



The Hidden Nutritional Deficiencies in Livestock: How Minerals Influence Fertility, Immunity and Productivity

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A dairy cow may receive sufficient fodder and concentrate and still experience poor fertility, reduced growth or recurrent health problems. In some cases, the explanation may involve deficiencies or imbalances of essential minerals. Minerals such as copper, zinc, selenium, manganese, iodine and cobalt are required in relatively small quantities, but they contribute to numerous physiological functions. They support enzyme activity, antioxidant defence, immune responses, thyroid function and reproductive processes. However, mineral nutrition is not simply a matter of providing more supplements. Both deficiency and excess can be harmful, and the correct approach depends on the animal's diet, physiological stage, mineral interactions and local conditions.

Why are minerals so important?

The Indian Journal of Animal Sciences has published a review by C. S. Prasad and N. K. S. Gowda on trace minerals in tropical animal feeding systems. It discusses the importance of essential trace elements and their relationships with livestock productivity, immunity and reproduction. A more recent review by Mondal and colleagues, published in 2025, examined the roles of zinc, copper and manganese in the growth, immunity and reproductive development of male cattle. It highlights the importance of these minerals in calf development and adult bull fertility.

The following table summarises some important functions and consequences of inadequate intake.

Mineral	Important functions	Possible consequences of deficiency
Copper	Iron metabolism, enzyme activity and immune function	Anaemia, poor growth and coat changes
Zinc	Skin integrity, enzymes, immunity and reproduction	Skin lesions, poor growth and impaired reproductive function
Selenium	Antioxidant defence and muscle function	White muscle disease and impaired immune function
Manganese	Bone development, enzymes and reproduction	Skeletal abnormalities and reproductive problems
Iodine	Thyroid hormone production	Thyroid dysfunction and reproductive abnormalities
Cobalt	Required by rumen microbes for vitamin B12 synthesis	Poor appetite, growth and productivity

These are general associations rather than diagnostic criteria. Clinical signs may overlap with infections, parasitism, energy or protein deficiencies and other metabolic disorders.

What do the data and research tell us?

One of the important findings in mineral nutrition research is that mineral status cannot always be determined from a single blood result. An invited review by Spears, Brandao and Heldt, published in Applied Animal Science in 2022, examined approaches to assessing trace

mineral status in ruminants. It emphasised the importance of analysing the animal's diet and forage, including minerals that can influence the availability and requirement of the mineral being investigated. This has practical significance because the amount of a mineral present in feed is not necessarily the amount that an animal absorbs and uses. Soil conditions, plant species, feed processing, mineral interactions and physiological demands can influence the final nutritional status. For example, high dietary concentrations of certain minerals may interfere with the availability of others. Consequently, an animal can have an apparently adequate mineral intake yet remain at risk of an imbalance.

How can mineral problems affect farm productivity?

1. Fertility and reproduction

Copper, zinc, selenium, manganese and iodine contribute to normal reproductive physiology. Deficiencies or imbalances may be associated with impaired ovarian function, poor reproductive performance or abnormalities in sperm development. review by Sharma and colleagues on mineral nutrition and reproductive performance in dairy animals describes the roles of minerals in reproductive function and the consequences of nutritional imbalances. Nevertheless, infertility should never automatically be attributed to mineral deficiency. Heat stress, infectious disease, poor body condition, reproductive disorders and management problems can produce similar outcomes.

2. Immunity and disease resistance

Trace minerals contribute to normal immune function and antioxidant systems. Inadequate mineral status may impair the animal's ability to maintain normal physiological responses, particularly during periods of increased demand. A 2022 review of trace mineral supplementation in beef cattle examined the use of selenium, zinc, copper and manganese in relation to immune function and animal health. It discussed evidence for strategic supplementation around management events such as weaning and vaccination, while recognising the importance of appropriate nutritional management. Supplementation should therefore be based on an identified need and suitable veterinary or nutritional guidance, rather than assuming that every animal will benefit from additional minerals.

3. Growth and production

Young animals need appropriate mineral nutrition for normal growth and skeletal development. In adult dairy animals, overall nutritional status can influence production indirectly through health, feed intake and reproductive performance. However, there is no universal percentage increase in milk yield or fertility that can be promised following mineral supplementation. Responses depend on whether a genuine deficiency exists, how severe it is, the mineral supplied and other limiting factors in the production system.

How should veterinarians investigate a suspected deficiency?

A systematic investigation is more reliable than treating clinical signs alone.

- Review the ration: assess fodder, concentrates, mineral mixtures and the quality of the feed ingredients.
- Examine the animals: record body condition, growth, coat quality, reproductive history and relevant clinical signs.
- Collect suitable samples: blood, liver tissue where appropriate, or representative feed and forage samples may be useful depending on the mineral.
- Interpret laboratory results carefully: reference intervals, sample handling, physiological status and the diagnostic limitations of each test must be considered.
- Identify interactions: investigate whether other minerals or dietary components could be affecting availability.
- Correct the problem safely: select a suitable formulation and dose based on the animal's requirements and the evidence of deficiency.

For example, serum copper can be useful in some situations, but it does not always represent total body copper reserves. Selenium status may be evaluated using suitable blood

measurements, while feed analysis can help identify dietary inadequacy. The choice of test should match the clinical question.

Can mineral supplementation solve every problem?

No. Supplementation can be valuable when a deficiency or inadequate intake is identified, but indiscriminate use may cause toxicity, increase costs or worsen mineral interactions. The goal should be to supply minerals in appropriate quantities, using good-quality feed and veterinary nutritional advice. Where deficiencies are widespread, regional feed and forage surveys can help identify patterns and support better-designed mineral supplementation programmes.

Conclusion

Mineral nutrition is a fundamental but sometimes overlooked component of livestock health. Small deficiencies can have important consequences, but their effects are not always obvious and cannot be diagnosed reliably from a single symptom. Combining feed analysis, clinical examination, appropriate laboratory testing and balanced supplementation offers a practical way to improve animal health and farm productivity. For veterinarians and farmers, the key is not simply to provide more minerals—it is to identify which nutrients are needed, in what quantities and for which animals.

References

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