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Review Article

The Importance of Minerals in the Health of Dogs

Milena Živanović[1], Staniša Stojiljković[2]* and Sasha Pavlovic Riess[3]

[1]*Faculty of Technology, Unversity of Niš, Niš, Serbia*

[2]*Shenemil Niš, Serbia*

[3]*Pure Love & Harmony, Miami, Florida, US*

***Corresponding Author:** Staniša Stojiljković, Department of Chemical, Shenemil Niš, Serbia.

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Abstract

Although the science and technology of nutrition have advanced a lot, there are more and more negative consequences of the modern way of feeding dogs, primarily dehydrated food. A dog, like most mammals, has a similar tooth structure. Their teeth and intestinal tract are adapted to omnivores, i.e. a combination of plant and animal food. Dogs can also thrive if fed a well-balanced vegetarian diet. A diet of only meat would be insufficient for the functioning of our pets. That's why now, in addition to the energy needs for the structure of food, which are dry, the processes in the body are analyzed in parallel. In this way, food processing processes are integrated with the respiratory system. This leads to equilibrium conditions in many biochemical reactions. There are more and more confirmed scientific and clinical studies that show the influence of minerals, trace elements and heavy metals on the biochemical and other processes of our pets. This provides new guidelines for returning to traditional methods of food preparation, which will not be dry-vapour balanced, but with its consistency and mineral composition will enable better digestion of food. That is why bone marrow and the bone itself have been the essential components of dog food for centuries. We know that the dog often buried the bone in the ground to ferment and then consumed it.

Keywords: *Importance of Minerals; Health of Dogs; Science and Technology of Nutrition; Dog Food*

Introduction

Dog food is growing at a rate of 2% per year. With the increased demand for dog food, the need for the development of digestion in modern conditions. This mandates companies to develop functional food products. The digestibility of carbohydrates, proteins, and fats is well-studied in dogs, while the digestibility of minerals has been studied much less. Our task is to look at the intersection of publishing activity and realistically applied techniques to improve the absorption of food through minerals. In particular, tissue analysis of dog hair should be included as one of the modern methods of determining mineral status in dogs.

In addition to meat, fish, vegetables, grains and vitamins, your dog's balanced diet also includes minerals. However, the nutritional needs of individual components of food, especially meat, are one thing, while their absorption and functioning in the body are something completely different. By comparison, it's one thing to have parts for a car, while it's quite another to drive a car made of the same parts.

When food is considered individually, then both advantages and disadvantages are considered individually. Metabolism requires a mutual correspondence between food and the potential of the digestive tract. That is why the classical science of nutrition must introduce the mechanisms of correspondence between food, organs, hormones, and enzymes. That is why the classical science of nutrition must introduce the mechanisms of correspondence between food, organs, hormones, and enzymes. For the pet's body to function in the best possible way, it needs adequate levels of minerals, as well as proportional relationships to each other in the body. There are four important minerals (calcium, magnesium, sodium, and potassium) and several other less important but equally important minerals (such as zinc, phosphorus, selenium, and chromium, among others). Over time, mineral levels and their related relationships can become out of balance.

Minerals are involved in most metabolic processes. We especially highlight the respiratory, digestive, cardiovascular and lymphatic systems. The presence of minerals in different systems enables them to communicate to maintain the homeostasis of the organism.

Many factors affect your pet's delicate mineral balance, such as stress, diet, and environmental influences (additives, toxins, and pesticides). Over time, these factors can negatively affect your pet's body, and as a result, your pet's energy and stress levels can be negatively affected. This can result in their bodies having difficulty functioning at optimal levels and resisting illness and common ailments.

Your pet's minerals can be rebalanced by assessing their levels and related mineral ratios determined by hair analysis, which can help revitalize their energy.

This work aims to evaluate the nutrition of adult maintenance dogs using natural ingredients and not supplements, to provide most, if not all, of the minerals in the diet.

