Glossary

(continued)

Lipids
The main component of fat, lipids have a high energy content in a small volume (fats, oils). They also play a functional role in the body by means of the vitamins dissolved in them (vitamins A, D, E and K) and the presence of essential life-sustaining lipid molecules (essential fatty acids).

Metabolism
All the biochemical processes occurring in a living being so that it may develop and survive. Some reactions make construction processes possible by means of synthesis (anabolism), others are degradation or breakdown processes (catabolism).

Micronutrients
Nutrients present in tiny amounts in food (vitamins, trace elements).

Minerals
In a food, everything organic matter or water consists of rock salt. Collectively they are also referred to as ash. According to their level of incorporation in food, one calls them "macronutrients" (eg: calcium and phosphorus) or "trace elements" (iron, copper, zinc…).

Nutrients
Simple mineral elements or organic molecules that are the components of food, each one of them being essential to the functioning of the body. According to the condition of the latter, preparing a balanced food involves making a complex jigsaw, each piece of which is a different nutrient. Nutrients are divided into families: proteins, lipids, carbohydrates, minerals, vitamins, without forgetting the most important one of all: water. Nutrients are prime elements, just like there are prime numbers, from which all conceptions of a balanced diet must derive.

Nutrition
All the phenomena by which the body breaks down food to absorb and use it for the purpose of development and survival in a given environment. Nutritional balance in food:
- provides the energy constantly required by the body,
- provides the materials needed to permanently build and renew organs,
- provides small amounts of those substances that are essential to the smooth functioning of the biological phenomena permanently occurring in the cells.

Protids
Protids or proteins are the only substances in the body that contain sulphur. They provide life-essential elements: amino acids, which are the building blocks of the cells that make up the body. They have a number of vital functions allied to growth, reproduction and immunity to name but three. Proteins are also required to manufacture the enzymes that trigger chemical reactions in the body.

Vitamin
A vitamin is an organic substance needed by the body, with no energy value of its own, and that the animal cannot synthesize in sufficient amounts to function normally. Therefore, an adequate daily supply of it must be provided by the diet.

Prof. Dominique Grandjean, is Director of the Sports and Breeding Medicine Unit at the National School of Veterinary Science in Alfort (France) where he also teaches and researches Animal Nutrition. In this book, he has compiled the most up-to-date knowledge in the constantly evolving field of cat and dog nutrition.

Indeed, what other field has undergone such fast developments, providing ever more accurate knowledge, than that of nutrition? We all know that nutrients (those elements, contained in food, that are "useful" for the body) do not only help take the edge off hunger! They also constitute the "building blocks" that build (or destroy) organs, tissues or the skeleton and keep the body in good running order (or the opposite).

This book reviews each of the elements that any quality cat or dog food must contain.

Comprehensively illustrated encyclopaedic information sheets will help you to understand the value of the various fibre types, the need for certain vitamins, and the crucial role of proteins, lipids and carbohydrates.

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Prof. Dominique Grandjean - Everything you need to know about the role played by Nutrients in the health of Dogs & Cats

Prof. Dominique Grandjean

Everything you need to know about the role played by Nutrients in the health of Dogs & Cats

UMES

ROYAL CANIN

Glossary

Energy requirements
The varying amount of energy required to compensate the body's daily energy losses. This amount depends on age, physiological status (growth, gestation, lactation, etc.), physical activity, neuter status and size of animal (in dogs).

Energy
In order to function smoothly, an animal's body needs the energy contained in its food (whether animal or vegetable in origin). During digestion, food is broken down into nutrients that, once absorbed and metabolised by the body, provide energy. In a premium cat or dog food:
- 1g proteins provides about 4 calories,
- 1g carbohydrates provides about 4 calories (excluding fibres),
- 1g lipids provides about 9 kilocalories.

Enzyme
An organic molecule with the ability to speed up or trigger biochemical reactions in the body.

Dietary fibres
Components found in plants, including cellulose, hemicelluloses and pectins, that cannot be assimilated by the body. Although of no direct nutritional value, dietary fibres are nevertheless very important: insoluble fibres facilitate intestinal transit while soluble or fermentable fibres help protect the intestinal wall and fight against bacteria that cause diarrhoea.

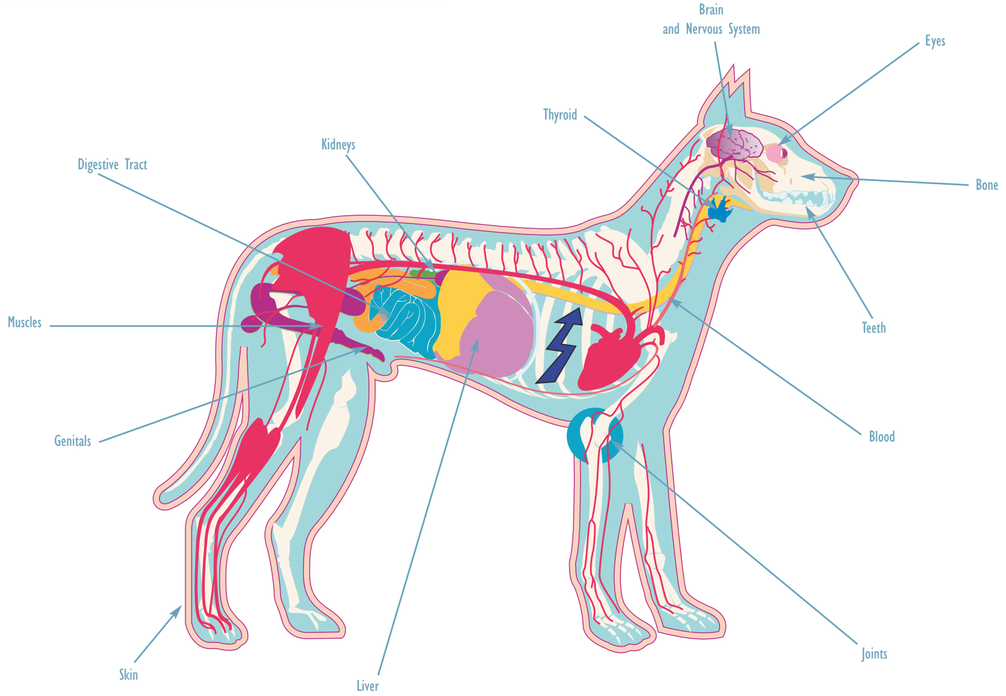
Carbohydrates
Organic compounds whose role is essentially energy-related, although some carbohydrates still play a structural or hygienic role in the digestive tract. They are split into two categories according to their function :
- simple carbohydrates, aka sugars (glucose, fructose, saccharose, lactose, etc) are found in fruit, flour, milk, sugar and sugar products
- complex carbohydrates, which include starch (energy sources)and dietary fibre (needed for general hygiene in the digestive tract).

Ingredients
The "visible" elements (the raw materials of food) in a recipe. An ingredient can be a source of several nutrients, and improved by eliminating its components with no nutritional value.

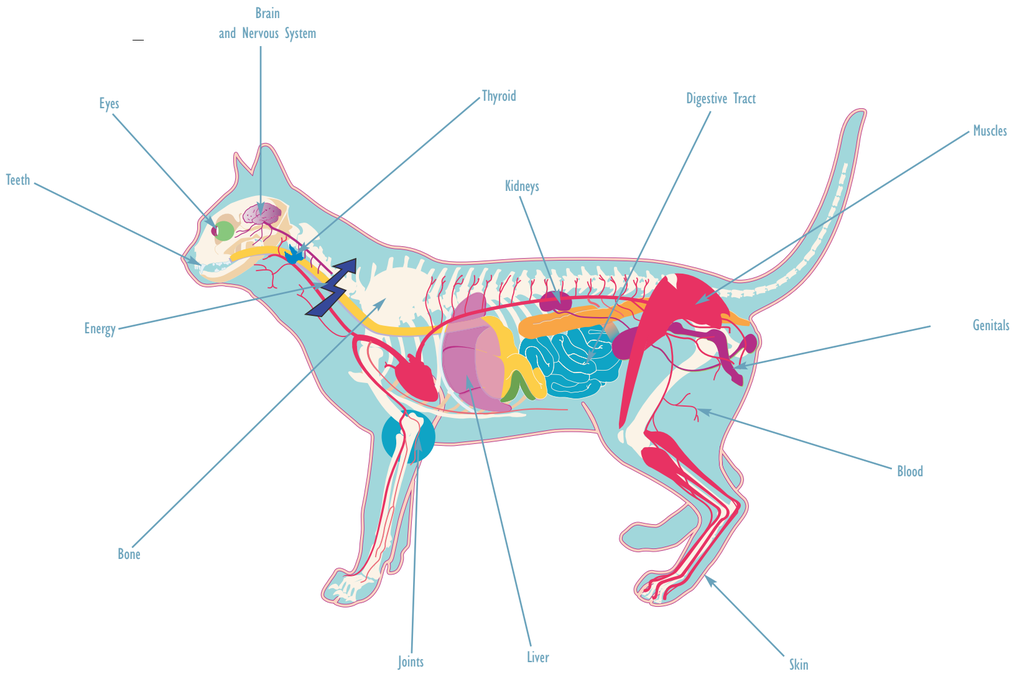
Kilocalorie
The unit of energy used in calculating an animal's energy requirements and the food's energy density. 1 kilocalorie = 1000 calories = 4.18 kilojoules.

Continued on other cover flap

Each kind of food, as a source of specific nutrients, ensures the proper functioning of the different organs



Each kind of food, as a source of specific nutrients, ensures the proper functioning of the different organs



Pr Dominique Grandjean

Everything you need to know about the role played by the Nutrients in the health of Dogs & Cats

UMES
unité de médecine de l'élevage et du sport

ROYAL CANIN®

WARNING

This book was written with a view to informing the reader.
It is not a medical guide and cannot replace a veterinary consultation or intervention.
Veterinary surgeons must be consulted on a regular basis in all cases.

Illustrations : Diffomédia/Élise Langellier, Vincent Jacques, Éric Josié, Lucie Sauget

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Contents

Foreword

A foreword encourages you to read the rest of the book, but my sights are set higher, as I feel you should also read other books by Dominique Grandjean. When you read Peter Singer and Tom Regan, the philosophical gurus of animal rights, you wonder if they even understand our animals. When you read Charles Darwin and Albert Schweizer and, daresay, Dominique, the empathy shines through. Even in a little book like this one that summarises the functions and health-giving properties of the essential chemicals in foods – the nutrients – an unmistakable desire to help our dogs and cats and other creatures emerges. And that is a gift from the author, whose life is devoted to the comradeship of human beings with dogs and cats.

Every minute you devote to this book is well invested.
I'll not bore you with a solemn proclamation of Professor Grandjean's expertise, because there are four or five other experts around this world that compare with him. His edge, however, is his vivid imagination that brings these pages to life. Most readers will learn more in a minute from this little book than any other on nutrition and health. I guarantee it.

Let me tell you a secret.
When the U.S. National Research Council defined the nutritional requirements of dogs in terms of energy in 1989, Royal Canin was already a step ahead. Not content with formulating its foods in terms of energy– and here's the Grandjean edge – Royal Canin furnishes every new product with a carefully chosen amount of energy per kilogram, adapted to the animal's lifestyle. This specific energy density for each product ensures that the animal can satiate its appetite without losing or gaining weight, while absorbing the optimal quantity of nutrients. So this little book helps spread understanding of the role played by each nutrient and thus how they are best used in the diet.

Well-known to veterinarians are Professor Grandjean's clinical trials of various diets on dogs with chronic kidney failure. The prevailing belief was that these dogs, most of them old and thin, should be fed special low protein diets, based on the knowledge acquired from rats. The tests at Alfort revealed that these dogs fared better on diets moderately high in protein, which sustained kidney functions that are depressed by low protein products. Sick dogs as well as the healthy are helped by a better understanding of nutrients.

This book is little in size but not in content. It is so well written and illustrated that it conveys everything that you will want to know about nutrients for your pets and, perhaps, yourself. It will enable you to make sound choices about feeding your dogs and cats, which is one way we show that we care for them.

David Kronfeld
"Paul Mellon Distinguished Professor"
of Agriculture and Veterinary Medicine,
Virginia Tech, Blacksburg

Nutrition and Health

In the last 30 years, the food prepared by the major pet food manufacturers has had a positive effect on the health of our cats and dogs.

It is estimated that the life expectancy of dogs, for instance, has increased by 3 years in the past 15 years.

Veterinary nutrition is a science that aims to identify the essential nutrients and the role they play, based on the intake. It is a field in which we are constantly acquiring fresh knowledge: the number of publications referenced under the keywords "Health" and "Nutrition" was 2748 in 2005, versus 1331 in 1995, a more than twofold increase in a decade!

Every year a whole new batch of pet foods and nutritional formulas appears on the market, containing, besides essential health-sustaining nutrients, natural elements to prevent a number of risks of diseases and protect the body.

From mere "survival", giving the minimum required for the animal to stay alive, the concept of "diet" was developed, making for more beautiful and active pets. We have now moved on to the concept of "nutrition" thanks to an ever more thorough knowledge of how the body functions and to the study of the benefits that our natural environment can contribute to health (plant extracts, certain minerals, different kinds of proteins, etc).

Nowadays, animal rations can be formulated according to specific needs, well-identified deficiencies to be prevented or other specificities discovered by ongoing research.

From food to Health Nutrition

	Parameters	
1970s	**Food**	Energy need (nutritional recommendations extrapolated from the Beagle)
1980s	**Nutrition**	Age and activity (ingredient digestibility)
1990s	**Nutrition by size**	Age, activity, size (study of the physiological differences between the breeds)
2000s	**Health/Nutrition**	Interest of certain ingredients for health (nutraceutica) Influence of breed

The four objectives of Health Nutrition

Thanks to scientific and veterinary research, the traditional concept of nutrition, i.e. developing, sustaining and providing energy to the body, now has a preventive and, in certain conditions, a curative dimension. These new dimensions mark the birth of Health Nutrition.

Nutrition has four objectives :

NUTRITION :

1 - Body development and maintenance :
Amino acids, minerals, trace elements, vitamins and fatty acids respond to the basic nutritional needs for the development maintenance of the body.

2 - Energy provision :
Lipids and carbohydrates are the main energy sources for dogs. Cats are also dependent on proteins for their energy metabolism.

HEALTH NUTRITION :

3 - Nourishing and prevention :
Some nutrients are incorporated in the ration (antioxidants, prebiotics, fibre, essential fatty acids, etc), to prevent such risks as kidney disease, digestive problems and the effects of ageing.

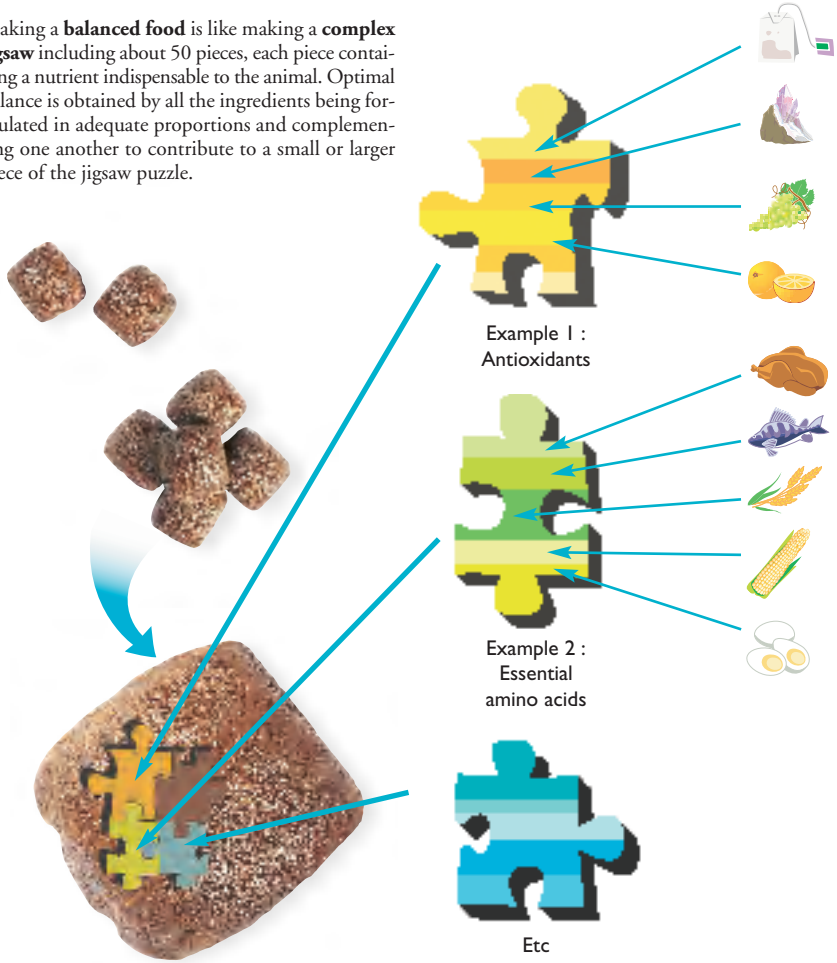
4 - Nourishing and caring :
Certain nutrients are added and others limited in food to support the therapeutic or convalescence process, helping pets recover from a number of ailments.

The nutritional approach means combining in one single food a complex jigsaw of just the right amount of about fifty nutrients needed to satisfy these four nutritional objectives and meet the real needs, precise and specific, of each body.

The ingredients approach, on the other hand, merely consists of a simple list of visible elements (namely dietary raw materials) entering into the composition of a food prepared with no consideration for a balanced nutritional content. It is therefore less accurate and less respectful of the animal's needs.

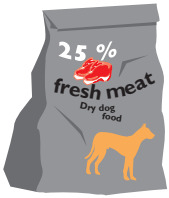
The *nutritional puzzle*

Making a **balanced food** is like making a **complex jigsaw** including about 50 pieces, each piece containing a nutrient indispensable to the animal. Optimal balance is obtained by all the ingredients being formulated in adequate proportions and complementing one another to contribute to a small or larger piece of the jigsaw puzzle.



The *pitfalls* of *designations* and *ingredients*

- ***A balanced diet involves paying close attention to NUTRIENTS (proteins, minerals, vitamins, lipids, carbohydrates), to their proportions and to the diversity of sources, rather than to DESIGNATIONS and INGREDIENTS ("with chicken, "with lamb","with salmon").***



25 %
fresh meat

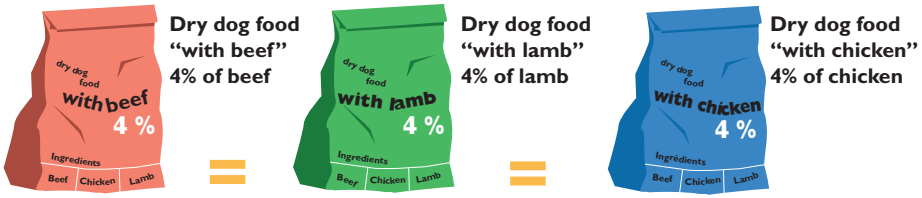
4 - 5%
proteins

Why does a food containing 25% fresh meat only provide 4-5% protein?

By law, food manufacturers are required to list ingredients by weight in descending order before cooking.
Thus fresh meat or other water-rich ingredients may be at the top of the list leading to the belief that they represent the main nutritional ingredient.
When you realise that fresh meat, for instance, contains 75% water, a food containing 25% lamb before cooking will contain only 6-7% lamb protein in the ultimate dry food. Let's imagine that the same food also contains 20% maize, 20% rice, 15% dried fish, 10% poultry fat and 10% vegetable oil. The manufacturer is allowed to write "Lamb" as the main ingredient; but in fact, the food will only contain about 4 to 5% lamb protein, and cereals will be the main ingredients in terms of quantity in the end product.

All ingredient designations are controlled

"contains…"	less than 4% of the ingredient mentioned
"with…"	4-14% of the ingredient mentioned
"rich in…"	14-26% of the ingredient mentioned
"…paste"	26-100% of the ingredient mentioned
"full…"	100% of the ingredient mentioned (which means the food cannot be balanced!)



The **same ingredients**... the **same foodstuffs**... but **3 different names and 3 different packs** !!

One food : three possible designations

Thus food can be formulated with, for instance, 4% chicken, 4% lamb and 4% beef, along with other ingredients, and then packaged with three different designations: "with beef", "with lamb" or "with chicken". And you'll always find someone to swear that their animal prefers the lamb, though it is exactly the same as the chicken!!

How do you judge the quality of a food ?

The quality of a food is judged at several phases :
- short term: palatability and digestive tolerance
- medium term: the development of the animal's weight and the quality of its coat
- long term: the development of the animal's health or its sporting or reproduction performance.

The quality of the food is first and foremost dependent on the quality of its ingredients. Highly digestible ingredients that provide all the nutrients the animal needs are key to a successful formulation. The job of the formulator is to combine the various ingredients in the proportions that respect nutritional and technological constraints. Quality also depends on how the food is cooked and stored.

A quality food is accordingly the result of a blend of many different expertises.

