic acid)	3.5 mg
Vitamin B12 (Cyanocobalamin)	0.1 mg

POSTBIOTICS/KG

Assimilation factors obtained from the lactic fermentation of germinated barley	3,000 mg

CLAY/KG

Bentonite mg	2,000 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Weather and housing conditions;
- Quantity, quality, and type of forage fed daily.

It is recommended to distribute meals of 1 to 2L and to split the daily ration into balanced meals.

Precautions for use
Do not exceed 3 litres per feed.

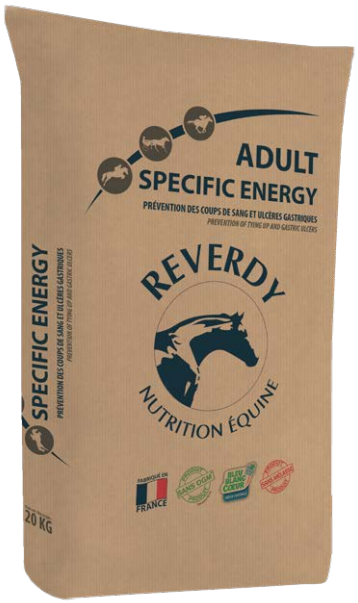
Elaborated and manufactured in our factory.

ADULT SPECIFIC ENERGY

DESCRIPTION

Pelleted feed for adult horses subject to tying up and gastric ulcers.

PRESENTATION



20 kg

COMPOSITION

Alfalfa 17 (HORSE), Barley, TRADI-LIN extruded linseed, Straw, Chicory pulp, Extruded soya beans without GMO*, Sepiolite, Bentonite, Sodium chloride, Skimmed milk powder, Postbiotics, Monocalcium phosphate, Clinoptilolite, Magnesium oxide, Magnesium phosphate, Trace elements and Vitamins, Lyophilized melon juice and flesh.

* <0.1% - French produced cereals and soya

WHY REVERDY ADULT SPECIFIC ENERGY?

- **Selected energy sources** › poor in starch, enriches in fibres and fats
- **Muscular protection and development** › antioxidant complex
- **Appeasement of nervous horses** › low glycemic index, magnesium
- **Gastric acid neutralisation** › alfalfa, bentonite, clinoptilolite
- **Digestive mucosa protection** › bentonite, clinoptilolite, Omega 3 & 6
- **Digestive security and better valuation of the ration** › assimilated factors
- **Red blood cell production** › vitamins B9 and B12

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.4 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATION	
		KG	L
Racing (training)	Trotter	4.2 - 5.6	6 - 8
	Thoroughbred	4.9 - 5.6	7 - 8
Equestrian sports	Moderate workload	2.8 - 4.2	4 - 6
	Heavy workload	4.2 - 5.6	6 - 8

CONDITIONING

Bag

Expiration date : 4 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	10.5 %
Crude proteins	12.5 %
Crude fats	8 %
Crude Fibre	15 %
Crude ash	11.5 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.6 %
Sodium	0.4 %

CARBOHYDRATES/KG

Starch	140 g
Starch + Sugars	175 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	35.5 g
Linoleic acid (Omega 6)	15 g

AMINO ACIDS/KG

Lysine	5,400 mg
Threonine	4,550 mg
Methionine	1,950 mg

RATIONING VALUES/KG

UFC	0.81
DE (Digestible Energy) MJ/KG	11.7
Digestible protein	85 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	90 mg
Copper (Chloride tri hydroxide)	35 mg
Manganese (Oxide)	50 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	1,500 IU
Vitamin E	600 mg
Vitamin K3	2 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	4 mg
Vitamin B9 (Folic acid)	7 mg
Vitamin B12 (Cyanocobalamin)	0.2 mg
Vitamin C protected (Phosphorylated L-ascorbic acid)	1,000 mg

NATURAL ANTIOXIDANT/KG

Melon extract: SOD activity (Superoxide dismutase)	104 IU

POSTBIOTICS/KG

Assimilation factors obtained from the lactic fermentation of germinated barley	6,000 mg

CLAYS/KG

Bentonite	11,000 mg
Clinoptilolite	4,500 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

It is recommended to distribute meals of 1 to 2L and to split the daily ration into balanced meals.

Precautions for use
Do not exceed 3 litres per feed.

SPECIFIC RECOMMENDATIONS

This feed is also suitable for horses suffering from a disease requiring the distribution of a diet low in carbohydrates.

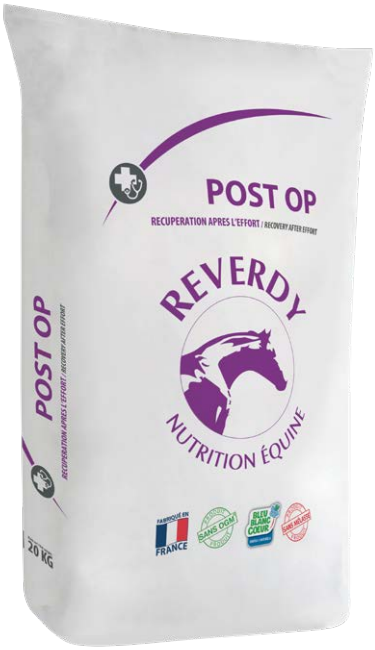
Elaborated and manufactured in our factory.

POST OP

DESCRIPTION

Pelleted feed for adult horses having undergone surgery or suffering from serious digestive disorders.

PRESENTATION



20 kg

COMPOSITION

Alfalfa 17 (HORSE), Barley, Oats, Dehydrated carrots, Extruded soya beans without GMO*, TRADI-LIN extruded linseed, Maize without GMO*, Chicory pulp, Sepiolite, Bentonite, Dicalcium phosphate, Postbiotics, Clinoptilolite, Lithothamnion, Sodium bicarbonate, Sodium chloride, Sodium sulphate, Trace elements and Vitamins, Lyophilized melon juice and flesh.

** <0.1% - French produced cereals and soya*

WHY REVERDY POST OP?

- **Selected energy sources** › poor in starch, enriches in fibres and fats
- **Transit speed regulation** › bentonite, clinoptilolite, carrots, sodium salt
- **Gastric acid neutralisation** › alfalfa, bentonite, clinoptilolite, lithothamnion
- **Digestive mucosa protection** › bentonite, clinoptilolite, glutamine, Omega 3 & 6
- **Digestive security and bettaer valuation of the ration** › assimilated factors
- **Organism protection and support** › antioxidant complex
- **Red blood cell production** › vitamins B9 and B12

RECOMMENDED DOSES

Consult your vet for advice.
1 measure REVERDY (2 L) = 1.4 KG

CONDITIONING

Bag

Expiration date : 6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	10.5 %
Crude proteins	13 %
Crude fats	7 %
Crude fibre	10 %
Crude ash	12,5 %
Calcium	1.2 %
Phosphorus	0.6 %
Magnesium	0.4 %
Sodium	0.4 %

CARBOHYDRATES/KG

Starch	185 g
Starch + Sugars	250 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	20.5 g
Linoleic acid (Omega 6)	20.5 g

AMINO ACIDS/KG

Lysine	6,150 mg
Threonine	4,800 mg
Methionine	2,100 mg
L-Glutamine	2,500 mg

RATIONING VALUES/KG

UFC	0.87
DE (Digestible Energy)	12.4 MJ
Digestible protein	90.5 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	90 mg
Copper (Chloride tri hydroxide)	35 mg
Manganese (Oxyde)	50 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	1,500 IU
Vitamin E	600 mg
Vitamin K3	2 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	4 mg
Vitamin B9 (Folic acid)	7 mg
Vitamin B12 (Cyanocobalamin)	0.2 mg
Vitamin C protected (phosphorylated L-ascorbic acid)	1,000 mg

NATURAL ANTIOXIDANT/KG

Melon extract: SOD activity (superoxide dismutase)	104 IU

POSTBIOTICS/KG

Assimilation factors obtained from the lactic fermentation of germinated barley	12,000 mg

CLAYS/KG

Bentonite	16,300 mg
Clinoptilolite	16,000 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

The amount fed must be precisely adjusted according to:
- Horse body condition, weight and workload;
- Quantity, quality, and type of forage fed daily.

SPECIFIC RECOMMENDATIONS

Once the health of the horse has stabilised the use of ADULT SPECIFIC ENERGY will assure optimal digestive security during the return to work.

Elaborated and manufactured in our factory.

MASH

DESCRIPTION

Flake mix to distribute for after an intense muscular effort, a stressful/traumatising event, or on the day of a competition in endurance horses.

PRESENTATION

MADE IN FRANCE

PRODUCT GMO FREE* PRODUCT

PRODUCT NO MOLASSES PRODUCT

14 kg

COMPOSITION

Flaked barley, Flaked oats, WAXY variety flaked maize without GMO*, Flaked peas, Dehydrated carrots.

** <0.1% - French produced cereals*

WHY REVERDY MASH?

- **Reconstitution glycogen reserves depleted during effort ›** easily assimilated energy sources
- **Appetence ›** dehydrated carrots, flakes

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 0.8 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE	DAILY RATION		VOLUME OF WATER TO BE ADDED (L)
	KG	L	
Intensive muscular effort (following a race or a strenuous work session)	0.8 - 1.2	2 - 3	1 - 1.5
After an exhausting event (foaling, etc.)	0.8 - 1.2	2 - 3	1 - 1.5
During an endurance competition	0.4 - 0.8	1 - 2	0.5 - 1

The recommended amounts of MASH are given before adding water.

CONDITIONING

	Bag	Container
Expiration date :	6 months	4 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	12 %
Crude proteins	10.5 %
Crude fats	3 %
Crude fibre	7 %
Crude ash	2.5 %

CARBOHYDRATES/KG

Starch	470 g
Starch + Sugars	500 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	0.5 g
Linoleic acid (Omega 6)	12 g

AMINO ACIDS/KG

Lysine	4,450 mg
Threonine	3,650 mg
Methionine	1,750 mg

RATIONING VALUES/KG

UFC	0.99
DE (Digestible Energy)	12.8 MJ
Digestible protein	73 g

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Naturally lysine rich protein sources**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse.
We advise following these steps in the preparation:

- Horse body condition, weight and workload;
- Mix 2 parts of Mash to 1 part of very hot water;
- Cover the mixture and leave for about 10 minutes.
- Let cool before distributing.

Precautions for use
Do not exceed 3 litres per feed.

SPECIFIC RECOMMENDATIONS

These events often lead to heavy sweating in the horse, it is advisable to add REVERDY ELECTROLYTES to the ration of MASH.
Likewise, these situations cause stress to the horses' digestive system, it is recommended to add REVERDY INTESTINAL FLORA to the MASH ration.

For endurance horses: The evening following the event it is advisable to feed no hard feed, only hay and/or grass.

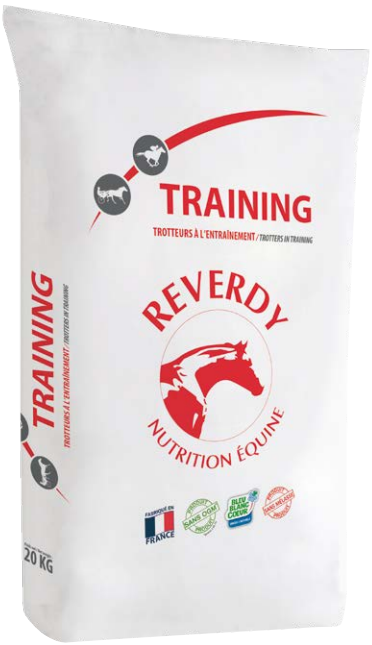
Elaborated and manufactured in our factory.

TRAINING

DESCRIPTION

Pelleted feed with flakes maize for adult racehorses in training.

PRESENTATION



MADE IN FRANCE

PRODUCT GMO FREE* PRODUCT

BLEU BLANC COEUR OMÉGA 3 NATURELS

PRODUCT NO MOLASSES PRODUCT

20 kg

COMPOSITION

Oats, Alfalfa 17 (HORSE), Barley, WAXY variety flaked maize without GMO*, TRADI-LIN extruded linseed, Soya bean meal without GMO*, Sepiolite, Dicalcium phosphate, Lithothamnion, Sodium Chloride, Postbiotics, Bentonite, Trace elements and Vitamins.

** <0.1% - French produced cereals and soya*

WHY REVERDY TRAINING?

- **Reinforced energy intake ›** based on oats, high level of extruded linseed and highly digestible flaked maize
- **Source of fibres ›** to promote good digestive health
- **Digestive security and better valuation of the ration ›** assimilated factors

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.3 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE	DAILY RATION	
	KG	L
Racing (training)	3.9 - 6.5	6 - 10

CONDITIONING

Expiration date :	Bag	Container	Vrac
	6 months	4 months	6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	12 %
Crude fats	5 %
Crude fibre	11 %
Crude ash	8.5 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.35 %
Sodium	0.2 %

CARBOHYDRATES/KG

Starch	305 g
Starch + Sugars	325 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	13 g
Linoleic acid (Omega 6)	13 g

AMINO ACIDS/KG

Lysine	5,200 mg
Threonine	4,550 mg
Methionine	2,050 mg

RATIONING VALUES/KG

UFC	0.88
DE (Digestible Energy)	12 MJ
Digestible protein	85 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	90 mg
Copper (Chloride tri hydroxide)	35 mg
Manganese (Oxide)	50 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	1,500 IU
Vitamin E	400 mg
Vitamin K3	2 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	0.5 mg
Vitamin B9 (Folic acid)	3.5 mg
Vitamin B12 (Cyanocobalamin)	0.1 mg

POSTBIOTICS/KG

Assimilation factors obtained from the lactic fermentation of germinated barley	3,000 mg

CLAY/KG

Bentonite	2,000 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Quantity, quality, and type of forage fed daily.

It is recommended to distribute meals of 1 to 2L and to split the daily ration into balanced meals.

Precautions for use
Do not exceed 3 litres per feed.

SPECIFIC RECOMMENDATIONS

For adult horses in hard work we advise feeding RACING.

Elaborated and manufactured in our factory.

RACING

DESCRIPTION

Pelleted feed with flaked maize for racehorses in training.

PRESENTATION

20 kg

COMPOSITION

Oat, Barley, Alfalfa 17 (HORSE), Waxy variety flaked maize without GMO*, TRADI-LIN extruded linseed, Extruded soya beans without GMO*, French soya bean meal without GMO*, Sepiolite, Sodium chloride, Lithothamnion, Dicalcium Phosphate, Postbiotics, Bentonite, Trace elements and Vitamins, Lyophilized melon juice and flesh.

** <0.1% - French produced cereals and soya*

WHY REVERDY RACING?

- **Reinforced energy intake ›** based on oats, high level of extruded linseed, extruded soya beans and highly digestible flaked maize
- **Muscular protection and development ›** lysine rich proteins, antioxidant complex
- **Digestive security and better valuation of the ration ›** assimilated factors
- **Red blood cells production ›** vitamins B9 and B12

RECOMMENDED DOSES

1 measure REVERDY : 2 L = 1.3 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE	DAILY RATION	
	KG	L
Racing (intensive training/Thoroughbred)	4.55 - 6.5	7 - 10

CONDITIONING

	Bag	Container	Vrac
Expiration date :	6 months	4 months	6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	13 %
Crude fats	6 %
Crude fibre	10 %
Crude ash	9.5 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.4 %
Sodium	0.4 %

CARBOHYDRATES/KG

Starch	290 g
Starch + Sugars	315 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	17 g
Linoleic (Omega 6)	17 g

AMINO ACIDS/KG

Lysine	5,900 mg
Threonine	4,950 mg
Methionine	2,150 mg

RATIONING VALUES/KG

UFC	0.90
DE (Digestible Energy)	12.4 MJ
Digestible protein	94 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	90 mg
Copper (Chloride tri hydroxide)	35 mg
Manganese (Oxide)	50 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	1,500 IU
Vitamin E	600 mg
Vitamin K3	2 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	0.5 mg
Vitamin B9 (Folic acid)	7 mg
Vitamin B12 (Cyanocobalamin)	0.2 mg
Vitamin C protected (Phosphorylated L-ascorbic acid)	1,000 mg

NATURAL ANTIOXIDANT/KG

Melon extract: SOD activity (Superoxide dismutase)	104 IU

POSTBIOTICS/KG

Assimilation factors obtained from the lactic fermentation of germinated barley	6,000 mg

CLAY/KG

Bentonite	5,300 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

It is recommended to distribute meals of 1 to 2L and to split the daily ration into balanced meals.

Precautions for use
Do not exceed 3 litres per feed.

SPECIFIC RECOMMENDATIONS

Switch to TRAINING when work intensity decreases.

Elaborated and manufactured in our factory.

BREEDING

DESCRIPTION

Pelleted feed for youngstock and broodmares.

PRESENTATION

20 kg

COMPOSITION

Barley, Oats, Alfalfa 17 (HORSE), Soya bean meal without GMO*, Maize without GMO*, TRADI-LIN extruded linseed, Sepiolite, Dicalcium phosphate, Lithothamnion, Sodium Chloride, Trace elements and Vitamins.

* <0.1% - French produced cereals and soya

WHY REVERDY BREEDING?

- **Optimal growth** › high level of lysine rich proteins, increased vitamin B9 dosage
- **Osteo-articular development** › trace-elements, vitamins D3 and K3 to reinforced doses

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.4 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATION	
		KG	L
Broodmares	Gestation months 1 - 8	1.4 - 2.8	2 - 4
	Gestation months 9 - 11	2.8 - 4.2	4 - 6
	Lactation months 1 - 3	4.2 - 5.6	6 - 8
	Lactation > 3 months	2.8 - 4.2	4 - 6
Youngstocks	From weaning up to breaking-in	1.4 - 2.8	2 - 4
	Breaking-in / Pre-training	2.8 - 4.2	4 - 6
Stallion	Covering	4.2 - 5.6	6 - 8

CONDITIONING



	Bag	Container	Vrac
Expiration date :	6 months	4 months	6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	16 %
Crude fats	4 %
Crude fibre	9.5 %
Crude ash	9 %
Calcium	1.2 %
Phosphorus	0.6 %
Magnesium	0.3 %
Sodium	0.2 %

CARBOHYDRATES/KG

Starch	285 g
Starch + Sugars	315 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	10.5 g
Linoleic acid (Omega 6)	10.5 g

AMINO ACIDS/KG

Lysine	7,900 mg
Threonine	6,100 mg
Methionine	2,500 mg

RATIONING VALUES/KG

UFC	0.87
DE (Digestible Energy)	12.2 MJ
Digestible protein	121 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	180 mg
Copper (Chloride tri hydroxide)	70 mg
Manganese (Oxide)	100 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	2,000 IU
Vitamin E	400 mg
Vitamin K3	3.5 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	0.5 mg
Vitamin B9 (Folic acid)	5 mg
Vitamin B12 (Cyanocobalamin)	0.10 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

Split the daily ration into balanced meals.