Importance of minerals in dog nutrition

Dogs fed diets with reduced or no additional iron supplementation was able to maintain normal haematological status without signs of iron deficiency anemia. Another study found that a diet based on plant ingredients had equivalent or higher digestibility values for minerals compared to a diet based on animal ingredients. These results suggest that reduction or elimination of mineral supplementation may be feasible and that new methods are needed to assess mineral digestibility in dogs [1]. Supplementation was a common practice in the feed and livestock industries; however, dietary ingredients play a key role in providing minerals to the animals that eat them, as additions [2]. Micronutrients can be over-supplemented in animal and human diets. Whole foods can supply most, if not all, of the essential micronutrients [3]. The wide field of application of minerals also influenced their decision about the percentage of participation. More abundant minerals represent macrominerals. Minerals with a greater share in the body are mainly those that affect the work of the cell, thyroid and adrenal glands. Trace elements are minerals that the body needs only in small (trace) amounts. Elements that are present in the body at less than 50 milligrams per kilogram of body weight are therefore known as trace elements. The exception is iron, which slightly exceeds the defined upper limit, but is still one of the trace elements. If you feed a "complete" dog food, it should provide all the minerals your dog needs for a balanced diet and to avoid mineral deficiencies. Regardless of the character of dog food, you should not ignore the minerals that participate in many metabolic processes. If you're not sure what to feed your dog, talk to a veterinarian or animal nutritionist who specializes in dog nutrition [5].

Some dog breeds or individuals with special requirements may require additional care with supplementation. For example, it is extremely important to balance calcium and phosphorus intake for developing dogs, especially large breeds. Fish with bones has a good ratio of calcium and phosphorus [6-8].

If the given recommendations are not followed, unwanted changes may occur in the bone system of dogs. About dog breeds prone to kidney stones due to excess copper. Owners of these breeds should analyze the dog's hair to have a detailed insight into the state of minerals. Some food components such as minerals are represented in a smaller percentage, which does not mean that they should be neglected.

If phosphorus is low, protein absorption may be reduced. This happens in the case of inability to absorb protein or poor digestion or low zinc. Zinc is needed for the formation of digestive enzymes and protein synthesis.

Phosphorus intake is important for the large intestine, as well as the ratio of omega 3 and omega 6 fatty acids. Vegetarians are often deficient in phosphorus [9].

Sodium is used for fluid balance, muscle function (including heart muscle), and nervous system health. The character of the water connection in the cell and outside the cell depends on the ratio of sodium and chlorine minerals. Chlorine and sodium also affect the state of the cardiovascular system. An imbalance in the ratio of chlorine and sodium leads to disturbances in the balance of water in the body. Both sodium and chloride also play an important role in regulating the body's acid-base balance [10].

Chlorine and sodium as electrolytes have an important function in signal transmission. This is especially important for the nervous system. Potassium helps maintain fluid balance in addition to sodium and chloride. Potassium is essential for heart function, while sodium is a water regulator. Both participate in thermoregulation. A lack of potassium can lead to diarrhoea, vomiting, and other ailments similar to a sodium/chloride deficiency.

Low hair sodium levels are associated with low energy and a lack of hydrochloric acid in the stomach, which can disrupt protein digestion.

Calcium plays an important role in the transmission of nerve impulses, muscle contraction, and the narrowing and dilation of blood vessels. It is therefore essential for your pet's healthy circulatory system [11].

High calcium in the hair with low potassium in the hair is associated with a copper imbalance. This happens even when the level of copper in the hair is in the normal range. Copper imbalance is linked to acne and premenstrual tension. Many factors affecting copper metabolism influence the likelihood of an animal developing chronic copper toxicosis through effects on copper absorption or retention. Too much copper in the diet causes molybdenum deficiency, and vice versa. Copper from different sources is an additive. Copper is an essential element for livestock and is usually added to their feed; however, molybdenum is not considered essential and is therefore not added. Therefore, livestock feed has a high concentration of copper and no molybdenum [56].

This can lead to bone deficiency and a loss of bone density. The calcium/phosphorus ratio represents the individual's autonomic state and indicates the functioning of the autonomic nervous system [12].

The magnesium ion is essential for the basic nucleic acid chemistry of life and is therefore essential for all cells in all known living organisms [13].

Amino acid analysis can help show magnesium-dependent rate-limiting steps (e.g. phosphorylation) [14]. Zinc deficiency in dogs can be a very widespread and serious problem if the symptoms are not recognized in time. Red spots can appear on the dog's skin, most often around the muzzle and mouth [15-17]. Copper is also important because it participates in the production of pigments that give a variety of colours to a dog's coat. One of the signs of copper deficiency is a loss of pigment in a dog's coat [18,56].