Physiological differences between human *canine* and *feline*

Digestive tract weight/body weight ratio	**10 – 12%**	
Area of olfactory membrane	3 - 10 cm^2	
Olfactory cells	2 - 10 million	
Taste buds	9 000taste buds	
Dentition	32 teeth	
Mastication	prolonged	
Salivary digestive enzymes	YES	
Food intake time	30 - 60 minutes	
Daily energy need	1800 - 2500 kcal/day	
Stomach pH	2 - 4	
Length of small intestine	6 - 6.5 m	
Length of large intestine	1.5 m	
Average Intestinal transit time	3 days	
Adult recommended carbohydrate intake	60 - 65% of dry matter	
Adult recommended protein intake	8 - 12% of dry matter	
Adult recommended lipid intake	25 - 30% of dry matter	
Diet	**omnivorous**	

A dog is not a person, a cat is not a small dog!!

The basic physiological and dietary differences between humans, cats and dogs call for specific nutritional requirements. But even then, you don't feed a small dog or a giant dog, a Persian or a Singapura cat in the same way!! Let's not allow our instinctively anthropomorphic reactions, detrimental to the health of our companion animals, get in the way. The table below explains these differences.

2.7% for a giant dog and 7% for a small dog	**2.8 to 3.5%**
60 to 200 cm^2	20 cm^2
80 to 220 millions	60 - 70 millions
1 700 taste buds	500 taste buds
42 teeth	30 teeth
very little	no mastication
NO	NO
1 to 5 minutes	multiple small meals
130 - 3500 kcal/day	200 - 300 kcal/day
1 - 2	1 - 2
2 - 6 m	1 - 1.7 m
20 - 80 cm	20 - 40 cm
24 - 48 hours	24 - 36 hours
low	low
20 - 40% of dry matter	25 - 40% of dry matter
10 - 65% of dry matter	15 - 45% of dry matter
semi-carnivorous	**carnivorous**

Understanding them to preserve their health

1. 42 **teeth** in dogs; powerful jaws can hack but they cannot chew.

2. Few **taste buds**, dogs don't have much sense of taste.

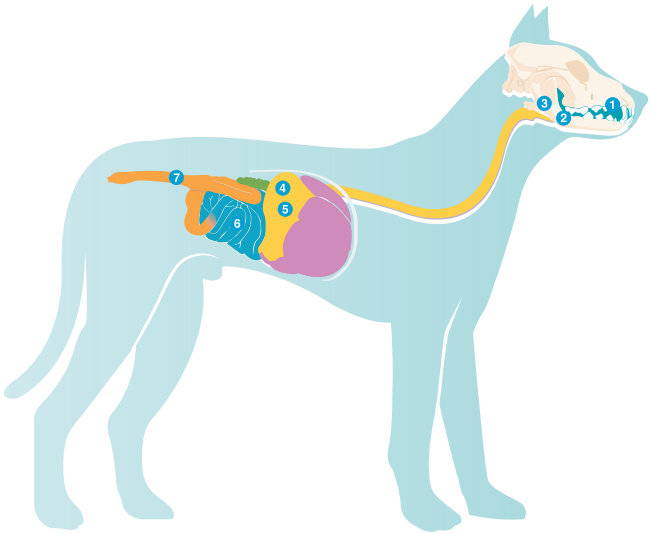
3. No **digestive enzymes** in the saliva (no predi-gestion).

4. A very expandable **stomach** holding up to 8 litres in giant dogs (adapted to large meals).

5. Stomach acidity is much higher than in humans.

6. The length of the **small intestine** is 2-6 m depending on the size of the dog. The transit time through the small intestine is only around two hours.

7. Despite the shortness of the **large intestine** (20-80cm), transit is very slow. This is where ingested food is fermented.



- *They swallow their food without "tasting" it*
- *The food reaches the stomach in the form of chunks*
- *Digestion is fast*

1. 30 **teeth** in cats, all of them sharp.

2. Cats have even fewer **taste buds** than dogs. They cannot taste sweet flavours.

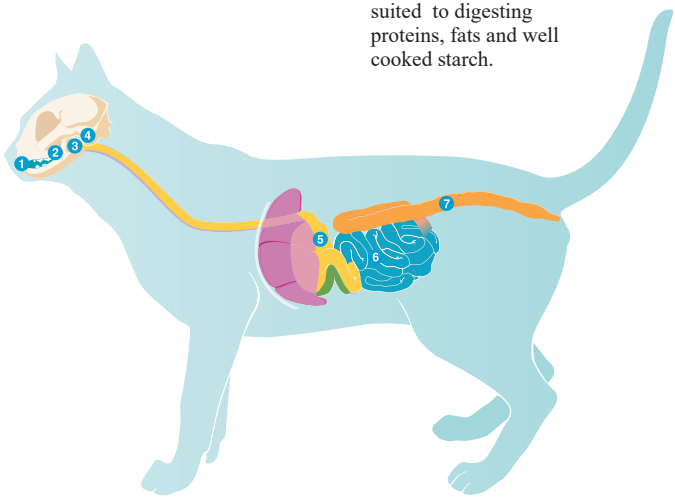
3. No **digestive enzymes** in the saliva (no predigestion).

4. Contrary to dogs, cats eat many small meals spread throughout the day.

5. Like the dog, the **cat's stomach** contains six times more hydrochloric acid than humans.

6. The cat's **small intestine** is well suited to digesting proteins, fats and well cooked starch.

7. Despite the shortness of the **large intestine** (20-40 cm), transit is very slow (20 hours at least). This is where non-digested food is fermented.



Carbohydrates

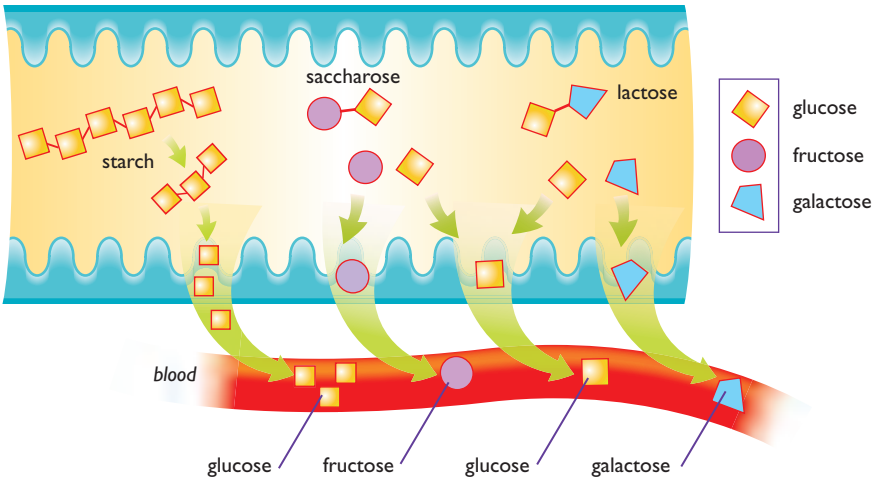
Carbohydrates is a term that covers molecules composed of carbon, oxygen and hydrogen that have certain chemical characteristics in common. Carbohydrates are predominantly vegetable, with the exception of blood glucose, glycogen in the muscles and the liver, and milk lactose.

All vegetables contain carbohydrates, ranging from saccharose in beet to the most indigestible fibre in tree bark.

Cats and dogs can synthesise the carbohydrates they need for the cells from amino acids. The intake of carbohydrates does however greatly improve the body's functioning.

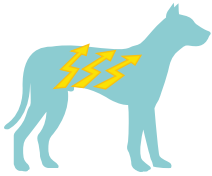
While glucose, saccharose, lactose and starch have the sole function of furnishing energy, their botanical origin and how well they are cooked influence their digestion. The presence in the food of poorly cooked starch can cause diarrhea. Fiber, which is also a carbohydrate, is very good for transit and for the balance of bacterial flora. This is true of fructo-oligosaccharides (FOS) and mannan-oligosaccharides (MOS) for instance.

digestive tract



Starch, lactose and saccharose are digested by the enzymes of the small intestine brush border. The simple glucose, fructose and galactose molecules then pass into the blood stream.

Starches



HEALTH & PREVENTION

To be digested by cats and dogs, starch must be very well cooked or it will ferment in the large intestine and cause diarrhoea. Too much starch can have the same result if the amount ingested exceeds the animal's enzymatic digestive capacity (in Nordic dog and cat breeds for instance).

A little background information

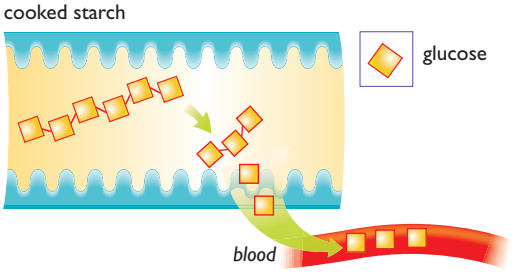
Starches are carbohydrate molecules in which thousands of glucose molecules are linked together by simple chemicals bonds.

Its role in the body

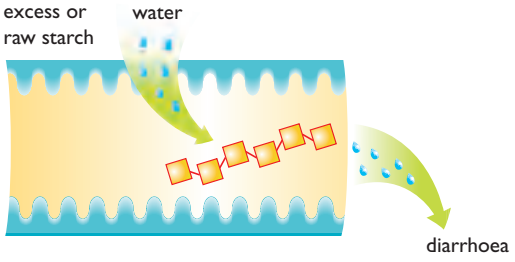
Starches are only used to provide energy to the animal, after being degraded by the digestive process to help the intestine gradually absorb the glucose molecules.

Natural sources

Starches are reserve substances (equivalent to fats in animals) peculiar to plants: cereals (rice, maize, wheat, barley, etc), potato or manioc tubers.
Starch represents 50-70% of cereal grain. In dry food, cereal starch helps obtain the typical honeycombed structure of the kibbles (expansion).



Starch is decomposed into glucose molecules by the enzymes (amylases) secreted by the pancreas and the digestive cells of the small intestine.

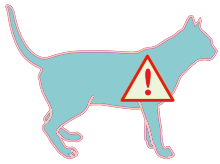


When there is a surfeit of starch or it is undercooked it is not completely digested. The undigested starch molecules ferment in the large intestine by generating an intake of water.

Energy source – Risk of diarrhoea if provided raw or in excess

Sugars

also known as :
Simple Carbohydrates, Di- and Tri-saccharides



Health & Prevention

Sugars have no preventive or curative functions in dogs or cats. But, when in excess in the food, they can cause overweight and diabetes.

A little background information

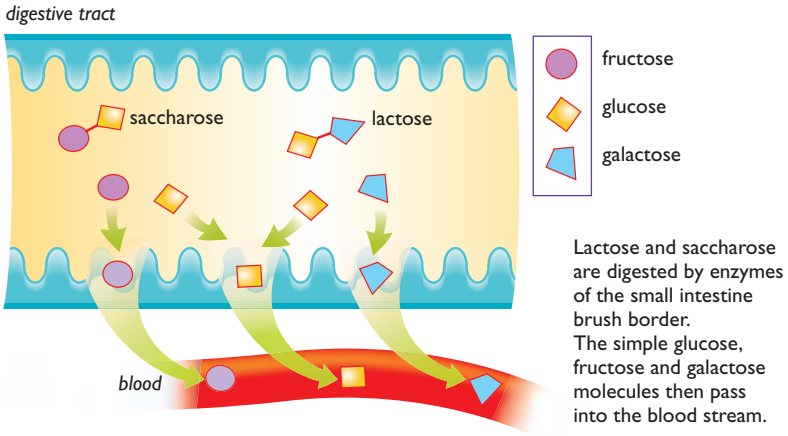
In everyday language, when we talk about sugar, we refer to the sweetening power and taste of carbohydrates like saccharose (sucrose) or fructose. With no qualifier, this term usually refers to saccharose (beet or cane sugar), but it could just as well refer to glucose (grape sugar), fructose (fruit sugar) or lactose (milk sugar).
Unlike the dog, the cat is not sensitive to sweet tastes.

Its role in the body

While lactose provides immediate energy to unweaned puppies or kittens, a digestive enzyme, lactase, is necessary to make it biologically available; lactase disappears once the animal stops feeding on milk. Since later on cats and dogs cannot taste "sweet" things and since they can synthesise their own blood glucose from proteins autonomously, sugars have no nutritional value for them.

Natural sources

Sugars are simple forms of energy reserves for most plants with fruit, berries, roots or tubers. The only known source of this type found in the body is milk lactose.

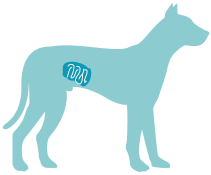


Lactose and saccharose are digested by enzymes of the small intestine brush border.
The simple glucose, fructose and galactose molecules then pass into the blood stream.

Energy source – Risk of diarrhoea and overweight

Cellulose

also known as :
Total dietary fibre (TDF)



Health & Prevention

Thanks to scientific knowledge on the raw fibre components of food, diseases like obesity, diabetes, constipation or diarrhoea can be prevented or cured more effectively by ad-ding these components in the right quality and amount to an animal's diet.

A little background information

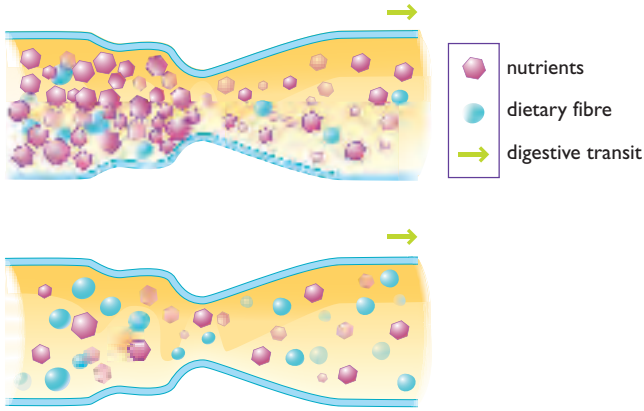
Cellulose is a very large molecule consisting of thousands of glucose units linked together by stronger chemical bonds than those found in starch. But cellulose represents only part of the total fibre in food. The term includes other soluble or insoluble fibrous plant substances, such as hemicelluloses, pectin, lignin and oligosaccharide fibres. On its own, cellulose does not have much of a nutritional effect, despite the raw cellulose content being stated on labels.

Its role in the body

The role of fibres in the body is dependent on their nature. Indigestible and insoluble fibres (pure cellulose, lignin) act as ballast in the bowels, inducing contractions to help them function mechanically by stimulating contraction (peristalsis). Soluble fibres can be important for the health and hygiene of the digestive tract (FOS, MOS).
The intake of sufficient fibre is important to produce a feeling of satiety in animals at risk of becoming overweight and in sedentary cats predisposed to the formation of hairballs in the digestive tract.

Natural sources

Fibres are one of the main constituents of plants, a kind of external skeleton providing support and lending them their shape. This explains why the generic term "cellulose" includes in fact a huge variety of molecules artificially grouped together; you only need to compare a tree trunk to a carrot or a French bean!



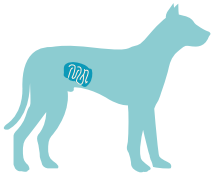
Intestinal transit must be slow enough to allow the absorption of nutrients but fast enough to avoid constipation.

Dietary fibre stimulates intestinal transit.


Aspergillus

FOS

also known as :
Fructo-oligosaccharides, Prebiotics



Health & Prevention

The addition of FOS to a food prevents infectious diarrhoea caused by the proliferation of dangerous bacteria in the intestine, while providing adequate nourishment to intestinal cells to facilitate their regular regeneration.

A little background information

Fructo-oligosaccharides (FOS) are fermentable fibres. They are not digested, but are nevertheless rapidly fermented by the bacteria in the colon, resulting in the release of small-sized fatty acids (known as volatile fatty acids) that :
- acidify the intestinal medium ;
- are excellent nutrients for cell maintenance and renewal ;
- line the walls of the large intestine.

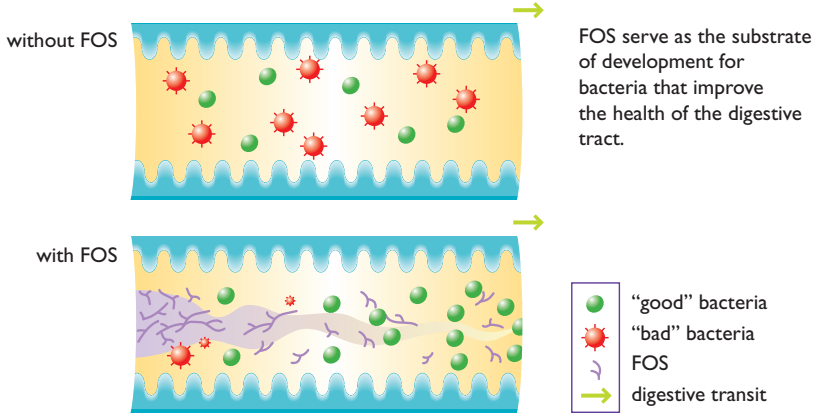
Its role in the body

Through fermentation, FOS are a direct source of nourishment for the cells of the large intestine. But they particularly promote the growth of specific bacterial flora (bifidus and lactobacillus) that have well-known beneficial effects on the health of the digestive tract :
- they inhibit the development of pathogenic bacteria ;
- they improve digestion and nutrient absorption.

FOS supplementation in the food of bitches used for breeding helps increase the antibody count (IgM) in the milk, which promotes the good immunity of the puppies.

Natural sources

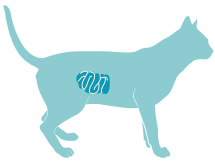
FOS are synthesised by a fungus (Aspergillus nigricans) in the presence of sugar, or saccharose, which is composed by the association of a glucose molecule and a fructose molecule. The fungus secretes an enzyme that permits the addition of extra fructose molecules to form FOS.



Prevention of infectious diarrhoeas – Intestinal health

MOS

also known as :
Mannan-oligosaccharides



Health & Prevention

MOS contribute to an adequately balanced bacterial population in the bowels, and have a direct and indirect effect on the health of the digestive tract. Thus, they are very effective in preventing diarrhoea and contribute to the prevention of digestion-related infectious diseases.

A little background information

Mannan-oligosaccharides belong to the large category of fibres, which means they are non-digestible carbohydrates. Just like FOS, they are effective against harmful bacteria living in the intestinal lumen, but have a different mode of action. They are composed of two sugars: glucose and mannose.

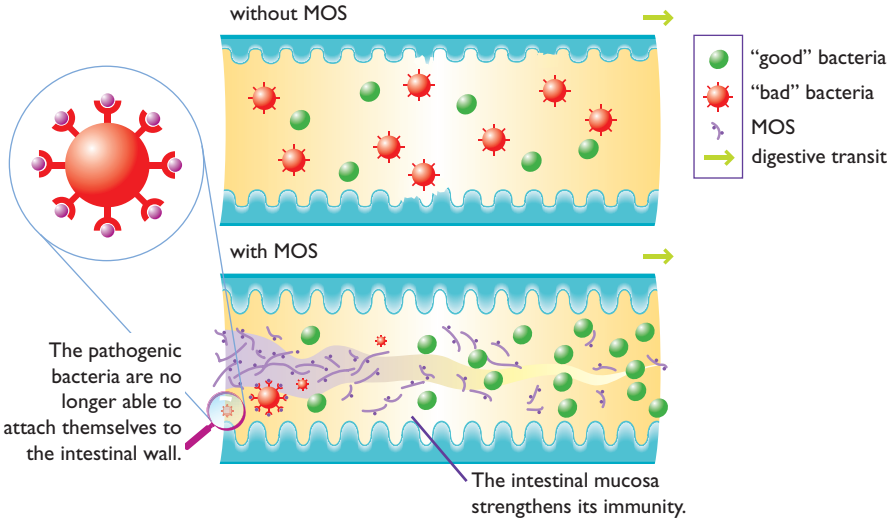
Its role in the body

These yeast fibres are beneficial to the digestive tract by acting in two ways :

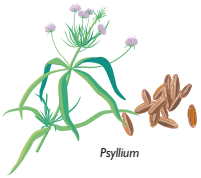
- they prevent the development of pathogenic bacteria by stopping them from attaching themselves to the intestinal mucosa ;
- they directly enhance the effectiveness of the body's immune system, making for an improved fight against pathogenic agents.

Natural sources

MOS are fibres found in the walls of yeasts.



Prevention of infectious diarrhoeas – Improvement of immune defences



Mucilage

Example : psyllium fibre

Health & Prevention

Mucilage is the soluble fibre used to treat problems of digestive transit. They regulate transit and facilitate faecal elimination.

A little background information

Psyllium grains are a very good source of mucilage. Psyllium comes from the Greek "psyllia", which means flea. The grains, black or golden depending on the species, resemble tiny psyllids. Psyllium is very commonly used in the food of sledge dogs, to prevent stress diarrhoea.

