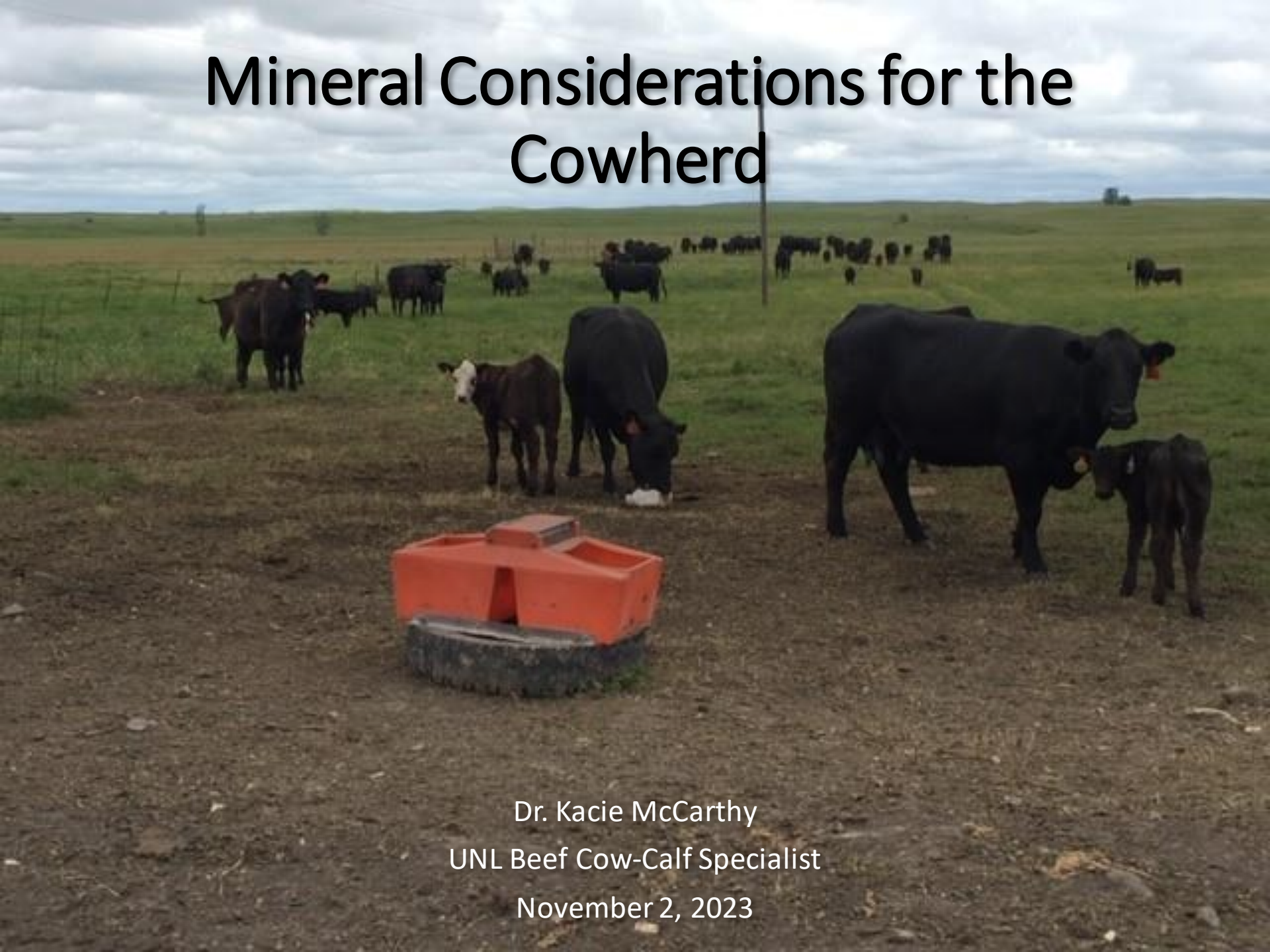
Mineral Considerations for the Cowherd



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UNL Beef Cow-Calf Specialist
November 2, 2023

Outline

SOURCES OF MINERALS

OVERVIEW OF MACRO- AND MICROMINERALS

INTAKE MANAGEMENT

CURRENT RESEARCH WITH MINERAL AND GRAZING CATTLE

QUESTIONS

What do we know?

- Proper mineral nutrition is essential
  - Growth
  - Immune function
  - Reproductive performance

P - Phosphorus
Cr - Chromium
Co - Cobalt
Pb - Lead
Fe - Iron
Se - Selenium
Na - Sodium
Ca - Calcium
Ag - Silver
Cd - Cadmium
Hg - Mercury
Al - Aluminum
Cu - Copper
Mn - Manganese
K - Potasium
Mo - Molybdenum
I - Iodine
Mg - Magnesium
Zn - Zinc
Si - Silica
As - Arsenic
F - Fluorine
S - Sulfur

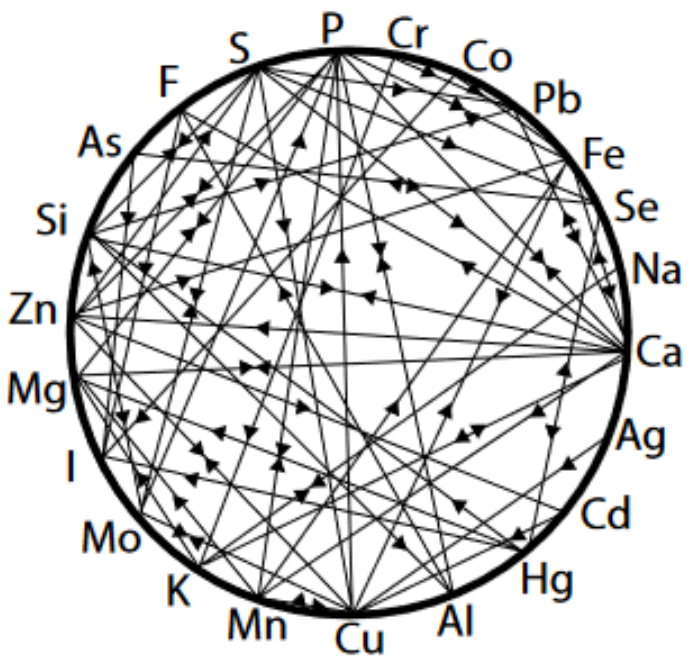


Figure 1. Mineral interactions. Lines on the "wheel" indicate an interaction between minerals. Adapted from Underwood, E. J. 1971.

Mineral Requirements

- Vary depending on:
  - Location
  - Soil material differences
  - Water sources
  - Stages of growth and reproduction of animal

(NRC, 2005; NASEM, 2016)

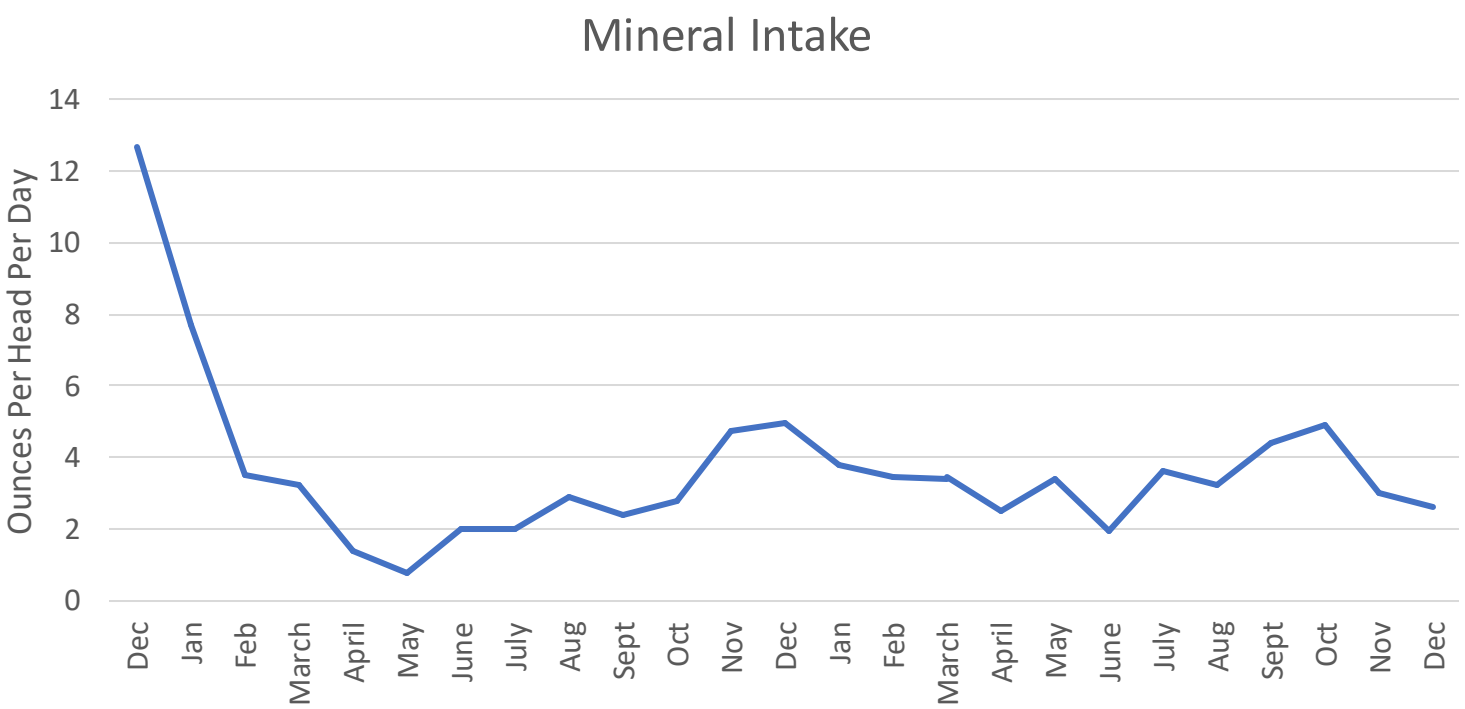
Table 1. Mineral requirements of beef cattle[a]

