Mineral Supplementation for Livestock, Part I

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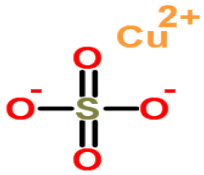

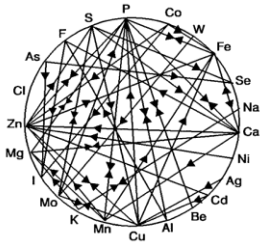

My associates and I are frequently asked questions about mineral supplementation for livestock. The following are a few of my introductory observations:

1. It is probably best for livestock to obtain as much of their daily mineral requirements from the **feeds they consume** as possible. The mineral content of livestock feeds is a function of **species, maturity, harvesting/storage circumstances, soil fertility and management practices**. The following table shows how the mineral profile of tall fescue pasture forage can change over time with **improved management**; rotational grazing, fertilization based on soil testing, and properly supplementing livestock with needed minerals**:**

Year	Phosphorus, % of DM	Zinc, mg per kg of DM	Copper, mg per kg of DM
2009	.10	8.0	3.0
2017	.19	24.0	8.0
Required	**.17**	**30.0**	**10.0**

2. Compared to other nutrients like carbohydrates, lipids, and proteins; mineral requirements are relatively low in terms of absolute amounts. The following table shows the crude protein versus phosphorus and copper requirements of a third term 1200 lb. beef cow:

Nutrient	Required, grams/day	Required, milligrams/day
Crude Protein	845.00	845000.00
Phosphorus	18.20	18200.00
Copper	.11	110.00

3. Compared to other nutrients, the **absorption** of most minerals from the gastro-intestinal tract of livestock is relatively low. The following table illustrates the absorption of some dietary minerals compared to crude protein:

Nutrient	Crude Protein	Calcium	Phosphorus	Zinc	Copper	Iodine
Absorption	80-90%	40-50%	60-70%	20-40%	10-30%	5-10%

Due to these differences in utilization, it is important to remember that animals have **metabolic requirements** for minerals but the **dietary mineral requirements** are usually much higher. For example, the metabolic calcium requirement for a third term 1200 lb. beef cow is about 14 grams/day. However, since dietary calcium is utilized at only about 50%, the dietary calcium requirement is about (14÷.50) 28 grams/day or .062 lbs./day.

4. Absorption of some minerals is **physiologically controlled** to varying degrees. During deficiencies the absorption of certain minerals can be increased somewhat, but these processes usually **cost energy** that could be used for other purposes.

5. Different sources of minerals vary in bioavailability. Supplemental mineral sources are usually in one of two forms: **Inorganic and Organic**. Inorganic refers to minerals in one of several chemical forms. Organic minerals are bonded or linked (chelated) to organic molecules like glucose, citrate or an amino acid, for example calcium citrate or zinc methionine. The following table shows the **relative bioavailability** of various forms of mineral supplements:

Mineral	Carbonate	Phosphate	Sulfate	Oxide	Chloride	Organic
Calcium	100	110	60	-------	125	130
Phosphorus	--------	85	----------	-------	--------	---------
Zinc	60	----------	100	100	--------	180
Copper	--------	----------	100	15	115	150

With time it is likely that mineral forms with higher bioavailability and less negative reactivity in feeds and in animal digestion and metabolism will be developed, e.g., **copper hydroxychloride.**

6. Although it is important that minimal mineral requirements are met, it is also important that the amounts of dietary minerals provided **relative to one another** are maintained within acceptable limits, **mineral ratios**. The following table illustrates:

Item	Calcium	Phosphorus	Ca:P Ratio
Amount in diet, lbs./day	.062	**.071**	.87
Required amount, lbs./day	.062	.040	1.55
Status	100% OK	176% OK?	reversed

Note that calcium and phosphorus requirements are met but since the utilization of these two minerals is linked, the high dietary level of phosphorus and the just adequate level of calcium would likely precipitate a **calcium deficiency**. Another example of such a relationship, high diet levels of sulfur and/or molybdenum can interfere with copper utilization.

7. There are different types of mineral requirements: **minimal** for specific production purposes, for livestock under **stress** (environmental, health, etc.), and **therapeutic** for prevention or treatment of disease (zinc and iodine for foot/hoof health).
8. Always be mindful that there are maximum tolerable dietary level for minerals, **toxicities**.
9. **Mineral supplements** are relatively expensive compared to other nutrients but **mineral supplementation** usually accounts for a small portion of total diet costs.

Item	Mineral Supplement	Hay
$/lb. of feed	**.52**	**.052**
Amount needed/day, lbs.	.25	28.00
$/day	**.13**	**1.46**
% of total diet cost	8.18	91.82

10. During mineral deficiencies, scarce mineral resources are **partitioned to the most essential functions (maintain life>immunity>growth>reproduction**). During a subclinical deficiency animals may appear normal but important functions are being compromised before clinical signs are manifest.
11. Remember **Liebig's Law of the Minimum**, livestock will perform in accordance with the most limiting nutrient. For example, in an otherwise well-nourished animal, the lack of .5 mg of selenium/day will impede productivity and good health.
12. And dietary mineral adequacy will not counter energy or protein deficiencies.