Precautions for use

Youngstocks: it is recommended to distribute meals of a maximum size of 1L at the age of 6 months, 1.5L at the age of 1 year and 2L starting from 18 months.

Broodmares: it is advisable to ration them up to 2L maximum per meal in gestation and 3L maximum per meal in lactation.

SPECIFIC RECOMMENDATIONS

If the forage (hay or grass) being fed to the mares contains good protein levels it is possible to feed an identical quantity of ADULT ENERGY instead of BREEDING during early pregnancy (months 1 to 8) and in late lactation (> 3 months).

Elaborated and manufactured in our factory.

FOAL

DESCRIPTION

Pelleted feed for foal, containing milk.

PRESENTATION

20 kg

COMPOSITION

Barley, Oats, Soya bean meal without GMO*, TRADI-LIN extruded linseed, Skimmed milk powder, Alfalfa 17 (HORSE), extruded soya beans, Sepiolite, Lithothamnion, Dicalcium phosphate, Sodium chloride, Postbiotics, Bentonite, Trace elements and Vitamins.

** <0.1% - French produced cereals and soya*

WHY REVERDY FOAL?

- **Progressive transition towards a 100 % vegetable diet** › skimmed milk powder, increased level of extruded linseed, extruded soya beans
- **Optimal growth** › high level of lysine rich proteins, increased vitamin B9 dosage
- **Osteo-articular development** › trace-elements, vitamins D3 and K3 to reinforced doses
- **Digestive security and better valuation of the ration** › assimilated factors

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.4 KG

For a foal which the adult weight will be 500 kg

AGE	DAILY RATION	
	KG	L
Nursing foal		
15 days	1 handful	-
1 month old	0.2	¼
1 ½ months old	0.35	½
2 months old	0.5	¾
3 months old	0.7	1
4 months old	1.1	1.5
6 months old	1.4	2
From 9 months old	2.1	3

CONDITIONING

Expiration date :	Bag	Container
	6 months	4 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	18 %
Crude fats	6 %
Crude fibre	7.5 %
Crude ash	10 %
Calcium	1.2 %
Phosphorus	0.6 %
Magnesium	0.4 %
Sodium	0.2 %

CARBOHYDRATES/KG

Starch	245 g
Starch + Sugars	305 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	17.5 g
Linoleic acid (Omega 6)	17.5 g

AMINO ACIDS/KG

Lysine	9,750 mg
Threonine	7,000 mg
Methionine	3,100 mg

RATIONING VALUES/KG

UFC	0.93
DE (Digestible Energy)	13.2 MJ
Digestible protein	141 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	180 mg
Copper (Chloride tri hydroxide)	70 mg
Manganese (Oxide)	100 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	2,500 IU
Vitamin E	400 mg
Vitamin K3	3.5 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	0.5 mg
Vitamin B9 (Folic acid)	5 mg
Vitamin B12 (Cyanocobalamin)	0.10 mg

POSTBIOTICS/KG

Assimilation factors obtained from the lactic fermentation of germinated barley	4,000 mg

CLAY/KG

Bentonite	2,500 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of horse which the adult weight will be 500 kg, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Foal body condition, weight and workload;
- Foal stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

It is recommended to distribute meals of 1 to 2L and to split the daily ration into balanced meals.

Race horses should be fed with a more traditional ration based on oat more than barley.

Precautions for use
Distribute the recommended rations in 2 feeds minimum.

SPECIFIC RECOMMENDATIONS

It is advisable to use Foal until the age of 8 months. Supply of milky proteins reinforce essential amino acids content, which allows to maintain optimal development during the critical phase of weaning.

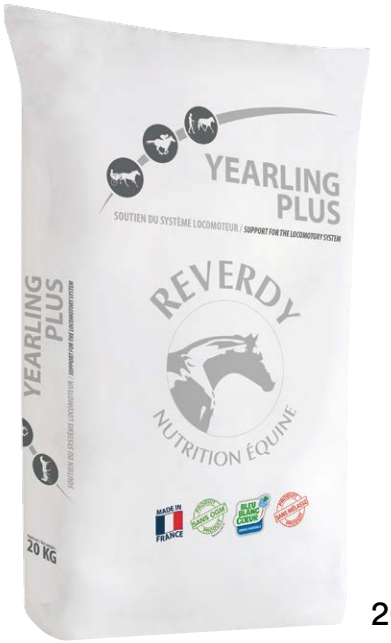
Elaborated and manufactured in our factory.

YEARLING PLUS

DESCRIPTION

Pelleted feed young for horses in training.
Support to osteo-articular system.
Support of hoof wall growth.

PRESENTATION



20 kg

COMPOSITION

Barley, Alfalfa 17 (HORSE), Oats, French soya bean meal without GMO*, Maize without GMO*, TRADI-LIN extruded linseed, Sepiolite, Dicalcium phosphate, Lithothamnion, Sodium chloride, Chondroprotective agents, Trace elements and Vitamins.

* <0.1% - French produced cereals and soya

WHY REVERDY YEARLING PLUS?

- **Optimal growth** › high level of lysine rich proteins, increased vitamin B9 dosage
- **Osteo-articular development** › trace elements, vitamins D3 and K3 to reinforced doses
- **Articulations (joint) protection and support** › chondroitin, glucosamine, MSM
- **Hooves horn growth and quality** › biotin

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.4 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATION	
		KG	L
Youngstocks	From weaning up to breaking-in	1.4 - 2.8	2 - 4
	Breaking-in / Pre-training	2.8 - 4.2	4 - 6

CONDITIONING

Expiration date :	Bag	Vrac
	6 months	6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	16 %
Crude fats	4 %
Crude fibre	9.5 %
Crude ash	9 %
Calcium	1.2 %
Phosphorus	0.6 %
Magnesium	0.3 %
Sodium	0.2 %

CARBOHYDRATES/KG

Starch	285 g
Starch + Sugars	315 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	11 g
Linoleic acid (Omega 6)	10.5 g

AMINO ACIDS/KG

Lysine	7,900 mg
Threonine	6,100 mg
Methionine	2,500 mg

RATIONING VALUES/KG

UFC	0.87
DE (Digestible Energy)	12.2 MJ
Digestible protein	121 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	180 mg
Copper (Chloride tri hydroxide)	70 mg
Manganese (Oxide)	100 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	2,500 IU
Vitamin E	400 mg
Vitamin K3	3.5 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	4 mg
Vitamin B9 (Folic acid)	5 mg
Vitamin B12 (Cyanocobalamin)	0.10 mg

CHONDROPROTECTIVE AGENTS/KG

Glucosamine (Sulphate 2 KCl)	2,000 mg
MSM (Methylsulfonylmethane)	2,000 mg
Chondroitin (Sulphate)	400 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg (young) horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

Split the daily ration into balanced meals.

Precautions for use
It is recommended to distribute meals of a maximum size of 1L at the age of 6 months, 1.5L at the age of 1 year and 2L starting from 18 months

SPECIFIC RECOMMENDATIONS

If less than the recommended quantity of YEARLING PLUS is being fed, the supply of chondroprotective agents will not reach their minimum daily effective dose. In this case it is preferable to feed BREEDING associated with a maintenance dose of REVERDY FLEXY.

Elaborated and manufactured in our factory.

SALES PREP

DESCRIPTION

Pelleted feed with flaked maize for the sale ring.

PRESENTATION

20 kg

COMPOSITION

Oats, Alfalfa 17 (HORSE), Flaked maize without GMO*, Barley, Soya bean meal without GMO*, Maize without GMO*, TRADI-LIN Extruded linseed, Extruded soya beans without GMO*, Chicory pulp, Skimmed milk powder, Sepiolite, Lithothamnion, Postbiotics, Dicalcium phosphate, Bentonite, Sodium chloride, Trace elements and Vitamins.

** <0.1% - French produced cereals and soya*

WHY REVERDY SALES PREP?

- **Muscular development ›** lysine rich proteins
- **Body condition gain ›** highly digestible flaked maize, fats rich in omega 3 and 6, skimmed milk, assimilated factors
- **Digestive security and better valuation of the ration ›** assimilated factors

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.3 KG

500 kg adult horse

DIRECTIONS FOR USE	DAILY RATION	
	KG	L
2 - 3 months before the sale date	2.6 - 3.9	4 - 6
1 - 2 months before the sale date	3.9 - 6.5	6 - 10

CONDITIONING

Expiration date :	Bag	Container
	4 months	4 months

Seasonal product available from May to November

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	16 %
Crude fats	6 %
Crude fibre	9 %
Crude ash	9 %
Calcium	1 %
Phosphorus	0.5 %
Magnesium	0.45 %
Sodium	0.1 %

CARBOHYDRATES/KG

Starch	265 g
Starch + Sugars	310 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	17 g
Linoleic acid (Omega 6)	17 g

AMINO ACIDS/KG

Lysine	8,050 mg
Threonine	6,100 mg
Methionine	2,700 mg

RATIONING VALUES/KG

UFC	0.92
DE (digestible Energy)	12.9 MJ
Digestible protein	120 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	90 mg
Copper (Chloride tri hydroxide)	35 mg
Manganese (Oxide)	50 mg
Iron (Sulphate)	35 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Organic selenium)	0.5 mg

VITAMINS/KG

Vitamin A	15,000 IU
Vitamin D3	1,500 IU
Vitamin E	400 mg
Vitamin K3	2 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	15 mg
Vitamin B3 (PP or Niacin)	35 mg
Vitamin B5 (Pantothenic acid)	15 mg
Vitamin B6 (Pyridoxine)	10 mg
Vitamin B8 (Biotin)	0.5 mg
Vitamin B9 (Folic acid)	3.5 mg
Vitamin B12 (Cyanocobalamin)	0.10 mg

POSTBIOTICS/KG

Assimilation factors obtained from the lactic fermentation of germinated barley	6,000 mg

CLAYS/KG

Bentonite	4,000 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg (young) horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

Split the daily ration into balanced meals.

Precautions for use
Do not exceed 2 litres per feed.

Elaborated and manufactured in our factory.

CEREAL BALANCER

DESCRIPTION

Pelleted cereal balancer formulated for growing youngsters and broodmares. Suitable also for horses in work.

PRESENTATION

20 kg

COMPOSITION

Soya bean meal without GMO*, Alfalfa 17 (HORSE), TRADI-LIN extruded linseed, Barley, Oats, Dicalcium phosphate, Lithothamnion, Sodium chloride, Trace elements and Vitamins.

* <0.1% - French produced cereals and soya

WHY REVERDY CEREAL BALANCER?

- **Corrects the deficiencies and imbalances of cereals** › source of calcium, lysine rich proteins, fats rich in omega 3, vitamins and trace elements
- **Optimal muscular growth and development** › high level of lysine rich proteins, increased vitamin B9 dosage
- **Osteo-articular development** › trace-elements, vitamins D3 and K3 to reinforced doses

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.4 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATIONS		
		BALANCER		CEREALS
		KG	L	KG
Stallions	Out of breeding season	0.5 - 0.7	¾ - 1	1 - 3.5
	Covering	1 - 2.1	1 ½ - 3	2 - 4
Broodmares	Mares	0.5	¾	1 - 2.5
	Gestation 1-8 months	0.5 - 1	¾ - 1 ½	1 - 2
	Gestation 9 - 11 months	1 - 1.4	1 ½ - 2	2 - 3
	Lactation 1 - 3 months	1.4 - 2.1	2 - 3	3 - 4
Youngstocks	From weaning-up to breaking-in	1 - 1.4	1 ½ - 2	0.75 – 2
	Breaking-in/ Pre-training	1 - 1.4	1 ½ - 2	2 – 3
Equestrian sports	Moderate workload	0.5 - 0.7	¾ - 1	2.5 - 3.5
Leisures activities, instructions and trekkings	Moderate workload	0.5	¾	1.5 - 3

CONDITIONING

Bag

Expiration date : 6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	25 %
Crude fats	5 %
Crude fibre	12.5 %
Crude ash	16 %
Calcium	3 %
Phosphorus	1 %
Magnesium	0.3 %
Sodium	0.4 %

CARBOHYDRATES/KG

Starch	45 g
Starch + Sugars	95 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	20 g
Linoleic acid (Omega 6)	9.5 g

AMINO ACIDS/KG

Lysine	13,950 mg
Threonine	9,900 mg
Methionine	3,650 mg

RATIONING VALUES/KG

UFC	0.73
DE (Digestible Energy)	11.6 MJ
Digestible protein	197 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	450 mg
Copper (Chloride tri hydroxide)	175 mg
Manganese (Oxide)	250 mg
Iron (Sulphate)	90 mg
Iodine (Calcium iodate)	1.25 mg
Selenium (Organic selenium)	1.25 mg

VITAMINS/KG

Vitamin A	37,500 IU
Vitamin D3	6,250 IU
Vitamin E	1,000 mg
Vitamin K3	8.8 mg
Vitamin B1 (Thiamin)	50 mg
Vitamin B2 (Riboflavin)	37.5 mg
Vitamin B3 (PP or Niacin)	87.5 mg
Vitamin B5 (Pantothenic acid)	37.5 mg
Vitamin B6 (Pyridoxine)	25 mg
Vitamin B8 (Biotin)	1.3 mg
Vitamin B9 (Folic acid)	12.5 mg
Vitamin B12 (Cyanocobalamin)	0.25 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg (young) horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

Split the daily ration into balanced meals.

For rations rich in cereals, it is advisable to prefer oats to barley.

Precautions for use
Distribute at most per meal: 0.5 kg of cereals in youngstocks under 1 year old and 1.5 kg of cereals in adults.

SPECIFIC RECOMMENDATIONS

In order to limit the quantity of cereals distributed, it is advisable to add OMEGA OIL oil to the ration.

For sports horses and racing horses in moderate to hard work it is preferable to use RACING BALANCER.

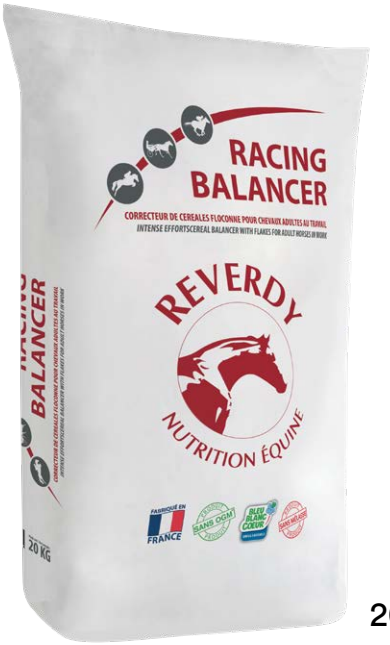
Elaborated and manufactured in our factory.

RACING BALANCER

DESCRIPTION

Flaked cereal balancer for adult horses in work.

PRESENTATION



20 kg

COMPOSITION

FRENCH Soya bean meal without GMO*, Alfalfa 17 (HORSE), WAXY variety flaked maize without GMO*, TRADI-LIN Extruded linseed, Barley, Lithothamnion, Sepiolite, Dicalcium phosphate, Sodium Chloride, Trace elements and Vitamins.

* <0.1% - French produced cereals and soya

WHY REVERDY RACING BALANCER?

- **Corrects the deficiencies and imbalances of cereals** › source of calcium, lysine rich proteins, fats rich in omega 3 and 6, vitamins and trace elements
- **Reinforced energy intake** › diversified energy sources
- **Optimal musculoskeletal development** › lysine rich proteins

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.3 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE		DAILY RATION		
		BALANCER		CEREALS
		KG	L	KG
Racing	Trotter	1 - 2	1.5 - 3	3 - 4
	Thoroughbred			
Equestrian sports	Moderate to heavy workload	1 - 2	1.5- 3	2 - 3

CONDITIONING

Bag

Expiration date : 6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	19 %
Crude fats	5.5 %
Crude fibre	9 %
Crude ash	16.5 %
Calcium	2.8 %
Phosphorus	0.7 %
Magnesium	0.5 %
Sodium	0.4 %

CARBOHYDRATES/KG

Starch	185 g
Starch + Sugars	220 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	22.5 g
Linoleic acid (Omega 6)	12 g

AMINO ACIDS/KG

Lysine	9,950 mg
Threonine	7,500 mg
Methionine	2,900 mg

RATIONING VALUES/KG

UFC	0.81
DE (Digestible Energy) MJ	12 MJ
Digestible protein	148 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	270 mg
Copper (Chloride tri hydroxide)	105 mg
Manganese (Oxide)	150 mg
Iron (Sulphate)	105 mg
Iodine (Calcium iodate)	1.5 mg
Selenium (Organic selenium)	1.5 mg

VITAMINS/KG

Vitamin A	45,000 IU
Vitamin D3	4,500 IU
Vitamin E	1,200 mg
Vitamin K3	6 mg
Vitamin B1 (Thiamin)	60 mg
Vitamin B2 (Riboflavin)	45 mg
Vitamin B3 (PP or Niacin)	105 mg
Vitamin B5 (Pantothenic acid)	45 mg
Vitamin B6 (Pyridoxine)	30 mg
Vitamin B8 (Biotin)	1.5 mg
Vitamin B9 (Folic acid)	10.5 mg
Vitamin B12 (Cyanocobalamin)	0.30 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Cereals of French origin**
- ✓ **Oils and fats rich in Omegas 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

Split the daily ration into balanced meals.

Race horses should be fed with a more traditional ration based on oat more than barley.

Precautions for use
Do not exceed 1.5kg of cereals per feed.

SPECIFIC RECOMMENDATIONS

In order to limit the quantity of cereals distributed, it is advisable to add OMEGA OIL oil to the ration.

Elaborated and manufactured in our factory.

CEREAL FREE

DESCRIPTION

Pelleted hay balancer, grain free, for horses and ponies.