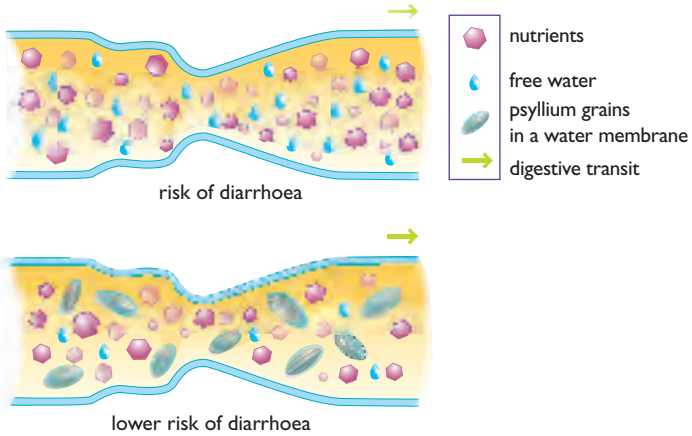
Its role in the body

The mucilage that makes up the exterior layer of psyllium grains has a large water retaining capacity. It puffs up by capturing water and creating a gel that increases the viscosity of the contents of the intestine (chyme). Psyllium improves digestive transit. It therefore combats constipation, which is its main indication in human medicine. The advancement of faecal matter through the colon is more regular and the lubrication induced by the psyllium cell facilitates faecal elimination.

Natural sources

The different species of psyllium (*Plantago ovata*, *Plantago ispaghula*) were originally found in India.

The testa fibres of psyllium grains act like a sponge, capturing water and regulating intestinal transit.



Lipids

Dogs, more than cats, are naturally attracted to foods rich in lipids, but they must be limited when the animal does not get a lot of physical exercise.

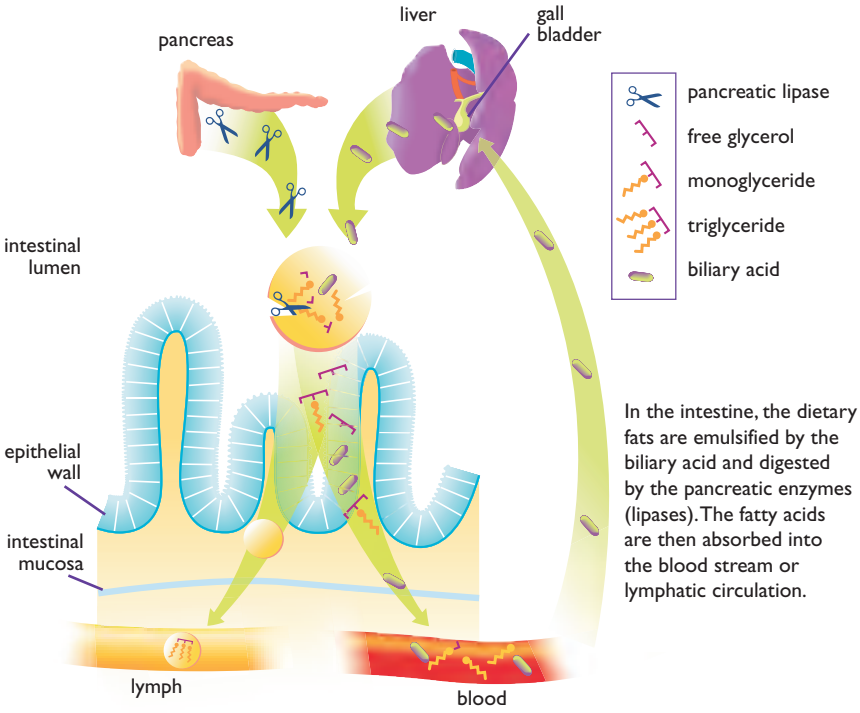
In the absence of very strict rationing the excess of lipids leads to obesity, but animals cannot do without them, as they provide energy and essential fatty acids.

Lipids constitute a family of organic substances more commonly known as fats. Fatty acids and glycerol, which together form the triglycerides, are the main elements. Lipids may be simple (triglycerides, waxes) or complex (containing many other elements). Cell membranes for example are composed of phospholipids.

Fats are the benchmark energy source for dogs and cats, which oxidise them to extract the energy they need. A gram of lipids represents approximately 9 kcal of metabolisable energy, two and a half times more than what a gram of carbohydrates or proteins provides.

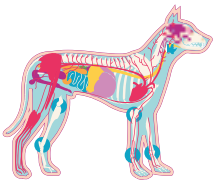
Some fatty acids – termed essential – also have structural roles for the cell or act as precursors to specific hormones.

Dietary lipid sources are all foods rich in animal fats (butter, tallow, lard, eggs, fowl fat, fish oil) and vegetable fats (oils, oilseeds).



In the intestine, the dietary fats are emulsified by the biliary acid and digested by the pancreatic enzymes (lipases). The fatty acids are then absorbed into the blood stream or lymphatic circulation.

Fatty acids



Health & Prevention

Polyunsaturated fatty acids, which are abundant in dietary oils, are degraded by oxygen, heat and light. This phenomenon of rancidity may become dangerous due to the formation of complex compounds (hydroperoxides). This is why the addition of antioxidants to food is indispensable.

A little background information

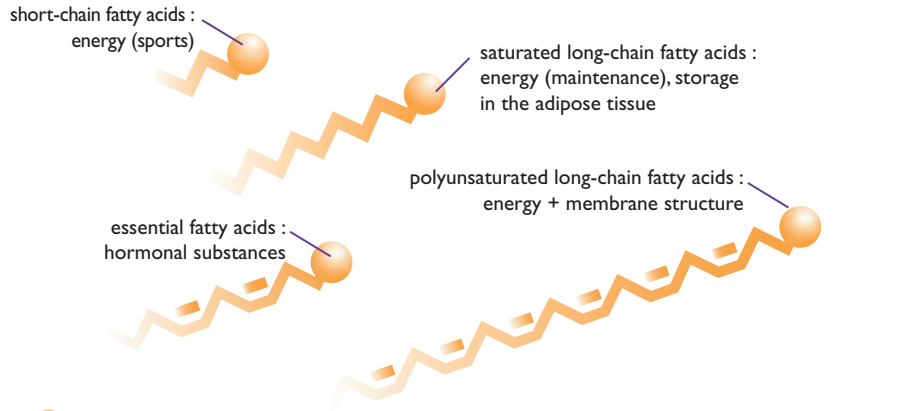
Fatty acids are the main constituents of lipids. They are characterised by the number of carbon atoms they possess, hence the expressions short-, medium- or long-chained fatty acids. They can be saturated (no double chemical bond between 2 carbons) or unsaturated (with 1 to 6 double bonds). Though the latter, more fragile, are subject to rancidity, they include many fatty acids that are essential to vital functions.

Its role in the body

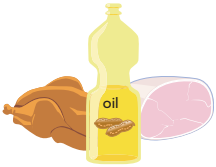
Saturated fatty acids are exclusively energy sources (one talks about "empty" calories since they play no other role). Short-chain saturated fatty acids (6-10 carbon atoms) are a very good source of fast energy for sports dogs, diabetic animals and newborn puppies. The function of polyunsaturated fatty acids is structural (in membranes or in blood lipoproteins); they include the omega 3 and omega 6 chemical series that have vital functions and cannot be synthesised by the body.

Natural sources

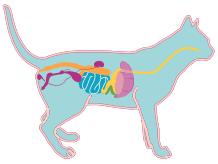
These are the same as for lipids: vegetable and animal oils and fats. The higher the unsaturated fatty acid content in the food, the greater the protection against oxidation (the increase in the antioxidant level – including vitamin E – is necessary).



Energy provision – Sources of essential fatty acids



Omega 6 fatty acids



Health & Prevention

The intake of linoleic acid is indispensable to the synthesis of cell membranes. Deficiency provokes the appearance of dry, brittle and thin hair. It also affects the integrity of the skin barrier: the skin becomes more sensitive to dehydration and infection.

A little background information

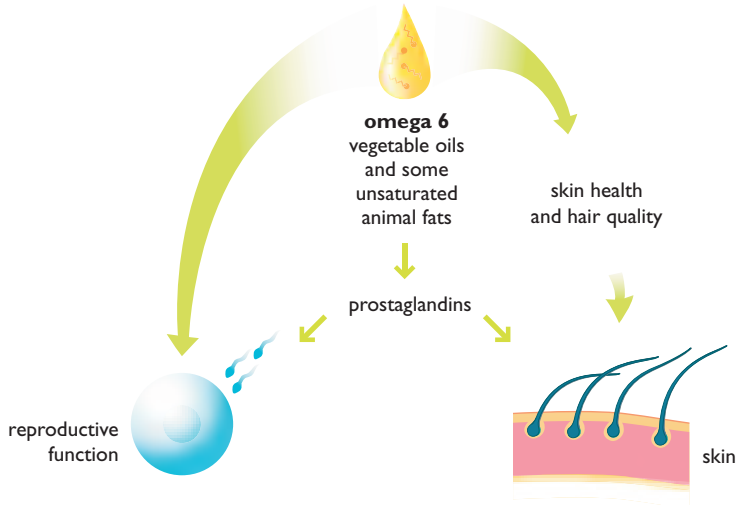
The omega 6 series of fatty acids are biologically indispensable fatty acids that are derived from an essential fatty acid containing 18 carbon atoms and two chemical double links, known as **linoleic acid**. Two other long-chain fatty acids are derived from linoleic acid: gamma-linolenic acid (GLA) and arachidonic acid.

Its role in the body

Indispensable to the synthesis of prostaglandins, hormonally active molecules, omega 6 fatty acids have a positive effect on the health of the skin and the quality of the hair, as well as the animal's reproductive system.

Natural sources

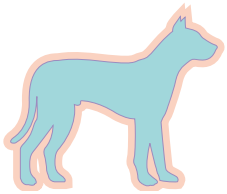
Vegetable oils are generally rich in omega 6 fatty acids. Some unsaturated animal fats, from pigs and especially fowl, can also contain large quantities of linoleic acid (more than 20% in the case of fowl). Beef fat (lard, butter) on the other hand contain very little linoleic acid.



Indispensable fatty acids – Skin health – Hair beauty – Reproduction

Gamma-linolenic acid

also known as : GLA



Health & Prevention

Gamma-linolenic acid (GLA) can play a significant role in combating all inflammatory problems, particularly dermatological diseases. The positive effects are particularly clear in allergic animals.

A little background information

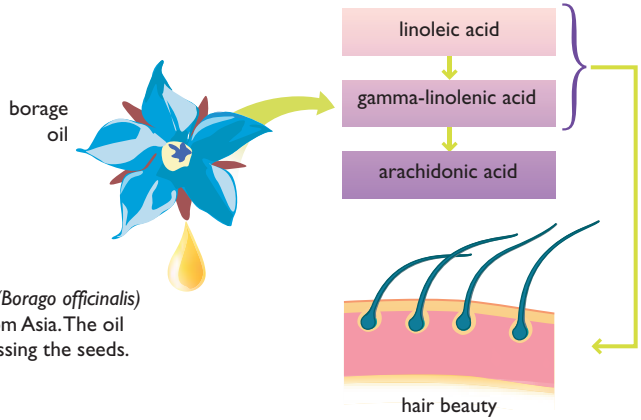
GLA is used in cosmetics products that claim to restore the skin's elasticity. It is especially good for dry skin or when excessive sebum is produced (seborrhoea).

Its role in the body

Enriching the food with GLA helps its incorporation in the liver, red blood cells and the vessel walls. Unsaturated fatty acids such as GLA help the cell membranes maintain their fluidity, which is an essential condition of vital exchanges between cells. GLA supplementation intensifies the production of hormones with well-documented anti-inflammatory effects, type 1 prostaglandins. This production is at the expense of the synthesis of type 2 prostaglandins, which have a pro-inflammatory effect.

Natural sources

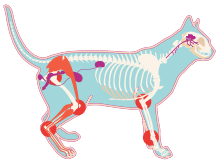
GLA is an unsaturated fatty acid of the omega 6 family (C18: 3) obtained from linoleic acid. In cats, the conversion of linoleic acid to GLA is a delicate step, because the activity level of the responsible enzyme is very low. The only oils that contain adequate quantities of GLA are borage oil, evening primrose oil and blackcurrant seed oil. Borage oil contains the highest concentration at > 20%.



The borage plant *(Borago officinalis)* originally came from Asia. The oil is obtained by pressing the seeds.

Health, elasticity of the skin

Omega 3 fatty acids



Health & Prevention

Due to their biological roles, omega 3 fatty acids are used in food for sports dogs, ageing cats and dogs, and animals suffering from chronic inflammatory disorders (osteoarthrosis, chronic renal failure, inflammatory diarrhoea, skin diseases).

A little background information

Omega 3 fatty acids form a specific family in the class of polyunsaturated fatty acids. This family is derived from alpha-linolenic acid (ALA), a fatty acid containing 18 carbon atoms and three double chemical bonds. Two other longer but very important fatty acids, EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) are derived from ALA.

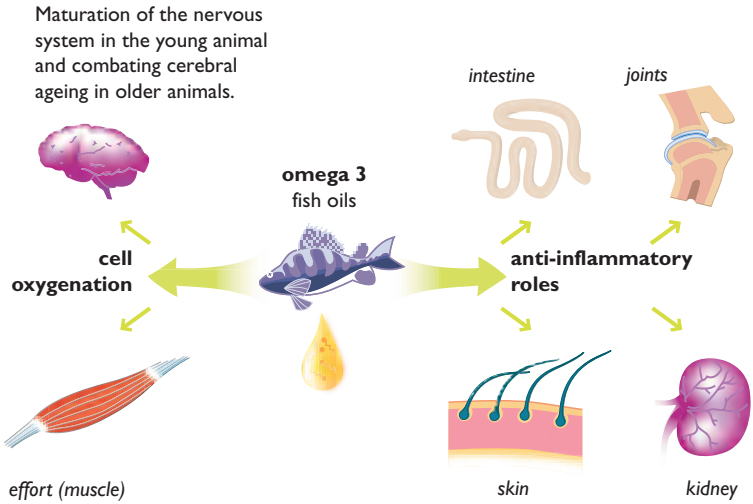
Its role in the body

The essential functions of omega 3 fatty acids make them interesting in many respects :

- they are anti-inflammatory agents, inhibiting the synthesis of certain chemical inflammation mediators ;
- they improve brain oxygenation (especially in old animals) and enhance the performance of dogs active in sports ;
- they stimulate the learning capacity of puppies.

Natural sources

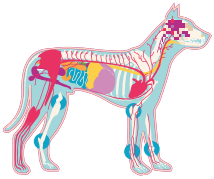
Some vegetable oils (linseed, rapeseed, soy) contain a non-negligible quantity of EPA/DHA precursor ALA. EPA and DHA are only found in concentrated form in fish oil (the actual concentration differs according to the fish) and in algae.



Indispensable fatty acids – Anti-inflammatory action – Cell oxygenation – Physical effort

EPA and DHA

also known as : eicosapentaenoic acid
and docosahexaenoic acid



Health & Prevention

Very long-chain omega 3 fatty acids (EPA and DHA) are especially known for their anti-inflammatory role. Enriching the food with EPA and DHA has many other benefits however:
- they protect the cardiac and kidney functions (blood thinning and anti-hypertensive action)
- they limit the risk of tumours.

There is a high concentration of EPA and DHA in the retina: supplementation during gestation and the first weeks of life increases the animal's visual acuity.

A little background information

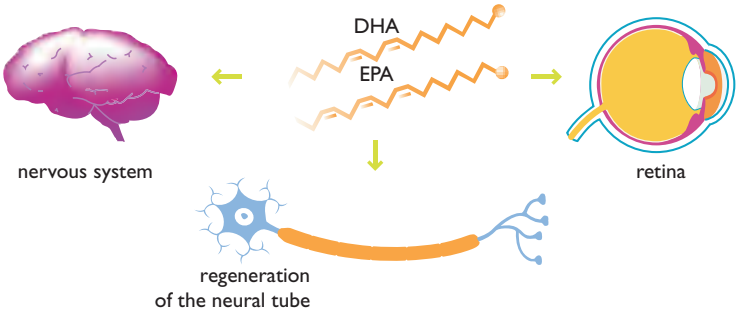
DHA is sometimes known as cervonic acid, because the brain is the organ with the highest concentration. Wild carnivores, especially felines, consume DHA when they eat the brains of their prey.

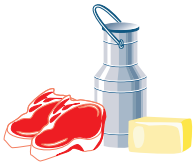
Its role in the body

Present in maternal milks, EPA and DHA are indispensable to the development of the embryo's and the fetus's brain and retinas. The higher the DHA concentration in the maternal milk, the greater the maturity of the young animal's nervous system.

Natural sources

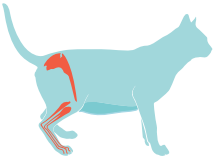
Very long-chain omega 3 fatty acids are concentrated in the oils of fatty fish from cold seas (e.g. salmon, mackerel, halibut, herring and capelin). EPA and DHA are present in phytoplankton and single-cell algae. They are concentrated in the adipose tissue in fish as they pass through the food chain.





Conjugated fatty acids

also known as : CLA



Health & Prevention

Conjugated fatty acids derived from linoleic acid – conjugated linoleic acid (CLA) – have been studied as part of the fight against obesity. A particular form of CLA (or isomer) prevents the build up of triglycerides in adipocyte cultures.

A little background information

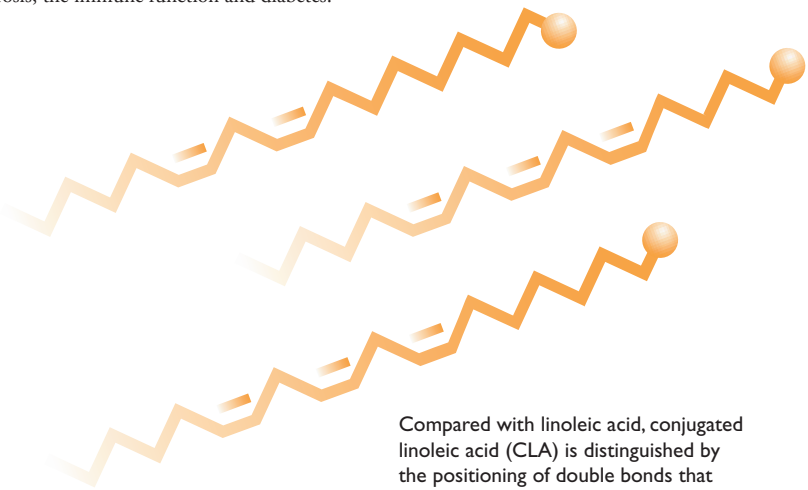
CLA does not reduce the body weight of human obesity patients, but it does help increase the lean mass (muscles) at the expense of fat (adipose tissue). CLA also has a positive effect on the body composition of dogs fed ad libitum.

Its role in the body

CLA's anti-adipogenic action is said to be due to an effect of the regulation of glucose and fatty acid metabolism in the adipose tissue cells. The various CLA isomers have been widely studied due to their potential beneficial properties: effects on cancers, atherosclerosis, the immune function and diabetes.

Natural sources

CLA is found in ingredients from animal sources, such as diary products, meats and fats. They are synthesised by specific micro-organisms in the rumen. In dogs on the other hand, CLA production by intestinal bacteria is very low. Synthetic forms of CLA are added to food.



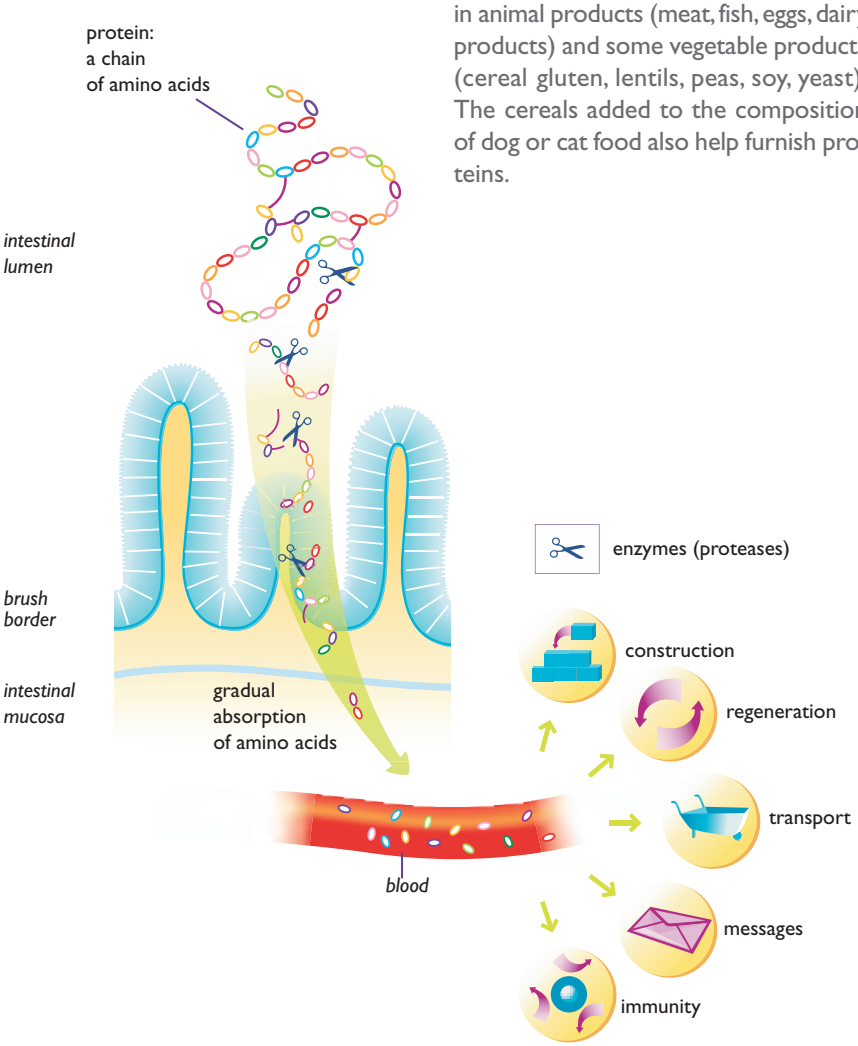
Compared with linoleic acid, conjugated linoleic acid (CLA) is distinguished by the positioning of double bonds that are not separated.

