

Importance of Micro-nutrient Supplementation for Livestock a Mini-Review

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Abstract

Trace minerals are very much crucial for livestock health and production. They play many tasks to maintain homeostasis of animal's body including regulation of enzymatic reactions, redox biology, acting as antioxidant agents. They are also involved in boosting various reproductive traits of animals by improving spermatozoa quality and having an influence on the endocrine system. They also enhance immunity and fight against viral infections. Despite various health benefits still, these nutrients are highly negligible in animal's ration. There must be an addition of trace minerals in animal ration up to a certain limit to improve animals' health and performance. Mineral deficiencies therapeutic episodes are uncommon, and thus their relevance to research and teaching programs is scarce. In recent years, we have faced new trends in the evolution of organic and other sustainable production systems, which have not allowed or at least limited mineral supplementation to respond to ethical, health, and environmental concerns in connection with intensive farming and related health care. The current review covers various aspects of animal health and the production based on trace minerals supplementation.

Keywords: Livestock; Health; Trace Minerals; Selenium

Introduction

The micronutrients, also known as trace minerals, are essential ingredients of animal rations [1]. As they are part of many enzymes

and coordinate many biological processes, therefore they are regarded as an indispensable factor of animal feedstuff [2]. There are various forms of trace minerals such as iron (Fe), copper (Cu),

iodine (I), zinc (Zn), manganese (Mn), cobalt (Co) selenium (Se), and molybdenum (Mo). The scientist recommended that the trace minerals should be provided to animals at optimum levels, their intake also depends on the body's physiological conditions like growth and development, and production cycle [3]. However, it is quite difficult to rationalize the term trace mineral demands just like it is for energy, protein, or organic molecules. Mineral requirements are difficult to determine and most assumptions are focused primarily on the standard threshold to resolve a symptom of insufficiency, not essential to support productivity [4]. Many researchers have proposed to satisfy mineral demands to ensure that native livestock production is not affected by food mineral imbalances. Although trace minerals play a prominent role in human and animal health, they are truly abandoned nutrients of animal diets [5]. The clinical episodes of mineral deficiency are not controverted by routine and highly standardized mineral supplements in concentrate feed ration for not only intensive farming but also in the feed of many traditional farms [6]. Therapeutic episodes of mineral shortcomings are rare, and the relevance of trace minerals in research and teaching programs is therefore rare. In recent years, however, we have faced new realities with the development of organic and other sustainable production systems where mineral supplementation in response to ethical, health, and environmental concerns relating to intensive farming practices and associated health scares is not allowed or at least limited [7]. The current review is designated to cover various aspects of trace minerals on animals' health and production.

Role of various trace minerals in different aspects of livestock

Most of the elements are in the tissue to a certain extent. However, they are characterized by being closely related to the characteristics of specific organic compounds, mainly enzymatically characterized proteins. The positive reactions of proper mineral supplementation may be observed throughout animal life [8]. The number of bioavailable minerals must be accompanied to maintain the homeostasis of the animal in all life stages [5]. Many trace minerals are very specific but often have several roles. They play a vital role in livestock and poultry [4]. These functions contribute to growth and development, immune function, and reproduction in animals and poultry. In addition, minerals are also vital to support several enzymatic systems to improve reproductive and production performance parameters [9].