A lack of copper can therefore also cause a problem with the level of iron in the body [56]. Sources of copper include whole grains, liver, and beans [19]. Sulfur is important for maintaining a dog's coat, skin, and nails. Skin conditions generally develop with sulfur deficiency.

Manganese deficiency can cause problems with reproduction and the development of bones and cartilage around the joints, along with poor skin and hair health. He speculated about sugar control in the blood, the code for diabetes, and reduction of inflammation, the

code for arthritis. Manganese participates in hematopoiesis, as well as in the production of hormones in the posterior lobe of the pituitary gland, which affects the function of the testicles and mammary glands [20,35].

However, a balanced diet likely provides these trace nutrients in some form to keep your dog in a healthy state [21].

Mineral sources

Sources of minerals are meat, fish, bones, milk, cereals, algae, vegetables, fruit, clay, water, etc. Legumes and pumpkins are especially good. For many years, the term "grain-free" has been widely used in the pet food market [22,23]. The best source of minerals is bone marrow because the minerals are bioavailable in it. Plaque build-up and decay are prevented, gingival indices are improved, and sweeter breath is noted through the use of bone marrow [24]. They encourage and provide exercise. Whether they are excited or calm with their bones, this is a happy time for your dog.

Due to agrotechnical cultivation measures as well as additives, the presence of heavy metals in pet food is possible [25].

It depends mainly on the component and its source, but also the pet food production process. A monotonous diet often leads to an imbalance of minerals. This results in an imbalance of vitamins, enzymes, and hormones.

Dogs fed a raw diet have higher concentrations of Zn and Se compared to those fed dry food.

Minerals as antioxidants

Trace elements are needed to maintain the structure of essential macromolecules such as proteins, enzymes, and carbohydrates so they can participate in biochemical reactions [26]. Recent evidence has revealed that trace minerals are important antioxidant components, and their role in the formation of active chemical constituents is essential [27]. While free radicals are harmful by nature, they are an inevitable part of life.

Manganese helps activate superoxide dismutase (SOD), an important antioxidant enzyme [28,57]. It is involved, among other things, in superoxide dismutase (SOD), which protects the body from free radicals [29].

The goal of the work is to determine the priority antioxidant components that improve skin hydration [30]. Furthermore, this study aimed to determine whether antioxidant intake or body composition correlates with skin condition. This is one of the initial papers in this area [31,32].

Mineral analysis of dog hair to assess the mineral status

The outer layers of the hair harden as soon as they reach the surface of the skin and therefore lock in the metabolic products they came into contact with while growing [33]. This development allows us to detect the body's recent metabolic activity and the body's mineral status [34].

The environment is increasingly polluted [37]. Hair is an excellent test material for several reasons [36]. Hair mineral levels are about ten times higher than blood levels, making them easy to detect and accurately measure in hair [4]. Non-essential excretory tissue. Blood has pronounced homeostasis even in a state of impaired health [38].

Both types of reading have value. Blood constantly changes its composition, so sometimes it cannot be an authoritative indicator [39,40].

With a hair mineral test, the level of minerals, as well as their significant relationships, can be assessed. Mineral ratios provide more information than individual values alone [41,43].

Clay in pet food

Clay is an absorbent aluminium phyllosilicate mineral from the Smectite family [44].

The early Native Americans called bentonite "Ee-Wah-Kee," which means "Healing Mud". Clay minerals are natural rock and soil materials that primarily consist of fine-grained aluminosilicate minerals, which are characterized by high hygroscopicity. The binding capacity of clay is not specific, and these minerals can form complexes with various compounds, such as nutrients and drugs, which can affect the intestinal absorption of important substances. As the presence of mycotoxins in animal feed is likely to become a major problem shortly due to climate change, the use of clays in animal feed, given their physicochemical properties, low cost, apparent low toxicity, and environmental compatibility [45-47].

You can put dry powder over your pet's fur or stick wet clay on it for a certain amount of time [48,49]. The ion exchange, adsorption, and emulsion properties of clay allow its use in dog food [50].

In pigs, supplementation with montmorillonite for 100 days reduced lead concentrations in the blood, brain, liver, bones, kidneys, and hair [52]. Minerals are critical for enzymes, vitamins, and many other body functions [44].

Montmorillonite clay also: binds and removes bacteria, viruses, and fungal organisms, supports immune function, improves weight gain and feed efficiency, promotes probiotic activity, helps strengthen and heal the intestinal lining; and has antibacterial activity [44,54]. Finally, adding clay to the diet resulted in less antibiotic use [54].