Proteins

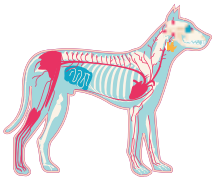
Cats and dogs require a lot of proteins. Some physiological conditions are more demanding than others: generation or regeneration phenomena like growth, gestation, lactation and physical effort for example.

Proteins are molecules made up of amino acids in a predefined chain that determine their nature and their roles. Amino acids, which are produced by the degradation of dietary proteins in the digestive tract, then serve as a basis of the body's synthesis of the proteins it needs to build or regenerate its organs and structures, convey certain molecules, send messages from one organ to another (hormones) and combat disease (antibodies), among other things.

Proteins are found in concentrated form in animal products (meat, fish, eggs, dairy products) and some vegetable products (cereal gluten, lentils, peas, soy, yeast). The cereals added to the composition of dog or cat food also help furnish proteins.



Amino acids



Health & Prevention

Some proteins are so complex and chemically 'solid' that they cannot be broken down by digestion so the amino acids cannot be absorbed in the intestine. They accordingly have no dietary or nutritional value for the animal. This is the case with feathers and hair for example.

A little background information

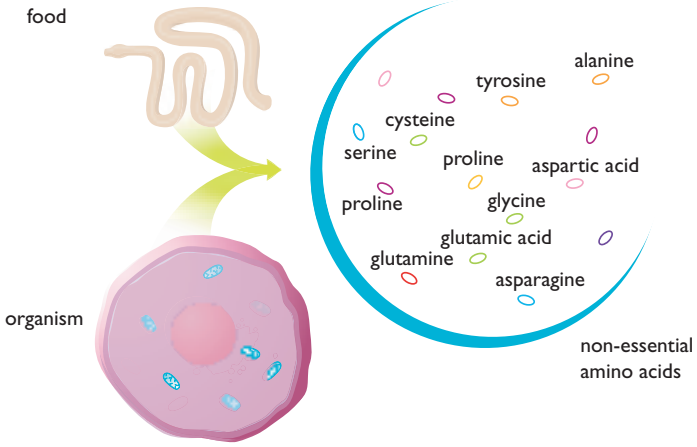
Amino acids are the building blocks of proteins and their derivatives. Proteins contain a total of about 20 amino acids, only 11 (cats) or 10 (dogs) of which must be provided in food as they are not produced by the body. Other amino acids must also be provided in food, but they make up a relatively smaller proportion of the total protein intake, as their role is less specific.

Its role in the body

Amino acids from dietary proteins are the building blocks of all proteins synthesised by the body to ensure its vital operation and physiological functions.

Natural sources

All food proteins of animal or plant origin are composed of a series of chemically bound interlinked amino acids.



Building blocks of proteins

Essential amino acids

Arginine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Taurine (cats only), Threonine, Tryptophan, Valine

Health & Prevention

The absence in the diet of any of these essential amino acids stops the synthesis of life-sustaining proteins. The animal then uses its natural proteins to synthesise what it needs, which gradually puts its survival in danger.

A little background information

Essential amino acids cannot be synthesised by the body and must therefore be provided by the food in appropriate quantities.

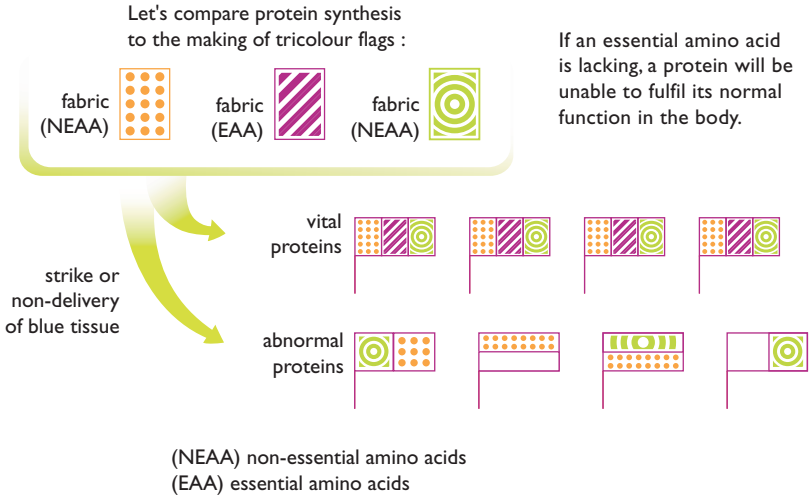
Its role in the body

Essential amino acids are aptly named, since, without them, the body cannot realise any normal protein synthesis.

The growth of kittens and puppies will be slowed down, while essential functions such as nitrogenous waste elimination and haemoglobin synthesis will be disrupted in adult animals.

Natural sources

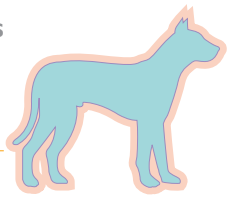
Dietary proteins of 'high biological value' are those that combine good digestibility and a high content of essential amino acids, such as casein, egg, meat and fish proteins and soy isolates.



Essential to the synthesis of proteins that the body cannot do without

Sulphur amino acids

Methionine and Cystine



Health & Prevention

Sulphur amino acids are essential to the synthesis of the main hair protein keratin. A sulphur amino acid deficiency results in hair loss, a slow down in growth and a generally dry, brittle appearance of the hair.

A little background information

The synthesis required for the maintenance of the skin and the hair may represent up to 30% of an adult dog's daily protein requirement.

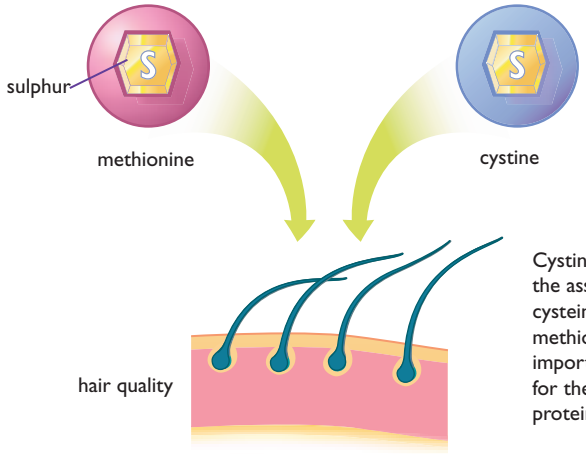
Its role in the body

Only methionine is considered to be an essential amino acid. If cystine is provided in sufficient quantities however, it helps free up methionine for other functions. The metabolism of sulphur amino acids produces sulphuric acid, which is eliminated through the urine. A carnivore's natural diet, which is rich in sulphur amino acids therefore tends to produce acidic urine.

Natural sources

Generally speaking, amino acids are present in animal proteins in large quantities. These amino acids are rarely missing from the diet of cats or dogs, unless the animal is fed an unsupplemented vegetarian diet. Dogs are less sensitive to these deficiencies than cats.

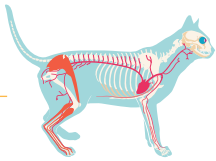
Methionine and cystine are particularly abundant in egg and fish proteins, as well as milk casein. Wheat and maize glutens are also very rich in methionine and cystine.



Cystine (formed by the association of two cysteine molecules) and methionine are the most important amino acids for the structure of the hair protein keratin.

Amino acids are an ingredient in hair protein keratin

Arginine



Health & Prevention

Arginine is an essential amino acid for cats and dogs. Newborn puppies fed with mothers' milk with an arginine deficiency soon develop cataracts that lead to blindness. Arginine is also a nitric oxide (NO) precursor, which relaxes the smooth fibers of the blood vessels. Arginine supplementation may accordingly have beneficial effects in case of heart or kidney disease.

A little background information

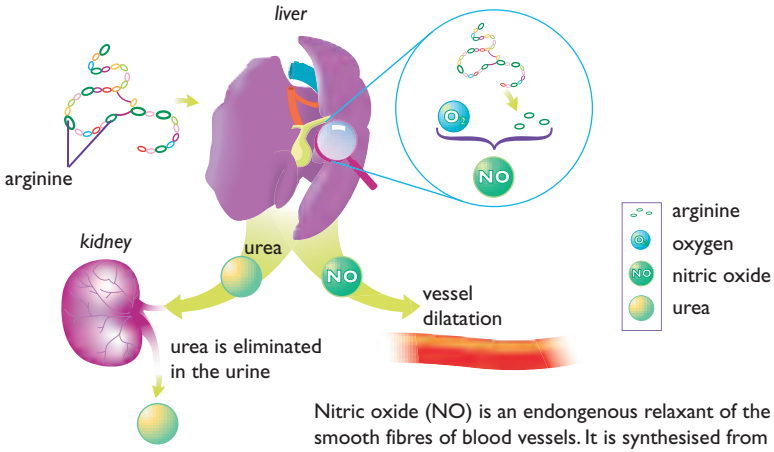
Arginine plays a part in the synthesis of urea from ammoniac. In the absence of arginine in the diet, in a few hours cats develop clinical signs of ammoniac intoxication (hyperammoniemia), with vomiting, hypersalivation and nerve problems. This deficiency may lead to death if it is not corrected rapidly.

Its role in the body

It has been shown that arginine reduces the respiratory problems caused by the increased production of CO^2 during effort in humans suffering from severe chronic heart failure. Arginine also plays a role in the immune mechanisms.

Natural sources

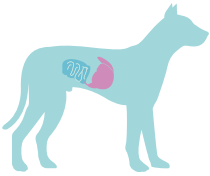
Arginine is abundant in animal tissue, such as muscle, skin and hair. Gelatine is fairly rich in arginine.



Nitric oxide (NO) is an endogenous relaxant of the smooth fibres of blood vessels. It is synthesised from L-arginine and oxygen.

Essential amino acid: growth, urea production, vascular protection

Glutamine



Health & Prevention

Glutamine is a very important amino acid for the metabolism of rapidly regenerating cells, like those in the digestive tract and the immune system. While it is not normally an essential amino acid, glutamine can become essential in certain circumstances. That is why it is termed a conditionally essential amino acid.

A little background information

In conditions of disease or intense stress, the consumption of amino acids speeds up and the blood glutamine concentration falls. The integrity of the intestinal mucosa is then put at risk, allowing intestinal bacteria to move into the bloodstream.

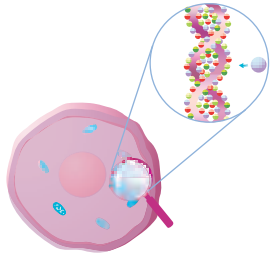
Its role in the body

Glutamine exercises many functions connected with protein synthesis, as a precursor of compounds that enter into the composition of cell DNA, a regulator of hepatic syntheses and a role-player in the detox process.

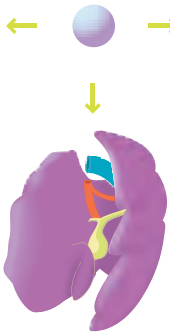
Glutamine is utilised by the cells of the intestinal mucosa as a source of energy. A low intake by an animal with a high requirement in a critical phase may compromise the integrity of the intestinal barrier. Glutamine supplementation may help reduce the risk of atrophy of villi. It may also be beneficial during convalescence after a period of digestive problems.

Natural sources

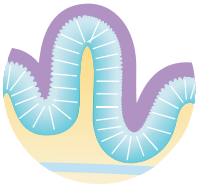
Glutamine is synthesised by many tissues and approximately 60% of glutamine is freely stored in the muscles. When the animal's requirement increases, the body may be unable to produce sufficient quantities. Wheat gluten is a good source of glutamine, containing close to 40%. It is also used as a milk protein substitute for newborns.



glutamine is a cell DNA precursor



has a role in hepatic
toxin-elimination processes



preferred energy source
of intestinal mucosa

Amino acid participating in the integrity of the intestinal barrier and the elimination of toxins

Lysine

Health & Prevention

Lysine is an essential amino acid for cats and dogs, which must be provided in the diet for the synthesis of all the proteins the body needs. Lysine deficiency in kittens and puppies for example slows down growth.

A little background information

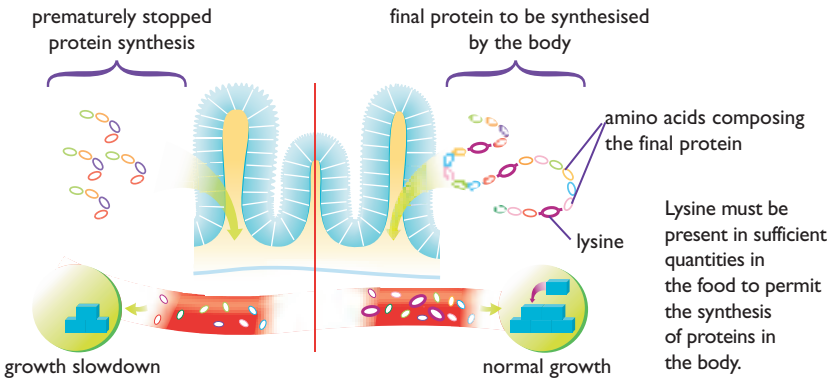
Lysine is very sensitive to heat, which means that overly aggressive thermal treatments provoke a reaction with the sugars (Maillard reaction), which makes lysine unavailable to the body. Milk that is too warm for example causes a reaction between lysine and lactose. This particular sensitivity makes lysine a good tracer in the control of cooking of food.

Its role in the body

Besides its major role in protein synthesis, studies have shown the benefit of increasing dietary intake of lysine to combat the herpes virus in cats, which is one of the agents responsible for diseases of the upper respiratory tract, collectively termed feline rhinitis. The herpes virus generally provokes more serious clinical signs than other agents, especially in the eye. Kittens that have not been immunised may die as a result of infection. The supplementation of lysine limits the intensity of viral excretion and clinical signs in infected animals.

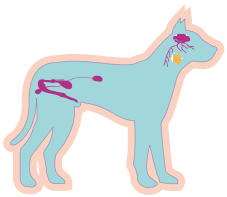
Natural sources

Lysine is abundant in animal proteins, especially meats and milk casein. Soy proteins also contain it in great quantities. There is however a risk that lysine will be missing from a cereal-based diet, which necessitates the supplementation of this amino acid.



Essential amino acid for the synthesis of all proteins

Tyrosine and phenylalanine



Health & Prevention

The colour of the coat depends on the presence of pheomelanin grains (yellow to red pigments) and eumelanin grains (brown to black). The production of these pigments requires the presence of tyrosine and phenylalanine, two aromatic amino acids (so-termed because of their ring structure). A default in the animal's intake in dark or black subjects provokes a reddening of the hair, which has already been shown in cats. Studies on Newfoundland and black Labrador puppies show that the phenylalanine and tyrosine levels needed for optimal coat pigmentation are twice that of the corresponding growth-related requirements. Tyrosine supplementation even helps increase the intensity of hair coloration.

A little background information

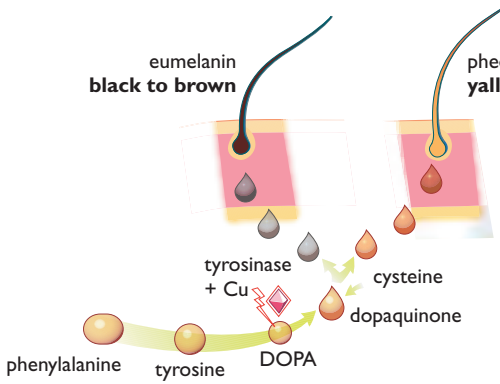
The Siamese cat's particular colour ("colourpoint") is due to properties of tyrosinase, the key enzyme in melanin production. In this breed, the enzyme works only at a relatively low temperature. Warmer areas like the flanks, the belly and the back remain clear, while colder areas like the head, feet and tail are coloured.

Their role in the body

Besides its role in hair and iris pigmentation, tyrosine is also a dopamine, noradrenalin and adrenalin precursor. These molecules are involved in the proper functioning of the brain and in the reproductive function. Tyrosine supplementation therefore has a positive effect on fertility.

Natural sources

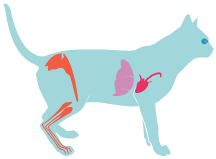
Tyrosine is either provided directly in the diet or synthesised from phenylalanine, an essential amino acid. Milk and dairy products are excellent sources of tyrosine. Rice is the only vegetable source to contain non-negligible quantities of this amino acid.



The main enzyme of melanogenesis is tyrosinase, which requires the presence of copper in sufficient quantities to be operational.

Prevention of red hair – Functioning of the thyroid gland and adrenal glands

Taurine



Health & Prevention

Taurine is used to prevent and treat a serious heart disease known as congestive cardiomyopathy. In cats, taurine is an essential amino acid. It is needed for vision and the reproductive function. It provides protection against free radicals, making it also a first-rate antioxidant in the fight against ageing.

A little background information

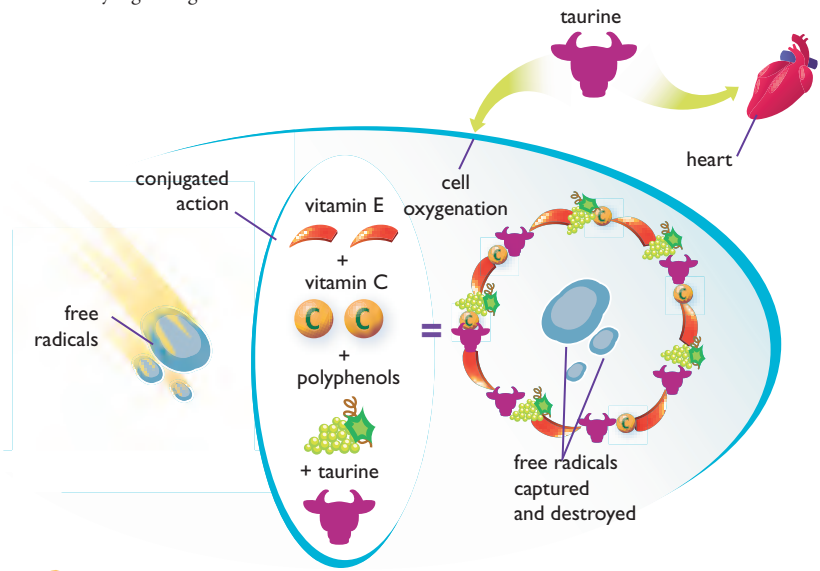
Taurine was discovered in 1826 in the bile of cattle *(Bos Taurus)*, hence its name. It is an amino acid containing sulphur that is found in most animal tissue, and concentrates in the muscles. Contrary to traditional amino acids however, it does not have any role in protein synthesis.

Its role in the body

Taurine enables the liver to synthesise bile salts. It also works by regulating calcium flows into and out of the cells and as a consequence it acts on the cardiac function. It has a major antioxidant action in the cell, as well as playing a role as a precursor for the synthesis of complex skin lipids (glycosphingolipids), which have antibacterial properties.

Natural sources

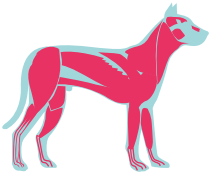
Meats (e.g. the organs of fowl) are the main natural source of taurine.



Prevention and treatment of heart disease – Natural antioxidant

Branched chained amino acids

also known as : BCAA



Health & Prevention

Leucine, isoleucine and valine constitute the class of branched chained amino acids (BCAA) within the essential amino acid family. They are studied because of their potential role in slowing down tumour growth. Clinical studies in humans have shown a link between BCAA supplementation and length of survival.

A little background information

The body is unable to synthesise leucine, isoleucine and valine sufficiently quickly, so the animal's needs must be met through its diet. The blood content of these three, more than other amino acids, varies depending on intake.

Its role in the body

Valine, leucine and isoleucine are able to stimulate the synthesis of proteins and slow down their degradation in the muscles. This property has been specifically attributed to leucine, which proves to be as effective on its own as a mixture of all three amino acids. Sensitivity to leucine appears to diminish with age. BCAAs help increase lean mass and prevent muscle atrophy in cachectic and cancer affected animals.