PRESENTATION

MADE IN FRANCE

PRODUCT GMO FREE PRODUCT

BLEU BLANC COEUR OMÉGA 3 NATURELS

PRODUCT NO MOLASSES PRODUCT

20 kg

COMPOSITION

Alfalfa 17 (HORSE), Extruded soya beans without GMO*, Soya bean meal without GMO*, Chicory pulp, Extruded linseed, Dehydrated carrots, Magnesium phosphate, Postbiotics, Bentonite, Sodium chloride, Trace elements and Vitamins.

** <0.1% - French produced soya*

WHY REVERDY CEREAL FREE?

- **Grain free**
- **Source of assimilated factors and fibres**
- **Covers daily requirements of trace elements , vitamins and essential amino acids**
- **Source of Omega 3 and 6**

RECOMMENDED DOSES

1 measure REVERDY (2 L) = 1.4 KG

500 kg adult horse

ACTIVITY OR PHYSIOLOGICAL PHASE	DAILY RATION	
	KG	L
At rest	1 - 1.4	1.5 - 2
Equestrian sports/ Leisure activities / Low to moderate work	1.4 - 2.1	2 - 3

Grain free pelleted feed for horses and ponies whose energy needs are covered by forage intake.

Due to the presence of high levels of trace elements and vitamins, **respect the daily recommended doses.**

CONDITIONING

Bag

Expiration date : 6 months

COMPOSITION

ANALYTICAL CONSTITUENTS

Humidity	11.5 %
Crude proteins	20 %
Crude fats	7 %
Crude fibre	16 %
Crude ash	11.5 %
Calcium	1.3 %
Phosphorus	0.7 %
Magnesium	0.7 %
Sodium	0.25 %

CARBOHYDRATES/KG

Starch	10.5 g
Starch + Sugars	76 g

ESSENTIAL FATTY ACIDS/KG

Linolenic acid (Omega 3)	20 g
Linoleic acid (Omega 6)	20 g

AMINO ACIDS/KG

Lysine	10,700 mg
Threonine	7,700 mg
Methionine	3,000 mg

RATIONING VALUES/KG

UFC	0.75
DE (Digestible Energy)	11.6 MJ
Digestible protein	145 g

TRACE ELEMENTS/KG

Zinc (Chloride hydroxide)	180 mg
Copper (Chloride tri hydroxide)	70 mg
Manganese (Oxide)	100 mg
Iron (Sulphate)	70 mg
Iodine (Calcium iodate)	1 mg
Selenium (Organic selenium)	1 mg

VITAMINS/KG

Vitamin A	30,000 IU
Vitamin D3	3,000 IU
Vitamin E	800 mg
Vitamin K3	4 mg
Vitamin B1 (Thiamin)	40 mg
Vitamin B2 (Riboflavin)	30 mg
Vitamin B3 (PP or Niacin)	70 mg
Vitamin B5 (Pantothenic acid)	30 mg
Vitamin B6 (Pyridoxine)	20 mg
Vitamin B8 (Biotin)	1 mg
Vitamin B9 (Folic acid)	7 mg
Vitamin B12 (Cyanocobalamin)	0.2 mg

POSTBIOTICS/KG

Assimilated factors obtained from the lactic fermentation of germinated barley	10,000 mg

CLAY/KG

Bentonite	6,680 mg

THE REVERDY QUALITY

Raw ingredients selected for their nutritional qualities

- ✓ **No molasses**
- ✓ **No GMO (<0.1%)**
- ✓ **Oils and fats rich in Omega 3 and 6**
- ✓ **French soya naturally rich in lysine**
- ✓ **Optimal doses of vitamins**
- ✓ **Easily assimilated Trace elements (zinc, copper, selenium)**

DIRECTIONS FOR USE

These recommendations are based on the requirements of a 500 kg horse, fed ad-lib quality hay with free access to a pure salt block and clean water.
The amount fed must be precisely adjusted according to:

- Horse body condition, weight and workload;
- Horse stabling and climatic conditions;
- Quantity, quality, and type of forage fed daily.

It is best to distribute 1L maximum per meal.

Precautions for use
For horses prone to oesophageal plugs, this feed needs to be soaked, ideally with slightly warm water. Wait for pellet complete disintegration before feeding.

Elaborated and manufactured in our factory.

Vitamin & mineral supplement

OLIGOVIT MINERAL

DESCRIPTION

Vitamin and mineral supplement, supplying protected vitamins and easily assimilable trace elements.
Suitable for all horses.

INDICATIONS

Covers daily requirements in trace elements and vitamins.
For horses and ponies receiving a diet containing sufficient calcium but lacking in vitamins and trace elements:

- exclusively hay or grass diet;
- "traditional" cereal based feeds or industrial compound feeds, providing good levels of calcium but deficient in vitamins and trace elements.

1.3 kg 3 kg 10 kg 20 kg

DIRECTIONS FOR USE

Can be fed alone or mixed with cereals or feeds.

In the case of feeding alongside an industrial feed the amount of **REVERDY OLIGOVIT MINERAL** to be given will depend on the quantity of industrial feed being fed and the levels of vitamins and trace elements provided by the latter. **1 measure = 30 g**

ADULT HORSE (500 KG)	RECOMMENDED DAILY DOSE
Maintenance	1 to 2 measures (equivalent to 30 to 60 g)
Horse in work	1 to 3 measures (equivalent to 30 to 90 g)
Growing foals	1 to 2 measures (equivalent to 30 to 60 g)
Stallions and broodmares	1 to 3 measures (equivalent to 30 to 90 g)

For ponies, administer a daily dose in proportion to the animal's liveweight.

NON DOPING PNFS*

**Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme)*

MADE IN FRANCE

Small pellets

COMPOSITION

Barley, magnesium oxide, calcium and sodium phosphate, calcium carbonate, fructose.

PER KG

Zinc (Chloride hydroxide)	6,500 mg
Copper (Chloride tri hydroxide)	2,500 mg
Manganese (Oxide)	3,500 mg
Iodine (Calcium iodate)	35 mg
Selenium (Organic selenium)	30 mg
Vitamin A	750,000 IU
Vitamin D3	75,000 IU
Vitamin E	15,000 mg
Vitamin K3	150 mg
Vitamin B1 (Thiamin)	700 mg
Vitamin B2 (Riboflavin)	700 mg
Vitamin B3 (PP ou Niacin)	1,400 mg
Vitamin B5 (Pantothenic acid)	700 mg
Vitamin B6 (Pyridoxine)	400 mg
Vitamin B8 (Biotin)	20 mg
Vitamin B9 (Folic acid)	550 mg
Vitamin B12 (Cyanocobalamin)	5 mg

ANALYTICAL CONSTITUENTS

Humidity	12.5%
Total Protein	8%
Crude Fats and oils	1.5%
Crude Fibre	3.5%
Crude Ash	21%
Calcium	2%
Phosphorus	1%
Magnesium	3.5%
Sodium	0.1%

1 MEASURE OF OLIGOVIT MINERAL (30 G) PROVIDES

195 mg of zinc, 75 mg of copper, 105 mg of manganese, 1.1 mg of iodine, 0.9 mg of organic selenium, 22,500 IU of vitamin A, 2,250 IU of vitamin D3, 450 mg of vitamin E, 4.5 mg of vitamin K3, 21 mg of vitamin B1, 21 mg of vitamin B2, 42 mg of vitamin B3, 21 mg of vitamin B5, 12 mg of vitamin B6, 0.6 mg of vitamin B8, 16.5 mg of vitamin B9 and 0.15 mg of vitamin B12.

PROPERTIES

The **vitamins** and **trace elements** are essential for the correct functioning of the organism in foals, youngstock, adult horses at rest, in work or breeding stock.

Copper and **zinc** are supplied in "hydroxide" form which offers better bio-availability than the inorganic forms (sulphate, oxide, etc.). Furthermore, this particular type of supply protects the vitamins within REVERDY OLIGOVIT MINERAL. As a result, these two trace elements are transported within a crystalline matrix structure that prevents them carrying out their pro-oxidant effect on the vitamins.

100% of the **selenium** provided is in the form of selenomethionine, the principal form under which selenium is stored in the organism. Selenium stemming from this organic source is better assimilated and stored than sodium selenite (the inorganic form).

Supplying **vitamins A, D and E** is indispensable to the correct functioning of the organism as they are unable to be synthesised by the body. Even if **vitamins K and B can** be produced by the intestinal flora, supplementation is advisable. It avoids any production failure by the flora and optimally covers daily requirements, notably in intensively worked horses, who, in addition to increased requirements, often exhibit a weakened flora.

PRECAUTIONS FOR USE

This product must not be distributed if a concentrate/compound feed containing good levels of vitamins and trace elements is already being fed in sufficient quantity.

If the diet is lacking in calcium, it is preferable to use REVERDY BREEDING MINERAL or REVERDY RACING MINERAL, depending on the age and activity of the horse.

Because of the high levels of vitamins and trace elements (including selenium) present, respect the recommendations for use.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 12 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Vitamin & mineral supplement

RACING MINERAL

DESCRIPTION

Vitamin and mineral supplement, source of marine calcium, protected vitamins and easily assimilable trace elements.
Suited to horses in work.

INDICATIONS

Covers daily requirements in calcium, trace elements and vitamins.
For working horses and ponies receiving a ration deficient in calcium, vitamins and trace elements.

4 kg 12.5 kg

DIRECTIONS FOR USE

Distribute with cereals. Mix well into the ration.
1 measuring cup = 115 g

ADULT HORSE (500 KG)	RECOMMENDED DAILY DOSE
Light to moderate work	⅓ to ⅔ measuring cup (equivalent to 38 to 77 g)
Moderate to heavy work	⅔ to 1 measuring cup (equivalent to 77 to 115 g)

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

For ponies, administer a daily dose in proportion to the animal's liveweight.

Small pellets

COMPOSITION

Lithothamnion, maize, calcium and sodium phosphate, barley, extruded linseed, extruded soya beans*, magnesium oxide, fructose.

** whithout GMO (< 0.1%)*

PER KG

Zinc (Chlorure hydroxide)	3,850 mg
Copper (Chlorure tri hydroxide)	1,450 mg
Manganese (Oxide)	1,450 mg
Iodine (Calcium iodate)	25 mg
Selenium (Organic selenium)	25 mg
Vitamin A	785,000 IU
Vitamin D3	78,500 IU
Vitamin E	26,100 mg
Vitamin K3	96 mg
Vitamin B1 (Thiamin)	875 mg
Vitamin B2 (Riboflavin)	600 mg
Vitamin B3 (PP or Niacin)	1,750 mg
Vitamin B5 (Pantothenic acid)	700 mg
Vitamin B6 (Pyridoxine)	435 mg
Vitamin B8 (Biotin)	175 mg
Vitamin B9 (Folic acid)	190 mg
Vitamin B12 (Cyanocobalamin)	4.5 mg
Vitamin C protected (Phosphorylated L-ascorbic acid)	17,500 mg

ANALYTICAL CONSTITUENTS

Humidity	9 %
Total Protein	5.5 %
Crude Fats and oils	6.5 %
Crude Fibre	1.5 %
Crude Ash	48.5 %
Calcium	15 %
Phosphorus	2.5 %
Magnesium	2.5 %
Sodium	1.4 %

1 MEASURING CUP (115 G) OF RACING MINERAL PROVIDES

443 mg of zinc, 167 mg of copper, 167 mg of manganese, 2.9 mg of iodine, 2.9 mg of organic selenium, 90,275 IU of vitamin A, 9,028 IU of vitamin D3, 3,002 mg of vitamin E, 11 mg of vitamin K3, 101 mg of vitamin B1, 69 mg of vitamin B2, 201 mg of vitamin B3, 81 mg of vitamin B5, 50 mg of vitamin B6, 20 mg of vitamin B8, 22 mg of vitamin B9, 0.5 mg of vitamin B12 and 2,013 mg of protected vitamin C.

PROPERTIES

Lithothamnion is calcareous seaweed presenting a sponge like ("honeycomb") structure. These special characteristics explain its prolonged and highly effective buffering effect in an acid environment. Its effectiveness in neutralising the acid secretions of the stomach has been validated in the horse. Likewise, calcium of marine origin is more assimilable than calcium carbonate from chalk. An increase in bone mineralisation and renewal has been demonstrated after supplementing for 112 days with lithothamnion compared to calcium carbonate from chalk.

The supply of **calcium** corrects the phosphorus to calcium unbalance of "traditional" cereal and grass/hay based rations.

The **vitamins and trace elements** are essential for the correct functioning of the organism in foals, youngstock, adult horses at rest, in work or breeding stock.

Copper and **zinc** are supplied in "hydroxide" form which offers better bio-availability than the inorganic forms (sulphate, oxide, etc.). Furthermore, this particular type of supply protects the vitamins within RACING MINERAL. Indeed, these two trace elements are transported within a crystalline matrix structure, that prevents them carrying out their pro-oxidant effect on the vitamins.

100% of the **selenium** provided is in the form of selenomethionine, the principal form under which selenium is stored in the organism. Selenium stemming from this organic source is better assimilated and stored than sodium selenite (the inorganic form).

Supplying **vitamins A, D and E** is indispensable in order for the organism to function correctly as they are unable to be synthesised by the body. Even if **vitamins K and B** can be produced by the intestinal flora, and **vitamin C** by the liver, supplementing with these vitamins is advisable. It provides against any endogenous production failure and optimally covers daily requirements in working horses, who, in addition to increased requirements, often exhibit a weakened intestinal flora and liver functioning.

At a dose of approximately 20 mg a day, **biotin** (**vitamin B8**) improves the growth rate and hardness of the hoof wall.

PRECAUTIONS FOR USE

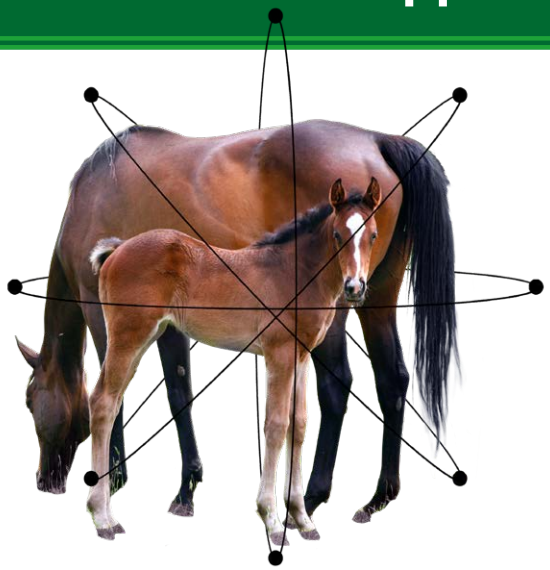
Because of the high levels of vitamins and trace elements (including selenium) present, respect the recommendations for use.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 12 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Vitamin & mineral supplement



BREEDING MINERAL

DESCRIPTION

Vitamin and mineral supplement, source of calcium, protected vitamins and easily assimilable trace elements.
For growing youngsters and broodmares.

INDICATIONS

Covers daily requirements in trace elements and vitamins.
For broodmares and growing youngsters receiving a diet deficient in calcium, vitamins and trace elements.

4 kg 12.5 kg

DIRECTIONS FOR USE

Distribute with cereals. Mix well into the ration.
1 measure = 45 g

ADULT HORSE (500 KG)	RECOMMENDED DAILY DOSE
Foals from weaning up to breaking in	1 to 2 measures (equivalent to 45 to 90 g)
Broodmares	1 to 3 measures (equivalent to 45 to 135 g)

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

For ponies, administer a daily dose in proportion to the animal's liveweight.

Small pellets

COMPOSITION

Calcium carbonate, calcium and sodium phosphate, corn (maize), magnesium oxide, barley, extruded soya beans*, extruded linseed, fructose.

**Without GMO (<0.1%)*

PER KG

Zinc (Chloride hydroxide)	5,000 mg
Copper (Chloride tri hydroxide)	2,000 mg
Manganese (Oxide)	3,000 mg
Iodine (Calcium iodate)	18.5 mg
Selenium (Organic selenium)	15 mg
Vitamin A	450,000 IU
Vitamin D3	65,000 IU
Vitamin E	9,000 mg
Vitamin K3	120 mg
Vitamin B1 (Thiamin)	500 mg
Vitamin B2 (Riboflavin)	500 mg
Vitamin B3 (PP ou Niacin)	1,000 mg
Vitamin B5 (Pantothenic acid)	500 mg
Vitamin B6 (Pyridoxine)	300 mg
Vitamin B8 (Biotin)	15 mg
Vitamin B9 (Folic acid)	400 mg
Vitamin B12 (Cyanocobalamin)	4 mg

ANALYTICAL CONSTITUENTS

Humidity	9%
Total Protein	5%
Crude Fats and oils	3.5%
Crude Fibre	1.5%
Crude Ash	63%
Calcium	18%
Phosphorus	3%
Magnesium	4.5%
Sodium	0.1%

1 MEASURE OF BREEDING MINERAL (45 G) PROVIDES

225 mg of zinc, 90 mg of copper, 135 mg of manganese, 0.8 mg of iodine, 0.7 mg of organic selenium, 20,250 IU of vitamin A, 2,925 IU of vitamin D3, 405 mg of vitamin E, 5.4 mg of vitamin K3, 22.5 mg of vitamin B1, 22.5 mg of vitamin B2, 45 mg of vitamin B3, 22.5 mg of vitamin B5, 13.5 mg of vitamin B6, 0.7 mg of vitamin B8, 18 mg of vitamin B9 and 0.2 mg of vitamin B12.

PROPERTIES

The supply of **calcium** corrects the phosphorus to calcium unbalance of "traditional" cereal and grass/hay based rations.

The **vitamins** and **trace elements** are essential for the correct functioning of the organism in foals, youngstock, adult horses at rest, in work or breeding stock.

Copper and **zinc** are supplied in "hydroxide" form which offers better bio-availability than the inorganic forms (sulphate, oxide, etc.). Furthermore, this particular type of supply protects the vitamins within BREEDING MINERAL. As a result, these two trace elements are transported within a crystalline matrix structure, that prevents them carrying out their pro-oxidant effect on the vitamins.

100% of the **selenium** provided is in the form of selenomethionine, the principal form under which selenium is stored in the organism. Selenium stemming from this organic source is better assimilated and stored than sodium selenite (the inorganic form).

Supplying **vitamins A, D** and **E** is indispensable to the correct functioning of the organism as they are unable to be synthesised by the body. Even if **vitamins K and B** can be produced by the intestinal flora, supplementation is advisable. It avoids any production failure by the flora and optimally covers daily requirements.

