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The importance of sulfur in animal nutrition

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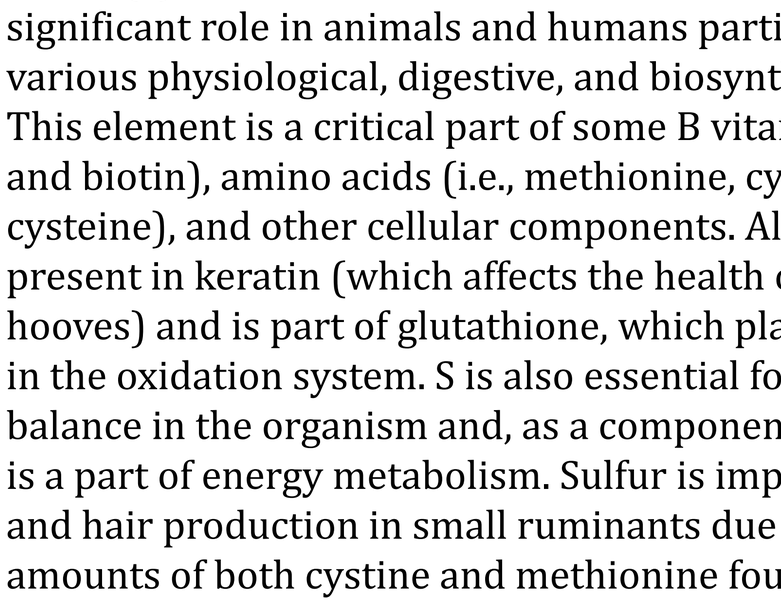
Abstract: Sulfur (S) is one of the basic building elements; after calcium and phosphorus, it is the third most abundant mineral in the human body. Sulfur is also essential in animal nutrition. It has long been recognized that S represents an essential element for rumen microbes and is closely related to nitrogen metabolism. Sulfur is an important constituent of amino acids, enzymes, and vitamins in humans and animals. Sulfur is a component of various organic nutrients required by ruminants. It is crucial for producing certain enzymes, vitamins, hormones, and amino acids in the rumen, including cystine, methionine, and cystine. Sulfur amino acids, for instance, are found in collagen, the primary structural protein in mammalian tissues. Also, sulfur is not stored in the body. Therefore, it needs to be presented in animal diets in order to maintain the synthesis of these nutrients in the rumen. In ruminants, sulfur supplementation is essential for overall health, growth and production, amino acid balance, and wool quality. Despite this, excessive sulfur digestion may cause a toxic effect on animals and adversely affect animals' performance and health, even causing serious diseases such as polioencephalomalacia (PEM). High sulfur levels in diets can significantly reduce animal performance, decrease milk production and sometimes even result in death. This article will focus on current knowledge about the metabolism and role of sulfur in the ruminant, factors affecting the production of hydrogen sulfide in the rumen, and the potential mechanisms behind sulfur toxicity in cattle. Additionally, possible strategies for minimizing sulfur toxicity in cattle diets will be discussed.

• Introduction

Sulfur (S) is one of the basic macroelements which play a significant role in animals and humans participating in various physiological, digestive, and biosynthetic processes. This element is a critical part of some B vitamins (thiamine and biotin), amino acids (i.e., methionine, cystine, and cysteine), and other cellular components. Also, sulfur is present in keratin (which affects the health of the coat and hooves) and is part of glutathione, which plays a crucial role in the oxidation system. S is also essential for the acid-base balance in the organism and, as a component of coenzyme-A, is a part of energy metabolism. Sulfur is important to wool and hair production in small ruminants due to the high amounts of both cystine and methionine found in hair. In addition, S-containing amino acids and B-vitamins are noted for their importance to milk and tissue protein production, collagen and connective tissue development, blood clotting, enzyme synthesis, and endocrine function in animals.

• Sulfur dietary sources and requirements



• Sulfur toxicity in ruminants

An excess of sulfur in animal feed can have harmful effects on animal performance and health, manifested by symptoms such as limiting microbial activity, reducing fiber digestion, diarrhea, breathlessness, blindness, muscular twitching, and causing death in some cases. These symptoms are commonly referred to as sulfur-related polioencephalomalacia (S-PEM), which can induce blindness, coordination problems, lethargy, and seizures in cattle. To minimize the risk of PEM development in cattle is important to fully understand the availability of S in ruminant diet, S metabolism by rumen microbes, and dietary factors affecting the synthesis of H_2S. Future research in this area is strongly required to propose an effective mitigation strategy and improve cattle feed management. Moreover, a higher level of S in the organism may also negatively affect dry matter intake, preventing the absorption of other minerals in the rumen. Several studies showed that increasing the amount of S in the feed ration (if the quality of forage and fiber is lower) leads to an increase in weight, wool, and milk yield. A combination of the following indicators further accompanies this phenomenon: increased digestibility of dry matter, fiber, and cellulose, increased feed intake, and improved nitrogen balance.

• Conclusions

In summary, to prevent and minimize S toxicity and keep an adequate level of S in the diet, it is necessary to evaluate sulfur levels in water and soil, investigate the potential mechanisms behind sulfur toxicity in cattle, and establish preventative management strategies that will enhance animal health and welfare.

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