Mineral	Unit	Growing Cattle	Cows/heifers	
			Gestating	Lactating
Calcium[b]	%	0.40-0.80	0.16-0.27	0.28-0.58
Phosphorus[b]	%	0.22-0.50	0.17-0.22	0.22-0.39
Magnesium	%	0.10	0.12	0.20
Potassium	%	0.60	0.60	0.70
Sodium	%	0.06-0.08	0.06-0.08	0.10
Sulfur	%	0.15	0.15	0.15
Cobalt	mg/kg	0.15	0.15	0.15
Copper	mg/kg	10	10	10
Iodine	mg/kg	0.50	0.50	0.50
Iron	mg/kg	50	50	50
Manganese	mg/kg	20	40	40
Selenium	mg/kg	0.10	0.10	0.10
Zinc	mg/kg	30	30	30

[a] Adapted from NRC, 1996 and NASEM, 2016

[b] Calcium and P requirement (% of DM intake) decreases with increasing weight, increases with rate of gain and increases with level of milk production

Free-Choice Mineral Intake

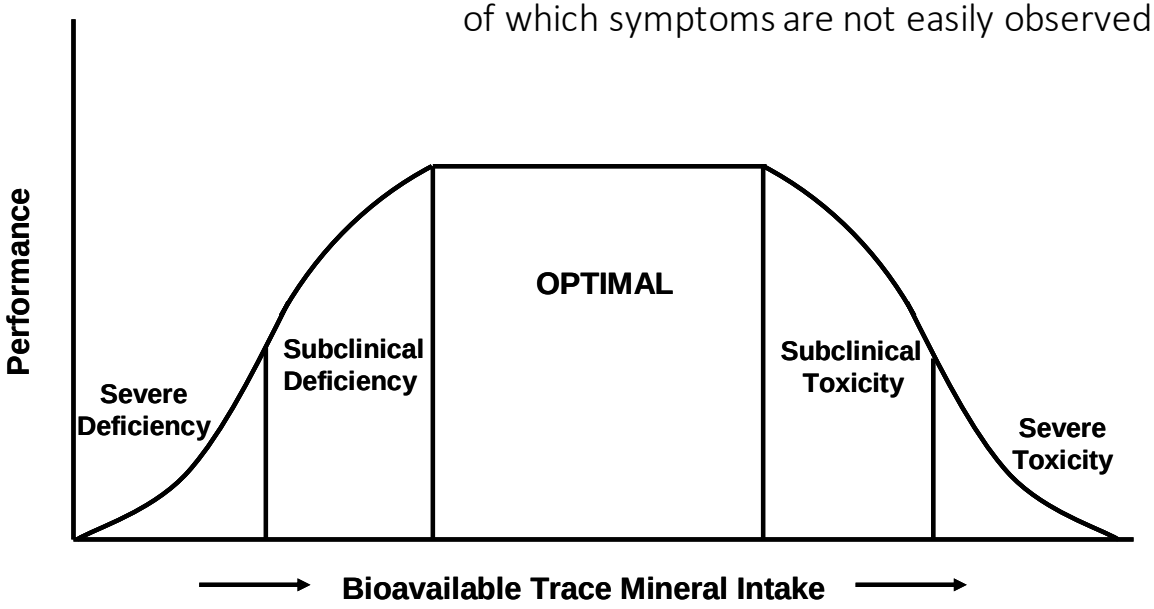


Variability of minerals

- Variability is high
  - 1) plant species
  - 2) soil type
  - 3) soil fertility
  - 4) plant maturity
  - 5) climatic conditions
- Testing your own forages to develop supplementation program can be cost effective
  - Testing liver status a year or so later

Mineral Deficiencies

Goal of supplementation is to prevent subclinical deficiency of which symptoms are not easily observed



How do we determine a mineral deficiency or toxicity problem?

- Clinical symptoms
- Forage analysis
- Water analysis
- Animal tissue (liver) samples

Symptoms of Mineral Deficiencies

- Clinical symptoms
  - Milk fever, grass tetany, white muscle disease
- Subclinical losses such as:
  - Decreased pregnancy rate
  - Increase calf morbidity
  - Decreased growth rate
- Subclinical losses reduce profitability and go undetected without good record keeping

Common Deficiency Problems

Mineral Element(s) Commonly Deficient	Signs of Problem
Magnesium	Excitability and convulsions (Grass Tetany)
Calcium and Phosphorus	Tender joints and stiff legs with arched back (calves); weak brittle bones (cows)
Phosphorus	Reduced fertility and poor weaning weights (when energy and protein are adequate)
Copper	Anemia and de-pigmentation of hair
Iodine	Calves born hairless
Selenium	Calves show stiffness in front legs and lameness (White Muscle Disease)
Zinc	Excessive salivation, listlessness, and scaly lesions (Parakeratosis)

http://extensionpublications.unl.edu/assets/pdf/ec288.pdf

What do we need to know when formulating mineral supplement

Overview

- Macrominerals
  - Required in gram quantities. They are important for structural components of bone and other tissues and serve as important constituents of body fluids.
- Microminerals
  - Required in milligram or microgram amounts. They are present in body tissues in very low concentrations and often serve as components of metalloenzymes, enzyme cofactors, or as components of hormones in the endocrine system.
- Vitamins
  - Fat Soluble: A, D, E, K
  - Water Soluble: B vitamins and Vitamin C

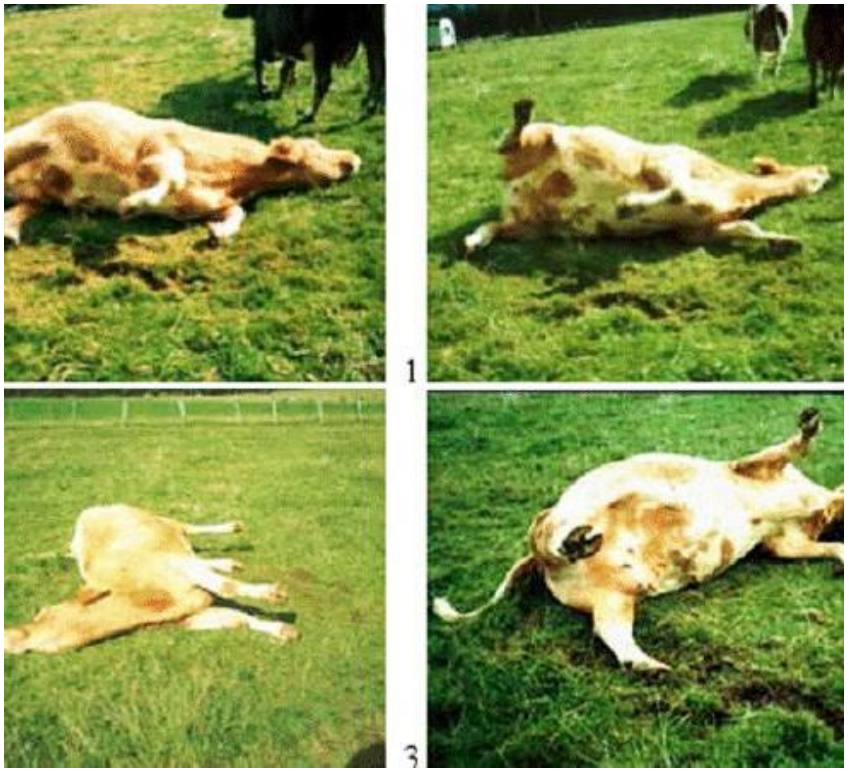
Calcium and Phosphorus

- Make up 70 to 75% of the mineral matter in beef cattle, including over 90% in the skeleton
  - Phosphorus – required for protein synthesis
  - Calcium – along with Sulfur are required for normal blood coagulation
  - **Deficiency** = Ca deficiency occurs early in lactation causing milk fever. Severe def. produces hypocalcemia (low blood Ca) and interferes with Ca role in muscle contractions which can lead to tetany or possibly death

- Phosphorus is typically the leading determinate of mineral costs
  - Low quality forages may be P deficient
  - Protein supplements (Distillers) provide enough P