PRECAUTIONS FOR USE

This product must not be given in addition to the feeding of a sufficient quantity of a concentrate/compound feed containing good amounts of calcium, vitamins and trace elements.

If the ration contains alfalfa (lucerne) (in the form of forage or dehydrated pellets) or any other source of high levels of calcium, it is preferable to use REVERDY OLIGOVIT MINERAL.

Because of the high levels of vitamins and trace elements (including selenium) present, respect the recommendations for use.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 12 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Locomotor system

BIOTIN

DESCRIPTION

A source of biotin, sulphur-containing amino acids, protected vitamins and chelated trace elements.
Contributes to improving the quality and growth rate of the hoof wall and integuments.

INDICATIONS

Covers daily requirements in biotin, vitamins B5 and B6.

REVERDY BIOTIN can be used at higher doses in the following situations:

- Poor quality brittle horn;
- Unshod work, frequent de-shoeing (trotting races);
- Damaged hair (coat/mane/tail).

1 kg 2.5 kg

DIRECTIONS FOR USE

Distribute with cereals or compound feeds. Mix well into the feed.
1 measure = 25 g

ADULT HORSE (500 KG)	DAILY DOSE
Maintenance dose	1 measure (25 g) *equivalent to 5 g /100 kg (liveweight)*
Maximum recommended dose	2 measures (50 g) *equivalent to 10 g /100 kg (liveweight)*

For ponies and youngstock, administer a daily dose in proportion to the animal's liveweight.

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Small pellets

COMPOSITION

Barley, MSM (Methylsulfonylmethane), extruded linseed, calcium carbonate.

PER KG

Zinc (Hydrated amino acids chelate)	7,000 mg
Copper (Hydrated amino acids chelate)	1,500 mg
DL-Methionine	90,000 mg
Natural L-Cystine	30,000 mg
Vitamin A	1,000,000 IU
Vitamin B5 (Pantothenic acid)	3,000 mg
Vitamin B6 (Pyridoxine)	3,000 mg
Vitamin B8 (Biotin)	850 mg

ANALYTICAL CONSTITUENTS

Humidity	11%
Total protein	15%
Fats and oils	2%
Crude fibre	3.5%
Ash	7%
Calcium	0.45%
Phosphorus	0.25%
Sodium	0.1%

1 MEASURE (25 G) OF REVERDY BIOTIN PROVIDES

21 mg of biotin (vitamin B8), 2,250 mg of DL-methionine, 1,250 mg of MSM, 750 mg of natural L-cystine, 175 mg of chelated* zinc and 38 mg of chelated* copper, 25,000 IU of vitamin A, 75 mg of vitamin B5 and 75 mg of vitamin B6.

**Amino acids chelate*

PROPERTIES

The **sulphur-containing amino acids (methionine, cystine)** are precursors of keratin, the constituent protein of hoof horn, the coat, the mane and the tail. This structural protein takes its rigidity from the sulphur atoms present in these precursor amino acids which link together with covalent bonds (disulphide bonds).

MSM also represents a source of organic sulphur.

The supply of easily assimilated **chelated copper** and above all **chelated zinc** ensures good keratinization and therefore healthy integuments.

At a dose of approximately 20 mg a day, **biotin (vitamin B8)** improves the growth rate and hardness of the hoof wall.

Vitamin B5 takes part in epithelium and integument renewal. It favours wound healing and hair growth.

Vitamin B6 intervenes in the metabolism of amino acid and proteins. Notably it participates in the synthesis of cysteine, sulphur containing amino acid precursor of cystine.

Vitamin A is involved in the synthesis of proteins and intervenes in the integrity and protection of the keratogenous epithelial.

PRECAUTIONS FOR USE

Due to the presence of high levels of vitamins and trace elements and furthermore, excess sulphur being harmful to keratin synthesis, respect the recommendations.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 18 months.

Conceived by our research and development department.
Manufactured in our laboratory.

BOOSTER

DESCRIPTION

Energy catalyst, rich in protected vitamins and chelated trace-elements.
Provides athletic horse support for strenuous work thanks to the supply of rapidly available nutriments for his organism.

INDICATIONS

Provides extra vitamins and trace elements on competition days.

60 ml

DIRECTIONS FOR USE

Adult horse (500 kg): the contents of 1 syringe to be swallowed *(equivalent to 12 ml /100 kg of liveweight)* few hours before the effort (outside of feeds). In case of strenuous exercise, it's possible to renew the dose (1 syringe) the evening after.

For ponies, administer a daily dose in proportion to the animal's liveweight.

NON DOPING PNFS*

MADE IN FRANCE

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

Gel

COMPOSITION

Demineralised water, fructose, sorbitol, natural orange flavour.

PER KG

Zinc (Hydrated amino acids chelate)..... 1,125 mg
Copper (Hydrated amino acids chelate)..... 375 mg
Manganese (Amino acids chelate)..... 375 mg
Iron (Sulphate)..... 1,500 mg
Selenium (Organic selenium) ..... 30 mg
Vitamin A..... 900,000 IU
Vitamin E ..... 75,000 mg
Vitamin B1 (Thiamin)..... 1,500 mg
Vitamin B2 (Riboflavin) ..... 1,200 mg
Vitamin B3 (PP or Niacin) ..... 2,625 mg
Vitamin B5 (Pantothenic acid)..... 1,125 mg
Vitamin B6 (Pyridoxine) ..... 750 mg
Vitamin B8 (Biotin) ..... 22.5 mg
Vitamin B9 (Folic acid)..... 900 mg
Vitamin B12 (Cyanocobalamin)..... 22.5 mg
Protected vitamin C (Phosphorylated L-ascorbic acid) ..... 15,000 mg

ANALYTICAL CONSTITUENTS

Humidity..... 50%
Total Protein..... 2%
Fats and oils 10%
Crude Fibre 0.3%
Ash 2%
Sodium..... 0.2%

1 SYRINGE (60 ML) OF BOOSTER PROVIDES

75 mg of chelated* zinc, 25 mg of chelated* copper and 25 mg of chelated* manganese, 100 mg of iron, 2 mg of organic selenium, 60,000 IU of vitamin A, 5,000 mg of vitamin E, 100 mg of vitamin B1, 80 mg of vitamin B2, 175 mg of vitamin B3, 75 mg of vitamin B5, 50 mg of vitamin B6, 1.5 mg of vitamin B8, 60 mg of vitamin B9, 1.5 mg of vitamin B12 and 1,000 mg of protected vitamin C.

** Amino acids chelate*

PROPERTIES

Vitamins E and **C** also organic selenium (and to a lesser extent vitamin A) are important biological antioxidants taking part in the protection of muscle cells and helping recovery after effort.

Vitamin B1 is essential for the metabolism of carbohydrates. At a muscular level during sprints, it intervenes in the combustion of sugars.

Vitamin B2 activates the catabolism of lactic aced (as does zinc) and intervenes in the metabolism of carbohydrates and lipids (as do **vitamins B3** and **B8**).

Vitamin B5 plays a role in fatty acid and carbohydrates oxidation.

Vitamin B6 intervenes in regulating blood sugar levels by contributing to the liberation of sugars from glycogen reserves in the organism.

Vitamin B12 is known for its role in red blood cell formation (just like **vitamins B6** and **B9**). On a more general level it is implied in the metabolism of carbohydrates, proteins and lipids.

Copper increases lipid use in energy production.

Copper and **zinc** are essential co-factors of copper-zinc superoxide dismutase (CuZn-SOD), a fundamental enzyme in the antioxidant struggle.

Iron is a co-factor to numerous enzymes which intervene in energy production (cellular respiration).

Manganese intervenes in the metabolism of lipids and carbohydrates. As co-factor of manganese superoxyde dismutase (Mn-SOD) it also involved in neutralising free radicals.

PRECAUTIONS FOR USE

Due to the presence of high levels of vitamins and trace elements (including selenium), respect the recommendations.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 18 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Digestive system

CARE

DESCRIPTION

A combination of gastric acidity regulators and L-glutamine.
Takes part in preventing and healing stomach ulcers in the horse.

INDICATIONS

Preventing gastric ulcers.

REVERDY CARE can be used at higher doses in the following situations:

- Suspicion of gastric ulcers in stressed horses;
- Stress causing situations:
  - transport over long distances;
  - periods of intense training;
  - preparation for the sale ring;
  - etc.
- Known presence of gastric ulcers, in addition to a suitable diet.

1.8 kg 4.5 kg

DIRECTIONS FOR USE

Mix well into the feed.
Distribute the daily dose divided between meals. **1 measure = 45 g**

ADULT HORSE (500 KG)	DAILY DOSE
Preventative dose	1 measure (45 g) *equivalent to 9 g /100 kg (liveweight)*
Maximum recommended dose	2 measures (90 g) *equivalent to 18 g /100 kg (liveweight)*

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

For ponies and youngstock, administer a daily dose in proportion to the animal's liveweight.

NON DOPING PNFS*

MADE IN FRANCE

Powder

COMPOSITION

Lithothamnion (*Phymatolithon calcareum*), scFOS (Short chain Fructo-oligosaccharides), natural green apple flavouring.

PER KG

L-glutamine ..... 200,000 mg
Zinc (Sulphate) ..... 4,445 mg

ANALYTICAL CONSTITUENTS

Humidity 2%
Total protein 27%
Crude fibre 0.9%
Ash 42%
Calcium 13%
Sodium 0.3%

1 MEASURE OF CARE (45 G) PROVIDES

20,000 mg of lithothamnion, 13,110 mg of scFOS, 9,000 mg of L-glutamine and 200 mg of zinc.

PROPERTIES

Lithothamnion is calcareous seaweed presenting a sponge like ("honeycomb") structure. These special characteristics explain its prolonged and highly effective buffering effect in an acid environment. Its effectiveness in neutralising the acid secretions of the stomach has been validated in the horse. In horses studied, giving the same quantity of lithothamnion as contained in the equivalent of 2 measures of CARE over a 30 day period, permitted a considerable reduction in ulcerous lesions.

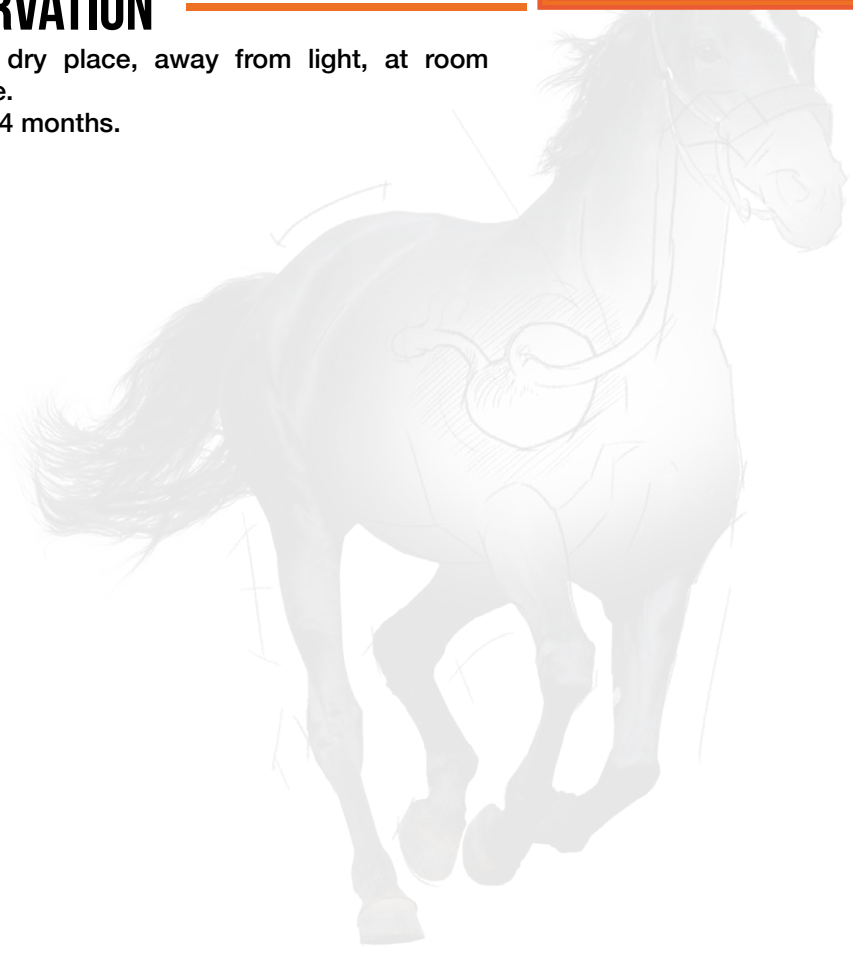
It has been proven that **scFOS** reduce the acidity of the stomach contents in the horse. As prebiotics, they increase the quantity and activity of the intestinal flora which use lactic acid.

L-glutamine is a significant source of energy for fast renewing cells, such as those of the digestive tract. This amino acid thus participates in preserving the integrity of the gastric mucosa and helps heal ulcerous lesions.

Zinc sulphate is involved in the rapid and prolonged inhibition of acid secretions in the stomach.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 24 months.



Conceived by our research and development department.
Manufactured in our laboratory.

Breeding

CAROTENE

DESCRIPTION

A source of beta-carotene, protected vitamins and chelated trace elements.
Contributes to the improvement of fertility in breeding stock and colostrum quality in broodmares.

INDICATIONS

Covers daily requirements in beta-carotene, vitamins A, E and B3, zinc, copper, manganese, selenium and iodine.

REVERDY CAROTENE can be used at higher doses in the following situations:

- Fertility disorders in mares and stallions;
- Last third of the gestation period (improvement in colostrum quality).

3 kg

DIRECTIONS FOR USE

Feed with cereals or pelleted feed. Mix well into the ration.
1 measuring cup = 90 g

ADULT HORSE (500 KG)	DAILY DOSE
Maintenance dose	½ measuring cup (45 g) *equivalent to 9 g /100 kg (liveweight)*
Maximum recommended dose	1 ½ measuring cups (135 g) *equivalent to 27 g /100 kg (liveweight)*

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Small pellets

In breeding stock (mares and stallions), we advise starting **REVERDY CAROTENE** at least 6 to 8 weeks before the first service.

For ponies, administer a daily dose in proportion to the animal's liveweight.

COMPOSITION

Barley, extruded linseed, calcium carbonate.

PER KG

Zinc (Hydrated amino acids chelate)..... 7,200 mg
Copper (Hydrated amino acids chelate).... 1,500 mg
Manganese (Amino acids chelate)..... 3,000 mg
Iodine (Calcium iodate) ..... 20 mg
Selenium (Organic selenium) ..... 15 mg
Beta-carotene ..... 10,000 mg
Vitamin A ..... 1,000,000 IU
Vitamin E ..... 15,000 mg
Vitamin B3 (PP or Niacin) ..... 2,150 mg

ANALYTICAL CONSTITUENTS

Humidity 10%
Total protein 15%
Fats and oils 4.5%
Crude fibre 4.5%
Ash 9%
Calcium 0.45%
Phosphorus 0.25%
Sodium 0.1%

1 MEASURING CUP (90 G) OF CAROTENE PROVIDES

900 mg of beta-carotene, 90,000 IU of vitamin A, 1,350 mg of vitamin E, 194 mg of vitamin B3, 648 mg of chelated* zinc, 270 mg of chelated* manganese and 135 mg of chelated* copper, 1.4 mg of organic selenium and 1.8 mg of iodine.

** Amino acids chelate*

PRECAUTIONS FOR USE

Due to the presence of high levels of vitamins and trace elements (including selenium) contained in this product, respect the recommendations.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 18 months.

PROPERTIES

Beta-carotene could improve **mare fertility:**

- as a precursor of vitamin A in the follicles, it participates in the synthesis of oestrogens and is thus favourable to good follicular growth,
- as local antioxidant, it protects cells in the reproductive system from attack by free radicals,
- following ovulation, it assures the correct functioning of the corpus luteum within which it takes part in the synthesis of progesterone. It contributes in this way to maintaining gestation.

Amongst the effects observed when supplementing with beta-carotene we can note more visible heats, a reduction in the number of ovarian cysts, an improved fertility level, a reduction in embryo mortality as well as a drop in the number of retained placentas.

In the stallion, beta-carotene participates (as a precursor of vitamin A) in the synthesis of testosterone. It assures correct production and maturity of spermatozoa. Thanks to its antioxidant action, it helps protect spermatozoa from attack by free radicals.

Vitamin A affects protein synthesis with consequences on epithelium integrity in the reproductive system, the production of sexual hormones and immunity.

Vitamin E and **organic selenium** reinforce the antioxidant action of beta-carotene. Furthermore, supplementing with them allows an increase in colostrum antibody concentrations (IgG and IgM) as well as the quantity of colostrum produced, thus leading to a better transfer of immunity from the mare to the foal.

Zinc can play a part in reproduction as an essential activator of sexual hormone production enzymes, and also in its function of transporting vitamin A.

Supplementing with **copper** would seem to improve the liberation of sexual hormones (FSH and LH) at a cerebral level (pituitary).

Manganese and **vitamin B3** intervene in the production of sexual hormones.

Iodine is essential for synthesising thyroid hormones that stimulate FSH and LH production by the pituitary gland.

Conceived by our research and development department.
Manufactured in our laboratory.

E SELENIUM

DESCRIPTION

A nutritional supplement providing protected vitamin E and organic selenium.

INDICATIONS

Covers daily requirements in vitamin E and selenium.
REVERDY E SELENIUM can be used at higher doses in the following situations:

- To help prevent muscular problems in horses prone to chronic myopathies ("tying up"), or in intensive training;
- Neurological disorders such as MND (Motor Neuron Disease).

1.3 kg 3 kg 10 kg

DIRECTIONS FOR USE

Feed alone, or mix with cereals or a compound feed. If **E SELENIUM** is being given alongside an industrial compound feed, the amount to be distributed will depend on the quantity of feed fed and the levels of vitamin E and selenium in the latter. **1 measure = 30 g**

ADULT HORSE (500 KG)	RECOMMENDED DAILY DOSE
Maintenance	½ to 1 measure (15 to 30 g) *equivalent to 3 to 6 g /100 kg (liveweight)*
Horses in work	1 to 3 measures (30 to 90 g) *equivalent to 6 to 18 g /100 kg (liveweight)*
Growing youngsters	½ to 1 measure (15 to 30 g) *equivalent to 3 to 6 g /100 kg (adult liveweight)*
Broodmares and stallions	1 to 3 measures (30 to 90 g) *equivalent to 6 to 18 g /100 kg (liveweight)*

For ponies, administer a daily dose in proportion to the animal's liveweight.

