ASC-270

Cooperative Extension Service

# Overview of the Mineral Nutrition of Yaks

*Jeff Lehmkuhler, Katie VanValin, Darrh Bullock, and Les Anderson, Animal and Food Sciences, and Michelle Arnold, Veterinary Diagnostic Laboratory*

*Photo by Daniele Garner, Pettee Ranch*

Mineral nutrition is a critical aspect of livestock management, particularly for yaks grazing on the challenging terrains of the Qinghai-Tibetan Plateau or the diverse range conditions of North America. As these animals adapt to their environments, understanding their mineral requirements becomes vital for ensuring health, productivity, and overall well-being.

Research on the mineral requirements of yaks is limited. Although a few studies have been published investigating mineral nutrition of yaks in their native country, further research is needed to establish precise mineral requirements for yaks. Additional information is needed on mineral nutrition, which considers factors such as season, region, physiological state, and interactions between minerals. Developing appropriate mineral supplementation strategies based on these findings will be crucial for optimizing yak health and productivity. Below is a summary of the available research on mineral needs of yaks.

- **Sodium (Na):** Sodium deficiency is especially prevalent in the yak's native range. Herbage on the Qinghai-Tibetan Plateau is consistently deficient in sodium, leading to widespread sodium deficiency in yaks. Yaks often compensate for this deficiency by licking soil, particularly during winter when limited forage availability exacerbates the issue. The reported recommended dietary sodium requirement for yaks is higher (8-12 g/kg of the diet) than recommendations for beef cattle diets (6-10 g/kg). The herbage sodium content often will only meet 50%-60% of the dietary needs with supplementation being required.
- **Phosphorus (P):** Phosphorus is essential for various bodily functions, and its availability in forage is significantly affected by seasonality. During the summer, herbage in the northwest region of China has sufficient phosphorus. However, during the winter, it becomes deficient, leading to seasonal phosphorus deficiency in yaks. For regions of North America phosphorus forage concentrations vary greatly. In many areas of the midwest and southern regions of the United States, forage phosphorus content likely meets the needs of mature yaks for most stages of production.
- **Copper (Cu):** Copper is crucial for various physiological processes, and like phosphorus, its availability in yak forage fluctuates with the season. Herbage copper content is generally sufficient in summer but deficient in winter. Additionally, high levels of molybdenum (Mo) in the soil and forage of some regions can induce copper deficiency, leading to a condition known as "shakeback disease." Copper supplementation is necessary to prevent the disorder. Other issues such as suppressed immune system, reduced fertility, and discoloring of black hair can occur with copper deficiency.
- **Calcium (Ca):** Calcium is essential for bone health and other physiological processes in yaks. While herbage calcium levels may be sufficient for maintenance in some areas, yaks can still experience calcium deficiency, particularly during the spring when cows are lactating and forage Ca levels are low. This might be related to lower levels of vitamin D status during winter, as vitamin D is essential for calcium absorption and utilization. Reduced day length, excessive periods of cloud cover, and heavy winter haircoats may reduce vitamin D synthesis.

- **Selenium (Se):** Selenium is an essential trace mineral, and deficiency is common in yaks grazing on the Qinghai-Tibetan Plateau, occurring in both summer and winter. In regions of North America, variation in soil and forage selenium levels can range from deficient to toxic. This variability necessitates sampling and learning about what selenium supplementation, if any, may be needed.
- **Other Minerals:** Other minerals, including potassium (K), magnesium (Mg), iron (Fe), manganese (Mn), and zinc (Zn), exhibit seasonal variations in their serum concentrations in yaks, typically with higher levels in the summer than in the winter. However, specific dietary requirements for these minerals in yaks have not been extensively studied.

Several factors influence the mineral status of yaks, including seasonality, regional soil composition, and dietary variations. Seasonal changes lead to higher mineral concentrations in herbage and yak serum during the summer than in winter, necessitating careful monitoring and potential supplementation. The geographical variances in mineral content further complicate the nutritional landscape, leading to specific deficiencies such as selenium being deficient in some regions while concerns over toxicity may exist in other regions of North America. Testing water and forages for mineral content is recommended. This information can be used to develop supplemental mineral feeding programs.