Fermented food is a bioavailable source of minerals

The fermentation process implies the breakdown of food using microorganisms [55]. Plant sources of minerals have difficulty being absorbed due to strong bonds with phytic acid [59]. In particular, potassium is a component of the phytate molecule, where it is covalently bound, making it unavailable to digestive enzymes. Fermentation increased the magnesium, iron, calcium, and zinc content of some fermented foods commonly consumed in India and was associated with a reduction in phytate [58]. However, the increase in mineral content may be due to the loss of dry matter during fermentation as microbes break down carbohydrates and proteins [61]. Fermentation also increases the bioavailability of calcium, phosphorus, and iron, probably due to the breakdown of oxalates and phytates that combine with minerals and thus reduce their bioavailability [60].

Carbohydrates from plant sources are more easily absorbed, unlike minerals [63].

In addition to valuable minerals, fermentation offers a spectrum of organic acids and vitamins [64]. Reducing the source of histamine, as well as the balanced functioning of the cardiovascular and lymphatic systems, gives a higher probability of strengthening the immune status. Immunity is seen as an accumulated state, and it represents the readiness of the organism to evenly distribute its defence forces at a given moment.

Modern diet with additives in food, cosmetics, and medicines interferes with the microbiology of food processing. Avoiding food additives in the form of hormones, flavour enhancers, artificial colours, etc. enables the development of normal microflora. Fermented food enables the breakdown or binding of toxins, thereby strengthening the immune system. Another study from the Netherlands focuses on reducing the risk of bladder cancer with regular consumption of fermented milk products.

Fermented food creates histamines, which, even in small concentrations, can cause allergic reactions. Allergies and hay fever are caused by histamines. Stagnation often occurs in the corresponding regions of the liver, i.e. collateral blood flow. It blocks antihistamine mechanisms. A lot of stress, then food or particles from the air that induce the production of histamine contribute to a decrease in immunity. Standard antihistamines over a long period can thicken mucus secretions and worsen bacterial rhinitis or sinusitis. It is necessary to fight for the reduction of histamines, not for their neutralization.

Bentonite clay contains dozens of naturally occurring trace minerals that can effectively prevent allergies and hay fever by absorbing and neutralizing allergen-produced histamines [62].

Conclusion

Mineral elements that include heavy metals and some functional metals in the analysis are one of tare the pillars of dog metabolism. The question of dehydrated and fresh dog food arises. Additives in dehydrated foods are a disruptive influence. Also, lectins and some enzymes in fresh plant foods can have an interfering influence. That is why fermentation in dog food is being used more and more. In addition to the many advantages of breaking down food and its bioavailability, there is also a disadvantage, which is the creation of histamine. That is why bentonite clay is increasingly used both in food and in water, which reduces the possibility of allergic reactions in dogs. Minerals are catalysts for many enzymatic reactions. That is why not only their share is important, but their mutual relationship is much more important, which is the goal of our further research. In addition to basic minerals, trace elements are of particular importance. Ions of oligo-elements react with proteins, enzymes, vitamins, and hormones and activate or regulate the function of these molecules, causing changes in their molecular structure. Oligoelements can enter the composition of the enzyme's active centre and be the carriers of its catalytic activity. Enzymes, on the other hand, participate in the storage or transfer of important cellular substrates and regulate the activities of other biopolymers. By studying oligo-elements in the cell, it was established that their content is variable in the same organ, even in the cell. The different amounts of microelements in the tissues, which depend on the degree of contamination and the defensive ability of the dog's organism, determine the different biological effects of these elements. The amount of copper that is taken in through food affects the content of molybdenum in the body, while an excess of molybdenum encourages increased excretion of copper from the liver. Similar mechanisms of influence exist between zinc and copper. Oligoelements affect reproduction (reproductive functions of the organism), immunity (cobalt and manganese salts cause an initial immune response), the permeability of cell membranes, the value of osmotic and oncotic pressure, hematopoiesis, etc. Now the question arises: which food or combination to use to achieve these complex mechanisms and relationships?

The latest research shows that the hydrogen we need to extract from the cell neutralizes the oxygen-free radical, creating water. One of the mechanisms for extracting hydrogen from the cell is drinking clay. That is why she was previously considered miraculous.

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