NON DOPING PNFS*

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

MADE IN FRANCE

Small pellets

COMPOSITION

Barley, calcium carbonate, fructose.

PER KG

Vitamin E ..... 33,333 mg
Selenium (Organic selenium) ..... 16.7 mg

ANALYTICAL CONSTITUENTS

Humidity 12.5%
Total protein 9%
Crude fats and oils 6%
Crude fibre 4%
Crude ash 9%
Calcium 1%
Phosphorus 0.3%
Magnesium 0.3%
Sodium 0.1%

1 MEASURE (30 G) OF E SELENIUM PROVIDES

1,000 mg of vitamin E and 0.5 mg of organic selenium.

PROPERTIES

Vitamin E is a major biological antioxidant playing a primordial role in the protection of cell membranes in the organism. Its use in the sports horse is of particular interest for helping prevent muscular problems (for example, “tying up”). Furthermore, it not only improves fertility in breeding stock but also, via colostrum, the transfer of passive immunity (antibodies) between the mother and newborn.

Selenium is a trace element which, as a co-factor of the enzyme glutathione peroxidase (GSH-Px), plays a key role in the antioxidant battle alongside vitamin E. 100 % of the selenium is supplied as selenomethionine, the principal form under which selenium is stored in the organism. Selenium from this organic source is better assimilated and stored than that provided by sodium selenite (the inorganic form).

PRECAUTIONS FOR USE

Due to the presence of high levels of selenium, respect the recommendations for use.

Do not exceed international guidelines for selenium intake (0.1 - 0.3 mg / kg total ration dry matter).

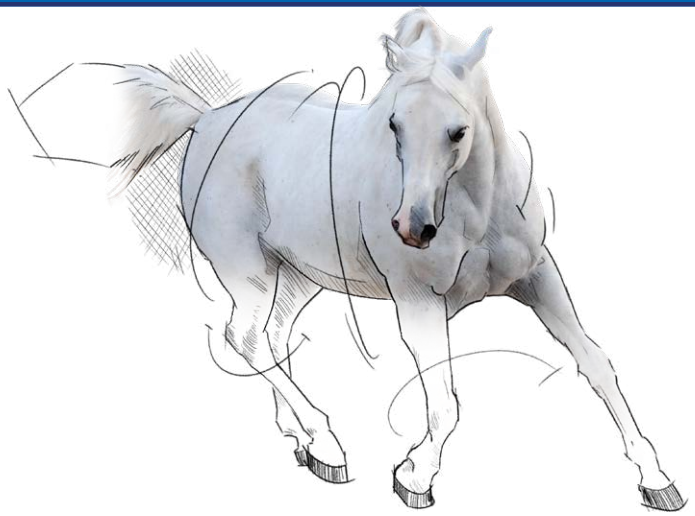
In the event of overdosing, or an accidental ingestion of excess E SELENIUM, contact a vet immediately.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 12 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Health & performance



ELECTROLYTES
GEL

DESCRIPTION
Mineral salt concentrate that allows the rapid reconstitution of electrolyte stocks lost through sweating.

INDICATIONS
Moderate, intense or prolonged muscular effort leading to sweating.
Transport over long distances.

DIRECTIONS FOR USE
Clean cool water should be permanently available.

ADULT HORSE (500 KG)	RECOMMENDED DOSE	WHEN TO ADMINISTER
Moderate efforts, transport over long distances	½ to 1 syringe *equivalent to 6 to 12 ml /100 kg (liveweight)*	After the event
Intense short efforts (racing)	1 to 2 syringes *equivalent to 12 to 24 ml /100 kg (liveweight)*	1 syringe the evening following the event. Repeat the morning after in the case of heavy sweating.
Prolonged intense efforts (endurance)	1 to 2 syringes *equivalent to 12 to 24 ml /100 kg (liveweight)*	1 syringe morning and/or evening up to 10 days following the event

For ponies, administer a daily dose in proportion to the animal's liveweight.

60 ml

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Gel

COMPOSITION

Demineralised water, sodium chloride, dextrose, potassium chloride, fructose, sodium citrate, magnesium chloride, glycine, natural green apple flavouring.

ANALYTICAL CONSTITUENTS

Humidity 45%
Total protein 1.5%
Ash 32%
Sodium 9%

1 SYRINGE OF ELECTROLYTES GEL (60 ML) PROVIDES

13,175 mg of chloride, 6,975 mg of sodium, 3,480 mg of potassium and 275 mg of magnesium.

PROPERTIES

The ingestion of the **mineral salts** contained in ELECTROLYTES GEL allows the rapid reconstitution of electrolyte stocks lost through sweating.

A 60 ml syringe compensates for the chloride, sodium, potassium and magnesium losses in approximately 2.5 L of sweat.

Dextrose and **glycine** facilitate sodium absorption.

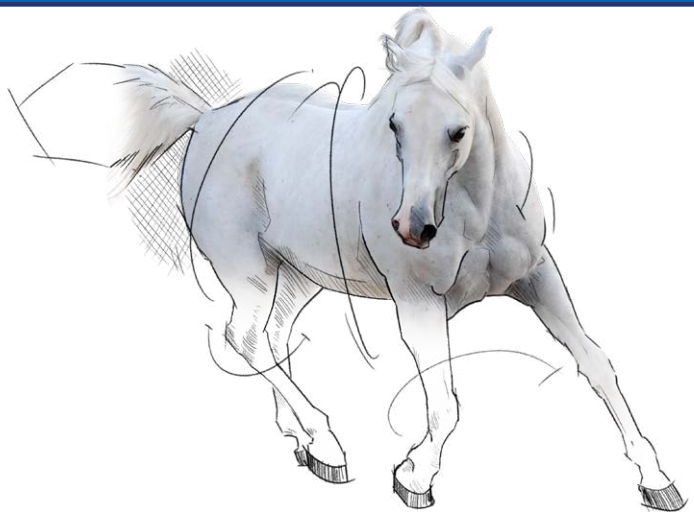
PRECAUTIONS FOR USE

Because of the high concentration of mineral salts contained in REVERDY ELECTROLYTES GEL, it is not advisable to distribute it the day of an endurance competition. If the horse does not drink sufficiently during the event, the ingestion of REVERDY ELECTROLYTES GEL may well worsen dehydration in the organism by creating a call for water to the digestive tract. However, it is possible to distribute REVERDY ELECTROLYTES LIQUID or POWDER the day of the event. They must be diluted in a large volume of water and placed at disposition in a container next to the habitual bucket of fresh water.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 24 months.

Health & performance



ELECTROLYTES
LIQUID

DESCRIPTION
Mineral salt concentrate that allows the rapid reconstitution of electrolyte stocks lost through sweating.

INDICATIONS
Moderate, intense or prolonged muscular effort leading to sweating.
Transport over long distances.

1 L 5 L

DIRECTIONS FOR USE
Distribute by mixing with the drinking water, cereals or the pelleted feed, or administer directly into the mouth using a syringe.
Clean cool water should be permanently available.
Shake well before use.

ADULT HORSE (500 KG)	RECOMMENDED DOSE	WHEN TO ADMINISTER
Moderate efforts, transport over long distances	50 to 75 ml *equivalent to 10 to 15 ml /100 kg (liveweight)*	After the event
Intense short efforts (racing)	75 to 150 ml *equivalent to 15 to 30 ml /100 kg (liveweight)*	75 ml the evening following the event. Repeat the morning after in the case of heavy sweating.
Prolonged intense efforts (endurance)	75 to 150 ml *equivalent to 15 to 30 ml /100 kg (liveweight)*	75 ml morning and evening up to 10 days following the event

For ponies, administer a daily dose in proportion to the animal's liveweight.

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Liquid

COMPOSITION

Demineralised water, sodium chloride, sodium citrate, potassium chloride, dextrose, magnesium chloride, glycine, natural orange flavouring.

ANALYTICAL CONSTITUENTS

Humidity 66%
Total protein 1.2%
Ash 26%
Sodium 7.7%

50 ML OF ELECTROLYTES LIQUID PROVIDE

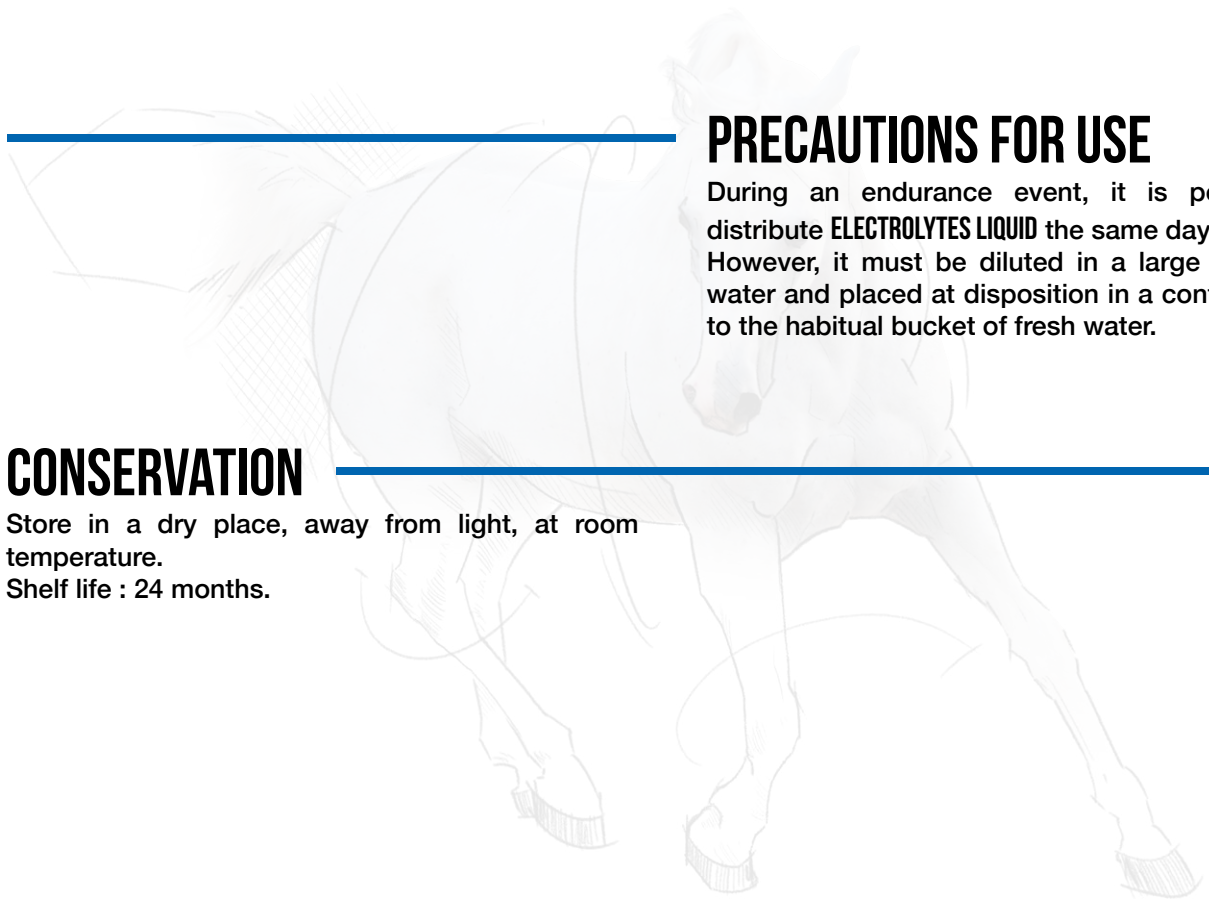
7,945 mg of chloride, 4,635 mg of sodium, 2,100 mg of potassium and 165 mg of magnesium.

PROPERTIES

The ingestion of the **mineral salts** contained in ELECTROLYTES LIQUID allows the rapid reconstitution of electrolyte stocks lost through sweating.

A 50 ml dose compensates for the chloride, sodium, potassium and magnesium losses in approximately 1.5 L of sweat.

Dextrose and **glycine** facilitate sodium absorption.



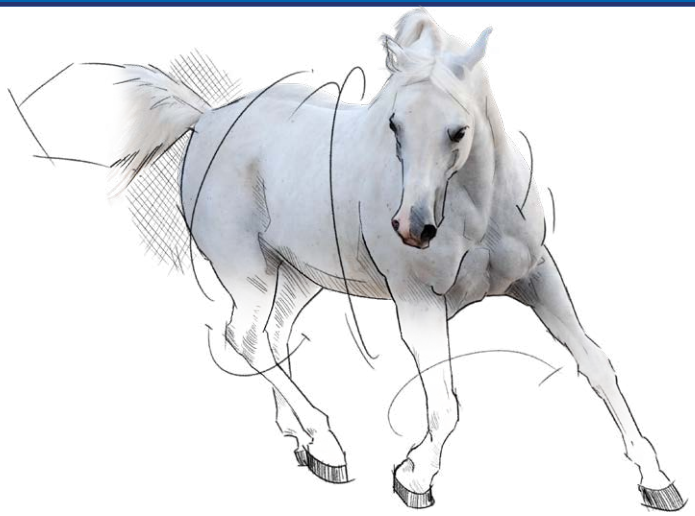
PRECAUTIONS FOR USE

During an endurance event, it is possible to distribute ELECTROLYTES LIQUID the same day.
However, it must be diluted in a large volume of water and placed at disposition in a container next to the habitual bucket of fresh water.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 24 months.

Conceived by our research and development department.
Manufactured in our laboratory.



ELECTROLYTES
POWDER

DESCRIPTION
Mineral salt concentrate that allows the rapid reconstitution of electrolyte stocks lost through sweating.

INDICATIONS
Moderate, intense or prolonged muscular effort leading to sweating.
Transport over long distances.

2.2 kg 5 kg

DIRECTIONS FOR USE
Distribute by mixing with cereals or pelleted feed. Clean cool water should be made permanently available.
1 measure = 50 g

ADULT HORSE (500 KG)	RECOMMENDED DOSE	WHEN TO ADMINISTER
Moderate efforts, transport over long distances	½ to 1 measure (25 to 50 g) *equivalent to 5 to 10 g /100 kg (liveweight)*	After the event
Intense short efforts (racing)	1 to 2 measures (50 to 100 g) *equivalent to 10 to 20 g /100 kg (liveweight)*	1 measure the evening following the event. Repeat the morning after in the case of heavy sweating.
Prolonged intense efforts (endurance)	1 to 2 measures (50 to 100 g) *equivalent to 10 to 20 g /100 kg (liveweight)*	1 measure morning and/or evening up to 10 days following the event

For ponies, administer a daily dose in proportion to the animal's liveweight.

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Powder

COMPOSITION

Sodium chloride, potassium chloride, glycine, magnesium sulphate, sodium bicarbonate, sodium citrate, natural green apple flavouring.

PER KG
Vitamin E ..... 5,000 mg

ANALYTICAL CONSTITUENTS

Humidity 1%
Total protein 10.5%
Ash 85.5%
Chlorides 44%
Sodium 22.5%
Potassium 12%
Magnesium 0.7%

1 MEASURE (50 G) OF ELECTROLYTES POWDER PROVIDES

22,000 mg of chloride, 11,250 mg of sodium, 6,000 mg of potassium, 350 mg of magnesium, 250 mg of vitamin E.

PROPERTIES

The ingestion of the **mineral salts** contained in ELECTROLYTES POWDER allows the rapid reconstitution of the electrolyte stocks lost through sweating.

A 50 g dose compensates for the chloride, sodium, potassium and magnesium losses in approximately 4 L of sweat.

Dextrose & **Glycine** facilitates sodium absorption.

PRECAUTIONS FOR USE

During an endurance event, it is possible to distribute ELECTROLYTES POWDER the same day. However, it must be diluted in a large volume of water and placed at disposition in a container next to the habitual bucket of fresh water.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 24 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Locomotor system

FLEXY
LIQUID

DESCRIPTION

A preparation based on the three major chondroprotective agents (chondroitin, glucosamine and MSM) and hyaluronic acid.
Contributes to relieving articular pains, slowing the evolution of arthritis and improving articular lubrication and cartilage elasticity.

INDICATIONS

Prevent articular problems.

REVERDY FLEXY LIQUID can be used at higher doses in the following situations:

- Sudden/considerable articular stress:
  - breaking/pre-training;
  - intensive training period;
  - competition;
  - work on hard ground.
- Articular pain/lameness due to arthritis in the aged horse;
- In compliment to articular surgery.

1 L 5 L

DIRECTIONS FOR USE

Distribute by mixing with cereals or the pelleted feed, or to be directly swallowed by administering into the mouth using a syringe.
Shake well before use.

ADULT HORSE (500 KG)	DAILY DOSE
Loading dose (1st month)	50 ml *equivalent to 10 ml /100 kg (liveweight)*
Maintenance dose (or preventive)	25 ml *equivalent to 5 ml /100 kg (liveweight)*
Maximum recommended dose	75 ml *equivalent to 15 ml /100 kg (liveweight)*

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Liquid

For ponies and youngsock, administer a daily dose in proportion to the animal's liveweight.

COMPOSITION

Demineralised water, glucosamine sulphate 2 KCl (marine origin), MSM (Methylsulfonylmethane), fructose, chondroitin sulphate (marine origin), hyaluronic acid, natural orange flavouring.

ANALYTICAL CONSTITUENTS

Humidity	75%
Total protein	5.5%
Ash	5.5%
Sodium	0.3%

50 ML OF FLEXY LIQUID PROVIDE

10,000 mg of glucosamine sulphate 2KCl, 4,000 mg of MSM, 2,000 mg of marine chondroitin sulphate and 300 mg of hyaluronic acid.

