Micro Mineral‘s and Beef Cattle Nutrition

Investigators: Max Irsik DVM MAB, Diane Kitchen DVM PhD,
John Roberts DVM ACVP, Gene Lollis, Wes Carlton,
Christy Waits, Hillary Swaim PhD.

The information and data provided is a brief summary reporting segments of a research project charged with evaluating calf losses in Florida beef herds. This project was supported by the Florida Cattlemen’s Association, Florida Department of Agriculture and Consumer Sciences, the University of Florida’s Department of Animal Sciences the College of Veterinary Medicine and MacArther Agro-ecology Research Center.

Minerals are an essential part of the beef cow’s nutritional requirement. Mineral supplementation of beef cow herds is a common and an often recommended practice. Although forages often provide adequate concentrations for select minerals deficiencies have affected cattle throughout Florida.

Research has shown that there are at least17 minerals required by beef cattle. Macro minerals required include calcium, magnesium, phosphorus, potassium, sodium, chlorine and sulfur. The micro minerals required are chromium, cobalt, copper, iodine, iron, manganese, molybdenum, nickel, selenium and zinc. Many of these essential minerals may be found in sufficient concentrations in common feedstuffs, however when feedstuffs do not provide adequate quantities of required minerals, supplementation will be necessary. Micro minerals often provided to Florida beef herds include, Copper, Selenium, Cobalt, Iron, Zinc, Manganese and Molybdenum.

Copper deficiency is common in grazing cattle in Florida that do not receive supplementations. Signs of copper deficiency include dull hair coat, changes in hair color, low pregnancy rates, scouring, bone fractures, lameness, immune system suppression, poor body condition and sudden death. Copper deficiency is also common in cattle grazing forages grown on organic soils. Such forages usually have a higher concentration of molybdenum which reduces availability of copper to the animals.

Cobalt is considered low in Florida’s forages. Cobalt deficiency results in loss of appetite, reduced growth rate, weight loss and anemia. Cobalt is necessary for the production of vitamin B_{12} by rumen microbes. Ruminal bacteria synthesize enough vitamin B_{12} to meet the requirements of ruminants provided that adequate dietary cobalt is supplied.

Selenium deficiency has been recognized in Florida cattle. Signs of selenium deficiency include stillborn or weak calves, immunosuppression, buckling or weakness in the rear legs, retained placentas and white muscle disease. Supplementation of selenium containing minerals is the most effective method to meet the selenium requirement of many animals.

Iron had been recognized as an essential nutrient for more than 100 years. Iron plays an important role in oxygen delivery to the tissues, and as a cofactor with several enzymes involved in energy metabolism and thermoregulation. Iron deficiency is of limited practical significance in most livestock. However iron deficiency can occur, examples of deficiencies are found in newborn pigs, calves raised for veal, copper-supplemented pigs, and animals with parasitic infestations.

Zinc functions as an important element in a number of enzymes, both as part of the molecule and as an activator. Among the most notable effects of Zn deficiency is the production and secretion of testosterone, insulin and adrenal corticosteroids.

Inadequate intake of manganese in young animals results in skeletal abnormalities that may include stiffness, twisted legs, enlarged joints and reduced bone strength. In older cattle, manganese deficiency causes lower reproductive performance characterized by depressed or irregular estrus, lower conception rates, abortion, stillbirths, and low birth weights.

There is no evidence that molybdenum deficiency occurs in cattle but molybdenum may enhance rumen microbial activity. It is well documented that relatively low dietary molybdenum can cause copper deficiency and that increasing dietary copper can overcome molybdenum toxicity.

Procedure

Liver samples were collected from 190 cull cows, (95 open and 95 pregnant) and 19 cull bulls. The age of the cull cows ranged from 2 to 17 years of age with an average age of 8 years. The individual age for cull bulls was not available, but all were identified as mature bulls. Cull animals were selected based upon multiple criteria; age, pregnancy status, production history, infertility, reproductive disorders identified at pregnancy testing, temperament, quality of the cow or bull compared to herd mates and stage of lactation (dry cows). The cow herd was maintained on Bahia grass pastures with cane molasses supplemented as needed. Free choice mineral was continuously provided as a dry supplement or incorporated into the molasses supplement.

