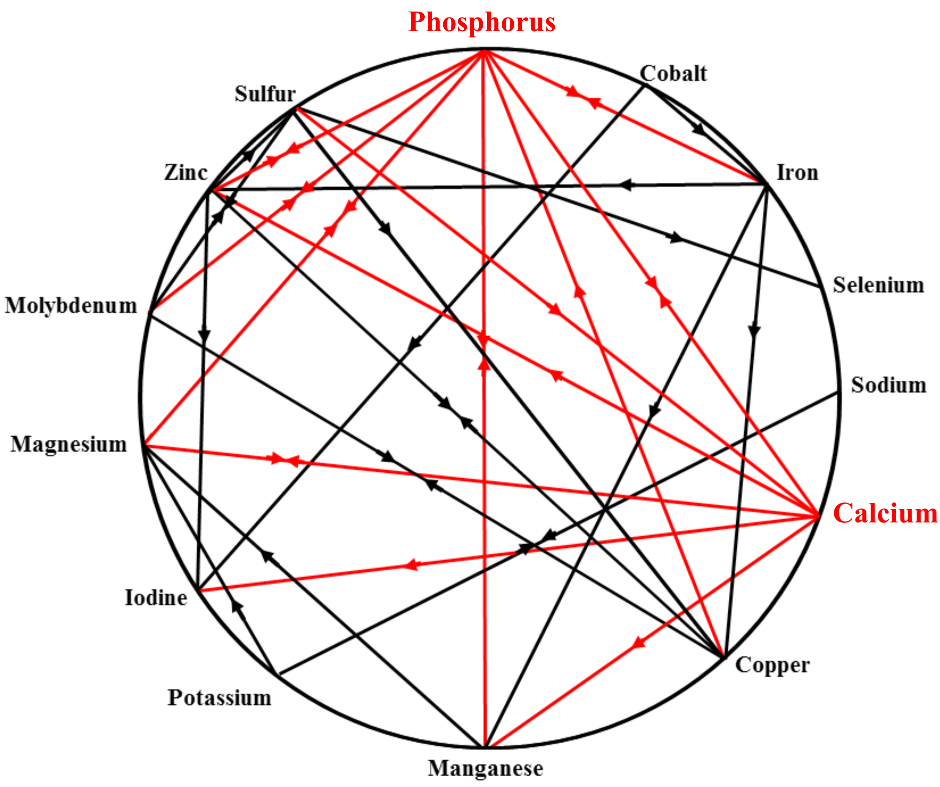
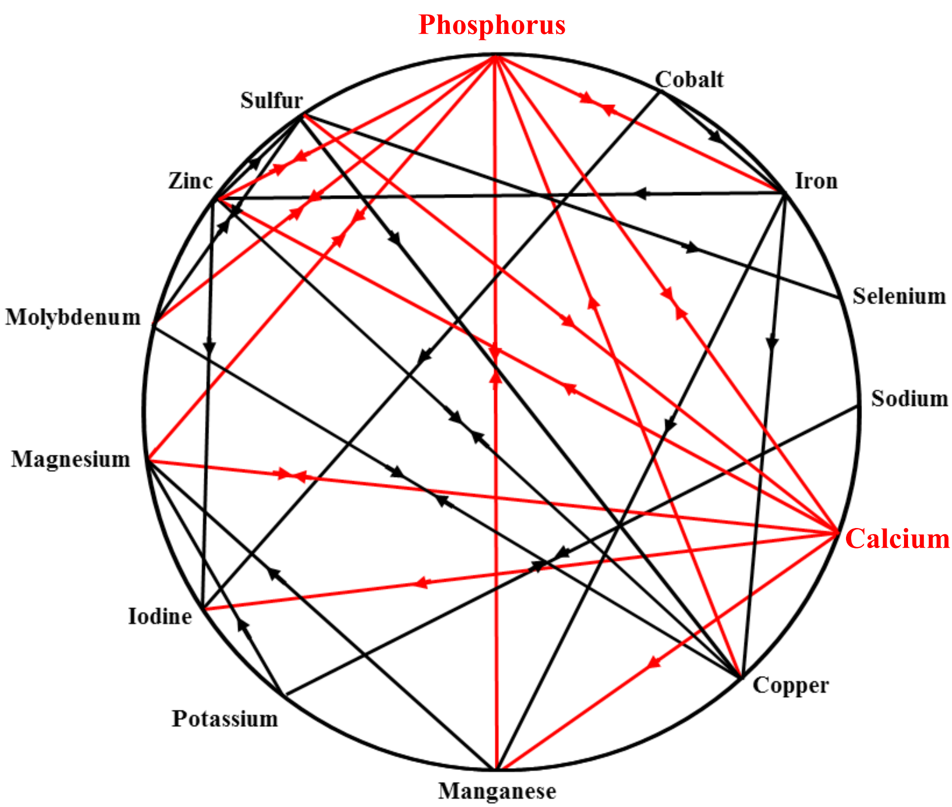
The Mineral Wheel