PROPERTIES

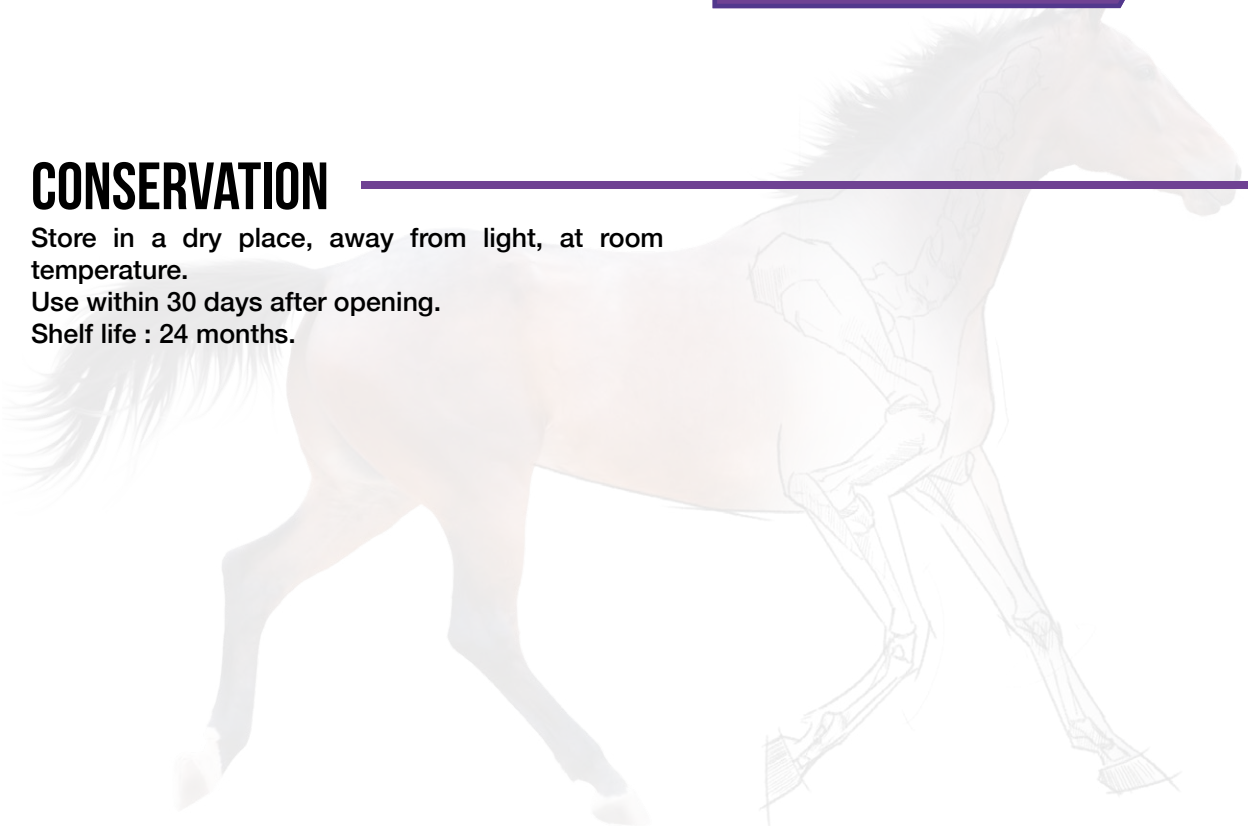
Chondroitin is a constituent of proteoglycans whose role are to maintain correct hydration of cartilage and bones. Furthermore, it directly protects cartilage cells from enzymatic reactions and free radicals.

Glucosamine is the precursor of many of the constituents of proteoglycans and of hyaluronic acid. In cartilage, hyaluronic acid is bound with proteoglycans and forms aggregates which assure good hydration of this tissue. In the synovial fluid of joints, hyaluronic acid has a role of lubricant and chondroprotective agent.

MSM also possesses chondroprotective properties. It is also a source of organic sulphur indispensable to the synthesis of collagen, an abundant cartilage protein, giving it hydration, resistance, elasticity and suppleness properties.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Use within 30 days after opening.
Shelf life : 24 months.



Conceived by our research and development department.
Manufactured in our laboratory.

Locomotor system

FLEXY
POWDER

DESCRIPTION

A preparation based on the three major chondroprotective agents (chondroitin, glucosamine and MSM) and hyaluronic acid.
Contributes to relieving articular pains, slowing the evolution of arthritis and improving articular lubrication and cartilage elasticity.

INDICATIONS

Prevent articular problems.
REVERDY FLEXY POWDER can be used at higher doses in the following situations:

- Sudden/considerable articular stress:
  - breaking/pre-training;
  - intensive training period;
  - competition;
  - work on hard ground.
- Articular pain/lameness due to arthritis in the aged horse;
- In compliment to articular surgery.

1.8 kg 4 kg

DIRECTIONS FOR USE

Distribute by mixing with the cereal or pelleted feed. **1 measure = 50 g**

ADULT HORSE (500 KG)	DAILY DOSE
Loading dose (1st month)	1 measure (50 g) *equivalent to 10 g /100 kg (liveweight)*
Maintenance dose (or preventive)	½ measure (25 g) *equivalent to 5 g /100 kg (liveweight)*
Maximal recommended dose	1 ½ measure (75 g) *equivalent to 15 g /100 kg (liveweight)*

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Powder

For ponies and youngsock, administer a daily dose in proportion to the animal's liveweight.

COMPOSITION

Fructose, glucosamine sulphate 2KCl (marine origin), MSM (Methylsulfonylmethane), chondroitin sulphate (marine origin), hyaluronic acid, natural orange flavouring.

ANALYTICAL CONSTITUENTS

Humidity	9%
Total protein	6.5%
Fats and oils	1%
Crude fibre	0.4%
Ash	8.5%
Sodium	0.5%

1 MEASURE (50 G) OF FLEXY POWDER PROVIDES

10,000 mg of glucosamine sulphate 2KCl, 4,000 mg of MSM , 2,000 mg of chondroitin sulphate and 300 mg of hyaluronic acid.

PROPERTIES

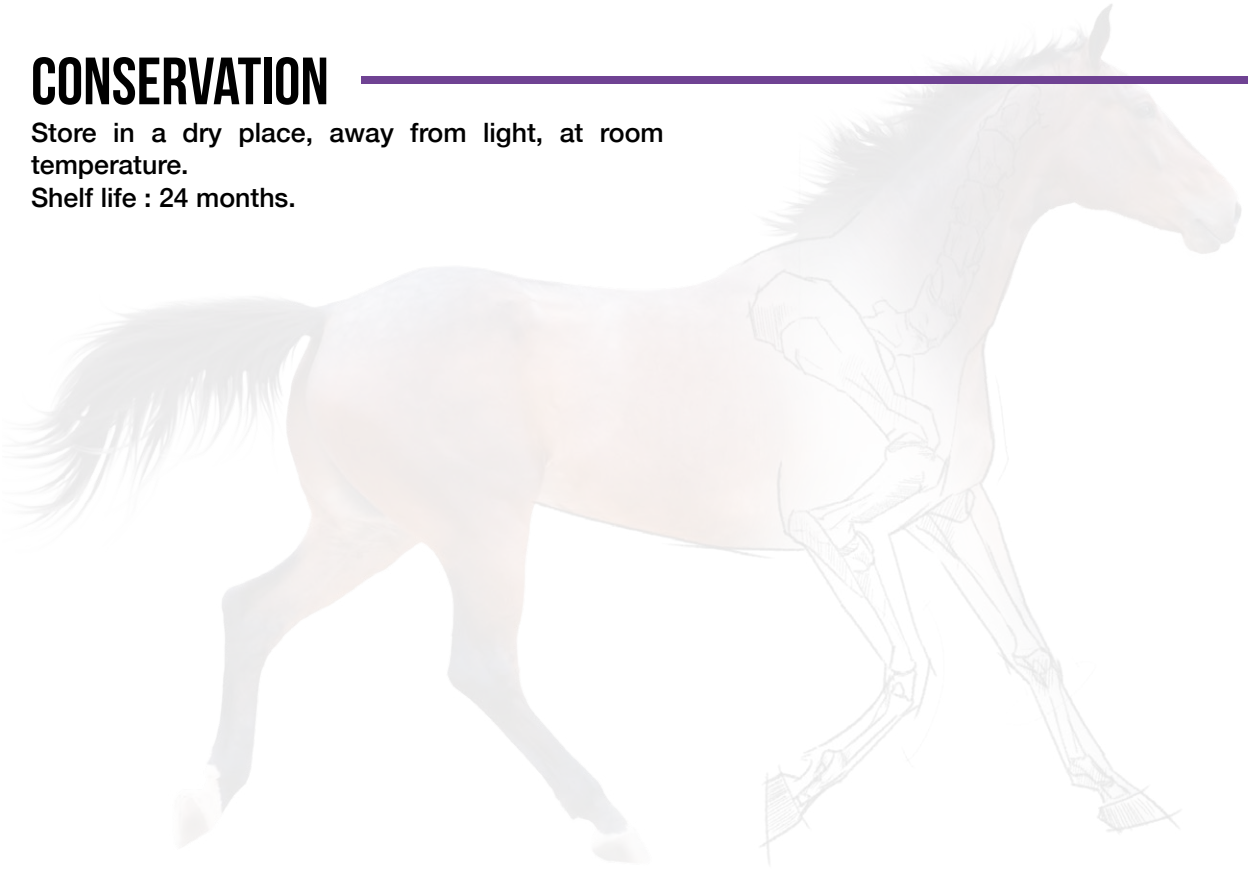
Chondroitin is a constituent of proteoglycans whose role are to maintain correct hydration of cartilage and bones. Furthermore, it directly protects cartilage cells from enzymatic reactions and free radicals.

Glucosamine is the precursor of many of the constituents of proteoglycans and of hyaluronic acid. In cartilage, hyaluronic acid is bound with proteoglycans and forms aggregates which assure good hydration of this tissue. In the synovial fluid of joints, hyaluronic acid has a role of lubricant and chondroprotective agent.

MSM also possesses chondroprotective properties. It is also a source of organic sulphur indispensable to the synthesis of collagen, an abundant cartilage protein, giving it hydration, resistance, elasticity and suppleness properties.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 24 months.



Conceived by our research and development department.
Manufactured in our laboratory.

Digestive system

FLORA

DESCRIPTION

An association of probiotics and postbiotics.
Supports the horse's intestinal flora and improves the digestibility of the feed ration.
Improves coat shine and promotes a gain in body condition in a matter of weeks.

INDICATIONS

Supports the intestinal flora.
Improves the digestibility of the ration.
REVERDY FLORA can be used at higher doses in the following situations:

- Insufficient body condition.
- Dull coat.
- When the intestinal flora comes under stress (in order to prevent the appearance of digestive disorders causing diarrhoea):
  - hospitalisation;
  - strenuous efforts;
  - weaning;
  - turn-out to grass;
  - transport over long distances;
  - preparation for the sale ring;
  - etc.

1.5 kg 4 kg

DIRECTIONS FOR USE

Distribute by mixing with cereals or the pelleted feed.
Mix well into the ration. **1 measure = 35 g**

ADULT HORSE (500 KG)	DAILY DOSE
Maintenance dose	1 measure (35 g) *equivalent to 7 g /100 kg (liveweight)*
Maximum recommended dose	3 measures (105 g) *equivalent to 21 g /100 kg (liveweight)*

For ponies and youngstock, administer a daily dose in proportion to the animal's liveweight.

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Powder

COMPOSITION

Assimilation factors obtained from the lactic fermentation of germinated barley grains, ferments from organic cereals, natural green apple flavouring.

PER KG

Live yeast (Saccharomyces cerevisiae Sc 47 strain) ..... 200,000 mg
equivalent to 2,000 x10^9 CFU

ANALYTICAL CONSTITUENTS

Humidity 9%
Total protein 15%
Fats and oils 2.7%
Crude fibre 3%
Ash 2.7%
Phosphorus 0.4%
Calcium 0.1%

1 MEASURE OF FLORA (35 G) PROVIDES

7,000 mg (70 billion CFU) of live yeast, 14,000 mg of assimilation factors, 13,650 mg of ferments from organic cereals.

PROPERTIES

Assimilation factors and ferments from cereals (postbiotics) as well as **live yeasts (probiotics)** reinforce the horse's intestinal flora and improve the digestibility of the feed ration.

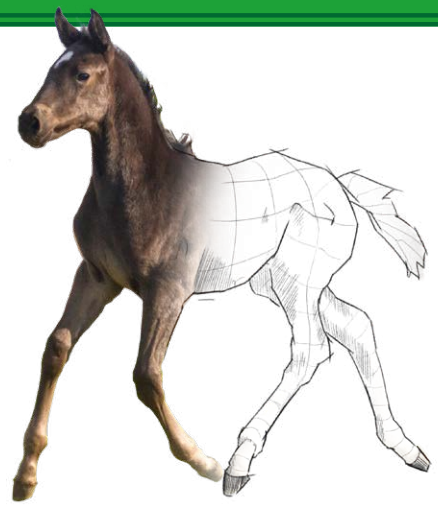
Their action can be observed in a shinier coat and an improvement in body condition in a matter of weeks.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 24 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Breeding



FOAL MILK

DESCRIPTION

Replacement milk, very close in composition to mares' milk, enriched in high nutritional value milk serum proteins, vitamins, and trace elements.
Formulated using milk products of "human food" quality only.
Does not contain palm or copra oils.

INDICATIONS

Orphan foals.
Foals whose dams have insufficient milk production.

10 kg

DIRECTIONS FOR USE

1 measure = 30 g. Use 120 g (4 measures) of **REVERDY FOAL MILK** per litre of very hot water. Mix vigorously with a whisk in order to obtain a homogeneous mixture. Leave to cool and feed the milk using a bottle, bowl or bucket with a teat.

These recommendations are for a foal who will reach 500 kg at maturity:

AGE (IN DAYS)	QUANTITY OF RECONSTITUED MILK (L/FOAL/DAY)	NUMBER OF RECOMMENDED MEALS PER DAY
1	Colostrum +4 - 5	12 - 24
5	7 - 8	10 - 12
10	10 - 11	8 - 10
15	11 - 12	6 - 8
30	12 - 13	4 - 6
45	13 - 14	4 - 6
60	14 - 15	4 - 6
75	14 - 15	3 - 4
90	14 - 15	3 - 4
110	12 - 13	2 - 3

MADE IN FRANCE

Powder

Simultaneously, from the age of 15 days, we advise introducing the concentrate feed **REVERDY FOAL**. Weaning then can take place around 4 to 5 months old providing that the foal is eating sufficient **REVERDY FOAL** (2 kg a day).

For ponies, administer a daily dose in proportion to the animal's liveweight.

COMPOSITION

Full fat milk powder, lactose, milk serum proteins, magnesium sulphate, sodium bicarbonate, vanilla flavouring, natural tocopherols.

PER KG

Zinc (Sulphate)	60 mg
Copper (Sulphate)	20 mg
Iron (Sulphate)	40 mg
Manganese (Sulphate)	60 mg
Iodine (Calcium iodate)	0.5 mg
Selenium (Sodium selenite)	0.3 mg
Vitamin A	20,000 IU
Vitamin D3	2,500 IU
Vitamin E	300 mg
Vitamin K3	3 mg
Vitamin B1 (Thiamin)	20 mg
Vitamin B2 (Riboflavin)	25 mg
Vitamin B3 (PP or Niacin)	40 mg
Vitamin B5 (Pantothenic acid)	20 mg
Vitamin B6 (Pyridoxine)	15 mg
Vitamin B8 (Biotin)	0.5 mg
Vitamin B9 (Folic acid)	15 mg
Vitamin B12 (Cyanocobalamin)	0.1 mg
Vitamin C (Ascorbic acid)	250 mg

ANALYTICAL CONSTITUENTS

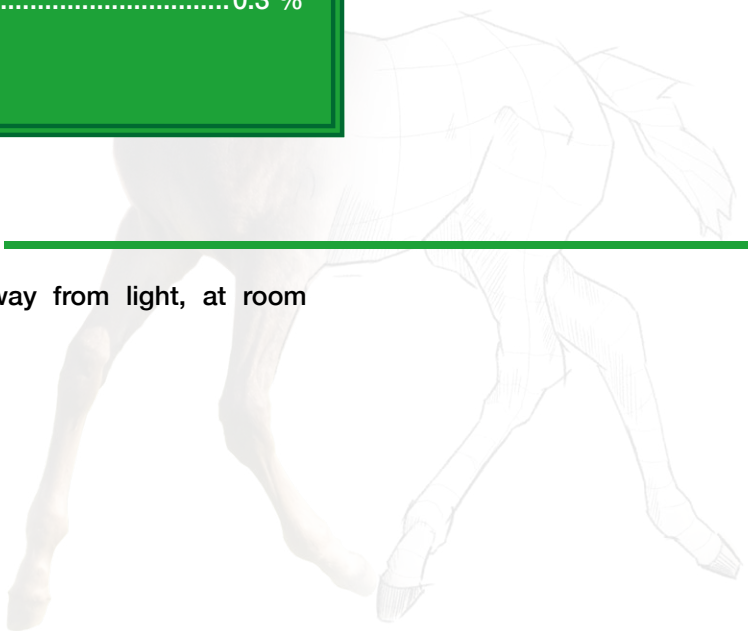
Humidity	3.5 %
Total Protein	19.5 %
Crude Fats and oils	14.5 %
Crude Fibre	0.3 %
Crude Ash	4.5 %
Calcium	0.5 %
Phosphorus	0.4 %
Magnesium	0.2 %
Sodium	0.3 %

PROPERTIES

A dairy product based **replacement milk**, containing levels of serum proteins, casein, fats and oils and lactose that are very close to the composition of mares' milk. Enables the daily nutritional requirements of unweaned foals to be met when maternal milk is absent or unavailable in sufficient quantity.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 18 months.



Conceived by our research and development department.
Manufactured in our laboratory.

GASTRIC GEL

DESCRIPTION

An aloe vera gel, aluminium phosphate, glutamine and scFOS based gastric protector.
Contributes to limiting acid secretions of the stomach, protecting the cells of the gastric mucosa and stimulating mucus production.

INDICATIONS

- Prevents gastric ulcers.
  REVERDY GASTRIC GEL can be used at higher doses in the following situations:
  - Suspicion of gastric ulcers in stressed horses;
  - Stressful conditions: transport over long distances, periods of intense training, preparation for the sale ring, etc.;
  - Known presence of gastric ulcers, in complement to a suitable diet.
- Diarrhoea in foals under the mother.

DIRECTIONS FOR USE

Gastric ulcers: administer preferably 1h before the concentrate feed, an effort, transport or any stressful situation.

ADULT HORSE (500 KG)	DAILY DOSE
Preventative dose	1 syringe (60 ml) *equivalent to 12 ml /100 kg (liveweight)*
Maximum recommended dose	3 syringes (180 ml) *equivalent to 36 ml /100 kg (liveweight)*

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

Diarrhoea in foals under the mother (weight at maturity estimated at 500 kg): administer ½ a syringe morning and evening for 3 days.