Magnesium

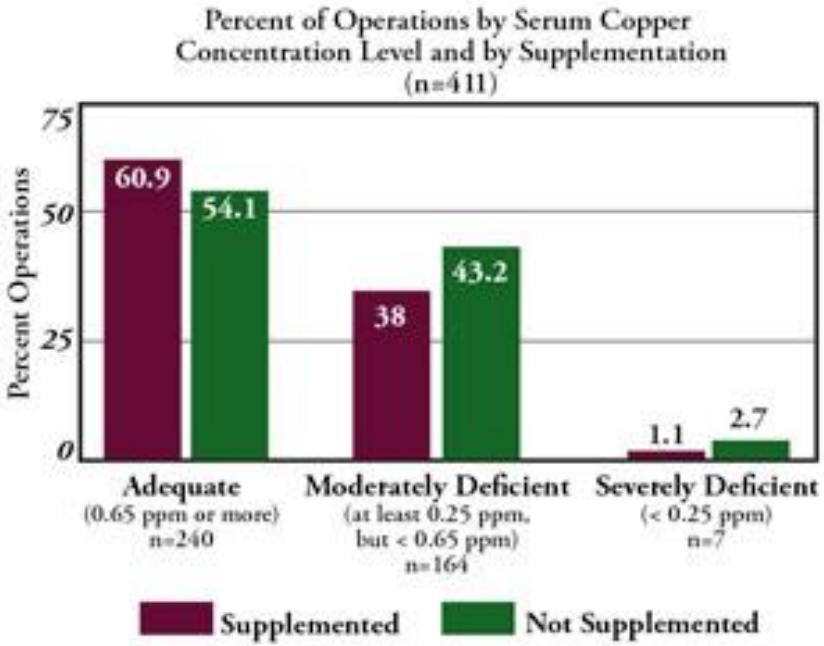
- Make up 70 to 75% of the mineral matter in beef cattle, including over 90% in the skeleton
  - **Deficiency** = causes grass tetany (hypomagnesemia or low blood Mg), occurring mostly in lactating cows on lush green pasture that is high in K and protein
    - Signs include nervousness, muscle twitching, reduced feed intake, staggering gait, convulsions, possibly death



Cobalt (Co)

- Component of vitamin B12. Cattle are not dependent on dietary source of vitamin B12 because ruminal microorganisms can synthesize B12 from dietary Co.
  - **Deficiency** = decreased appetite, reduced milk production, failure to grow or moderate weight loss
  - Supplemented as = cobalt sulfate and cobalt carbonate
  - **Toxicity** = decreased feed intake, reduced body weight gain, anemia, emaciation, hyperchromia, debility, and increased liver cobalt (Church and Pond, 1975; NRC 1996)

Copper (Cu)



- Required for normal red blood cell formation, normal bone formation, normal elastin formation in the aorta and cardiovascular system, pigmentation of hair. Important function of the immune system.
  - Requirements are affected by dietary Mo and S. Antagonistic action of MO occurs at levels above 2 mg/kg diet Mo, and antagonistic action of sulfur at levels above 0.25% S.
    - Mo and S interact in the rumen to form thiomolybdates
  - **Deficiency** = anemia, reduced growth rate, changes in pigmentation of hair, cardiac failure, diarrhea
  - Supplemented as = copper sulfate and copper carbonate

https://www.aphis.usda.gov/animal_health/nahms/beefcowcalf/downloads/beef97/Beef97_is_SerumCopper.pdf

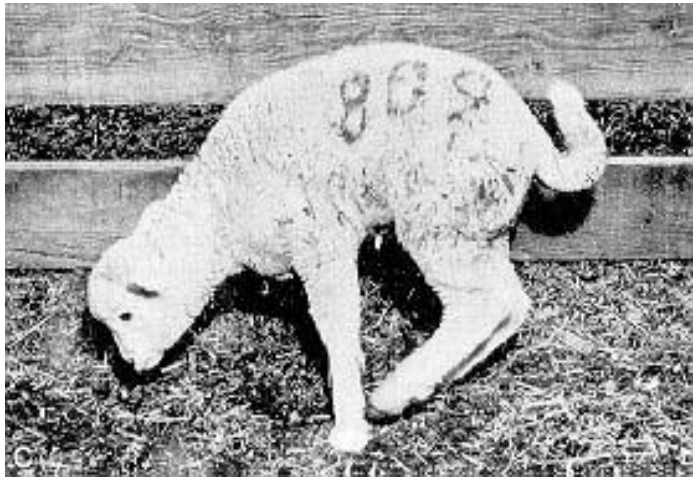
Iron (Fe)

- Component of hemoglobin in red blood cells, myoglobin in muscles, and other proteins involved in transport of oxygen to tissues or utilization of oxygen. Important function of immune system.
  - **Deficiency** = unlikely in cattle because adequate levels of Fe are available from numerous sources.
  - Supplemented as = ferrous sulfate or ferrous carbonate. Ferric oxide is biologically unavailable
  - **Toxicity** = diarrhea, metabolic acidosis, hypothermia, reduced feed intake, and reduced weight gain (Church and Pond, 1975; NRC 1996)

Manganese (Mn)

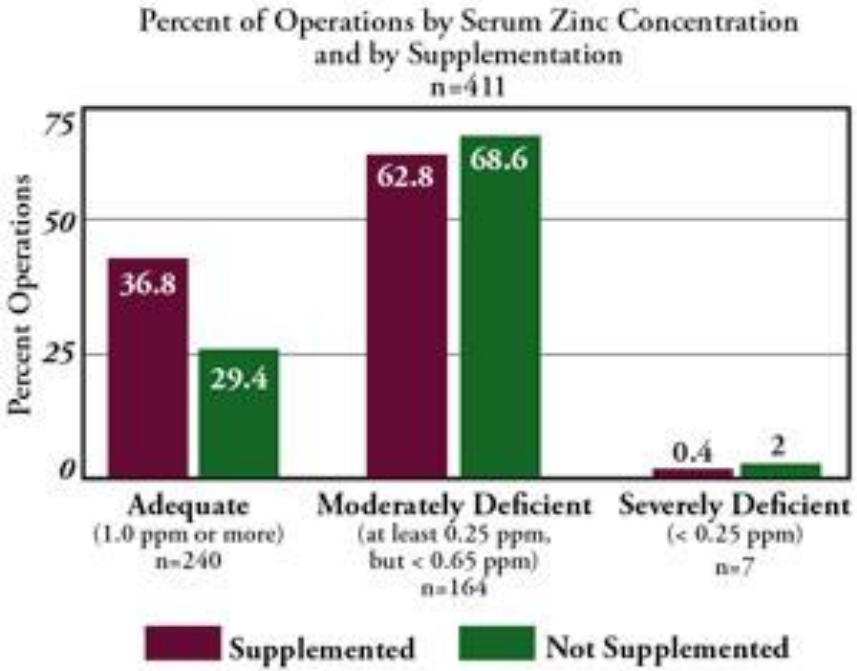
- Component of metalloenzymes that function in carbohydrate and lipid metabolism. Important in cattle reproduction because it is required from normal estrus and ovulation in cows and for normal libido and spermatogenesis in bulls. Essential for normal bone formation and growth.
  - **Deficiency** = skeletal abnormalities in young and older animals, low reproductive performance due to depressed or irregular cycles, low conception rate, abortion, stillbirths, and low birth weights
  - Supplemented as = Mn sulfate, Mn oxide, or various organic forms. Mn oxide is less biologically available than manganese sulfate

Selenium (Se)



- Functions are interrelated with vitamin E. Failure of functions involving Se can result in nutritional muscular dystrophy. Important function in immune system.
  - **Deficiency** = degeneration of muscle tissue (white muscle disease), unthriftiness, weight loss, diarrhea, anemia, and reduced immune responses
  - **Toxicity** = lameness, anorexia, emaciation, liver cirrhosis, inflamed kidneys, loss of hair from the tail, cracked/deformed hoofs (Church and Pond, 1975; NRC 1996)

Zinc (Zn)



Required for normal protein synthesis and metabolism. A component of insulin, Zn functions in carbohydrate metabolism. Important for normal development and functioning of the immune system.