Many studies on yak mineral nutrition rely on the assumption that reference ranges established for cattle are also applicable to yaks. It's important to acknowledge that specific data directly comparing the mineral requirements of yaks and beef cattle are limited and this assumption requires further validation through targeted research.

Serum reference values may aid in assessing the mineral status of yaks. Serum values considered marginal for yak sampled in the Asian literature are shown in Table 1. The challenge with serum reference values is they may not accurately reflect the mineral status of the animal. Additional testing may be needed to accurately determine mineral status of the animal, such as liver biopsies or ceruloplasmin, which is a protein that binds copper transporting it to the tissues in the body. Low levels of copper will reduce ceruloplasmin levels and may be used in combination with serum/blood copper level.

Despite existing knowledge, further research is required to establish precise mineral requirements tailored to the yak's physiological state, region, and seasonal dynamics. Effective mineral supplementation strategies will be crucial in addressing these deficiencies and enhancing the health and productivity of yaks in their natural habitat. The use of the recommended requirements for beef cattle in combination with the published guidelines for yaks is the best approach for developing recommendations for dietary mineral concentrations presently. Table 2 contains a summary of the yak and beef dietary recommendations for minerals.

In summary, the dietary mineral requirements for yaks are not well understood. Using the available information for yaks and beef cattle will aid in preventing mineral deficiencies while avoiding toxicities until further knowledge is gained on the specific mineral needs of yaks to optimize performance and productivity.

**Table 1. Serum/blood trace mineral reference values for yaks adapted from research literature.**

| Mineral (ppm) | Deficient | Marginal | Adequate |
|---|---|---|---|
| **Calcium** | NA | 90 | NA |
| **Potassium** | NA | 98 | NA |
| **Phosphorus** | NA | 46.5 | NA |
| **Magnesium** | NA | 25 | NA |
| **Manganese** | 0.002 | 0.006 | >0.006 |
| **Iron** | NA | 1.1 | 1.1-2.5 |
| **Cobalt** | NA | NA | 0.00017-0.002 |
| **Copper** | <0.45 | 0.60 | >0.65 |
| **Zinc** | <0.5 | 0.60 | >0.8 |
| **Selenium** | <0.035 | 0.035 | 0.05-0.08 |
| **Molybdenum** | NA | NA | 0.002-0.035 |

**Table 2. Recommended dietary mineral levels for yaks.**

| Mineral | Unit | Growing | Lactating | Dry Cows | Max Tolerable |
|---|---|---|---|---|---|
| **Macro** | | | | | |
| **Calcium** | % | 0.58 | 0.30 | 0.21 | -- |
| **Phosphorus** | % | 0.26 | 0.21 | 0.16 | -- |
| **Potassium** | % | 0.70 | 0.60 | 0.60 | 3.0 |
| **Magnesium** | % | 0.20 | 0.20 | 0.12 | 0.40 |
| **Sodium** | % | 0.10 | 0.10 | 0.06-0.10 | -- |
| **Sulfur** | % | 0.15 | 0.15 | 0.15 | 0.40 |
| **Micro** | | | | | |
| **Cobalt** | ppm | 0.15 | 0.15 | 0.15 | 10 |
| **Copper** | ppm | 15 | 10 | 10 | 100 |
| **Iodine** | ppm | 0.50 | 0.50 | 0.50 | 50 |
| **Iron** | ppm | 50 | 50 | 50 | 1000 |
| **Manganese** | ppm | 50 | 40 | 20 | 1000 |
| **Selenium** | ppm | 0.10 | 0.10 | 0.10 | 2 |
| **Zinc** | ppm | 30 | 30 | 30 | 500 |

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Lexington, KY 40506 Issued 02-2025