THE MINERAL WHEEL

Commonly Accepted Mineral Interrelationships in Animals



How to Interpret The Mineral Wheel:

An arrow pointing from one element to another indicates that an excess of the mineral from whence the arrow originates may interfere with the absorption or metabolism of the mineral to which the arrow points.
For example: An excess of Calcium may interfere with the utilization of Zinc.

Two major elements, Calcium and Phosphorus, (shown in red in the chart) affect the utilization of most other elements.

About The Mineral Wheel

The mineral wheel was first developed in the mid Twentieth Century by an agronomist named Mulder, hence the name "Mulder's Wheel."

The original wheel depicted the mineral interrelations between soils and plant growth. It has been modified and revised many times since then. It appears in many cases the original wheel was used to show the interrelationships of minerals in animals. Unfortunately, the relationships are different in animals than they are in soil. No one wheel can accurately show all relationships.

When applied to livestock nutrition there are several variables to consider. Not all species metabolize minerals the same way - e.g. non-ruminant calves vs. adult ruminants, ruminants vs. mono-gastric, etc.

Nevertheless, the concept is useful to illustrate the complexity of the general interrelationships that do occur in many animals.

I have simplified our wheel by removing some elements that have relevance in soils but not in animals. I have modified the wheel to conform to extant research on mineral antagonism in livestock.

Following are relevant notes from many sources, as well as some of the original sources.

NOTES

"A high intake of Calcium decreases intestinal zinc adsorption, while an excess intake of zinc can decrease copper absorption."

Nutrient Interrelationships: Mineral - Vitamins - Endocrines. David L. Watts, D.C .. , Ph.D., F,A,C,E,P. Trace Element. Inc. P.O. Box 514, Addison, Texas 75001

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Selenium bioavailability is reduced by high dietary sulfur.

High dietary molybdenum in combination with moderate to high dietary sulfur results in formation of thiomolybdates in the rumen. Thiomolybdates greatly reduce copper absorption.

Independent of molybdenum, high dietary sulfur reduces copper absorption.

High dietary iron also reduces copper bioavailability.

Manganese is very poorly absorbed in ruminants, and limited research suggests that high dietary calcium and phosphorus may reduce manganese absorption.

Selenium and sulfur have similar physical and chemical properties, and a number of studies indicate that increasing dietary sulfur reduces the bioavailability of selenium.

Limited research suggests that either high or low dietary calcium may reduce selenium absorption. It is well documented that copper requirements vary greatly in ruminants depending on concentrations of other dietary components, especially sulfur and molybdenum.

A three-way interaction between copper, molybdenum and sulfur has been recognized since the 1950s. When ruminal sulfide concentrations are low, molybdenum may have little effect on copper bioavailability. However, the addition of 3.0 g of sulfur and 4.0 mg of molybdenum/ kg of diet to a basal diet that contained 1.0 g of sulfur and 0.5 mg of molybdenum/kg of diet reduced copper availability by 40-70%.

Independent from its role in the molybdenum-copper interaction, sulfur reduces copper bioavailability.

Ruminants are often exposed to high iron intakes through ingestion of water, soil or feedstuffs that are high in iron. A number of studies indicate that addition of 250- 1,200 mg of iron (from ferrous carbonate)/kg of diet greatly reduces copper status in cattle and sheep.

However, dietary factors that affect zinc bioavailability in ruminants are not clearly defined.

High dietary calcium reduced serum zinc concentrations in ruminants.

Dietary factors that may influence manganese bioavailability have received little attention, probably because manganese deficiency is not considered to be a major problem in ruminants. Limited evidence suggests that high dietary calcium and phosphorus may reduce manganese bioavailability.

Trace Mineral Bioavailability in Ruminants. Jerry W. Spears, Department of Animal Science and Interdepartmental Nutrition Program, North Carolina State University, Raleigh, NC 27695-7621. E-mail: Jerry _Spears@ncsu.edu.

From NRC

Forage over 400 ppm and/or water over .3 to .5 ppm may cause some of the following symptoms:

- Sore feet problems; laminitis
- Rough, dull hair coat
- Silent heats
- Increased susceptibility to infectious diseases
- Increase in SCC
- Increased udder edema
- Increased need for trace minerals, especially Zinc, Copper, and Manganese.

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