For ponies and youngstock, administer a daily dose in proportion to the animal's liveweight.

60 ml

NON DOPING PNFS*

MADE IN FRANCE

Gel

COMPOSITION

Pure Aloe vera (gel), aluminium phosphate, scFOS (Short chain Fructo-oligosaccharides), sorbitol, natural green apple flavouring.

PER KG

L-glutamine ..... 131,234 mg

ANALYTICAL CONSTITUENTS

Humidity 50%
Total protein 16%
Ash 14%
Phosphorus 3.5%
Sodium 0.7%

1 SYRINGE (60 ML) OF GASTRIC GEL PROVIDES

34,650 mg of Aloe vera, 10,000 mg of aluminium phosphate, 10,000 mg of glutamine and 9,000 mg of scFOS.

PROPERTIES

Aloe vera gel contains lectins which inhibit acid secretions of the stomach by acting directly on the parietal cells. The tannins, saponins and flavonoids which it contains may be responsible for its protective action on the cells and the anti-inflammatory action on digestive mucosa. Finally aloe vera stimulates mucus production by the glandular cells and improves its qualities.

Aluminium phosphate has the ability to cover and line the gastric mucosa. It also has a cytoprotective role: stimulating the production of endogenous prostaglandins which favour the secretion of mucus and bicarbonates, increasing blood flow in the mucosa and decreasing acid secretion.

Glutamine represents an important energy source for fast renewing cells, such as those in the digestive tract. This amino-acid therefore participates in maintaining the integrity of the gastric mucosa and helping heal ulcerous lesions.

As prebiotics, the **scFOS** support and stabilise the beneficial intestinal flora in the stomach. They therefore contribute to limiting undesirable bacterial fermentations that produce lactic acid and gases, resulting in bloating.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 12 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Health & performance

IMMUNE

DESCRIPTION

Source of purified beta-glucans and chelated zinc.
Helps to strengthen immunity.

INDICATIONS

- Strengthen immunity:
  - During periods of intensive work;
  - During the winter;
  - During viral outbreaks;
- To support, and alongside medical treatments prescribed by veterinary surgeons in case of:
  - Drop in form, performance;
  - Known problems of infection (respiratory, digestive, etc.).
- Prepare for annual vaccinations against equine influenza/equine rhinopneumonitis;
- Support sporting performances;
- Improving colostrum quality.

3 kg

DIRECTIONS FOR USE

Distribute with cereals or compound feeds. Mix well into the ration.
1 measuring cup = 90 g

	RECOMMENDED DAILY DOSE	HOW LONG TO ADMINISTER
Adult horse (500 kg)	1 measuring cup (90 g) *equivalent to 18 g /100 kg (liveweight)*	Between 1 to 3 months

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

For ponies and youngstock, administer a daily dose in proportion to the animal's liveweight.

For gestating mares, it's recommended to start administering 6 to 8 weeks before the presumed foaling date.

A 2.8 kg container is sufficient for 1 month.

NON DOPING PNFS*

MADE IN FRANCE

Small pellets

COMPOSITION

Barley, purified beta-(1,3/1,6)-glucans, sodium chloride.

PER KG

Zinc (Hydrated amino acids chelate)..... 4,000 mg

ANALYTICAL CONSTITUENTS

Humidity	12.5%
Total protein	10.5%
Fats and oils	3.5%
Crude fibre	4.5%
Ash	6%
Calcium	0.5%
Phosphorus	0.3%
Sodium	0.6%

1 MEASURING CUP (90 G) OF IMMUNE PROVIDES

5,000 mg de beta-(1,3/1,6)-glucans and 360 mg of chelated zinc.

PROPERTIES

Beta-(1,3/1,6)-glucans extracted from the yeast cell walls of bakers yeast (Saccharomyces cerevisiae) have recognised immunity stimulating properties. They have been the subject of hundreds of articles showing that beta glucans **induce an intensified immune reaction.**

The powerful immunity stimulating effect of beta glucans from bakers yeast is due to their special molecular structure which is able to activate specific receptors present on the cell membranes of macrophages.

In this manner, the activation of macrophages by beta-glucans increases their phagocytosis ability and leads to their production of cytokines being modulated, intervening in innate (immediate) and adaptive (specific) immunity by participating in lymphocyte activation.

By boosting immunity in general, beta glucans have **positive repercussions on zoo-technical and athletic performances in animals.**

Supplementation with beta glucans during the final two months of gestation increases antibody levels in the colostrum, thus contributing to **improving passive immunity transfer between dam and foal.**

Zinc plays a central role in the immune response. It's essential for hormones and enzymes directly implicated in immunity.

PRECAUTIONS FOR USE

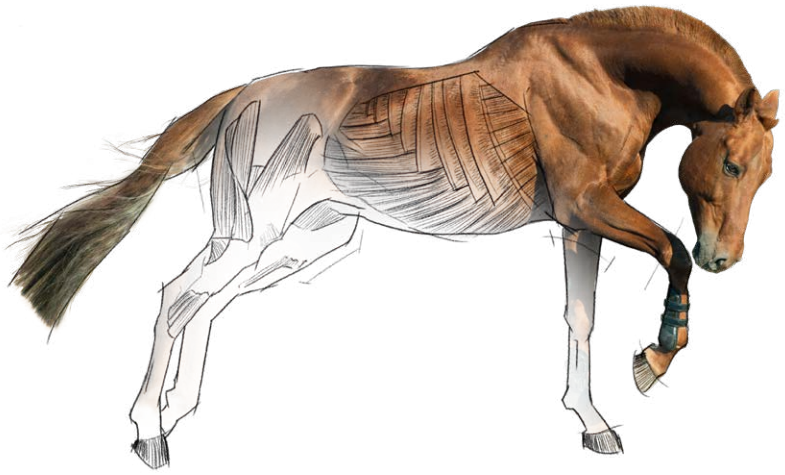
It's recommended to limit the use of IMMUNE to a maximum of 3 months.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 18 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Muscular system



MYOSTIMUL

DESCRIPTION

A source of essential amino acids, vitamin E and organic selenium.
Contributes to improving muscular development and protection.

INDICATIONS

Covers daily requirements in essential amino acids.
Supports muscular development in young growing horses and adult horses.

3 kg 10 kg

DIRECTIONS FOR USE

Distribute with cereals or compound feed.
1 measuring cup = 100 g

ADULT HORSES, YOUNG GROWING HORSES (ADULT LIVEWEIGHT = 500 KG)	DAILY DOSE
Maintenance dose	1 measuring cup (100 g) *equivalent to 20 g /100 kg (adult liveweight)*
Maximum recommended dose	3 measuring cups (300 g) equivalent to 60 g /100 kg (adult liveweight)

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Small pellets

For ponies, administer a daily dose in proportion to the animal's liveweight.

COMPOSITION

Soya bean meal without GMO*, milk serum protein concentrate, fructose.

** <0.1%*

PER KG

DL-methionine ..... 2,420 mg
Selenium (Organic selenium) ..... 2.5 mg
Vitamin E ..... 5,000 mg

ANALYTICAL CONSTITUENTS

Humidity 12.5%
Total protein 47.5%
Fats and oils 2%
Crude fibre 5%
Ash 7.5%
Calcium 0.3%
Phosphorus 0.5%
Magnesium 0.5%
Sodium 0.4%

1 MEASURING CUP (100 G) OF MYOSTIMUL PROVIDES

39 g of digestible proteins, including 3,350 mg of lysine, 2,000 mg of threonine, 1,000 mg of methionine, 2,300 mg of isoleucine, 4,050 mg of leucine, 2,350 mg of valine and 3,000 mg of arginine as well as 500 mg of vitamin E and 0.25 mg of organic selenium.

PROPERTIES

The combination of **GMO-free French soya bean meal** (<0.1%) and **serum milk protein concentrate** makes it possible to supply the main essential amino acids in proportions close to those found in mare's milk.

Providing these amino acids promotes muscle development in both young growing and adult horses at rest or at work.

Feeding 1 cup (100 g) of REVERDY MYOSTIMUL provides a similar quantity of lysine, an essential amino acid in the horse, to that provided by 1 L (0.7 kg) of REVERDY ADULT ENERGY.

Vitamin E is a major biological antioxidant that plays a key role in protecting the cell membranes of the body. Its use is particularly interesting in the sports horse as it helps to prevent muscle disorders ("tying-up").

Selenium is a trace element which, as a co-factor of the enzyme glutathione peroxidase (GSH-Px), plays a key role in the antioxidant battle alongside vitamin E. 100 % of the selenium is supplied as selenomethionine, the principal form under which selenium is stored in the organism. Selenium from this organic source is better assimilated and stored than that provided by sodium selenite (the inorganic form).

PRECAUTIONS FOR USE

Due to the presence of high levels of selenium and vitamin E, respect the recommendations.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 18 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Muscular system

NATURAL E

DESCRIPTION

A concentrate of protected natural vitamin E.
An important biological antioxidant, playing a primordial role in cell membrane protection.

INDICATIONS

Covers daily requirements in vitamin E.
REVERDY NATURAL E can be used at higher doses in the following situations:

- In preventing muscular problems in horses prone to chronic myopathies ("tying up"), or in intensive training;
- Before a competition;
- Neurological disorders such as MND (Motor Neuron Disease).

DIRECTIONS FOR USE

Distribute by mixing with cereals or pelleted feed, or administer directly into the mouth using a syringe.

ADULT HORSE (500 KG)	RECOMMENDED DAILY DOSE	DURATION
Fulfilling vitamin E requirements	5 to 10 ml *equivalent to 1 to 2 ml /100 kg (liveweight)*	Continuously
Prevention of muscular disorders	20 to 30 ml *equivalent to 4 to 6 ml /100 kg (liveweight)*	During the entire period of risk
Before a competition or any stressful situation	20 to 50 ml *equivalent to 4 to 10 ml /100 kg (liveweight)*	Few hours before the event
Motor Neurone Disease (MND)	40 to 50 ml *equivalent to 8 to 10 ml /100 kg (liveweight)*	Continuously

For ponies and youngstock, administer a daily dose in proportion to the animal's liveweight.

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

1 L

NON DOPING PNFS*

MADE IN FRANCE

Liquid

COMPOSITION

Non GMO* virgin corn (maize) oil, natural tocopherols. ** <0.1%*

PER LITRE
Natural vitamin E (d-α-tocopherol acetate).100,000 mg

ANALYTICAL CONSTITUENTS

Fats and oils 99%

10 ML OF NATURAL E PROVIDE

1,000 mg equivalent to 1,360 IU of natural vitamin E.

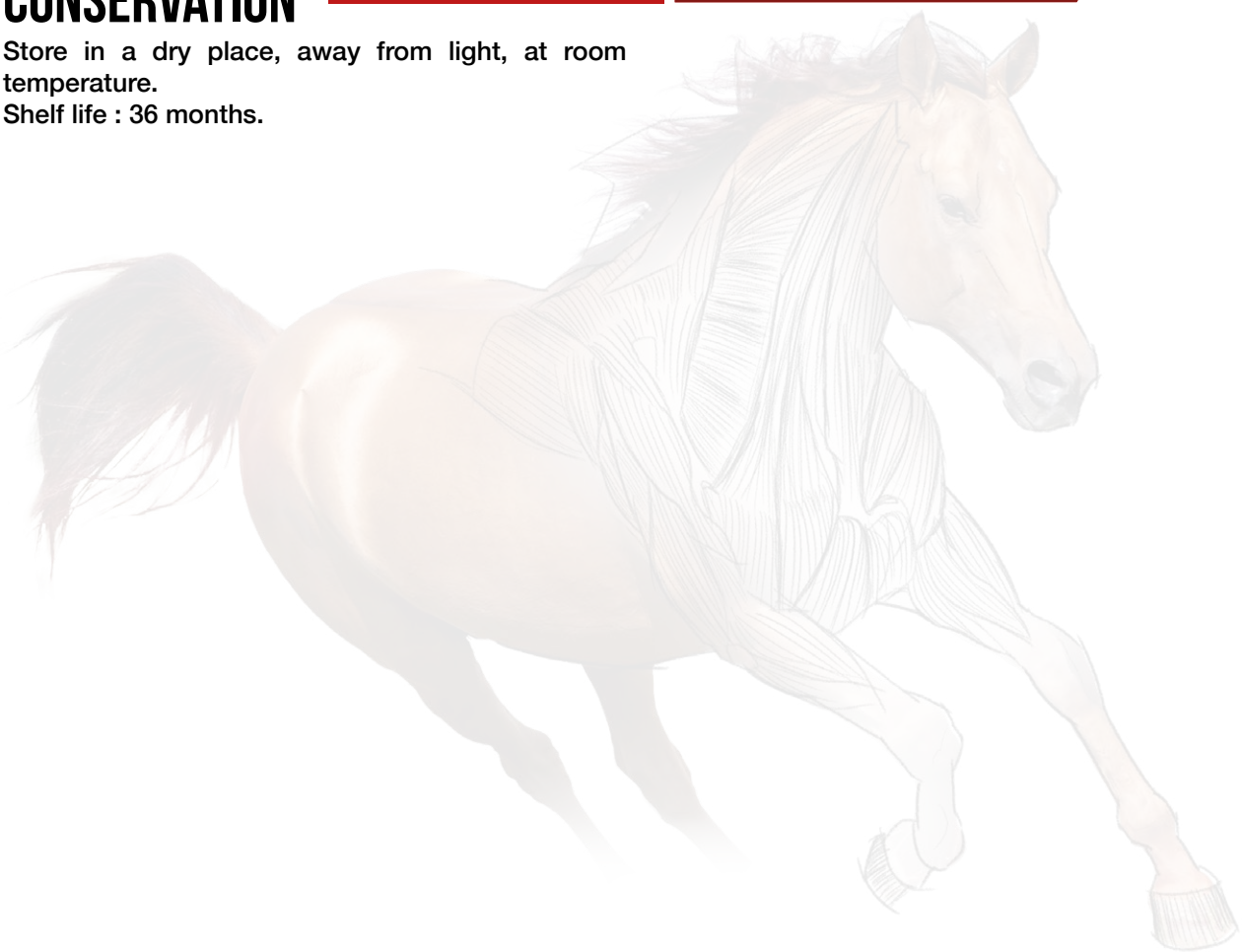
PROPERTIES

Vitamine E is an important biological antioxidant playing a primordial role in cell membrane protection.

The natural form of **vitamin E** is more bioavailable than the synthetic form.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 36 months.



Conceived by our research and development department.
Manufactured in our laboratory.

OMEGA OIL

DESCRIPTION

A blend of linseed oil and non-GMO* maize germ oil, non refined, first pressed, and of “human food” quality.
A source of essential fatty acids and natural antioxidants.
Permits a well thought out supply of Omega 3, 6 and 9, beneficial to health.

** <0.1%*

INDICATIONS

Diversifies energy sources in the concentrate ration.
Increases the energy value of the ration.
Use of this product is of particular interest in the following situations:

- Lack of body condition
- Pathological disorders related to, or aggravated by high cereals rations:
  - behavioural problems (nervousness);
  - muscular disorders (chronic myopathies such as “tying-up”);
  - gastric ulcers;
  - etc.

1 L 5 L 25 L

DIRECTIONS FOR USE

Adult horse (500 kg) :
Give 50 to 100 ml per meal. Mix well into the feed.

For ponies, administer a daily dose in proportion to the animal’s liveweight.

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Liquid

COMPOSITION

First pressed linseed oil, non-GMO* virgin maize germ (corn germ) oil, natural tocopherols.

** <0.1%*

ANALYTICAL CONSTITUENTS

Oils and fats	99.9%
of which: Saturated fatty acids	approx. 11 %
Unsaturated fatty acids	approx. 87 %
Omega 3 (Linolenic acid)	34%
Omega 6 (Linoleic acid)	31%
Omega 3/Omega 6 ratio	*1.1*
Omega 9 (Oleic acid)	22%

PROPERTIES

First pressed linseed oil is very rich in Omega 3 **whilst the non-GMO** (<0.1%) **virgin maize germ oil** is an important source of Omega 6 and natural tocopherols (antioxidants).

This blend of non-refined **vegetable oils**, first pressed, is of "human food" quality and is rich in essential fatty acids. It allows a well thought out supply of **Omega 3, 6** and **9**, beneficial to health.

Feeding oil permits a reduction in the glycaemic index of cereal based concentrate rations. Furthermore, it assists the intestinal transit and soothes inflamed mucous membranes in the upper digestive tract (oesophagus, stomach and small intestine).

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 12 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Locomotor system

OSTEOFLEXY

DESCRIPTION

A source of minerals, trace elements, vitamins & chondroprotective agents.
Contributes to improving bone mineralization and cartilage & bone renewal.

INDICATIONS

- Covers daily requirements in calcium, phosphorus, magnesium, zinc, manganese, copper, vitamins D3 and K3;
- Supports bone mineralization in young growing horses;
- Mineralization disorders, to help bone consolidation following a fracture.

1.5 kg 3.5 kg 12.5 kg

DIRECTIONS FOR USE

Distribute with cereals or compound feed. Mix well into the feed.
1 measure = 35 g

ADULT HORSES YOUNG GROWING HORSES (ADULT LIVEWEIGHT = 500 KG)	DAILY DOSE
Maintenance dose	2 measures (70 g) *equivalent to 14 g /100 kg (adult liveweight)*
Maximum recommended dose	4 measures (140 g) *equivalent to 28 g /100 kg (adult liveweight)*

For ponies, administer a daily dose in proportion to the animal's liveweight.

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

NON DOPING PNFS*

MADE IN FRANCE

Small pellets

COMPOSITION

Calcium and sodium phosphate, lithothamnion, barley, maize, extruded linseed, magnesium phosphate, glucosamine sulphate 2 KCl (marine origin), extruded soya beans, MSM (Methylsulfonylmethane), fructose.

PER KG

Zinc (Hydrated amino acids chelate)..... 2,571 mg
Manganese (Amino acids chelate)..... 1,429 mg
Copper (Hydrated amino acids chelate)..... 900 mg
Vitamin D3.....35,714 IU
Vitamin K3 ..... 86 mg

ANALYTICAL CONSTITUENTS

Humidity.....12.5%
Total protein 9%
Fats and oils 1%
Crude fibre 4%
Ash 44%
Calcium 10.7%
Phosphorus.....5.4%
Magnesium 2.5%
Sodium 1%

2 MEASURES (70 G) OF OSTEOFLEXY PROVIDE

7,500 mg of calcium, 5,000 mg of glucosamine (sulphate 2 KCl), 3,750 mg of phosphorus, 2,500 mg of MSM, 1,750 mg of magnesium, 180 mg of chelated zinc*, 100 mg of chelated manganese*, 63 mg of chelated copper*, 2,500 IU of vitamin D3, 6 mg of vitamin K3.