Deficiency = decreased weight gain, reduced milk production, reduced reproductive performance, listlessness, excessive salivation, reduced testicular growth, failure of wounds to heal, reduced intake

Supplemented as = Zn oxide, Zn sulfate, Zn methionine, and Zn proteinate

Toxicity = reduced feed intake, reduced feed efficiency, and decreased weight gain (Church and Pond, 1975; NRC 1996)

https://www.aphis.usda.gov/animal_health/nahms/beefcowcalf/downloads/beef97/Beef97_is_SerumZinc.pdf

Vitamin A

Role in maintenance of epithelial tissue; proper kidney function; normal development of bones, teeth and nerve tissue; vision

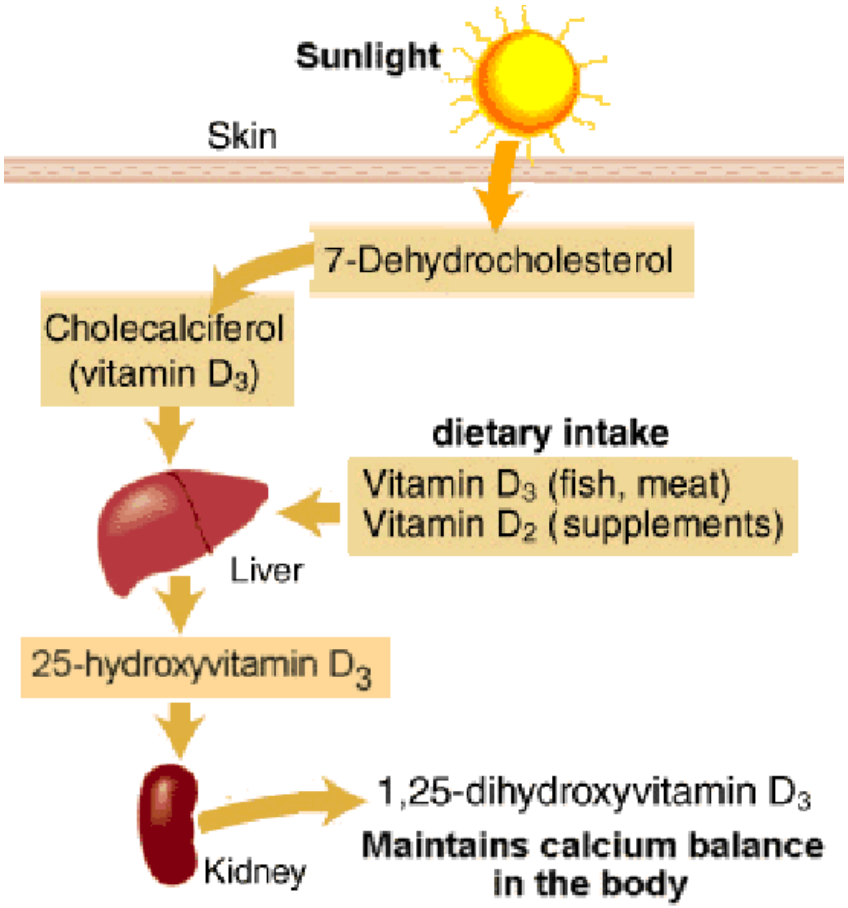
Deficiency = reduced feed intake, rough hair coat, excessive tear production, night blindness, slow growth, diarrhea, seizures, abortion, low conception rates

Still a relevant concern in beef production particularly following drought or in late winter and early spring

https://www.dsm.com/markets/anh/en_US/Compendium/ruminants/vitamin_A.html

Vitamin D

- Formation of bones and teeth; role in prevention of rickets in young animals or osteomalacia in mature animals is associated with involvement in metabolism of calcium and phosphorus
  - **Deficiency** = Rickets (soft, porous, poorly developed bones); poor appetite, decreased growth, stiff gait, swollen joints, arching back, bent knees



Vitamin E

- Role as chemical antioxidant to reduce the destruction of other vitamins and essential fatty acids in the digestive tract and after their absorption.
  - **Deficiency** = impairs reproduction, stiff lamb disease and white-muscle disease in calves

Vitamin Requirements in Beef Cattle

Mineral	Requirement			
	Growing and Finishing Cattle	Stressed Calves*	Dry, Gestating Cows	Lactating Cows
Vitamin A, IU/kg	2200	4000-6000	2800	3900
Vitamin D, IU/kg	275	275	275	275
Vitamin E, IU/kg**	15-60	75-100	–	–

**Vitamin E requirements depend upon concentrations of antioxidants, sulfur-containing amino acids, and selenium in the diet. The growing and finishing cattle requirement presented here is an estimate.

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Vitamin K

- Derived from Danish word “koagulation”
- Required for the synthesis of several plasma clotting factors
- 2 sources:
  - K1 = phylloquinones
  - K2 = menaquinones (most significant source of Vitamin K for ruminants because large amounts synthesized by ruminal bacteria)

- **Deficiency** = “Sweet clover disease” results from the metabolic antagonistic action of dicoumarol that occurs when an animal consumes moldy or improperly cured sweet clover hay.
  - Dicoumarol passes through the placenta, and thus, the fetus of pregnant animals can be affected

B vitamins

- Complex of thiamin, biotin, riboflavin, niacin, pantothenic acid, pyridoxine, folic acid, vitamin B12, and choline.
  - **Function** = biotin is an essential coenzyme in carbohydrate, fat, and protein metabolism; folic acid is essential for one-carbon metabolism; vitamin B12 and cobalt play an important role in intrinsic factor; niacin is a coenzyme for nicotinamide (NAD and NADP); choline is important for fat metabolism in the liver and formation of acetylcholine and building and maintaining cell structure

Different forms of minerals/supplements

- Organic vs. Inorganic
  - Organic means complexed or chelated (affixed to an amino acid)
  - Inorganic means affixed to sulfate, chloride, or oxide compound
    - Common standard industry form
- Injectable trace minerals
  - High bio-availability
  - Short-term response

Table 3. Comparison of bio-availability of mineral packages. Data are based on a compilation of research on mineral bio-availability. The availability of the sulfate form is set at 100 percent to serve as the benchmark for comparison purposes. Adapted from Greene 2000.

Mineral	Sulfate form	Oxide form	Carbonate	Chloride form	Chelated form (complexed, organic, etc.)
Copper	100	0	-	105	130
Manganese	100	58	28	-	176
Zinc	100	-	60	40	159-206

Supplement needs differ based on feed resources used and location

- The most common trace mineral deficiencies in beef cow systems are copper and zinc.
- Supplemental magnesium is needed for lactating cows: when grazing lush cool season grass, when high-quality alfalfa is a main part of the diet, and when low quality forage and distillers grains are the primary feeds in the diet.
- If feeding high amounts of corn co-products (such as distillers grains) then additional calcium may be needed.
- Phosphorus is the most expensive mineral to supplement.
- The less time cows spend grazing green forage, the greater their supplemental vitamin A needs.

https://extensionpublications.unl.edu/assets/html/g2340/build/g2340.htm

Table 1. General guidelines for concentration of mineral for free-choice supplementation of grazing cows[1]

			Amount on tag	
Mineral	**Cow requirement**	**Will supply to total diet[2]**	**4 oz intake**	**2 oz intake**
Copper, ppm[3]	10	10 to 15	1,300 to 2,500	2,600 to 5,000
Zinc, ppm	30	15 to 22	2,000 to 3,000	4,000 to 6,000
Manganese, ppm	40	0 to 40	0 to 5,200	0 to 10,400
Selenium, ppm	0.1	0.1 to 0.2	13 to 26	26 to 52
Iodine, ppm	0.5	0.5	65	130
Cobalt, ppm	0.15	0.15	20	39
Magnesium, %	0.12 to 0.20	0.03 to 0.10	3 to 13	6 to 26
Calcium, %	0.16 to 0.40	0 to 0.10	0 to 13	0 to 26
Phosphorus, %	0.13 to 0.23	0 to 0.10	0 to 13	0 to 26
Vitamin A, IU[4]/lb.	89,000 to 132,000	0 to 100,000	0 to 400,000	0 to 800,000

[1]See text for guidance based on feed resources and production system

[2]Assumes 1,300 lb. cow consuming 2.5% body weight (BW)

[3]ppm = parts per million

[4]IU = international units

Feedstuff and Water Analysis

- Mineral intake is a summation of multiple sources
  - Forage (grazed and harvested)
  - Supplements
  - Water
- Impacts water quality
  - Drinkability
  - Animal performance
- Changes by source of water

Table 2. Average and range of concentrations, percentage of samples exceeding maximum upper level, and concentration at maximum upper limit for minerals, total dissolved solids (TDS), and temperature evaluated in 393 samples

Item	Avg concentration, mg/L	Range of concentrations, mg/L	Samples exceeding maximum upper limit for livestock,%	Maximum upper limit, mg/L[1]
Calcium	47.5	0.51 to 912	2.5	200
Chloride	14.9	0 to 255	0	300
Fluoride	1.1	0 to 8	18	2
Iron	15.9	0 to 1,192	66	0.4
Magnesium	25.5	0.14 to 529	3	100
Manganese	0.3	0 to 19.8	11	0.5
Nitrate N	0.29	0 to 26.7	0	100
pH	8.3	6.9 to 10.6	36	8.5
Sodium	281	5.72 to 3,757	42	300
Sulfate	366	0 to 9,591	37	300
TDS	939	83 to 9,490	0.001	5,000
Temperature, °C	15.4	6–27	—	—

[1]The percentage of samples exceeding the maximum upper level is from Socha et al. (2003).

Feedstuff Analysis

- Trace mineral antagonists should be considered
  - Sulfur is one of the most impactful of all trace mineral antagonist
  - Molybdenum is an antagonist of copper and is catalyzed by high-sulfur.
  - Iron may antagonize several minerals, but concentrations must be quite high

Mineral Status and Production Losses

- What factors could be responsible? Start by ruling out more directly contributing factors.
  - Are energy and protein adequate?
  - Adequate cow body condition?
  - Are production losses well defined?
  - What are the sources of trace minerals?
  - What is your mineral intake?
  - Have there been recent changes in management?