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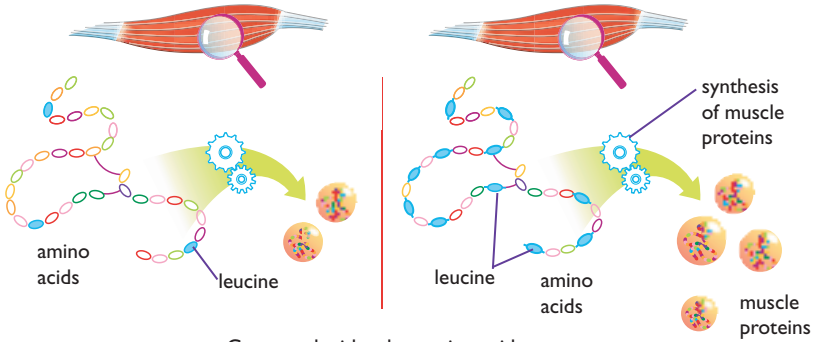
Natural sources

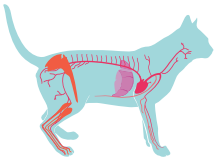
Valine, leucine and isoleucine represent at least one third of all essential amino acids in the composition of the muscle proteins. They are the only amino acids to be initially broken down by the muscles.



Compared with other amino acids, leucine shifts the protein balance of the cell towards anabolism rather than catabolism.

Essential amino acids for the synthesis of muscle proteins

Carnitine



Health & Prevention

Physiologically speaking, carnitine helps turn fats into fuel for the cells. It is consequently very useful and effective during physical effort, especially when it is sustained. In some dog breeds (Boxers, Dobermans, Cocker Spaniels, etc), a serious heart disease is often related to a deficient production of carnitine by the body. Weight loss can be accelerated in obese animals by adding carnitine to the food.

?

A little background information

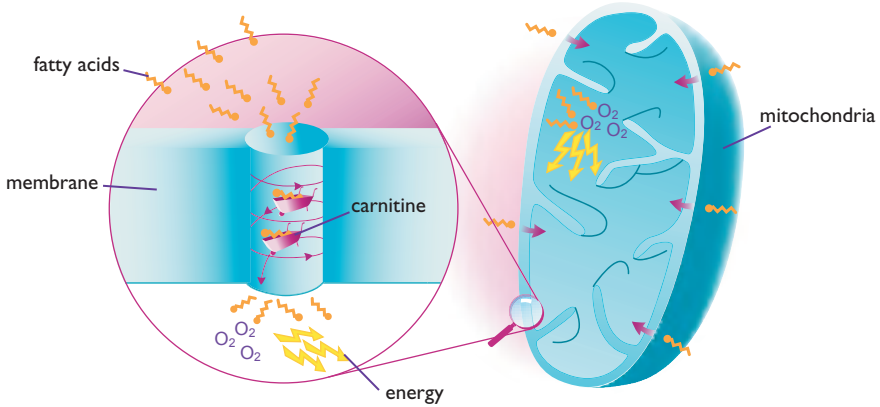
Carnitine is a non-essential amino acid normally made by the body from two other amino acids, lysine and methionine. It becomes essential in food only when the body is unable to synthesise enough of it to cover its needs. Its chemical structure allows two forms of the molecule, D and L. Only L-carnitine is active and effective.

Its role in the body

Energy is mainly produced in dogs and cats through the oxidation of fat in the mitochondria, which are tiny power generating plants in the cells. The role of carnitine is to shuttle fatty acids through the membrane around each mitochondria. Carnitine also has an important role to play in reproduction. In some species, carnitine supplementation during gestation and lactation increases the weight of newborns and the number of animals in a litter.

Natural sources

Besides synthesis in the liver, food is another source of supply. While plants contain negligible quantities of carnitine, fresh meat is a rich source, mutton and lamb in particular.



Essential during physical effort – Cardiac protection – Combating obesity

Minerals

A complete food does not require any mineral supplement. An excess in mineral salts has an adverse effect on good digestibility and may even produce effects contrary to expectations.

When a food is burnt the ashes produced are the minerals that were in the food, which generally represent 5-8% of a dry food.

The minerals that are present in high quantities (calcium, phosphorus, potassium, sodium, magnesium) are called **macro elements**. Those present in very low quantities – **trace elements** – represent a few mg/kg (or ppm), but

they are essential to the functioning of the body (e.g. iron, zinc, manganese, copper, iodine, selenium).

Minerals are provided by the different ingredients in the ration. They may also be included in the form of purified salts: iron sulphate, zinc oxide, manganese oxide, copper sulphate, sodium selenite, calcium iodate, etc.

Each mineral is involved in several different functions. To keep things simple, we limit ourselves to some of the main roles the most important minerals play in the body :

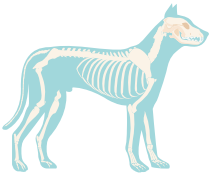
Macro elements

calcium	ossification
phosphorus	energy transfer
potassium/sodium	cellular ionic balance
magnesium	sensory impulses

Trace elements

iron	synthesis of haemoglobin of red blood cells
zinc	health of the skin
manganese	formation of cartilage and skin
copper	synthesis of skin pigments
iodine	functioning of the thyroid gland
selenium	antioxidant

Calcium



Health & Prevention

A calcium intake adapted to the animal's size and physiological condition prevents diseases caused by nutritional deficiency (osteofibrosis) or excess (anarchistic calcification).The growth and suckling periods require a high calcium intake.

A little background information

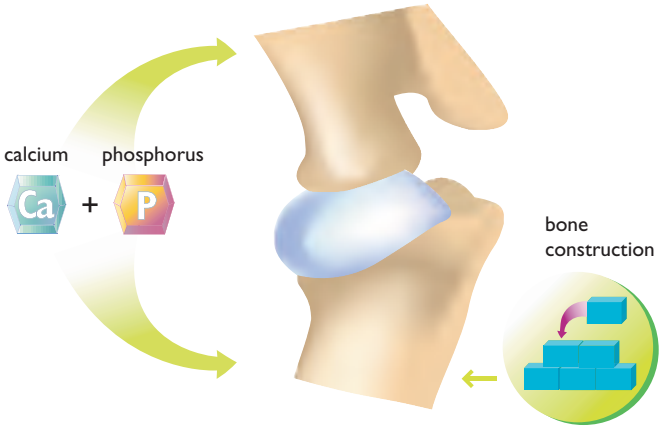
Calcium is a major mineral element, an alkaline-earth metal known in nutrition as a mineral macro element because of the large amounts needed by the body. Calcium (Ca) and phosphorus (P) intake ratios must be perfectly balanced in the food. The ratio is 1 to 2.

Its role in the body

Calcium plays two fundamental roles in the body. 99% of the body's calcium is retained in the bones, where it is responsible for making the skeleton solid together with phosphorus. Together they form the 'cement' of the bone. It also allows the transfer of information between the cells and the transmission of sensory impulses. If the calcium level in its food is very high young puppy is unable to adapt to the excess, continuing to passively absorb at least 30-40% of the calcium ingested, which brings a risk of abnormal skeleton development.

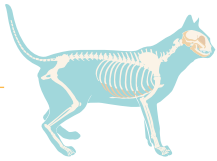
Natural sources

Calcium is found in the bones of mammals in the form of mineral salts, as well as in the mineral sources such as calcium carbonate (chalk) and calcium phosphates.



Bone structure – Growth – Transmission of sensory impulses

Phosphorus



Health & Prevention

An adequate phosphorus intake adapted to the physiological stage and size of the animal and perfectly balanced with calcium intakes, promotes harmonious growth and enhances body functions. In ageing animals, phosphorus intake should be reduced as it might aggravate chronic renal failure.

A little background information

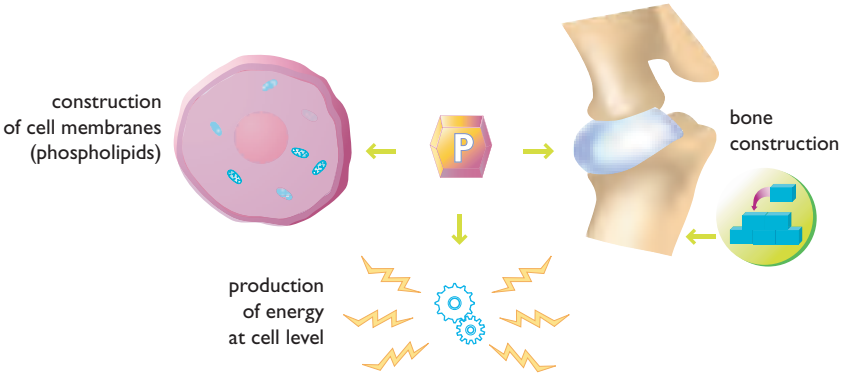
Etymologically speaking, the word phosphorus means "light-bearing." It was discovered in 1669 by a German alchemist, who released phosphorus in the form of a vapour that glows in the dark by evaporating urine and burning off the residue in a retort.

Its role in the body

Phosphorus has multiple roles, each of which is as important as the other. 86% of the body's phosphorus is retained in the bones, where together with calcium, it is responsible for making the skeleton solid. It is a constituent of the cell membranes and a mineral that the body needs to dispense energy (through adenosine triphosphate, a.k.a. ATP). Phosphorus is also incorporated into the major molecules, DNA and RNA, which carry the cell's genetic programming.

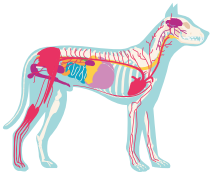
Natural sources

Phosphorus is found in mammalian bones in the form of mineral salts, as well as in minerals such as phosphates. Meat is generally rich in phosphorus. When phosphorus has to be limited in the diet, some of the animal proteins can be replaced by vegetable proteins (wheat or maize gluten).



Bone structure – Constitution of cell membranes – Cell energy

Potassium



Health & Prevention

There is no particular problem related to potassium intake, except in the case of diarrhoea which causes high potassium losses. Some heart or kidney diseases demand a modification of the dietary amounts. During diuretic treatment, the potassium content should be increased.

A little background information

Potassium is a major mineral element, an alkaline that nutritionists call a mineral macro element because of the large amounts needed by the body.

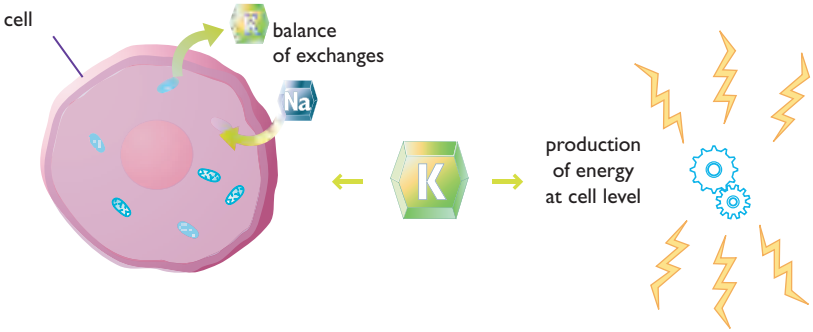
Its role in the body

This mineral element is essential to the functioning of the cell, together with sodium maintaining the balance in internal and external pressure and playing important roles in its energy metabolism.

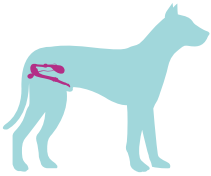
Potassium has a major role in the cardiac function. An excessive acidification of the urine can lead to potassium deficiency.

Natural sources

It is often found in the form of mineral salts. In humans, the best sources of potassium are vegetables and dried fruits, avocado, meat and smoked fish, as well as chocolate and bananas.



Potassium citrate



Health & Prevention

Citrate helps inhibit the formation of calcium oxalate urinary stones: it can chelate with calcium to form a soluble salt. The calcium cannot accordingly bond with the oxalate to form a stone. Potassium citrate administered orally is also an alkalinising agent (it increases the urine pH). Urine alkalinisation reduces the excretion of calcium in the urine, increasing the excretion of citrate.

A little background information

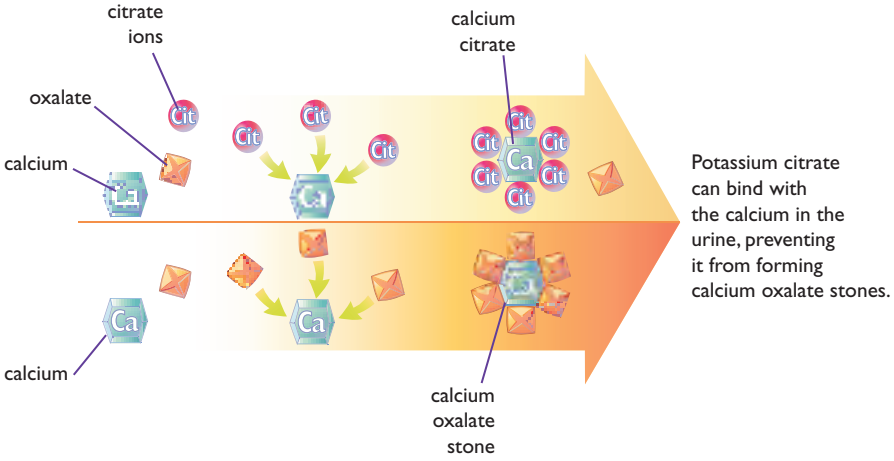
The alkalinising effect of potassium citrate should be managed with care, as it can also induce the risk of stone formation in alkaline urine: struvite stones and calcium phosphates stones.

Its role in the body

The alkalinising effect of potassium citrate is interesting in the fight against other types of stones that can develop in acidic pH environments, ammonium urate stones (alkaline urine containing low concentrations of ammoniac and ammonium ions) and cystine stones. Calcium oxalate stones are not sensitive to urine pH, but alkalinisation indirectly permits the excretion of calcium in the urine.

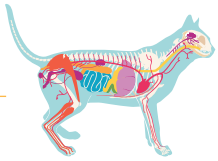
Natural sources

Potassium citrate is a mineral salt



Mineral salt helping to reduce urine acidity

Sodium



Health & Prevention

Sodium intake does not pose any particular problems, as cats and dogs do not transpire, even in case of intense physical effort, unlike humans and horses. Only some heart diseases require a reduction in the dietary sodium intake. During severe diarrhoea, hydration powders should be used in the animal's drinking water. These must be isotonic, to compensate for electrolyte loss, especially sodium.

A little background information

Sodium is a major mineral element, an alkaline metal, that nutritionists call a mineral macro element due to the large amounts needed by the body.

Its role in the body

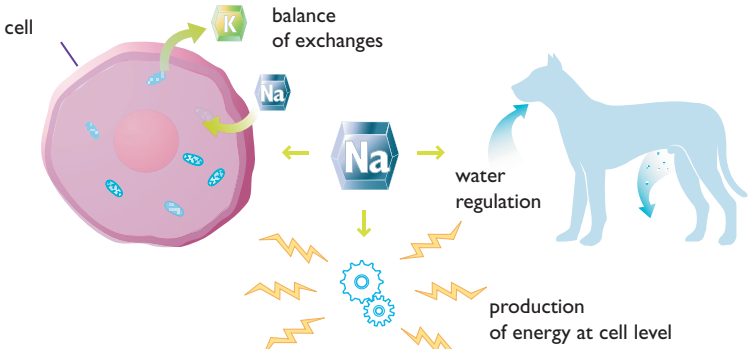
This mineral element is essential for the cell's functioning :

- it maintains the pressure balance between the inside and the outside of the cell ;
- it plays major roles in the cell's energy metabolism.

Sodium is also the element that regulates water balance: sensation of thirst or urinary elimination. Its role is very closely linked to that of potassium. The simplest way to prevent the formation of urinary stones in cats is to encourage the animal to drink and so eliminate the sodium. Major urine volumes increase the frequency of urination and so help evacuate the crystals forming in the urinary tract. Slightly increasing the sodium chloride content in the food encourages the consumption of water and stimulates urine output.

Natural sources

The sodium needed by the animal is provided through sodium chloride (kitchen salt or NaCl), of mineral or marine origin, which contains 39% sodium and 61% chloride. Increasing the NaCl content in a food by 2.5% represents a 1% increase in the sodium content.



Cellular equilibrium – Regulation of thirst and urine output – Energy metabolism

Sodium phosphates

Health & Prevention

When they are released in the oral cavity some forms of phosphate bind with the calcium ions in saliva, limiting the mineralisation of dental plaque. This slows down the formation of dental tartar. The tartar deposits in dogs and cats fed daily with kibbles coated in sodium phosphates are significantly lower than animals fed with the same diet without sodium phosphates.

A little background information

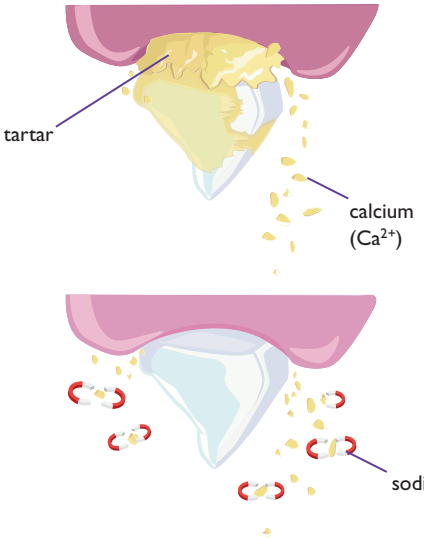
Sodium phosphate salts are used in many human toothpastes to improve oral hygiene. In animals, phosphates must be incorporated in the coating of kibbles or in a chewing bar, to facilitate their release during mastication and promote their contact with the calcium in the saliva.

Its role in the body

The calcium ions in saliva are liable to form calcium hydroxyapatite crystals, the mineral form of calcium used for the formation of tartar. Sodium phosphates have the capacity to chelate the calcium, significantly reducing tartar deposits on the teeth. The calcium phosphate complexes disassociate during digestion and the calcium and the phosphorus are released into the digestive tract where they are absorbed in accordance with the needs of the animal.

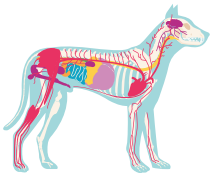
Natural sources

Sodium phosphates are a family of mineral salts comprising more than 150 different substances (orthophosphate, pyrophosphate, polyphosphate, metaphosphate).



Magnesium

Mg



Health & Prevention

Magnesium deficiency is expressed by the appearance of nervous problems. It was long recommended as a way of curbing the formation of struvite (or ammonia-magnesium phosphate) stones, especially in cats. Nowadays, it has been shown that maintaining an acidic urine pH is a much more effective prevention measure. Magnesium inhibits the formation of calcium oxalate stones. Sports dogs require a higher magnesium intake.

A little background information

Magnesium is a major mineral element, an alkaline-earth metal, qualified in nutrition as a macro element because of the large amounts needed by the body.

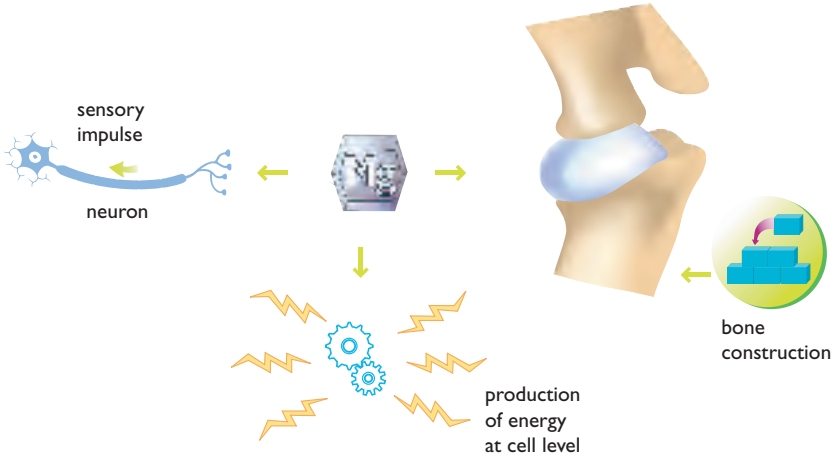
Its role in the body

Magnesium, like calcium and phosphorus, is a constituent part of the skeleton, to which it imparts solidity, albeit to a lesser degree than the other two.

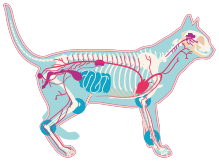
Magnesium is also essential to the good working order of nervous conduction and muscle contraction, contributing to the body's general energy metabolism.

Natural sources

Magnesium is found in the bones of mammals and in mineral sources like magnesia or various mineral salts.



Chelated trace elements



Health & Prevention

Chelated elements, bound to an organic molecule, are absorbed more easily by their target organ and are thus more effective. Chelated zinc for instance is more easily attached in the hair than free zinc, stimulating hair growth. Improving the nutritional quality of the food using chelates helps better cover the animal's requirements with respect to each trace element.