Results

Liver samples were analyzed for the micro minerals iron, zinc, copper, selenium, cobalt, molybdenum, and manganese. When comparing the micro mineral tissue levels between the cull cows and cull bulls there was a significant difference in the average liver values for all micro minerals except copper. When comparing the micro mineral tissue levels between pregnant and open cows there was significant differences found in the tissue levels for iron, copper, molybdenum and manganese. Copper was found significantly higher in pregnant cows while iron, molybdenum and manganese were significantly higher in open cows. Table 1 & 2 provides the micro mineral data by animal and the laboratory reference values.

When comparing the means of the group cull cow data with the reference values, none of the mean tissue values for the group cull cows indicate a mineral deficiency. The tissue levels for iron and selenium were considered marginal. However when the data for the cull cow group is further analyzed comparing the individual's tissue level with the Michigan State Laboratory standard, 43% were deficient in iron, 4 % were deficient in zinc, 17% were deficient in copper, 52% were deficient in selenium, 3% were deficient in cobalt, 2% were deficient in manganese and no cows were deficient in molybdenum. Table 3 provides the statistics for the herd regarding individual mineral status.

Summary

Micro minerals are important dietary components for ruminant animals. Numerous research projects have reported the effects of mineral deficiencies and toxicities. In this commercial beef herd receiving year round micro mineral supplementation there were differences noted in the levels of select micro minerals for different segments of that herd. The differences in tissue levels for microminerals in cull

animals may be due to maintenance and production demands for females vs. males. Mineral deficiencies for some animals could also be due to the herd dynamics, dominant females may be consuming a proportional greater amount of the minerals provided. Further research regarding micro nutrient supplementations is needed; evaluating the economic effectiveness of mineral supplementation, comparing the benefits of differing types of supplemental minerals organic and inorganic and their effect on the health and performance of animals.

Table 1. Average dry liver mineral content of selected microminerals, µg/gm of dry liver tissue.

Animal category	Iron (SE)	Zinc (SE)	Copper (SE)	Selenium (SE)	Cobalt (SE)	Molybdenum (SE)	Manganese (SE)
Cull cows	173.4 (72.82)[2]	116.47 (36.94)	61.84 (60.87)	0.42 (0.12)	0.19 (0.06)	2.97 ().78)	8.38 (1.73)
Cull bulls	223.91 (176.92)	218.17 (101.81)	90.52 (103.36)	0.53 (0.17)	0.26 (0.06)	3.85 (0.74)	9.53 (2.37)
P value[1]	0.016	< .01	0.07	< 0.01	< 0.01	< 0.01	< 0.01
Pregnant Cows	161.28 (62.80)	112.57 (23.12)	74.48 (70.32)	0.42 (0.11)	0.18 (0.06)	2.79 (0.79)	7.96 (1.41)
Open cows	185.58 (80.13)	120.37 (46.67)	49.21 (46.70)	0.43 (0.13)	0.19 (0.07)	3.16 (0.73)	8.80 (1.92)
P value[1]	0.02	0.14	0.004	0.8	0.22	< 0.01	< 0.01

[1] P value P≤.05 indicates a significant statistical difference.
[2] number in ( ) indicates the value for one standard deviation

Table 2. Michigan State University diagnostic laboratory reference values (µg/g) dry weight liver.

	Iron	Zinc	Copper	Selenium	Cobalt	Molybdenum	Manganese
Deficient	<150	<80	<10	<0.40	<0.1	<0.80	<4.5
Adequate	200 - 450	100 - 300	50 - 300	0.7 - 2.5	0.33 - 0.60	1.5 - 3.0	5.0 - 9.0

Table3. Micro Mineral status for study herd.

Herd mineral status	Iron	Zinc	Copper	Selenium	Cobalt	Molybdenum	Manganese
% Deficient	43%	4%	17%	52%	3%	0%	2%
% Marginal	23%	28%	37%	46%	94%	3%	1%
% Adequate	23%	68%	46%	2%	3%	97%	97%