Mineral Composition at GSL

Mineral Composition of Upland Native Range at GSL

Mineral	July	January	Mineral Requirement
	Macro Mineral, %		
Calcium	0.34	0.47	0.16 - 0.40
Phosphorus	0.15	0.07	0.13 - 0.23
Potassium	0.93	0.17	0.60
Sulfur	NA	0.09	0.15
Magnesium	0.10	0.09	0.10
Sodium	0.01	0.00	0.07
	Trace Mineral, ppm		
Iron	134	157	50
Manganese	38	37	20
Zinc	14	20	30
Copper	3	3	10
Selenium	0.09	0.06	0.10

Liver Mineral Status at GSL

Liver Mineral Status at GSL

Mineral	December	April
	Marco Mineral, ppm	
Calcium	640.9	348.7
Phosphorus	9,770.3	8,856.8
Postassium	6,768.8	8,934.5
Magnesium	487.0	559.3
Molybdenum	4.8	4.1
	Trace Mineral, ppm	
Iron	228.4	206.3
Manganese	10.0	9.6
Zinc	88.1	82.6
Copper	130.9	72.1
Selenium	0.6	0.6

Prevention & Correction of Mineral Imbalances

- Hand feed (forced feeding)
  - Least variation in intake
- Free choice mineral
  - Salt as a key ingredient for intake
  - Greater variation in intake
- Injectables
  - High bioavailability
  - Quick fix
- Drenches
- Slow-release bolus

Mineral Intake Management

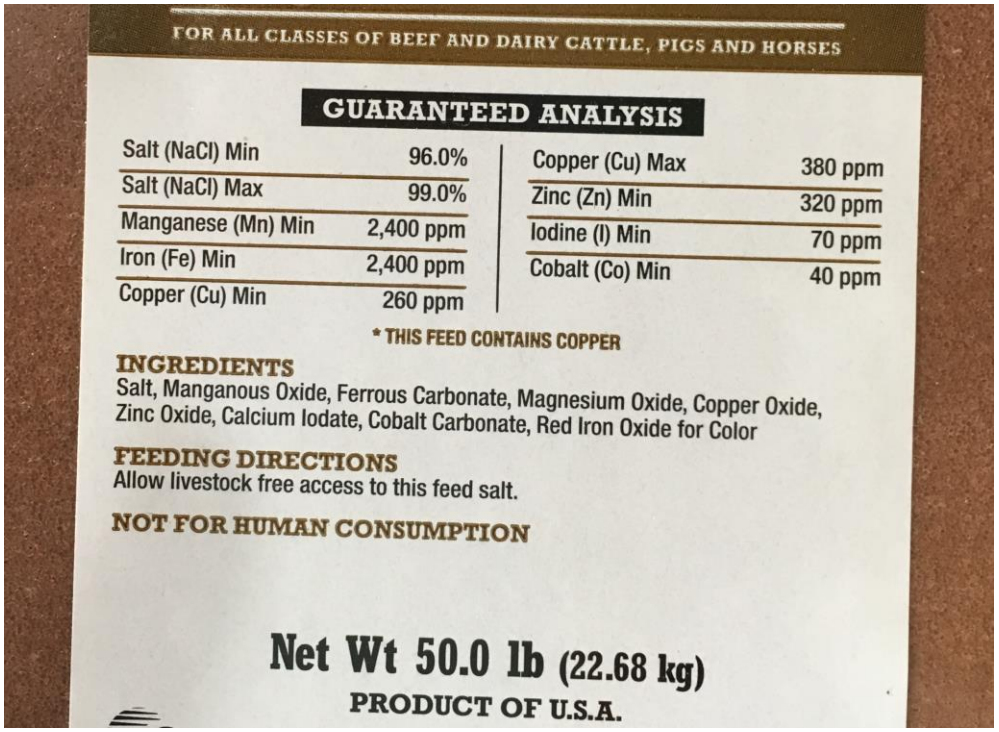
- Properly formulated free-choice minerals assume an average daily intake
  - Achieving this intake is an important factor impacting cowherd mineral status
- Variation in intake is due to seasonal and production status
  - Temperature
  - Forage dry matter
  - Lactation
  - Salt cravings

Intake Considerations

- If mineral intake is excessive
  - Add salt
  - Move mineral feeder further away from water
  - Change formulation
- If mineral intake is inadequate
  - Add a protein meal (DDG) as a carrier
  - Add dry molasses
  - Move mineral feeder closer to the water source
  - Change formulation

Intake Considerations

- Salt is your friend
  - Cattle crave salt
  - Salt can control intake
- Mineral without salt
  - Increased variability in intake of mineral
  - Reduced palatability



FOR ALL CLASSES OF BEEF AND DAIRY CATTLE, PIGS AND HORSES

GUARANTEED ANALYSIS

Salt (NaCl) Min	96.0%	Copper (Cu) Max	380 ppm
Salt (NaCl) Max	99.0%	Zinc (Zn) Min	320 ppm
Manganese (Mn) Min	2,400 ppm	Iodine (I) Min	70 ppm
Iron (Fe) Min	2,400 ppm	Cobalt (Co) Min	40 ppm
Copper (Cu) Min	260 ppm		

* THIS FEED CONTAINS COPPER

INGREDIENTS

Salt, Manganous Oxide, Ferrous Carbonate, Magnesium Oxide, Copper Oxide, Zinc Oxide, Calcium Iodate, Cobalt Carbonate, Red Iron Oxide for Color

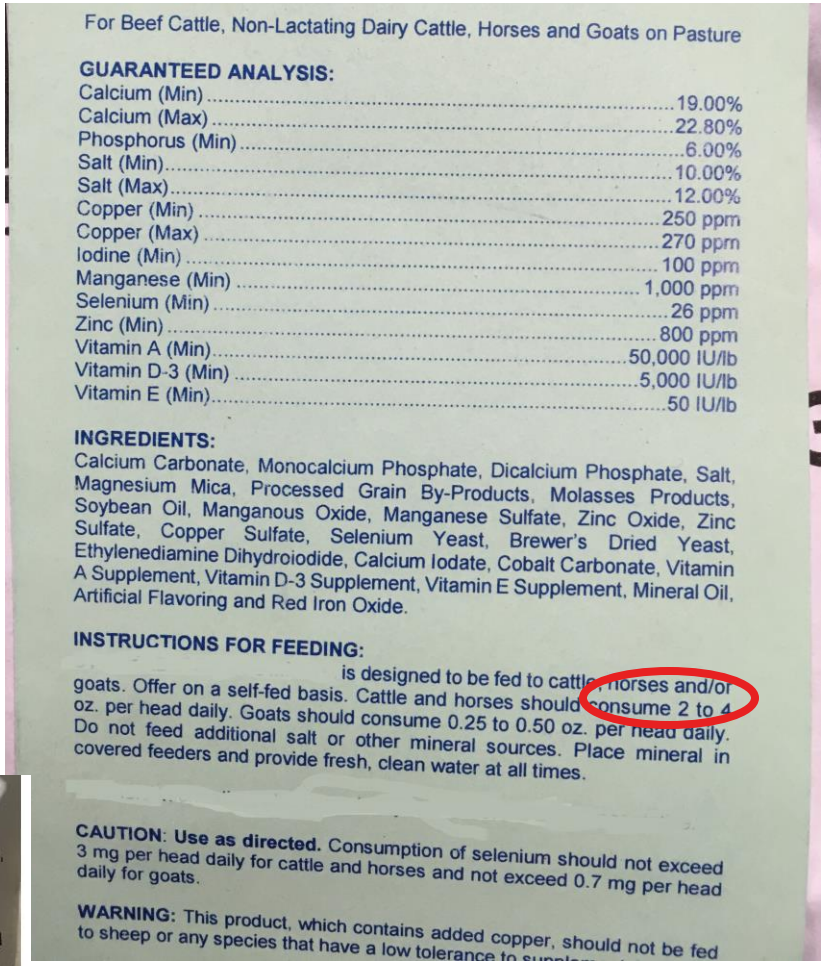
FEEDING DIRECTIONS

Allow livestock free access to this feed salt.

NOT FOR HUMAN CONSUMPTION

Net Wt 50.0 lb (22.68 kg)

PRODUCT OF U.S.A.



For Beef Cattle, Non-Lactating Dairy Cattle, Horses and Goats on Pasture

GUARANTEED ANALYSIS:

Calcium (Min)	19.00%
Calcium (Max)	22.80%
Phosphorus (Min)	6.00%
Salt (Min)	10.00%
Salt (Max)	12.00%
Copper (Min)	250 ppm
Copper (Max)	270 ppm
Iodine (Min)	100 ppm
Manganese (Min)	1,000 ppm
Selenium (Min)	26 ppm
Zinc (Min)	800 ppm
Vitamin A (Min)	50,000 IU/lb
Vitamin D-3 (Min)	5,000 IU/lb
Vitamin E (Min)	50 IU/lb

INGREDIENTS:

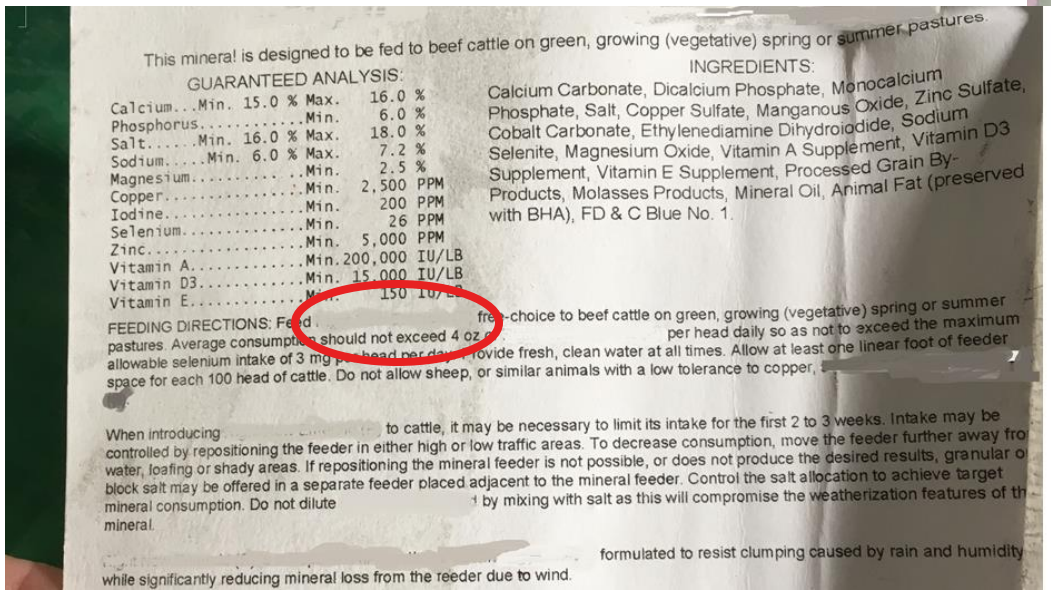
Calcium Carbonate, Monocalcium Phosphate, Dicalcium Phosphate, Salt, Magnesium Mica, Processed Grain By-Products, Molasses Products, Soybean Oil, Manganous Oxide, Manganese Sulfate, Zinc Oxide, Zinc Sulfate, Copper Sulfate, Selenium Yeast, Brewer's Dried Yeast, Ethylenediamine Dihydroiodide, Calcium Iodate, Cobalt Carbonate, Vitamin A Supplement, Vitamin D-3 Supplement, Vitamin E Supplement, Mineral Oil, Artificial Flavoring and Red Iron Oxide.

INSTRUCTIONS FOR FEEDING:

[redacted] is designed to be fed to cattle, horses and/or goats. Offer on a self-fed basis. Cattle and horses should consume 2 to 4 oz. per head daily. Goats should consume 0.25 to 0.50 oz. per head daily. Do not feed additional salt or other mineral sources. Place mineral in covered feeders and provide fresh, clean water at all times.

CAUTION: Use as directed. Consumption of selenium should not exceed 3 mg per head daily for cattle and horses and not exceed 0.7 mg per head daily for goats.

WARNING: This product, which contains added copper, should not be fed to sheep or any species that have a low tolerance to [redacted]



This mineral is designed to be fed to beef cattle on green, growing (vegetative) spring or summer pastures.

GUARANTEED ANALYSIS:

Calcium	Min. 15.0 %	Max. 16.0 %
Phosphorus	Min.	6.0 %
Salt	Min. 16.0 %	Max. 18.0 %
Sodium	Min. 6.0 %	Max. 7.2 %
Magnesium	Min.	2.5 %
Copper	Min.	2,500 PPM
Iodine	Min.	200 PPM
Selenium	Min.	26 PPM
Zinc	Min.	5,000 PPM
Vitamin A	Min.	200,000 IU/LB
Vitamin D3	Min.	15,000 IU/LB
Vitamin E	Min.	150 IU/LB

INGREDIENTS:

Calcium Carbonate, Dicalcium Phosphate, Monocalcium Phosphate, Salt, Copper Sulfate, Manganous Oxide, Zinc Sulfate, Cobalt Carbonate, Ethylenediamine Dihydroiodide, Sodium Selenite, Magnesium Oxide, Vitamin A Supplement, Vitamin D3 Supplement, Vitamin E Supplement, Processed Grain By-Products, Molasses Products, Mineral Oil, Animal Fat (preserved with BHA), FD & C Blue No. 1.

FEEDING DIRECTIONS: Feed [redacted] free-choice to beef cattle on green, growing (vegetative) spring or summer pastures. Average consumption should not exceed 4 oz [redacted] per head daily so as not to exceed the maximum allowable selenium intake of 3 mg [redacted] per head per day. Provide fresh, clean water at all times. Allow at least one linear foot of feeder space for each 100 head of cattle. Do not allow sheep, or similar animals with a low tolerance to copper, [redacted]

When introducing [redacted] to cattle, it may be necessary to limit its intake for the first 2 to 3 weeks. Intake may be controlled by repositioning the feeder in either high or low traffic areas. To decrease consumption, move the feeder further away fro water, loafing or shady areas. If repositioning the mineral feeder is not possible, or does not produce the desired results, granular o block salt may be offered in a separate feeder placed adjacent to the mineral feeder. Control the salt allocation to achieve target mineral consumption. Do not dilute [redacted] by mixing with salt as this will compromise the weatherization features of th mineral.

[redacted] formulated to resist clumping caused by rain and humidity while significantly reducing mineral loss from the feeder due to wind.

Variation in mineral intake

- Soil fertility
- Forage type and availability
- Season/time of year
- Mineral palatability
- Location and ease of access
- Aggressive animals
- Neophobia of feeding equipment

(Bowman and Sowell, 1997; McDowell, 2003; Tait and Fisher, 1996)

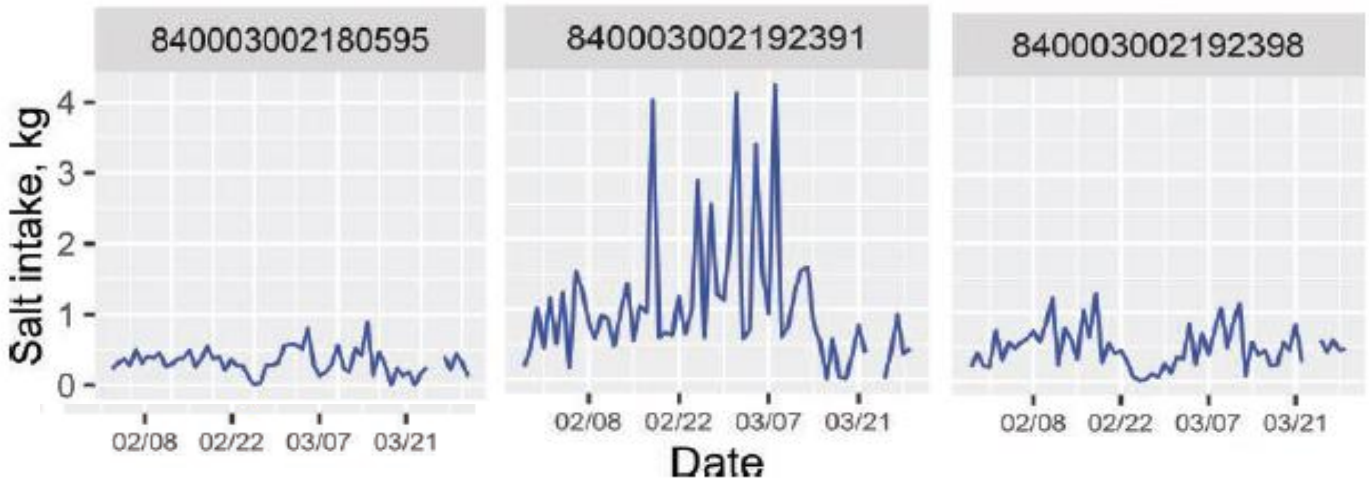
Cow and calf variation in mineral intake with additional inclusion of salt (Cockwill et al., 2000)

- Cow intake ranges 0 to 974 g/d
- Calf intake ranges 0 to 181 g/d

Daily intake of salt-limited supplement by grazing steers

- Number of observations
- Average number of daily visits

(Reuter et al., 2017)



Utilizing an electronic feeder to measure individual mineral intake, feeding behavior, and growth performance of cow–calf pairs grazing native range[1]

Kacie L. McCarthy,[†,2] Michael Undi,[‡] Stephanie Becker,[‡] and Carl R. Dahlen[†,3,]

[†]Department of Animal Sciences, North Dakota State University, Fargo, ND 58102, USA; and
[‡]Central Grasslands Research Extension Center, North Dakota State University, Streeter, ND 58483, USA

Using precision tools to manage and evaluate the effects of mineral and protein/energy supplements fed to grazing beef heifers[1]

Kacie L. McCarthy, [*2] Sarah R. Underdahl, [*] Michael Undi, [#] and Carl R. Dahlen, [*3]