A little background information

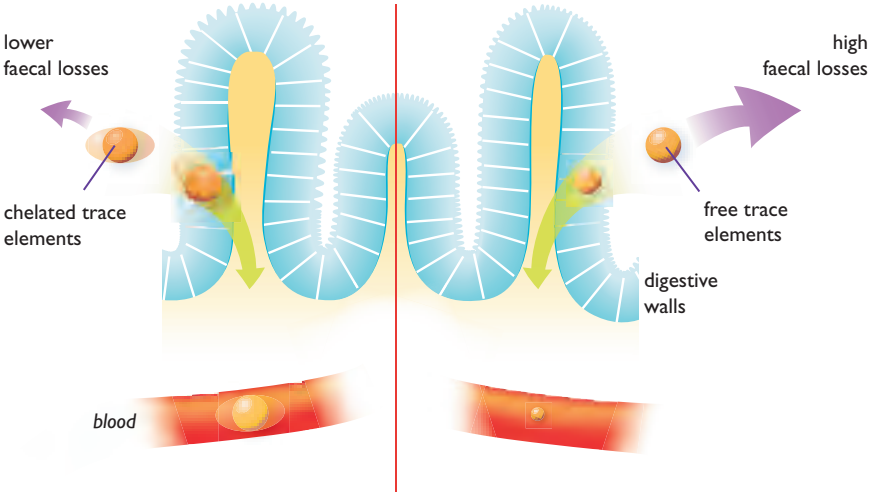
A chelated trace element is made up of a metallic ion and three amino acids.

Its role in the body

The use of this form of trace elements simply improves their digestion and especially digestive absorption, which is typically lower than 30% (70% of the mineral is found in excrement). When the trace elements are chelated, the absorption rate can exceed 60%.

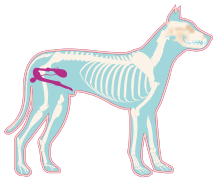
Natural sources

Purified amino acids from natural sources are used to chelate such minerals as iron, copper, zinc, manganese, iodine and selenium.



Improved digestive and metabolic utilisation of trace elements

Zinc



Health & Prevention

Besides its overall effect on the body, this trace element is crucial for collagen and keratin synthesis. It therefore has healing qualities and promotes beautiful coats. Zinc deficiencies most often occur in foods of poor quality, rich in bran and minerals that prevent the normal absorption of zinc.

A little background information

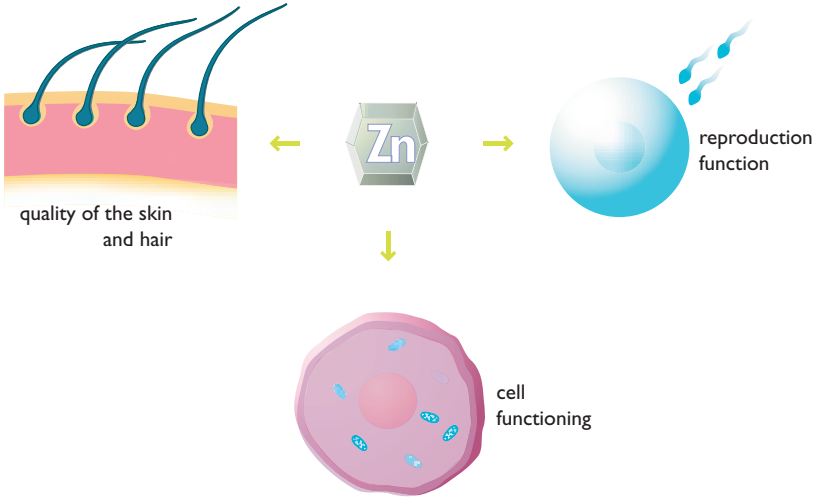
Zinc is a minor mineral, a transition element, qualified in nutrition as a trace element due to its low quantitative importance, although it is vital for the body. Nordic breeds of dog sometimes have problems assimilating zinc.

Its role in the body

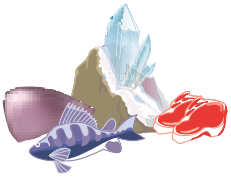
Zinc is the coenzyme in a great many metabolic systems. It is essential to the transport of vitamin A in the blood and plays an important role in reproduction. It is also a fundamental element for the integrity of the skin and so also the quality of the hair. Lastly, zinc helps the elimination of lactates produced during short, intense muscle effort.

Natural sources

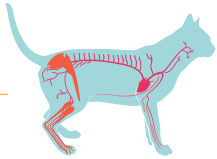
Zinc is found in the form of mineral salts, but also in whole meal cereals and in all animal products. During supplementation, zinc can be provided in organic form (zinc gluconate or zinc plus methionine) to facilitate its absorption.



Quality of the skin and the hair – Reproduction function



Iron



Health & Prevention

Iron is an essential nutrient in the prevention and treatment of anaemia.

A little background information

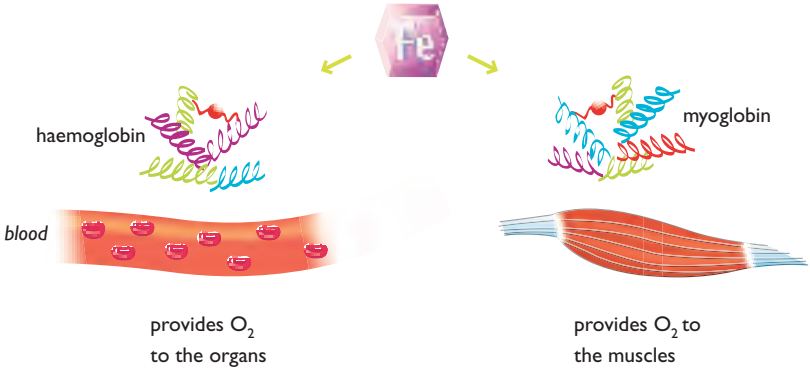
Iron is a minor mineral, a transition element, qualified in nutrition as a trace element due to its low quantitative importance, although it is vital for the body.

Its role in the body

Iron is the essential constituent in haemoglobin, the pigment that transports oxygen in the red blood cells, and of myoglobin, which does the same job in the muscles (explaining the red colour of blood and muscle). It also has many enzymatic functions, especially with respect to cellular respiration.

Natural sources

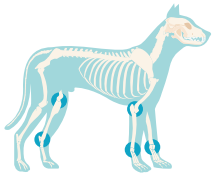
Liver, meat and fish, as well as green vegetables and especially some mineral salts are major sources of iron for animals.



Prevention and treatment of anaemia – Cellular respiration

M I N E R A L S

Manganese



Health & Prevention

Manganese contributes to the quality of the bone and cartilage, which means it must be especially monitored in puppies and kittens, as well as ageing animals and animals suffering from osteoarthroses.

A little background information

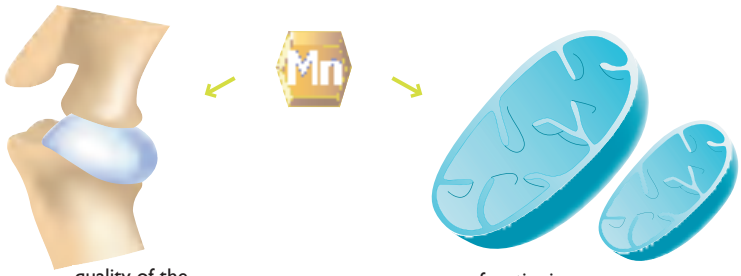
Manganese is a minor mineral, a transition element, qualified in nutrition as a trace element due to its low quantitative importance, although it is vital for the body.

Its role in the body

Manganese is a trace element that plays an active part in the functioning of the mitochondria, the cell's energy plant and an important role in the formation of bone and joint cartilage.

Natural sources

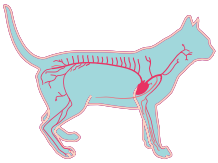
Generally speaking, meat is a mediocre source of manganese, while cereals, grain, fruits and of course mineral salts are good sources.



Quality of bones and cartilage

Copper

Cu



Health & Prevention

This trace element is one of the anti-anaemic factors that include folates, vitamin B12 and iron. Stored in the liver, it can be toxic for a very small number of dog breeds. It participates in the synthesis of melanin, which is a hair pigment.

A little background information

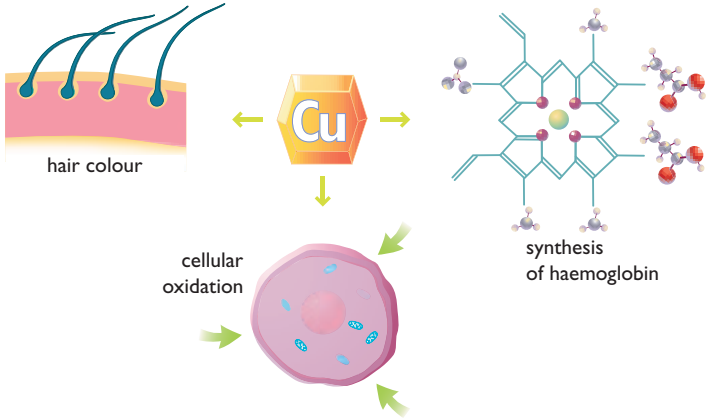
Copper is a minor mineral, a transition element, qualified in nutrition as a trace element due to its low quantitative importance, although it is vital for the body (<10 mg/ kg of body weight). Most of the body's copper is stored in the liver. It can be toxic in excessive quantities, as produced by some predisposed breeds or lines of dog.

Its role in the body

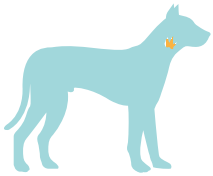
Copper acts in the body to facilitate the intestinal absorption of iron and its incorporation in haemoglobin. It is an active element in many enzymes, especially those that promote cellular oxidation. It also plays a part in the synthesis of collagen in the tendons and the myelin of the nervous system.

Natural sources

Food that have a high copper content include meat (lamb, pork, duck) and proteinaceous grains (peas, lentils, soy).



Iodine



Health & Prevention

Without iodine the thyroid gland would not be able to function, and the resulting goitre would severely disrupt all metabolism.

A little background information

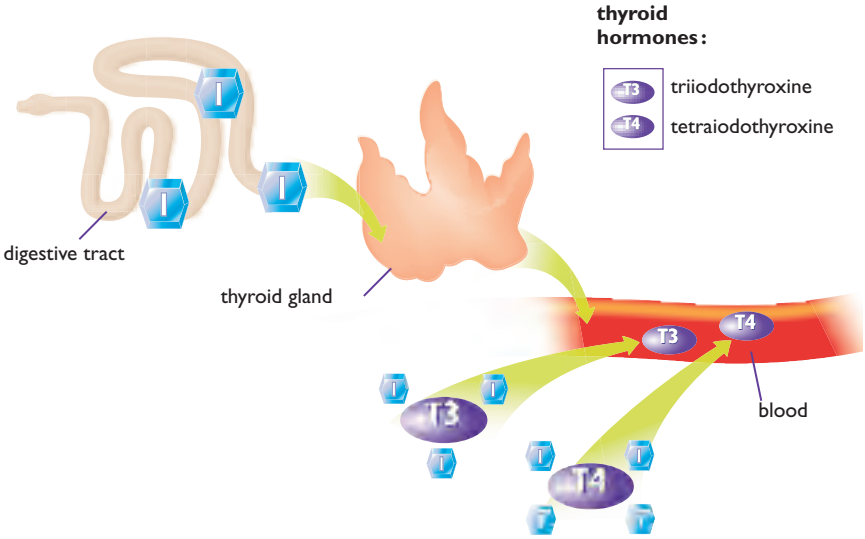
Iodine is a minor non-metallic mineral, qualified in nutrition as a trace element due to its low quantitative importance, although it is vital for the body.

Its role in the body

This trace element enters the body in the composition of the thyroid hormones, which it helps synthesise.

Natural sources

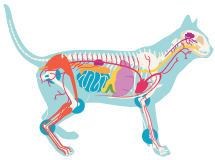
Sea salt and fish are the preferred sources of iodine.



Synthesis of thyroid hormones

M I N E R A L S

Selenium



Health & Prevention

Like other antioxidants, selenium plays a complementary role in the fight against all states of oxidative stress the body is subjected to, such as ageing, intense physical effort, pollution, cancer and inflammatory diseases.

A little background information

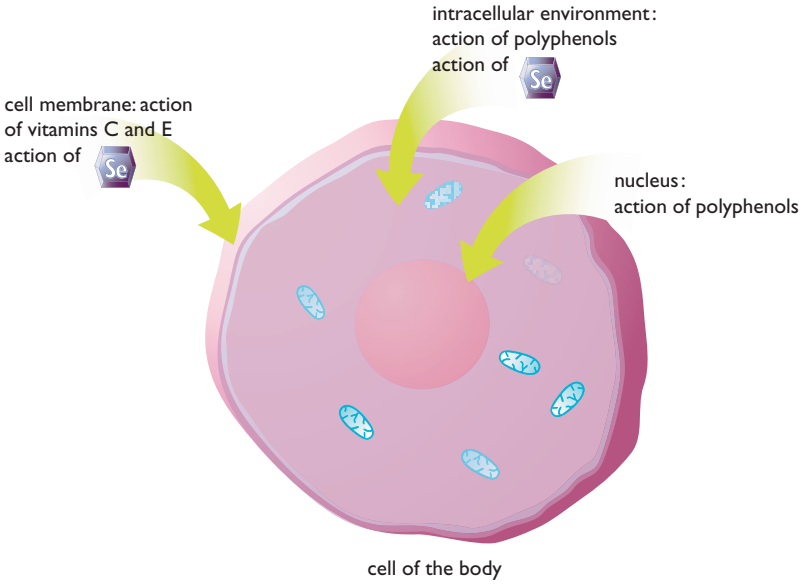
Selenium is a minor non-metallic mineral, qualified in nutrition as a trace element due to its low quantitative importance, although it is vital for the body.

Its role in the body

This trace element is an antioxidant that acts in synergy with vitamin E to protect the cell membranes, especially those of the muscle cells.

Natural sources

Selenium is found in mineral salts, fish and in meat in lower quantities.



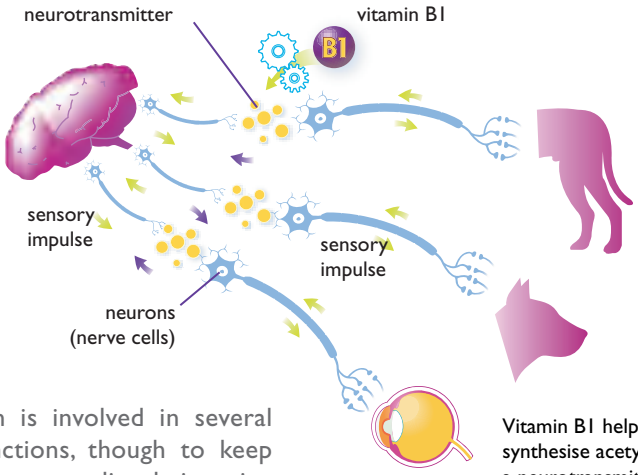
Prevention and treatment of diseases caused by free radicals

Vitamins

The word vitamin is derived from thiamine, which was the first substance to be referred to as such. Thiamine is an amine, which has a vital role for the body in the fight against beriberi. By extension, other substances that play a similar role are also referred to as vitamins.

The vitamins are split into two families: vitamins that are soluble in fats – liposoluble vitamins (A, D, E, K) – and vitamins that are soluble in water – hydrosoluble vitamins (B, C). If they are consumed excessively, liposoluble vitamins accumulate in the body and can become toxic.

Vitamins are provided in various ingredients and they can also be included in pure form. As naturally fragile substances, sensitive to light, heat and oxidation, vitamins need to be protected during the cooking process.



Vitamin B1 helps synthesise acetylcholine, a neurotransmitter.

Each vitamin is involved in several different functions, though to keep things simple we can list their major roles in the body.

Liposoluble vitamins

Vitamin A	vision, skin regeneration
Vitamin D	calcium and phosphorus metabolism
Vitamin E	protection against cell oxidation
Vitamin K	coagulation

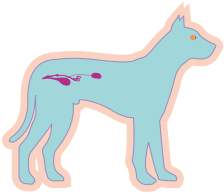
Hydrosoluble vitamins

B1 (thiamine)	nervous system
B2 (riboflavin)	skin
B5 (pantothenic acid)	growth, skin
B6 (pyridoxine)	cell energy
Choline	synthesis of phospholipids
B12 (cyanocobalamin) and folic acid	formation of blood cells
PP (nicotinic acid)	skin, cell energy
H (biotin)	skin, hair
C (ascorbic acid)	antioxidant

V I T A M I N S

Vitamin A

also known as :Retinol



Health & Prevention

Vitamin A deficiency causes :
- eye problems (reduced night vision, opacification of the cornea, dryness of the conjunctiva) ;
- skin problems (dry skin, atrophy of the sebaceous glands) ;
- reproduction anomalies ;
- greater sensitivity to infections and pulmonary complications.

An excess of vitamin A is also harmful to the body (joint problems, reproduction problems).

A little background information

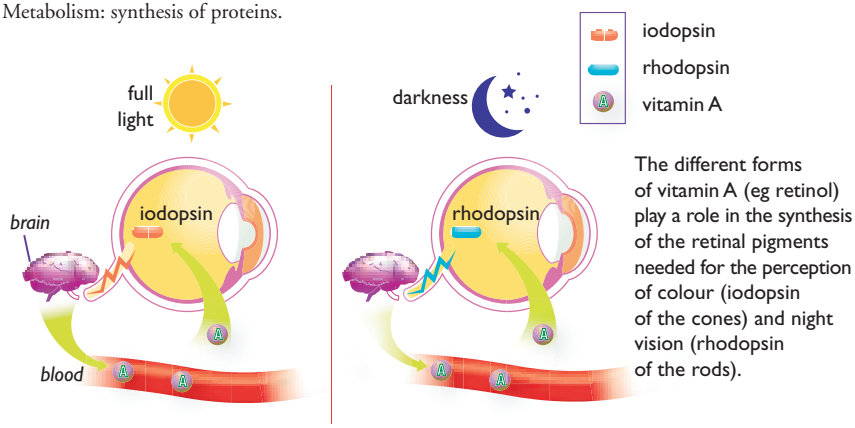
In antiquity, liver was used to treat some visual disorders. Vitamin A was isolated in 1913 and its chemical structure was mapped in 1931. It is a long-chain alcohol that is soluble in fat. It is absorbed in the small intestine and stored in the liver. Beta carotene is a vitamin A precursor for dogs, but cats are unable to realise this synthesis.

Its role in the body

- Vision: adaptation to darkness.
- Reproduction: synthesis of certain hormones.
- Metabolism: synthesis of proteins.
- Skin and hair : regulates the growth of epidermis cells and the production of sebum. Vitamin A helps fight seborrhoea and the dandruff that often forms after pruritus. It acts in synergy with zinc and sulphur amino acids.

Natural sources

As retinol: liver, meat, fish, eggs, dairy products.

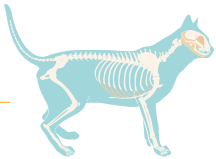


The different forms of vitamin A (eg retinol) play a role in the synthesis of the retinal pigments needed for the perception of colour (iodopsin of the cones) and night vision (rhodopsin of the rods).

Vision, skin, reproduction – Fight against infection

V I T A M I N

Vitamin D



also known as :
Calciferol
Vitamin D2 : ergocalciferol
Vitamin D3 : cholecalciferol

Health & Prevention

Vitamin D deficiency causes :
- rickets (rare in dogs and cats) ;
- osteomalacia (joint and muscle pains, bone fractures).

In large-breed puppies, an excess of vitamin D is more common than a deficiency. Excessive intake causes severe ossification problems (osteochondritis).

A little background information

The rickets-fighting power of fish liver oil was discovered in 1782 and vitamin D was isolated in 1932. This liposoluble vitamin is provided in the diet. It is naturally synthesised by humans and herbivores by the conversion of skin sterols under the action of solar rays. To be active in the body it must be modified, first in the liver, then in the kidney.

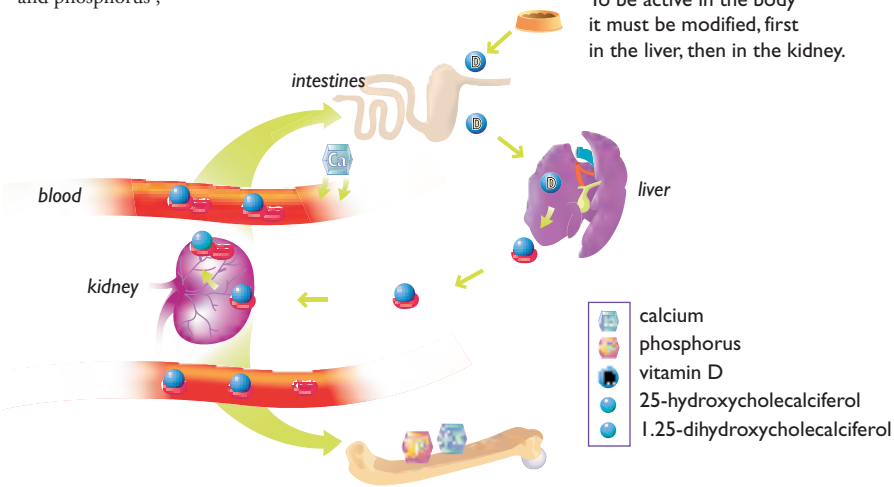
Its role in the body

Vitamin D plays an essential role in the regulation of calcium and phosphorus metabolisms :
- increase in the intestinal absorption of calcium and phosphorus ;
- optimisation of calcium bonding (or unbonding) by the bone ;
- reduction in the loss of calcium and phosphorus in the urine.