** Amino acids chelates*

PRECAUTIONS FOR USE

Due to the presence of high levels of vitamins and trace elements, respect the recommendations.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 18 months.

PROPERTIES

Calcium, phosphorus and magnesium are vital minerals for bone mineralization. Calcium of marine origin is better assimilated than calcium provided by limestone. Lithothamnion has been shown to increase bone renewal and mineralization after 112 days compared to calcium carbonate from limestone.

Glucosamine is the precursor of many of the constituents of proteoglycans and of hyaluronic acid. In cartilage, hyaluronic acid is bound with proteoglycans and form aggregates which ensure good hydratation of this tissue. In the synovial fluid joints, hyaluronic acid has a role of lubricant and chondroprotective agent. It has been shown glucosamine supplementation decreased inflammation while supporting the growth of new cartilage in response to joint trauma in young growing horses when glucosamine was administered for 84 days prior to the injury in question.

MSM also possesses chondroprotective properties. It is a source of organic sulphur which is indispensable to the synthesis of collagen, an abundant protein in cartilage and which gives it hydration, resistance, elasticity and suppleness.

Zinc, manganese and copper are provided in an easily absorbed amino acid chelates form. These trace elements are associated with a number of enzymes which play important roles within the body in the formation of bone and cartilage.

Vitamin D3 participates in bone mineralization, playing a part in regulating the balance between phosphorus and calcium.

In horses, **menadione (vitamin K3)** has been demonstrated to be the only patented vitamin K that increases the plasma concentration of menaquinone-4, the most effective vitamin K form regulating bone metabolism. Vitamin K contributes to increasing bone volume and strength by stimulating bone formation and reducing bone resorption.

Conceived by our research and development department.
Manufactured in our laboratory.

Breeding

STARTER

DESCRIPTION

Energy catalyst, containing high levels of protected vitamins and chelated trace elements.
Gives the newborn foal support by providing his organism with rapidly available nutriments.

INDICATIONS

Covers the newborn foal's requirements in trace elements and vitamins.

DIRECTIONS FOR USE

For a foal destined to weigh 500 kg at maturity:
The contents of 1 syringe to be swallowed a few hours after birth then repeated at the age of 3 and 6 days old.
If required, renew every 10 days up until the age of 2 months.

For ponies, administer a daily dose in proportion to the animal's liveweight.

15 ml

MADE IN FRANCE

Gel

COMPOSITION

Demineralised water, dextrose, sorbitol, natural orange flavouring.

PER KG

Zinc (Hydrated amino acids chelate)..... 1,250 mg
Copper (Hydrated amino acids chelate)..... 469 mg
Manganese (Amino acids chelate)..... 1,250 mg
Iron (Sulphate)..... 1,563 mg
Selenium (Organic selenium) ..... 6.3 mg
Vitamin A..... 3,750,000 IU
Vitamin D3..... 400,000 IU
Vitamin E..... 28,125 mg
Vitamin B1 (Thiamin)..... 1,250 mg
Vitamin B2 (Riboflavin) ..... 938 mg
Vitamin B3 (PP or Niacin) ..... 2,188 mg
Vitamin B5 (Pantothenic acid)..... 938 mg
Vitamin B6 (Pyridoxine) ..... 625 mg
Vitamin B8 (Biotin) ..... 19 mg
Vitamin B12 (Cyanocobalamin)..... 37.5 mg
Vitamin C (protected) (Phosphorylated L-ascorbic acid) ..... 9,375 mg

ANALYTICAL CONSTITUENTS

Humidity..... 53 %
Total protein ..... 2 %
Fats and oils ..... 3.5 %
Crude fibre ..... 0.5 %
Ash ..... 4.5 %
Sodium..... 0.5 %

1 SYRINGE (15 ML) OF STARTER PROVIDES

20 mg of chelated* zinc, 7.5 mg of chelated* cooper and 20 mg of chelated* manganese, 25 mg of iron, 0.1 mg of organic selenium, 60,000 IU of vitamin A, 6,400 IU of vitamin D3, 450 mg of vitamin E, 20 mg of vitamin B1, 15 mg of vitamin B2, 35 mg of vitamin B3, 15 mg of vitamin B5, 10 mg of vitamin B6, 0.3 mg of vitamin B8, 0.6 mg of vitamin B12 and 150 mg of vitamin C.

** Amino acids chelate*

PROPERTIES

Vitamin A affects protein synthesis and intervenes in tissue development, particularly of the skeleton. It intervenes in the fight against infection and contributes to epithelium integrity. Vitamin A is also of importance for sight.

Vitamin D plays a part in bone mineralization: it increases the intestinal uptake of calcium and facilitates its absorption into the bones.

Vitamins E and **C** as well as **organic selenium** (and to a lesser degree, vitamin A), are important biological antioxidants participate in protecting muscular cells and help recovery after exertion.

Vitamin B1 is vital to the metabolism of carbohydrates.

Vitamin B2 activates the catabolism of lactic acid (like zinc) and intervenes, as do vitamins B3 and B8, in the metabolism of carbohydrates and lipids.

Vitamin B5 plays a role in the oxidation of fatty acids and carbohydrates.

Vitamin B6 intervenes in the regulation of the blood sugar level and contributes to the releasing of sugars from the glycogen reserves of the organism.

Vitamin B12 is known for its role in the formation of red blood cells (just like vitamin B6). More generally, it is involved in the metabolism of carbohydrates, proteins and lipids.

100 % of the **selenium** provided is in the form of Organic selenium, the principal form under which selenium is stored in the organism.

Copper increases the use of fats for the production of energy.

Copper and **zinc** are essential co-factors of copper-zinc superoxide dismutase (CuZn-SOD), fundamental enzyme in the antioxidant struggle.

Iron is a co-factor of numerous enzymes which intervene in energy production (cellular respiration).

Manganese intervenes in the metabolism of carbohydrates and fats. It also participates in neutralising free radicals as a co-factor of manganese superoxide dismutase (Mn-SOD).

PRECAUTIONS FOR USE

Due to the presence of high levels of vitamins and trace elements (including selenium) in this product, respect the recommendations.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 18 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Locomotor system

SUPER FLEXY

DESCRIPTION

A preparation based on the three major chondroprotective agents (chondroitin, glucosamine and MSM), hyaluronic acid and extracts of avocado and soya oils.
Contributes to relieving articular pains, slowing the evolution of arthritis and improving articular lubrication and cartilage elasticity.

INDICATIONS

- Proven joint problems;
- Articular pain/lameness due to arthritis;
- In complement to articular surgery;
- Sudden/considerable articular stress:
  - breaking/pre-training;
  - periods of intensive training;
  - competition;
  - work on hard ground.

DIRECTIONS FOR USE

Feed by mixing with the cereal or pelleted feed.
1 measure = 50 g

ADULT HORSE (500 KG)	DAILY DOSE
Loading dose (1st month)	1 measure (50 g) *equivalent to 10 g /100 kg (liveweight)*
Maintenance dose (or preventive)	½ measure (25 g) *equivalent to 5 g /100 kg (liveweight)*
Maximal recommended dose	1 ½ measure (75 g) *equivalent to 15 g /100 kg (liveweight)*

For ponies and youngstock, administer a daily dose in proportion to the animal's liveweight.

1.8 kg

NON DOPING PNFS*

** Non doping product without Prohibited Natural Feed Substances (analysed within the framework of a control scheme).*

MADE IN FRANCE

Powder

COMPOSITION

Fructose, glucosamine sulphate 2 KCl (marine origin), avocado and soya unsaponifiable fractions, MSM (Methylsulfonylmethane), chondroitin sulphate (marine origin), hyaluronic acid, natural orange flavouring.

ANALYTICAL CONSTITUENTS

Humidity	11%
Total protein	9,5%
Fats and oils	8,5%
Ash	7,5%
Sodium	0,3%

1 MEASURE OF SUPER FLEXY (50 G) PROVIDES

10,000 mg of glucosamine sulphate 2 KCl, 6,000 mg of avocado/soya extracts, 4,000 mg of MSM, 2,000 mg of chondroitin sulphate and 300 mg of hyaluronic acid.

PROPERTIES

Avocado and **soya unsaponifiable fractions** improve healing of articular lesions localised at a synovial membrane and cartilage tissue level. They also permit an increase in the synthesis of glycosaminoglycans (constituents of proteoglycans) within articular cartilage.

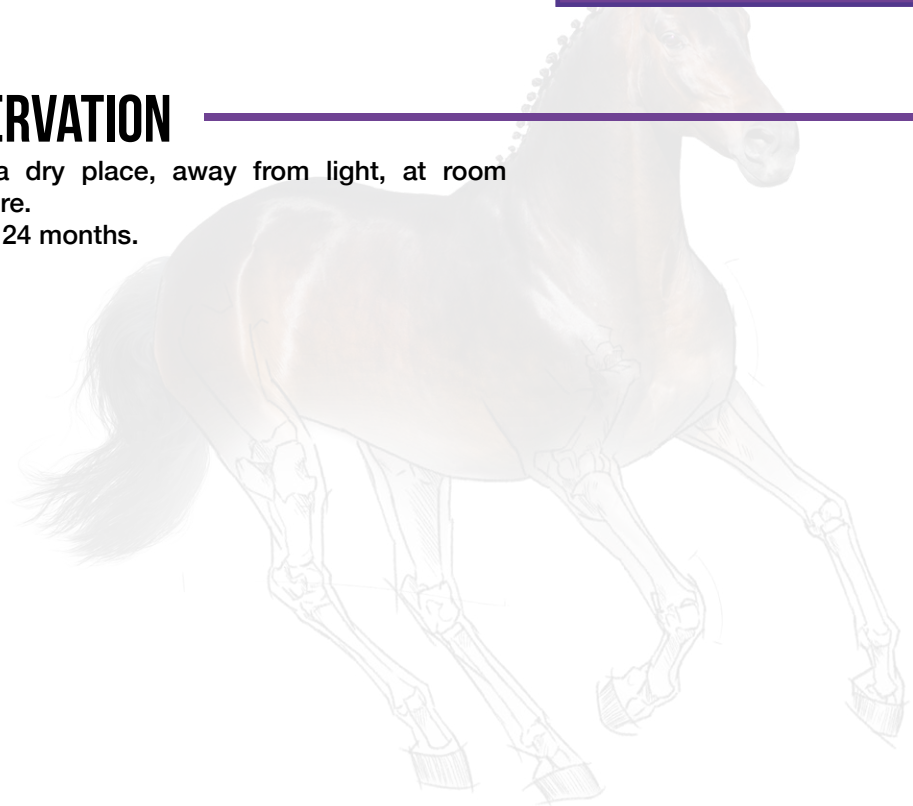
Chondroitin is a constituent of proteoglycans whose role are to maintain correct hydration of cartilage and bones. Furthermore, it directly protects cartilage cells from enzymatic reactions and free radicals.

Glucosamine is the precursor of many of the constituents of proteoglycans and of hyaluronic acid. In cartilage, hyaluronic acid is bound with proteoglycans and forms aggregates which assure good hydration of this tissue. In the synovial fluid of joints, hyaluronic acid has a role of lubricant and chondroprotective agent.

MSM also possesses chondroprotective properties. It is a source of organic sulphur which is indispensable to the synthesis of collagen, an abundant protein in cartilage and which gives it hydration, resistance, elasticity and suppleness.

CONSERVATION

Store in a dry place, away from light, at room temperature.
Shelf life : 24 months.



Conceived by our research and development department.
Manufactured in our laboratory.

Treats

CARROT

DESCRIPTION
Cereal treats containing pieces of carrots.

750 g 3.5 kg

DIRECTIONS FOR USE
Place a treat in the palm of your hand and present it to your horse or pony.

MADE IN FRANCE

COMPOSITION
Barley, maize, dehydrated carrots, fructose.

ANALYTICAL CONSTITUENTS

Humidity	13 %
Total protein	9 %
Fats & oils	2 %
Fibre	4 %
Ash	5 %
Calcium	0.1 %
Phosphorus	0.3 %
Magnesium	0.5 %

PRECAUTIONS FOR USE
Do not feed the treat by holding it between your fingers.

CONSERVATION
Store in a dry place, away from light, at room temperature.
Shelf life : 20 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Treats

APPLE

DESCRIPTION
Green apple flavoured cereal treats.

750 g 3.5 kg

DIRECTIONS FOR USE
Place a treat in the palm of your hand and present it to your horse or pony.

MADE IN FRANCE

COMPOSITION
Barley, maize, micronised alfalfa (lucerne) protein concentrate, fructose, natural green apple flavouring.

ANALYTICAL CONSTITUENTS

Humidity	13 %
Total protein	11 %
Fats & oils	2.5 %
Fibre	4 %
Ash	5 %
Calcium	0.3 %
Phosphorus	0.3 %
Magnesium	0.5 %

PRECAUTIONS FOR USE
Do not feed the treat by holding it between your fingers.

CONSERVATION
Store in a dry place, away from light, at room temperature.
Shelf life : 20 months.

Conceived by our research and development department.
Manufactured in our laboratory.

Factory 100% dedicated to the horse


REVERDY
NUTRITION EQUINE


NUTRITION EQUINE

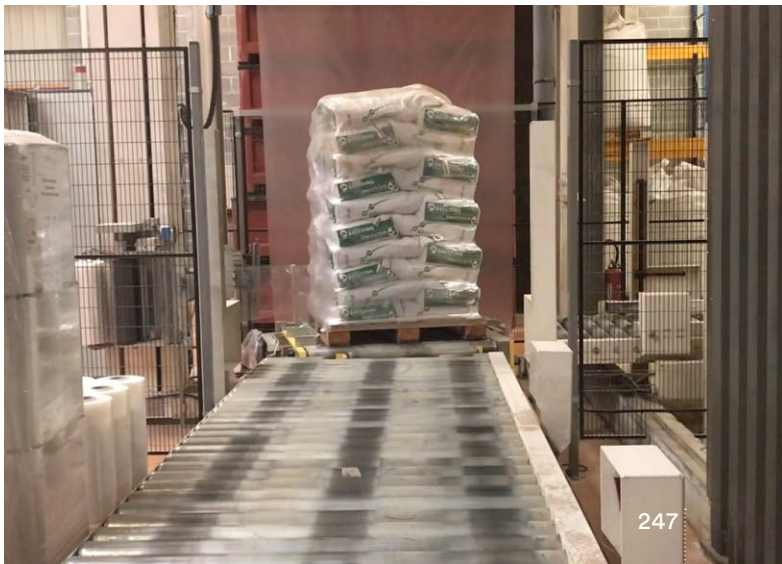
Our feed manufacturing line


REVERDY
BREEDING


REVERDY
BREEDING


REVERDY
REVERDY
BREEDING


BREEDING



Filling containers and loading lorries

Storage

SI Pharma facilities (vitamin and mineral supplements + premix facilities)

Nutritional supplements laboratory

GROUPAGE REVERDY

Bundle your feed orders with other clients.

Your benefits:

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  Preferential rate for collective orders
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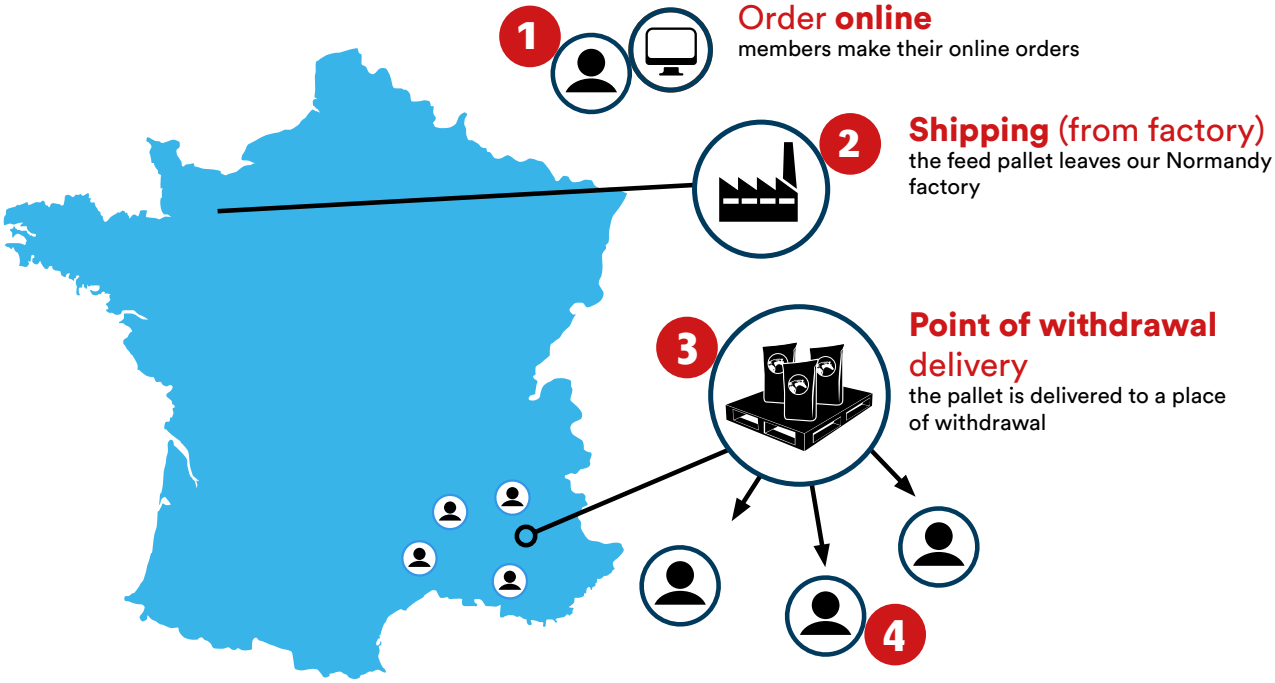

1 **Order online**
members make their online orders

2 **Shipping** (from factory)
the feed pallet leaves our Normandy factory

3 **Point of withdrawal** delivery
the pallet is delivered to a place of withdrawal

4 Redistribution to **members**
members attached to the point of withdrawal pick-up their orders

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