SmartFeed system

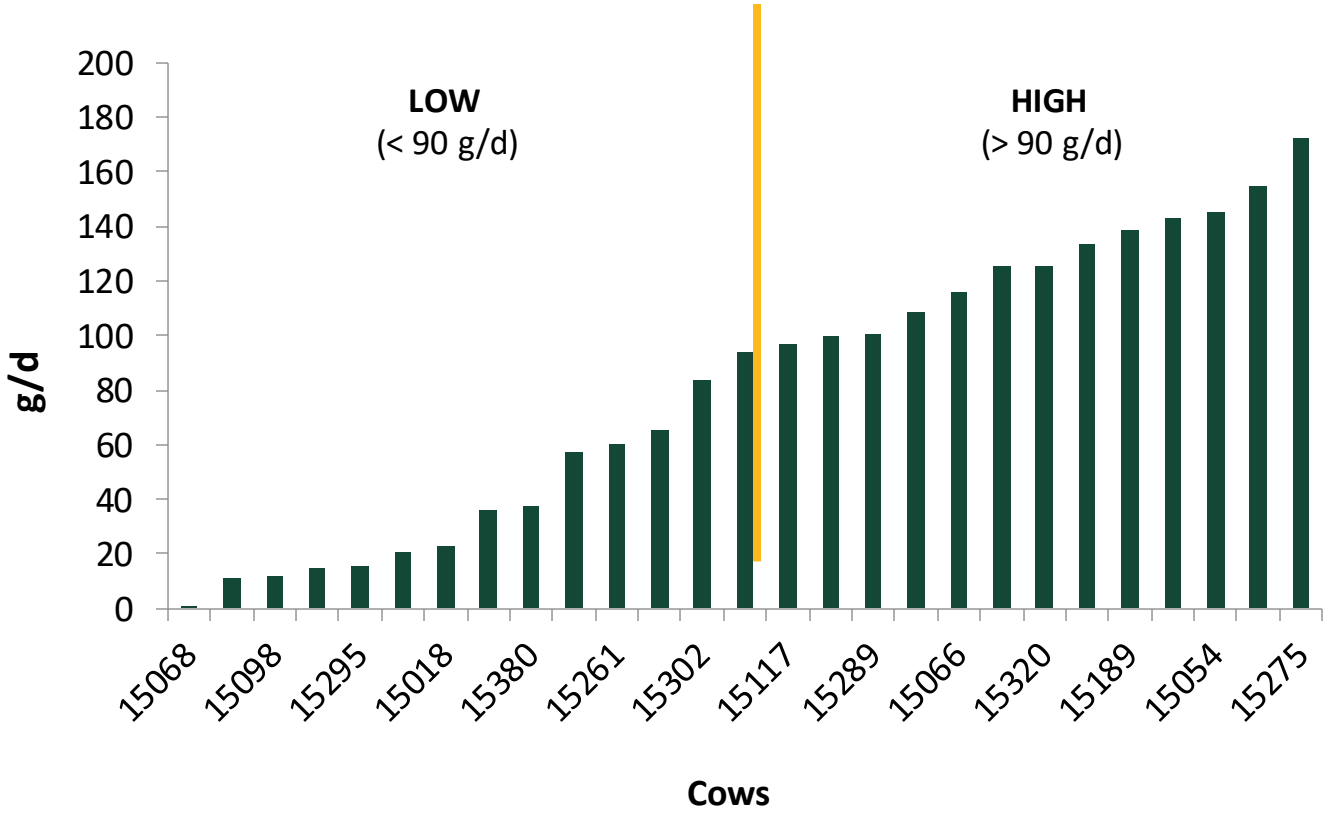
- SmartFeed system (C-Lock Inc., Rapid City, S.D.)
  - Self-contained and wirelessly networked
  - Solar powered
  - Stainless steel feed bin on two load cells
  - Radio frequency (RFID) tag reader and antenna
  - Adjustable framework
  - Intake or treatment control
  - Data acquisition system

Materials and methods

- Crossbred Angus cow-calf pairs (n = 28)
- Grazing native range 95 d monitoring period
- Access to loose mineral from SmartFeed system
  - Daily mineral intake, g
  - Number of visits to the feeder
  - Duration at the feeder, min

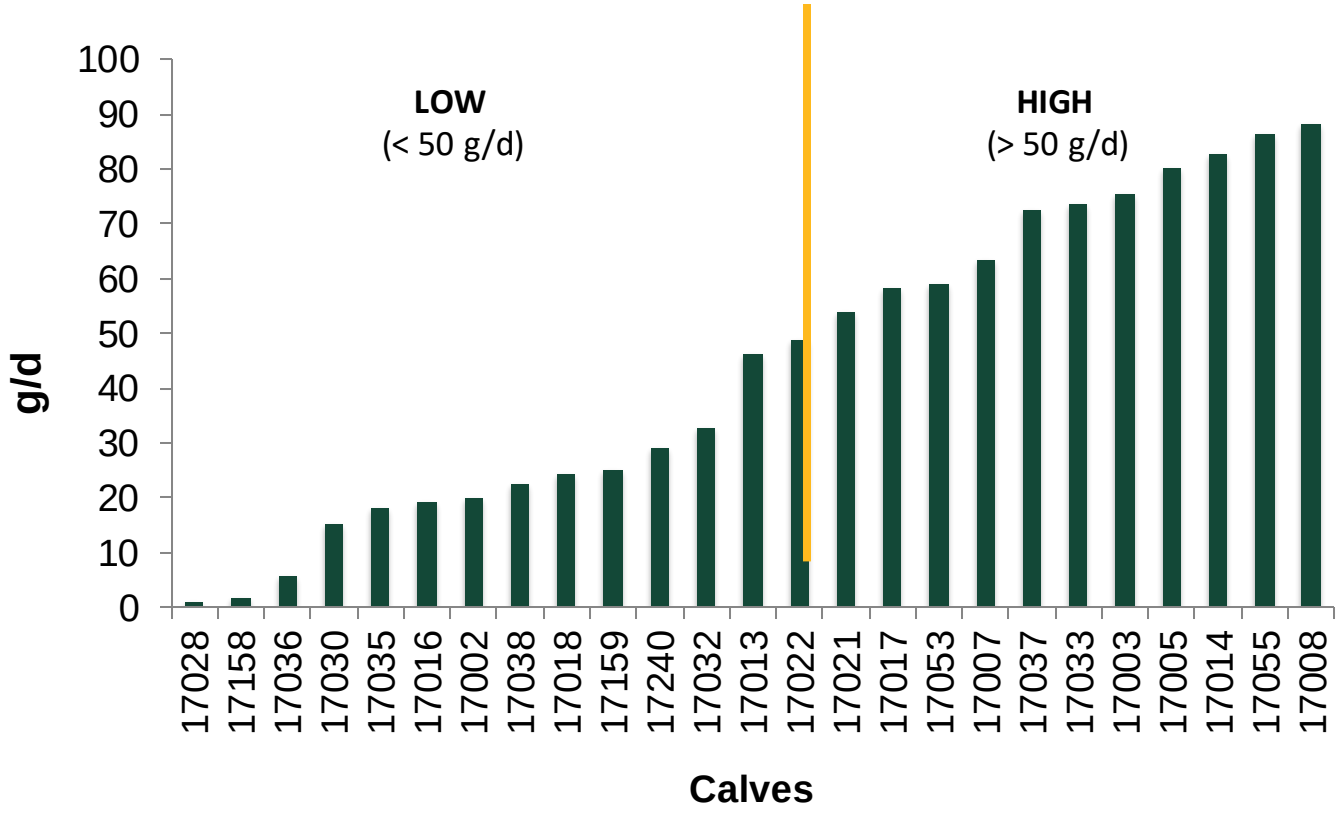
Variation in mineral intake among cows over a 95 d grazing period

(McCarthy et al., 2018)