Natural sources

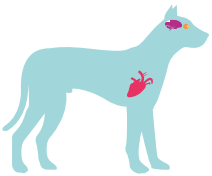
Meat and vegetables are almost completely lacking in vitamin D, which is naturally found in fish liver oil, oil fish (sardines, tuna), egg yoke, milk and dairy products.

To be active in the body
it must be modified, first
in the liver, then in the kidney.



Vitamin E

also known as :
Tocopherol



Health & Prevention

Vitamin E is used in nutrition to prevent or treat many diseases caused by oxidative stress in the cell (physical effort, pollution) and caused by ageing (cardiovascular diseases, cataracts, degenerative neurological diseases).

A little background information

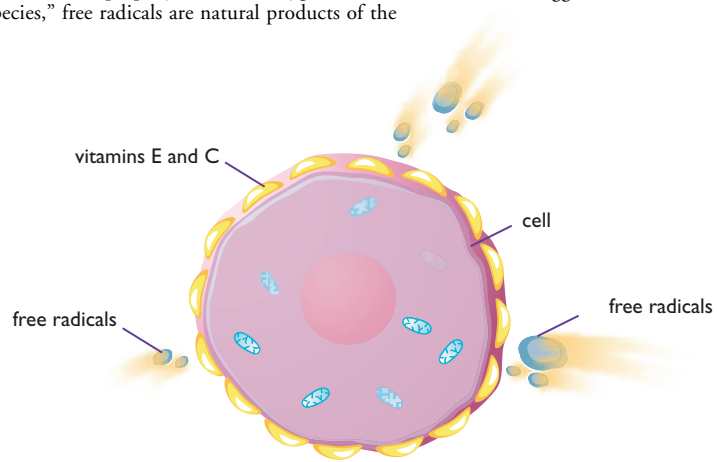
Vitamin E was discovered in 1920 as a factor in fertility and it was isolated in 1936. It was not until the eighties that its major antioxidant role for the cell was proven. Vitamin E is a generic term that covers several substances, of which alphatocopherol is the most widespread and the form that is the most active biological antioxidant in the cell membranes. Vitamin E is stored in the body's fat tissue, in the liver and in the muscles.

Its role in the body

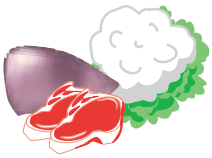
Vitamin E protects the cell against the action of free radicals. More properly known as "oxygen-reactive species," free radicals are natural products of the cells during biological oxidation. They are normally part of the body's natural defences, but when the balance between antioxidants and free radicals is disrupted, the result is oxidative stress.
Generally speaking, vitamin E helps :
- protect the cell membranes ;
- fight against the biological effects of stress ;
- improve the immune defences.

Natural sources

The most important sources of vitamin E are vegetable. They include oils, oleaginous grains and cereals. It is also found in some animal products, such as liver, eggs and butter.

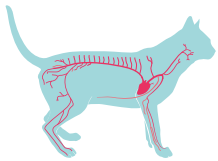


Antioxidant – Protection against free radicals – Anti-cell stress



Vitamin K

also known as :
Phylloquinone, Menaquinone-7 (MK-7)



Health & Prevention

A vitamin K deficiency is responsible for digestive, nasal, skin and cerebral haemorrhages, as blood coagulation is no longer possible. In time, these minor, sometimes imperceptible haemorrhages lead to anaemia (lack of the red cells that transport oxygen in the blood). An appropriate intake through the diet helps prevent these risks.

A little background information

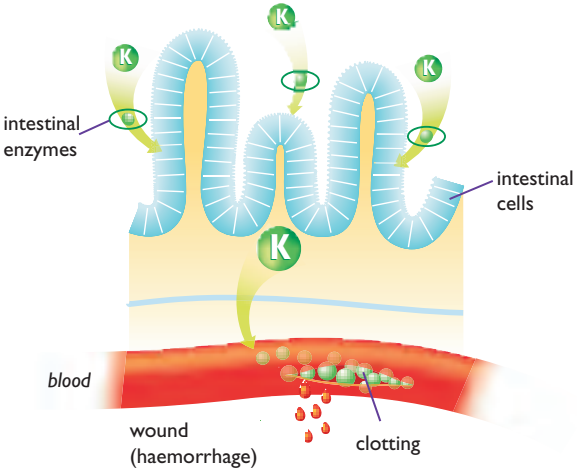
The existence of an anti-hemorrhagic dietary factor was proven in 1929 and isolated in 1936. It was given the name vitamin K, but in fact it is a group of several similar liposoluble substances that permit blood coagulation in certain conditions through complex biochemical mechanisms.
Vitamin K is traditionally administered by injection following the intoxication of anticoagulants (e.g. accidental ingestion of rodenticides).

Its role in the body

Vitamin K is a co-factor for many enzymes, which means that these enzymes cannot be active without it. As a consequence, it is essential to some blood coagulation factors. It also has a role in protein metabolism, helping to bind calcium in bone.

Natural sources

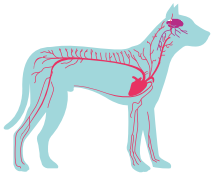
The main dietary sources of vitamin K are meat and vegetables, especially cabbage, parsley and spinach. In animals, vitamin K is mainly stored in the liver.



Blood coagulation

Thiamine

also known as :
Vitamine B1, Anti-nephritic factor



Health & Prevention

Vitamin B1 deficiency causes beriberi in humans and animals (fatigue, muscle weakness, problems with gait and vision). A balanced diet helps prevent this disease. But vitamin B1 is also an important substance in the prevention and treatment of nervous degenerative diseases or some heart diseases, among other things.

A little background information

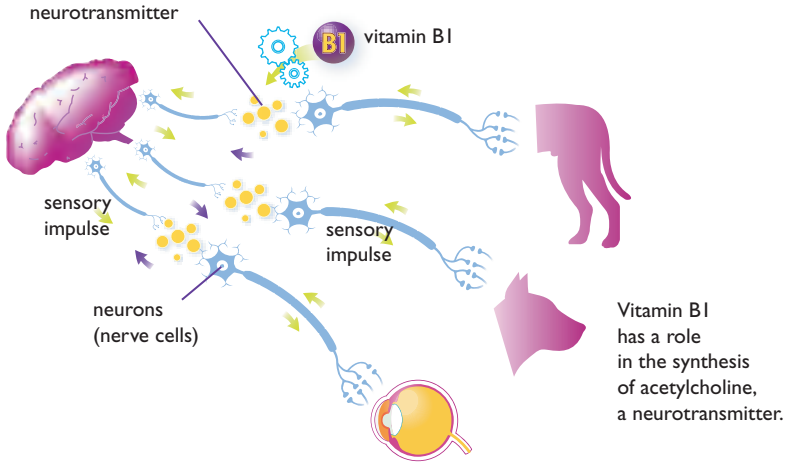
Thiamine was the first vitamin to be discovered. Beriberi was known among rice eaters in China 2600 BC, but it was only in 1885 that its nutritional origin was proven and not until 1910 was thiamine identified. Thiamine deficiency causes the disease. This vital amine – given the name "vitamin" – is soluble in water and concentrated in the heart, the kidneys, the liver and the brain.

Its role in the body

Thiamine is an essential substance involved in many complex biochemical reactions that help generate energy for the cell. But it is above all indispensable to the functioning of the nervous system, where its role is in the synthesis of the neurotransmitter acetylcholine, which transmits sensory impulses from one neuron to the other.

Natural sources

Yeast and wheat germs have the highest vitamin B1 content, but it is also found in meat, bran and cereals.



Riboflavin

also known as :
Vitamin B2

Health & Prevention

Vitamin B2 contributes to the quality of the animal's skin and coat. A deficiency produces changes to the skin around the eyes and the abdomen.

A little background information

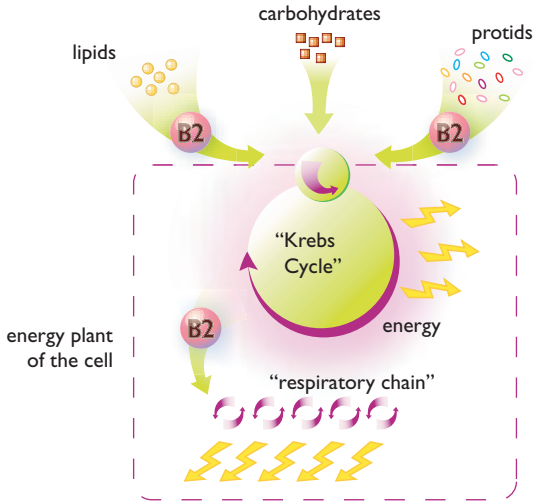
After being confused with vitamin B1, riboflavin was finally discovered in 1937, but it was only in the eighties that a number of disease were identified with very general symptoms, caused by a deficiency of this vitamin. It is water-soluble.

Its role in the body

Riboflavin is a coenzyme, which means it is essential to the functioning of a given enzyme, with a role in many biochemical reactions, including the production of energy from fat, the catabolism of amino acids and the functioning of the cell's energy plants.

Natural sources

Vitamin B2 is very common in nature, being found in yeast, liver, cheese, eggs and all diary products. It is also produced by the intestinal bacteria of dogs and cats. Riboflavin is very light-sensitive.

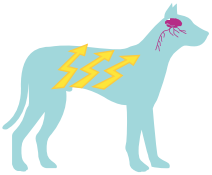


Prevention of skin disease – Energy functioning of the body

V I T A M I N S

Pantothenic acid

also known as : Vitamin B5



Health & Prevention

This vitamin is very common in food, so vitamin B5 nutritional deficiencies are exceptional and their symptoms are general in character.

A little background information

Lipman's discovery of pantothenic acid – composed of a pivotal molecule for the functioning of the cell's energy production (coenzyme A) – was rewarded with the Nobel Prize for Chemistry in 1953, which underlines the importance of this vitamin.

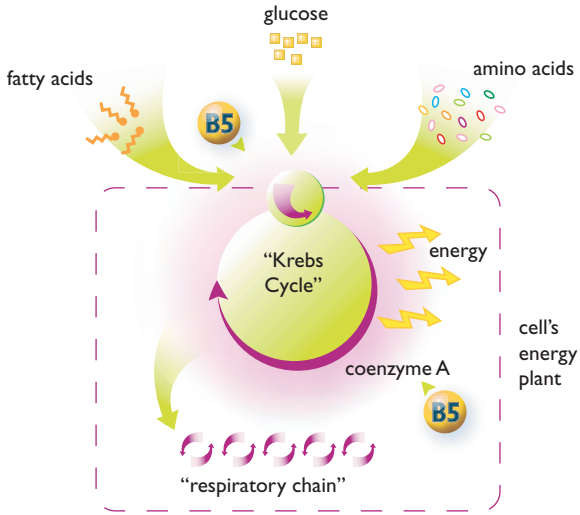
Its role in the body

Pantothenic acid enters the composition of coenzyme A, which is involved in almost every metabolism (carbohydrates, lipids, proteins) to produce energy for the cell.

Associated with other group B vitamins (niacin, choline and inositol) and histidine, a particular amino acid, pantothenic acid plays a very effective role in skin protection. It promotes the synthesis of skin lipids, especially ceramides, and helps limit skin dehydration.

Natural sources

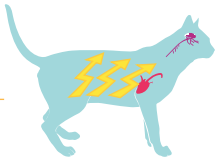
The substance's name comes from the Greek pantos, which means "found everywhere." The main sources of vitamin B5 are meat, eggs and dairy products.



Coenzyme A – Energy functioning of the cell

Pyridoxine

also known as :
Vitamin B6



Health & Prevention

A pyridoxine deficiency is expressed by skin, nerve and blood anomalies. Pyridoxine helps prevent or treat some diseases affecting the corresponding organs.

A little background information

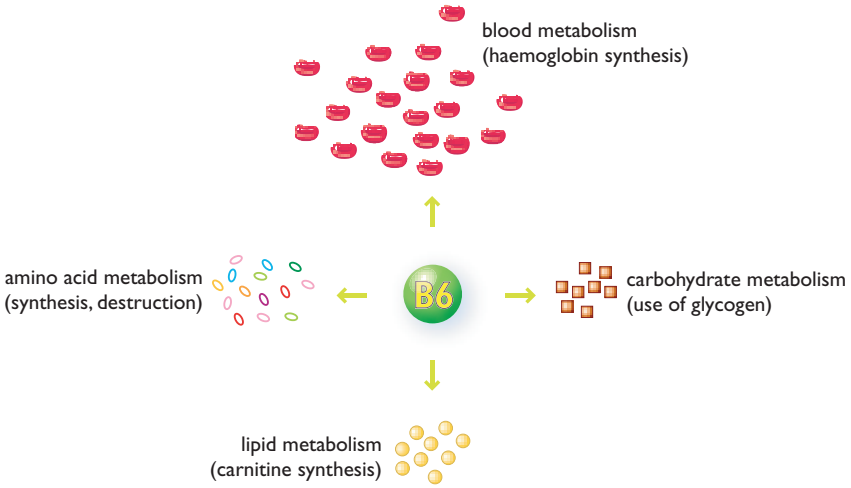
Pyridoxine or vitamin B6 was not discovered and isolated until the mid twentieth century and scientists continue to map its roles in the body, which would appear to be manifold.

Its role in the body

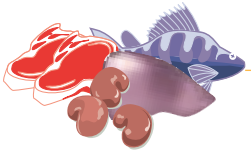
Vitamin B6 acts as a coenzyme of many enzyme systems, thus playing multiple roles in different metabolisms, especially that of amino acids.

Natural sources

Like all group B vitamins, pyridoxine is a water-soluble substance present in various foods, including yeast, wheat germ and meat. Dairy products and cereals contain only very low quantities.

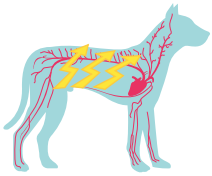


Coenzyme with multiple roles – Amino acid metabolism



Vitamin B12

also known as :
Cobalamin



Health & Prevention

Ageing, vegetarianism and digestive diseases are liable to generate vitamin B12 deficiencies, which must be compensated for through the diet. The same goes for some types of cancer.

A little background information

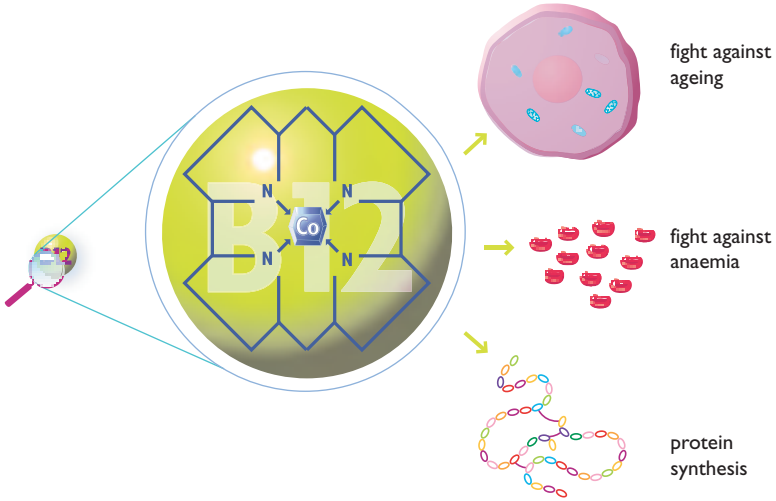
The anti-anaemic virtues of veal liver were discovered in 1925. At the time, an extrinsic dietary factor was identified, which was not isolated until the middle of the century, when it was given the name vitamin B12. It is the only vitamin that incorporates a mineral (cobalt) in its composition.

Its role in the body

Vitamin B12 is involved in many essential biochemical reactions as a coenzyme and plays a primary role in the synthesis of proteins and the production of red cells.

Natural sources

Vitamin B12 is only found in animal products (liver, kidneys, fish, meat). Vegetables do not contain any vitamin B12.



Protein synthesis – Intermediary metabolisms – Prevention of anaemia

Niacin

also known as :
Vitamin PP, nicotinic acid, Nicotinamide

Health & Prevention

Niacin helps prevent pellagra, a serious disease combining signs of skin, digestive, psychic and haematological disorders. In dogs and cats it contributes to skin health and a hair sheen.

A little background information

Vitamin PP is so named because it prevents pellagra in humans. Pellagra is a disease that makes the skin rough. A niacin deficiency in dogs causes dermatitis around the abdomen and the hindlegs, which may appear when the food is low on animal ingredients and group B vitamin supplements.

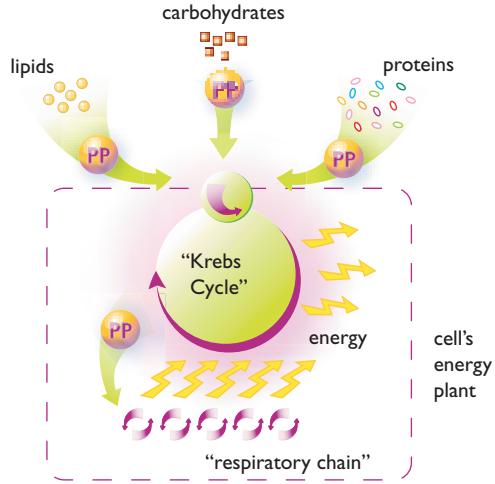
Their role in the body

The activation of niacin helps the body complete all the oxidoreduction reactions that are essential to the production of energy from fats and sugars.

Associated with other group B vitamins (pantothenic acid, choline and inositol) and histidine, a particular amino acid, pantothenic acid plays a very effective role in skin protection. It promotes the synthesis of skin lipids, especially ceramides, and helps limit skin dehydration.

Natural sources

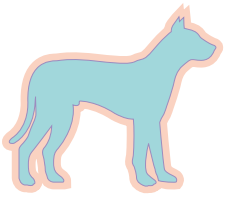
In the body niacin is synthesised from tryptophan, an essential amino acid. Present in most foods, vitamin PP exists in especially large quantities in meat, fish, cereal and mushrooms.



Prevention of pellagra – Energy functioning of the body

Biotin

also known as :
vitamin B8 or vitamin H



Health & Prevention

This is one of the most active vitamins for a glossy coat and healthy skin in animals. It is also directly involved in the smooth running of the nervous system.

A little background information

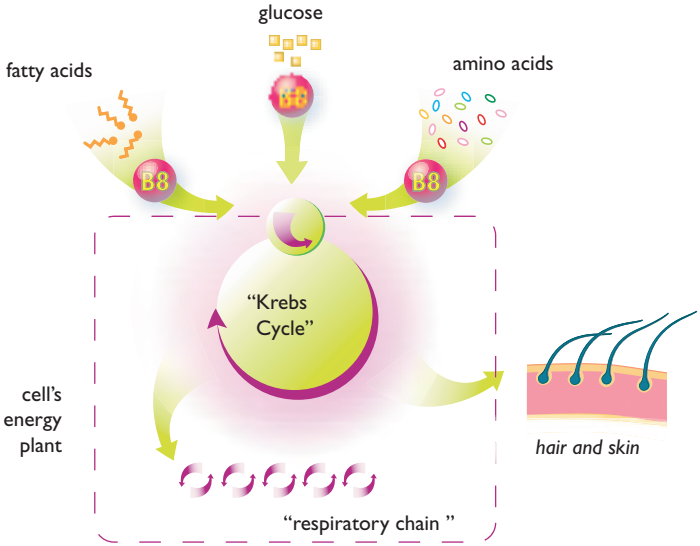
Biotin was discovered at the turn of the last century in research on "egg white disease": the consumption of large amounts of raw egg whites induced skin lesions, hair loss and neuromuscular disorders. The disease can be cured by cooking the whites, associated with yeast distribution. The intestinal absorption of biotin, a vitamin included in yeasts, is actually inhibited by an antibiotin substance present in raw egg whites, avidin.

Its role in the body

Biotin is involved in the catabolism (chemical breakdown) of glucose, fatty acids and some amino acids. It is essential to the synthesis of some other fatty acids.

Natural sources

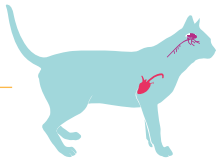
Biotin is a water-soluble vitamin found in large amounts in yeasts, liver, kidneys and cooked eggs.



Quality of the skin and the hair – Functioning of the nervous system

Folic acid

also known as :
Folate, Vitamin B9



Health & Prevention

Folic acid is involved in the development of the tissues of the nervous system. A deficiency causes malformation (such as spina bifida) in the fetus. Folic acid supplementation in gestating bitches appears to have a very beneficial effect on reducing the incidence of cleft pallet in newborn puppies. Folic acid also has a preventive role with respect to anaemic problems.

