Minerals and Micronutrients for Goats

Objective
Learn that most minerals in the goat's diet come from plants and therefore, mineral levels in the diet are dependent on the plant species and the fertility of the soil. Understand that minerals in the diet interact and an excess of one may depress the utilization of another.

Mineral contents of the diet may be deficient resulting in reduced animal production and deficiency symptoms in which case we supplement. Minerals are often adequate, but at times may be excessive which results in toxicity.

Nutrition is the science of determining the nutrients required by animals and how to provide those nutrients to the animal.

Plants are the major source of minerals for the goat. Plants require all the minerals for growth that goats do except for iodine. However, the requirements for plants may be much lower for plants than animals such as cobalt and selenium.

Many factors affect mineral content of plants.
1. Legumes tend to be richer in minerals than grasses.
2. Browse and weeds usually have higher mineral contents.
3. Some minerals which are excess in the soil can result in high levels in plants, especially potassium, calcium.
4. Different species of plants will have different concentrations of minerals when grown in the same soil.
5. Therefore since goats eat a variety of plants, it probably makes them less likely to have mineral deficiencies.
6. Some soils are inherently deficient in some minerals due to geology such as iodine and selenium.
7. Plants grown on soils deficient in a mineral may be deficient in that mineral. Some plants can concentrate available minerals.
8. Phosphorus fertilizer reduces potassium in plants and potassium fertilizer reduces calcium content.
9. Soil pH is a factor in that especially in acid conditions, trace mineral availability to the plants is reduced.
10. Temperature-grass tetany deficiency symptom for magnesium usually happens under cool soil temperatures which may reduce root uptake of magnesium.
11. Seasonal variation which may be an affect of growth rate Can test plants, but you need to get a sample of what the goats are eating throughout the day and take several samples throughout the growing season. Is expensive and not likely worth the expense. Many state extension specialists know what minerals are likely to be deficient in given areas of their state i.e. Se, I.

Macrominerals—required in fraction of percent.
Calcium, phosphorus, sodium, potassium, chloride sulfur, magnesium

Microminerals, required at the ppm level
Iron, copper, cobalt, zinc, iodine, manganese, selenium, molybdenum
Calcium
Biological function
Bones—contain 99% of calcium in body
Necessary for muscle contraction, nerve conduction, blood clotting
Deficiency symptom
Rickets, bowing of limbs, lameness
Vitamin D deficiency causes similar symptoms
Urinary calculi if not 2:1 calcium to phosphorus ratio
Toxicity
Metabolic bone disease—bent legs
Sources of calcium
Legumes, limestone, bone meal, dicalcium phosphate
Phosphorus
Biological function
Soft tissue and bone growth
Energy metabolism and acid-base balance
Deficiency
Slowed growth, pica, decreased serum phosphorus
Sources of phosphorus
Bone meal, protein supplements, cereal byproducts
Sodium
Potassium  0.8–2.0%
Chloride
Biological function
All three function as electrolytes in the body
Lost in diarrhea
Deficiency
Potassium on high concentrate diets—poor appetite, urinary calculi, stiffness progressing from front to rear, pica
Chloride depressed growth
Sodium—reduced growth and feed efficiency
Sources
Salt block
Potassium in most forages
Sulfur  0.2–0.32%
Biological function
Protein synthesis, including milk production and hair production
Production of amino acids enzymes, hormones, hemoglobin, connective tissue and vitamins
Deficiency symptoms
Poor performance, hair loss, excessive saliva, excess tearing of eyes, weakness
Sources
Protein therefore, may be a problem on NPN diets
Sulfur blocks used for ticks
Magnesium  0.18–0.4%
Biological Functions
Proper function of nervous and muscular systems, enzyme systems
Closely associated with metabolism of calcium and phosphorus. Essential component of bones and teeth
Deficiency symptoms
Loss of appetite, excitability, staggering, convulsions, death
deficiency on fastgrowing lush pasture, especially cool season
grasses called grass tetany
Sources
Bone meal
Magnesium oxide fed with protein supplement

Micro or trace elements

Iron 50-1000ppm
Biological function
Component of hemoglobin, required for oxygen transport
Component of certain enzymes
Deficiency symptoms
Anemia lack of hemoglobin
Sources
Iron is stored in the liver, spleen and bone marrow
Iron is very low in milk, kids raised for a long time on milk alone will develop anemia

Copper 10-80ppm
Biological function
Essential for formation of hemoglobin
Component of enzymes
Deficiency symptoms
Anemia, rough "bleached coat", diarrhea and weight loss
Toxicity
Angora goats are sensitive, meat and dairy goats are similar to beef cattle
Sources
Forages, Grains Trace mineralized salt

Cobalt 1.1-10 ppm
Biological function
Essential for formation of vitamin B-12
Rumen microbes utilize cobalt for growth
Deficiency symptoms
loss of appetite, anemia, decreased production, weakness
Sources
Most natural feedstuffs

Zinc 40-500ppm
Biological function
Found in all animal tissues
Required for the immune system
Deficiency symptoms
Dermatitis, thick dry patches of skin, hair loss, lesions on feet, poor hair growth, loss of hair
Essential for male reproduction
Sources
Bran and germ of cereals

Manganese 40-1000ppm
Biological function
Bone formation reproduction enzyme functioning
Deficiency symptoms:
Reluctance to walk, deformity of forelegs, 
Delayed onset of estrus, poor conception rate 
Low birthweight 
Source difficult to get a deficiency

Selenium .2-3ppm 
Biological function 
Reproduction 
Metabolism of copper, cadmium, mercury, sulfur and vitamin E 
Deficiency symptom 
Poor growth rate, kids unable to suck 
White muscle disease sudden death by heart attack 
progressive paralysis 
Retained afterbirth 
Toxicity in a few regions 
Shedding of hair, diarrhea, lameness 
Sources 
Most plants which are not grown is Selenium deficient soils 
Molybdenum .1-3.ppm 
Deficiency very rare 
Toxicity above 3 ppm due to reduced copper absorption

Iodine 
Biological function 
Formation of thyroid hormones which regulate energy 
metabolism 
Reproductive function 
Deficiency symptoms 
Goiter-swellled or enlarged thyroid 
Do not confuse with the thymus gland on young animals 
Reproductive problems-late term abortion, hairless fetus, 
weak kids 
Source 
Iodized salt

Diagnosing mineral deficiency or toxicity-procedure used is dependent on which mineral you are looking at. 
1. Blood tests for some may be mineral level such as magnesium 
calcium or phosphorus or another factor in the blood 
such glutathione peroxidase for selenium or hemoglobin for 
iron or zinc binding protein for zinc or thyroid hormones 
for Iodine. 
2. Hair analysis has been used for zinc and Selenium 
3. Tissue tests such as liver for iron and copper 
4. Deficiency or toxicity symptoms are important-manganese and 
knuckling over.

To summarize: 
Adequate levels of calcium and phosphorus in 2:1 ratio. 
Free-choice salt 
Use Trace mineralized salt for prevention. 
Avoid going overboard on any supplementation.

Sources of mineral information 
Goat Medicine by Smith and Sherman 
Mercks Veterinary Handbook 
State livestock Extension Specialist