Micro-nutrients and animal health maintenance

Overall mineral nutrition is important for the maintenance of livestock health (Table 1). Cows with organic or inorganic sources of Co, Cu, Mn and Zn were expected to have increased concentrations of these minerals in the liver as compared to others. Even though concentrations of liver trace minerals have been fully-fledged, but the health impacts have not been determined [7]. Moreover, the inorganic and organic trace minerals added to the cows at either lower or higher levels did not affect the body weight conditions; even then, cows induced by a high threshold of inorganic trace minerals lost more body fat during the calving period than cows fed large concentration of organic trace mineral. In another research, the source and bioavailability of trace minerals resulted in better clinical outcomes [1]. Improved skin strength leading to better track integrity and health have been observed with additional trace minerals in the broiler. Another research revealed that the intake of Zn, Cu, Mn for about 60 days leads to increased concentration of immunoglobulins and antioxidants before calving [10]. It has been revealed by scientists that the Mn works as both an activator of the enzyme and as a metalloenzyme component. It could act by binding on either a substratum (like ATP) or directly on the protein for Mn-activated reactions to innovative sustainable alterations [11]. Moreover, the multiple metabolic reactions also require micronutrients [12]. There may be no external signs of the symptoms of sub clinically deficient animals, although these may be less performing and healthy. This step can be prevented by the thinly tuned supply of trace minerals in the animal ration. The correct formulation of feeding stuff in micronutrients contributes to the production and productivity sequence of animals. The Cu is the world's second most serious phosphorous deficiency [7]. The formation of hemoglobin, enzyme systems, nervous and immune functions is all about Cu. It interacts antagonistically with Zn, I, and Mo. Sheep are very susceptible to Cu toxin, as the food level of Cu is 20 ppm or higher [6]. Another trace mineral Se is engaged in white muscle disease prevention. Recent research has proved that Se is also involved in the prevention of Coronavirus infection [13]. It also has a great impact on animals' reproductive physiology and maintenance of antioxidant status in both tissues and serum [14]. Researchers claimed Zn is very much important for various catalytic reactions of the body. It has been suggested that Zn is involved in the regulation of more than 200 enzymatic reactions. All major metabolic pathways involved in the metabolism of carbs, nucleic acids, fatty acids, polypeptides are found to contain Zn-containing metabolites [15].

Minerals	Abbreviations	Functions	References
Copper	Co	Iron metabolism, Enzymatic activities	(López-Alonso and Miranda) molybdenum and sulphur (Cu-Mo-S
Selenium	Se	Antioxidant, ferroptosis, sperm motility and reproductive physiology	(Bano, Moolchand Malhi, <i>et al.</i>)
Iron	Fe	The main component of hemoglobin	(Van Emon <i>et al.</i>)
Iodine	I	Metabolism, Thyroid hormone, growth and development regulation	(Mohanta and Garg)
Fluoride	F ⁻	Formation of teeth and bones	(Mohanta and Garg)
Manganese	Mn	Enzymatic activities	(Awuchi, <i>et al.</i>)
Zinc	Zn	Immunity, wound healing, embryogenesis, sexual maturation	(Gondal)
Molybdenum	Mo	Enzymatic activities	(López-Alonso)

Table 1: Micro-nutrients and their tasks to maintain homeostasis in animals' body.

Micro-nutrients and animal production

Several studies have shown that organic trace minerals improve various reproductive indexes, including an increase of cows pregnant at 150 days in milk [4]. Minerals are generally linked to the quantity and quality improvements in the production of meat and eggs. Therefore, they must be added to the correct concentrations during the life cycle to support energy and production performance like immunogenic responses, egg production, and milk production [16]. Animals fed the recommended mineral concentration have minimum dietary challenges and overall performance is increasing. The correct formulation of feeding stuff in micronutrients contributes to the production and productivity sequence of animals. Previous studies showed that the addition of organic trace minerals increased milk production in lactating cows as compared with cows that fed inorganic trace minerals [17]. Moreover, the response in the second lactation was more than in the first lactation [1]. Mineral supplementing strategies become complex as differences are critical to achieving optimum production in modern animal production systems for all livestock and avian species. Subclinical or marginal deficiencies can be a greater problem than acute mineral deficiencies, as specific clinical symptoms do not make it apparent that the producer has identified the deficiency [17]. Nutrient balance, protein, energy, minerals, and vitamins are key to the optimal production of animals. Several of today's modern animal production systems and performance standards cause animal stress during the whole phase. The stress is related to low production as well

as the low performance of the animal [18]. The trace mineral status of the animal in the event of stress is critical to minimize negative production effects. Like Se has close links on thyroid and adrenal glands by acting on aldosterone hormone [19].

Conclusion

It is well known that trace minerals are essential to the proper functioning of most biochemical processes in the body. Adequate intake levels of certain chemical elements are needed to maintain optimum health. The requirements for most animals on a food energy basis are similar (e.g., kcal or joules). The conventional diet meets the requirements more often than not. However, most of the weaknesses occur when the diet is simple and monotonous. Even a decade ago, the wide range of supplements, such as I, Mo, Se, Fe, Mn, and Zn reflect the research success. A safety margin should be provided for mineral recommendations to take into consideration the occurrence of antagonistic effects of certain trace minerals to prevent allergic reactions and toxicity.

Conflict of Interest

No conflict of interest exist.

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