A little background information

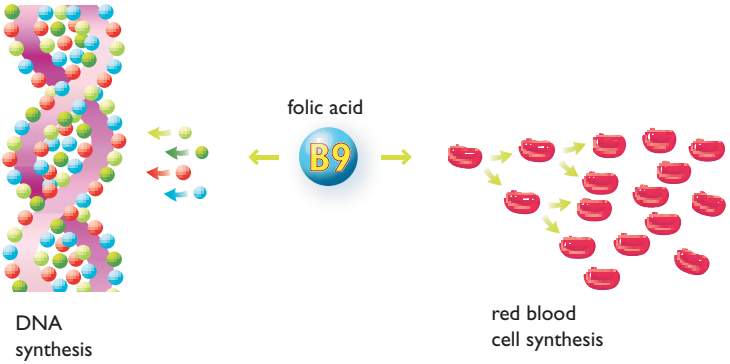
Discovered in the middle of last century, folic acid is a water-soluble vitamin stored in the animal's liver. For some years now, it has been better known as vitamin B9, but folates used to be called vitamin M or vitamin Bc or L. casei factor.

Its role in the body

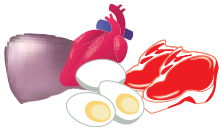
Folic acid is a group B vitamin that is essential for fast cell multiplication (e.g. fetus). It is involved in the synthesis of essential DNA components. During embryogenesis, the fetus works like a folic acid pump and a deficiency can easily develop in the female if she does not receive enough of it.

Natural sources

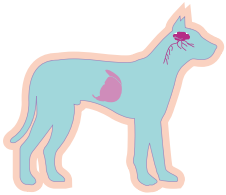
As with most B vitamins, yeast is the best dietary source of folic acid, although liver and green vegetables – especially spinach and watercress – are especially rich sources.



DNA synthesis - Prevention of anaemia



Choline & Inositol



Health & Prevention

Choline and inositol help prevent the pathological accumulation of fatty acids in the liver. These substances, which can be easily assimilated in vitamins, are lipotrophic factors.

A little background information

Choline and inositol are not vitamins in the proper sense of the word, even when they are attached to group B vitamins. The body is able to synthesise choline in the liver, but production is not always sufficient to cover requirements and it is wise to add it to the diet. The body's cells and the intestinal bacteria on the other hand are able to convert glucose into inositol.

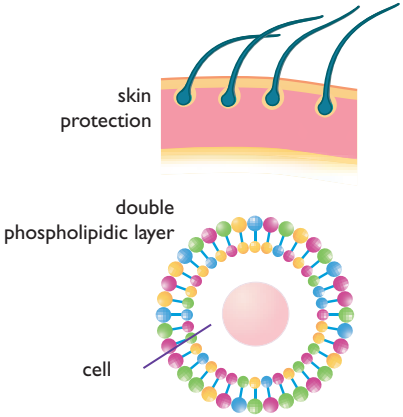
Their role in the body

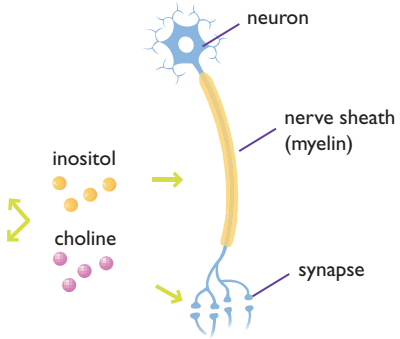
Choline and inositol work together to build the cell membranes. Associated to other group B vitamins and to histidine they play a positive role in protecting the skin from dehydration.

Combined with phosphorus, choline becomes lecithin, a particular form of phospholipid in the cell membranes and blood lipoproteins. Choline also enters the synthesis of acetylcholine, a very important mediator in the nerve endings. Inositol is an integral part of the myelin sheath covering the nerves.

Natural sources

Choline is abundant in meat, eggs and nuts. Offal, such as cows liver and heart are excellent sources of inositol.



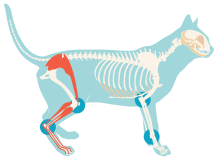


Release of acetylcholine between two synapses to allow the sensorial impulse to be transmitted.

Protection of the liver – Strengthening of the skin barrier – Nerve conduction

Vitamin C

also known as :
Ascorbic acid



Health & Prevention

Generally non-indispensable in dogs and cats, it is important to provide vitamin C in the food when the animal's liver cannot produce enough. It helps prevent or treat diseases related to ageing, cell stress induced by physical effort and joint degeneration (arthritis)…

A little background information

While scurvy – vitamin C deficiency – has been known since the dawn of time in humans (sailors consumed lemons to prevent it), ascorbic acid is not an essential vitamin in the strict sense of the word in dogs and cats, which can synthesise it in normal conditions.

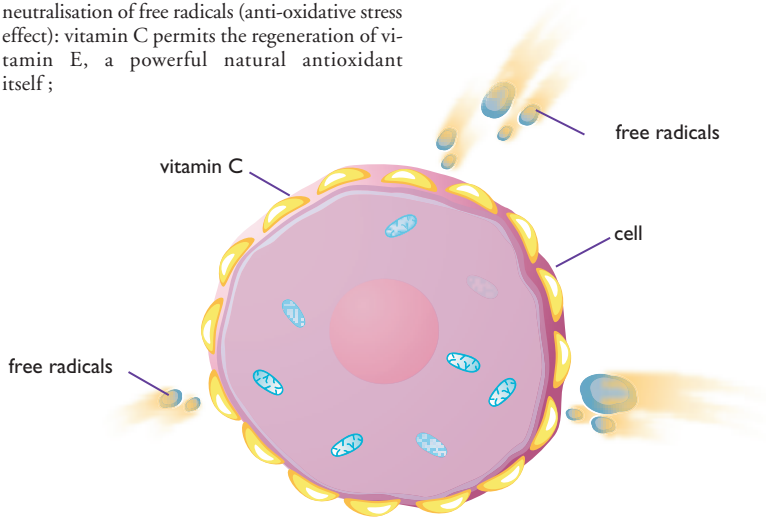
Its role in the body

Ascorbic acid is responsible for various vital bodily functions, such as :

- neutralisation of free radicals (anti-oxidative stress effect): vitamin C permits the regeneration of vitamin E, a powerful natural antioxidant itself ;
- metabolism of iron ;
- selected anti-infection immune reactions.

Natural sources

Vitamin C is very common in nature and all vegetables contain it, especially citrus fruits (lemons, oranges), berries (blackcurrant), kiwis and strawberries. In dogs and cats vitamin C is synthesised in the liver from glucose.



Other nutrients

Nowadays, some foods have more ambitious goals than simply meeting nutritional requirements by avoiding excesses and deficiencies. In terms of health nutrition it is worthwhile examining selected nutrients that can have added value in the prevention of some diseases, in slowing down degenerative processes like ageing, or simply in improving the animal's wellbeing.

The terms "Nutraceutic" and "Health Nutrition" are sometimes used in connection with nutrients that are not essential but that can improve quality of life.

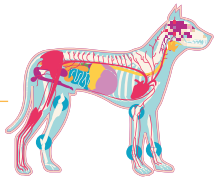
This highly heterogeneous family, which is being enlarged all the time as our knowledge of nutrition increases, comprises substances as varied as antioxidants to fight free radicals, substances to protect the joints, vegetable extracts to strengthen the skin protection, bacteria to balance in the intestinal flora, etc.

The list is very long, but we have selected a few key examples.

These other nutrients can have short-term or long-term effects. Short-term goals are improving the functioning of the body or reducing undesirable phenomena, such as painful joints, skin irritations or digestive disorders. In the longer term, the goal is to minimise the incidence of external attacks and curb the effects of the ageing process on selected organs.

These nutrients work on the animal's body and mind – the cognitive capacities. The provision of antioxidants from an early age for example helps fight against the development of cataracts in the ageing dog and the appearance of some behavioural problems connected to the loss of these adaptation capacities. Many studies in humans have proven the effectiveness of antioxidants in the prevention of some neurological diseases, such as Parkinson's and Alzheimer's.

Water



Health & Prevention

Free access to clear drinking water helps prevent dehydration, the signs of which are dry skin that lacks elasticity when pinched, blood capillaries that do not fill up easily, a higher heart rate and high fever. Dogs and cats that are 10% dehydrated are more likely to die. It is important to monitor these animals' water intake, especially when they are getting on in years. Increased intake can be a sign of diabetes mellitus or the start of kidney disease.

A little background information

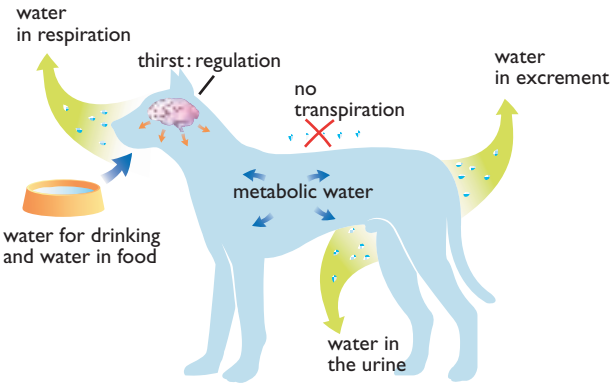
Water (H_2O), the most well known of organic substances, is a major constituent of the animal's body (75% at birth and 60% in adult age). It is the more important nutrient to life, in absolute and relative terms, participating in all major physiological functions. Body fat contains just 15% water, the skeleton 50%, muscles 75% and blood 83%. Cats have a reputation for drinking little, because they are able to concentrate their urine. But if that concentration is too high it heightens the risk of crystals and the formation of stones, so cats must be encouraged to drink.

Its role in the body

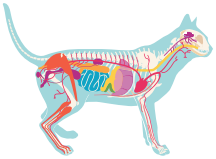
Water has many essential roles for life :
- ideal dispersion environment for nutrients and waste ;
- optimal environment for all biochemical reactions ;
- regulation of body temperature ;
- lubrication of the joints, the eyes and the inner ear (transmission of sounds)…

Natural sources

There are three sources of water :
- drinking, which is the principal source ;
- food, which can comprise between 10% (kibbles) and 85% (tins) water ;
- oxidation reactions in nutrients (e.g. 1 g of oxidised lipids produces 1.07 g of water in the body).



Antioxidants



Health & Prevention

The mapping of the roles of antioxidants is one of the main subjects of medical research at this time. They include the fight against ageing, the prevention and treatment of cardiovascular disease, some cancers, nerve diseases, cataracts and problems induced by physical effort.

A little background information

Antioxidants help the body fight the destructive effects of free radicals (more properly known as "oxygen-reactive species"), which are unstable substances derived from oxygen that are being produced by the body all the time. The production of free radicals is increased during inflammation, stimulation of the immune system and exposure to toxins.

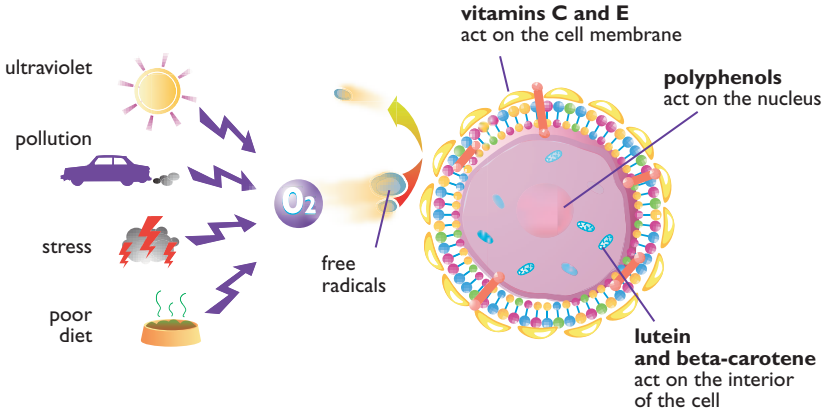
Their role in the body

Antioxidants protect the cell membranes and nucleus against free radicals, which bombard them without penetrating them.

The body has a large force to defend itself against these attacks, armed with enzyme mechanisms (superoxide dismutase, glutathione peroxidase and catalase) and endogenous and dietary antioxidant substances. The disruption of this natural defence system leads to oxidative stress.

Natural sources

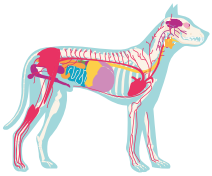
Antioxidants (vitamin, colorant, enzyme) are found in various fruits (lemon, orange, melon, tomato, grape), cereals, green tea leaves and red wine. The most commonly used antioxidants are vitamin E, vitamin C, carotenoid pigments, taurine and polyphenols.



Prevention and treatment of diseases caused by free radicals – Fight against ageing

Carotenoid pigments

Examples: beta-carotene (or pro-vitamin A), lycopene, lutein and zeaxanthin.



Health & Prevention

The carotenoids are a family of yellow-orange pigments that have an antioxidant role.
Lutein and zeaxanthin are pigments in the crystalline lens and the retina that absorb UV rays and act as a filter for the retina cells. In humans, the risk of cataracts is inversely proportional to the quantity of lutein ingested. Supplementation is also recommended in people suffering from retina degeneration (macula degeneration). Lutein specifically protects the rod cells, while zeaxanthin protects the retinal cones.

A little background information

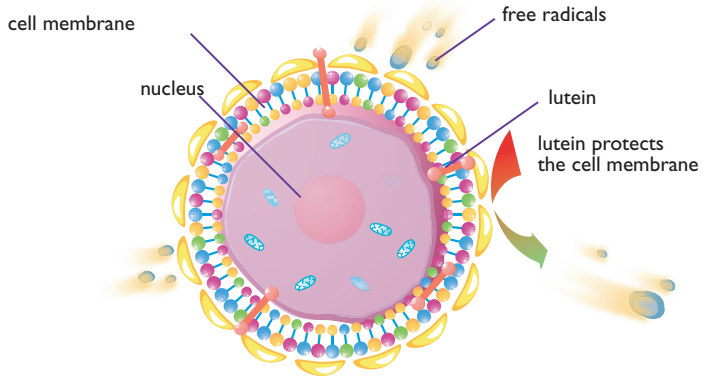
Cats are carnivores, so their health depends on the regular intake of animal nutrients. Contrary to dogs, cats do not convert beta-carotene from vegetable sources into vitamin A.

Their role in the body

Carotenoids are natural antioxidants that stimulate the immune system. In bitches, beta-carotene promotes the synthesis of progesterone and oestrogen, hormones involved in behavioural changes during oestrous and in preparing the uterus for possible gestation. Through these hormones, beta-carotene in food provides a favourable environment for the development and growth of the embryo. There is a synergy between the various carotenoid pigments: lutein permits the regeneration of zeaxanthin, which regenerates the beta-carotene, which in turn regenerates the lycopene.

Natural sources

Carotenoids are generally found in fruit and vegetables, like carrots (beta-carotene), tomatoes (lycopene), oranges, marigold, pumpkins and maize gluten (lutein and zeaxanthin).



Polyphenols

Health & Prevention

Polyphenols form a family of major antioxidants, which protect the cell membranes and DNA, preventing some mutations that cause cancer.

A little background information

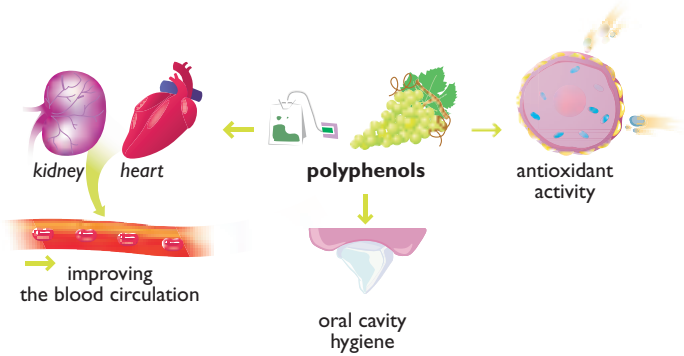
Some epidemiological studies in humans have shown a positive correlation between the regular moderate consumption of red wine - a concentrated source of polyphenols – and a lower incidence of cardiovascular disease (e.g. atherosclerosis). This is currently known as the French paradox. Dogs and cats on the other hand are rarely affected by atherosclerosis, as they possess less LDL cholesterol ("low-density lipoprotein cholesterol") than humans.

Their role in the body

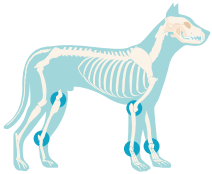
The major positive of polyphenols is their impact on free radicals, limiting the harmful effects of oxidative stress. The incorporation of green tea polyphenols in the diet can improve oral hygiene. Some compounds inhibit the growth of dental plaque bacteria, which cause periodontal disease, a common complaint among aging animals. The positive effect of flavanols, a special category of polyphenols, has also been observed in kidney and heart disease. They stimulate nitric oxide production, relaxing the smooth muscle fibres of the blood vessels. Daily administration of flavanols is associated with a fall in blood pressure.

Natural sources

There are more than 8000 known types of polyphenols and they are found in all vegetable sources. They are involved in pigmentation (tanins), growth, reproduction and plant resistance to disease. Grapes, green tea and cacao are the plants with the highest flavanol content.



Glucosamine



Health & Prevention

This nutrient is recommended for the prevention and treatment of osteoarthritis problems in large-sized dogs, dogs active in sports or ageing cats and dogs. The earlier it is added to the diet, the better the chances of limiting the inevitable degeneration of cartilage.

A little background information

It enters into the composition of glycosaminoglycans (GAGs), which are base components in the formation of joint cartilage.

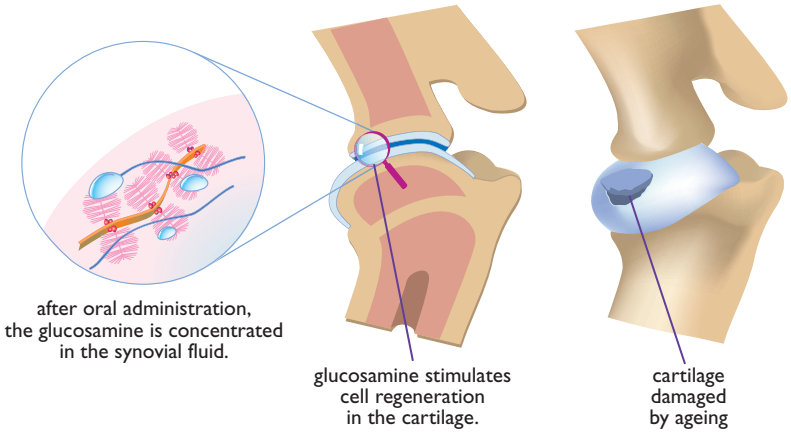
Its role in the body

Glucosamine is one of the main substances involved in the elaboration of joint cartilage and contributes to its elasticity. Its main action consists of stimulating the formation of new cartilage. Hence it acts in perfect conjunction with glucosamine that inhibits the destruction of older cartilage.

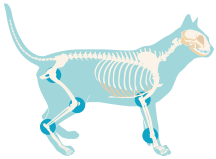
Glucosamine has minor anti-inflammatory effects. The administration of glucosamine is also effective against interstitial cystitis in cats. The mucosa of the bladder is covered by a protective layer of GAGs.

Natural sources

It is found in the cartilage of numerous animals. It can be easily extracted from the shell, which is rich in chitin, of some crustaceans (e.g. shrimps).



Chondroitin



Health & Prevention

This substance prevents and treats osteoarthritis problems in large-sized dogs, dogs active in sports or ageing cats and dogs. The earlier it is added to the diet, the better the chances of limiting the inevitable degeneration of cartilage.

A little background information

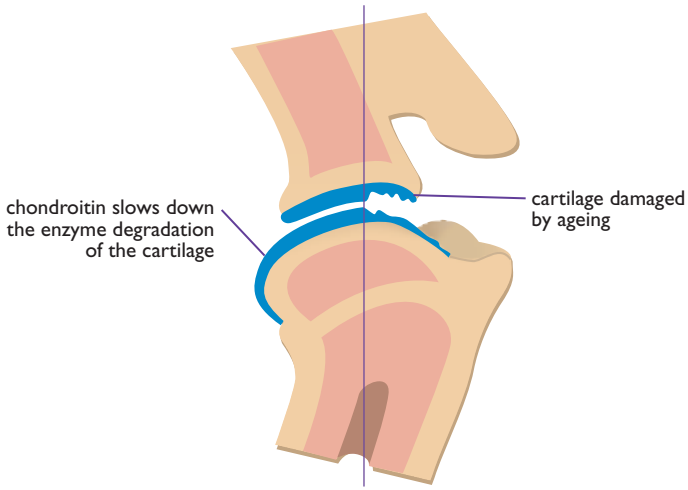
Chondroitin sulphate is a carbohydrate that enters the composition of glycosaminoglycans (GAGs), which are base components in the formation of joint cartilage. GAGs are sulphate derivatives with a high molecular mass that control the water retention capacity of proteoglycans. In the cartilage matrix GAGs contribute to the nutrition of cartilage.

Its role in the body

Chondroitin is one of the main GAGs, which are essential ingredients in cartilage. They contribute to its elasticity and absorb impacts suffered by the joints. Its main action is inhibiting the effect of the enzymes that cause the permanent destruction of cartilage. Its action perfectly complements that of glucosamine, which promotes the production of new cartilage.

Natural sources

Chondroitin can be extracted from the cartilage of various species of animal, including fish, shellfish, pigs and fowl.



Prevention and treatment of osteoarthritis