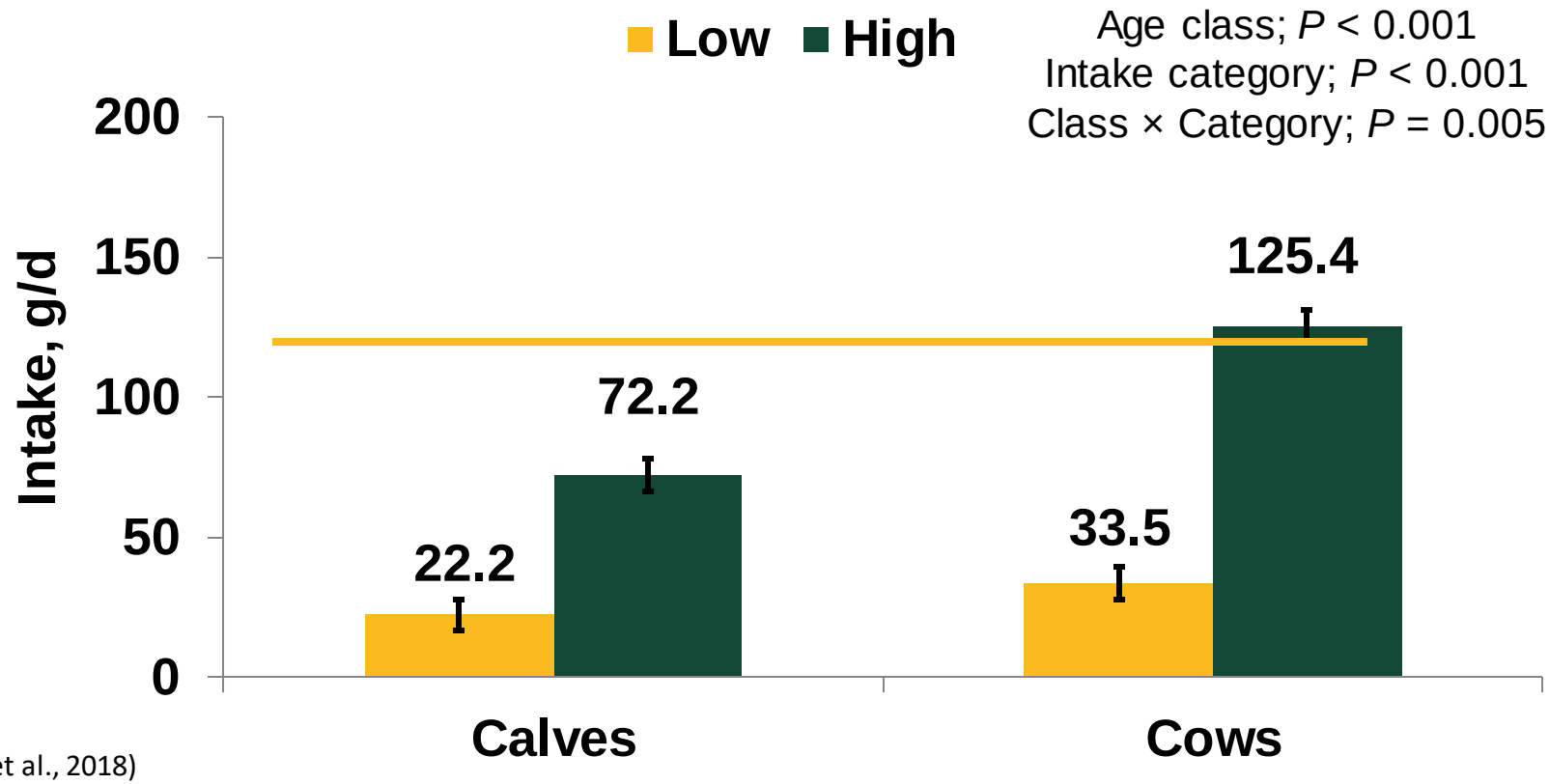


Variation in mineral intake among calves over a 95 d grazing period

(McCarthy et al., 2018)

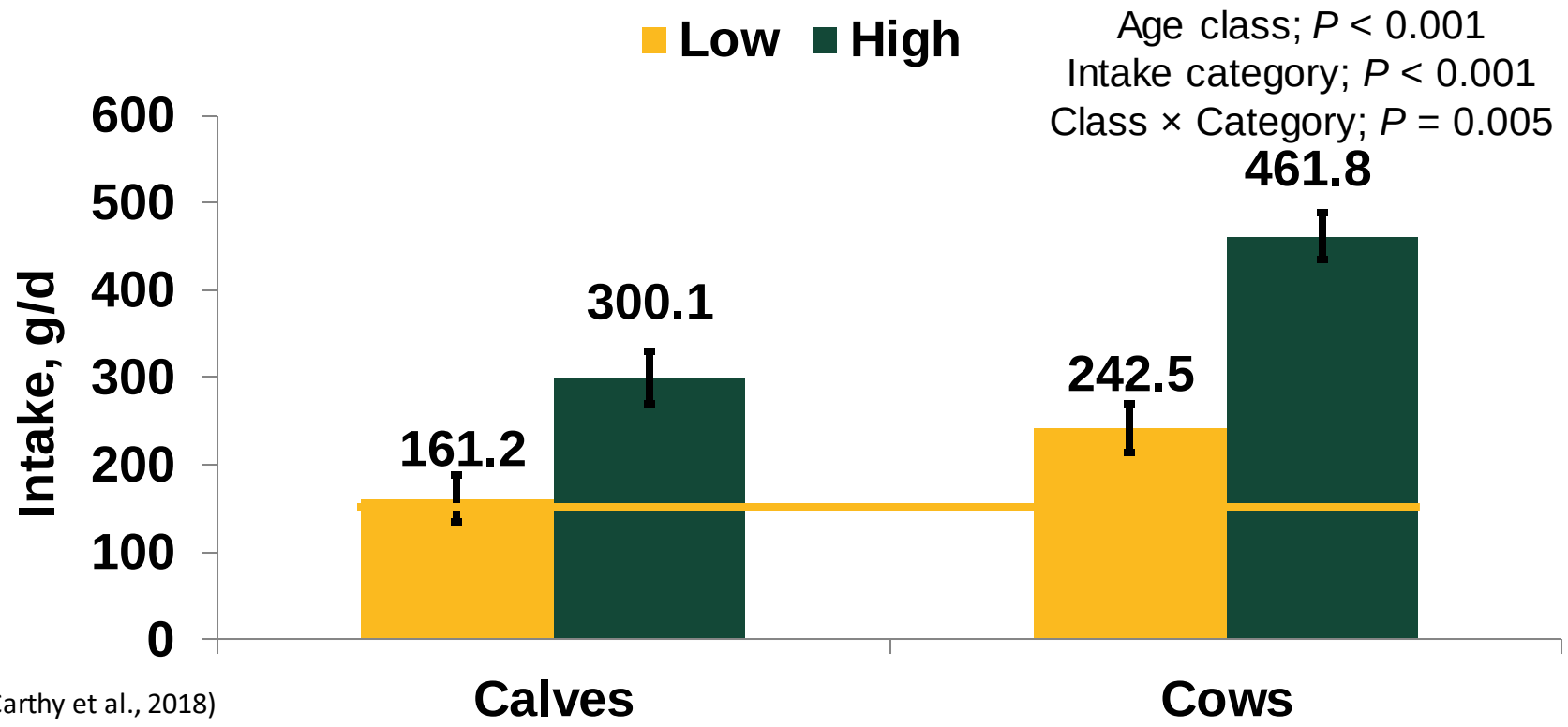


Intake over 95 d grazing period



(McCarthy et al., 2018)

Intake on d visiting feeder



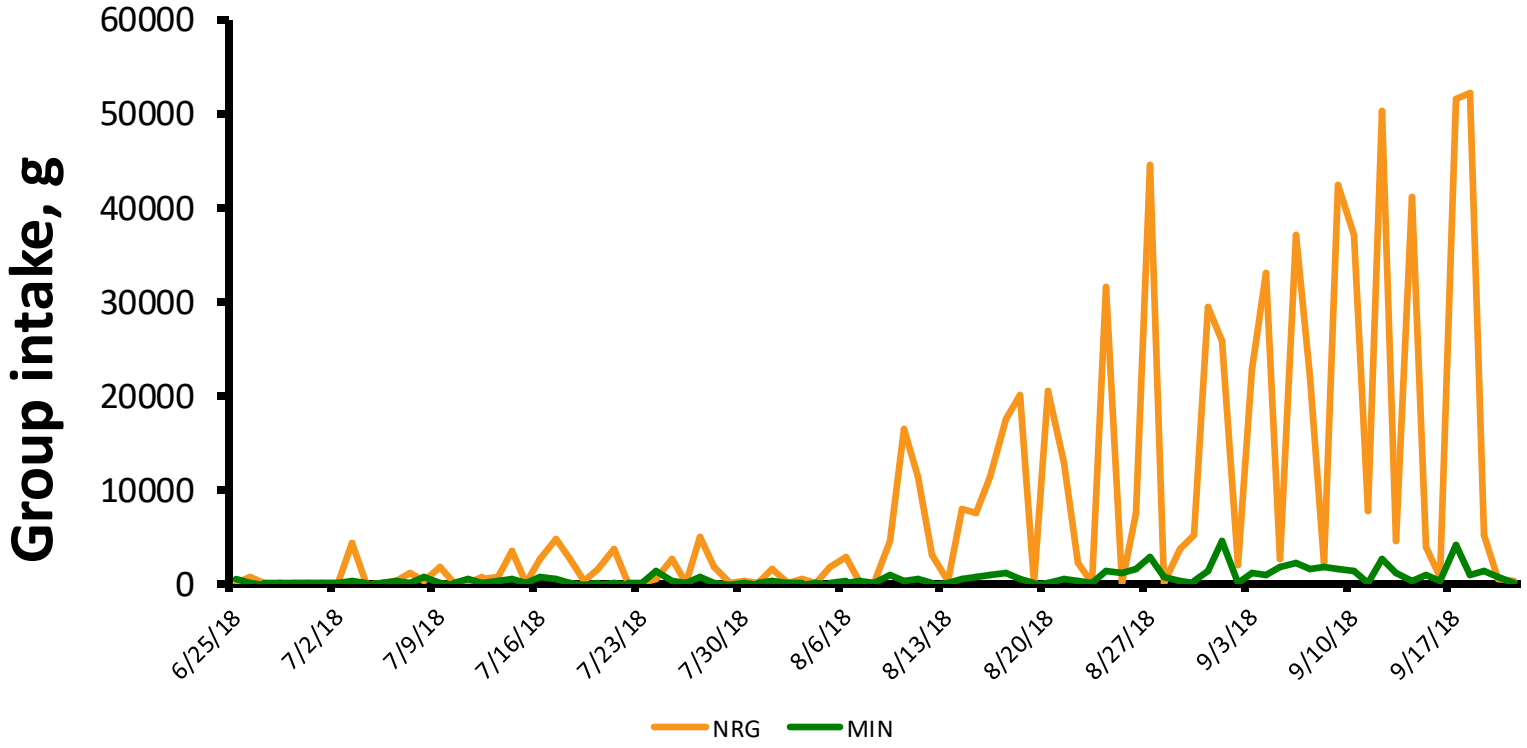
(McCarthy et al., 2018)

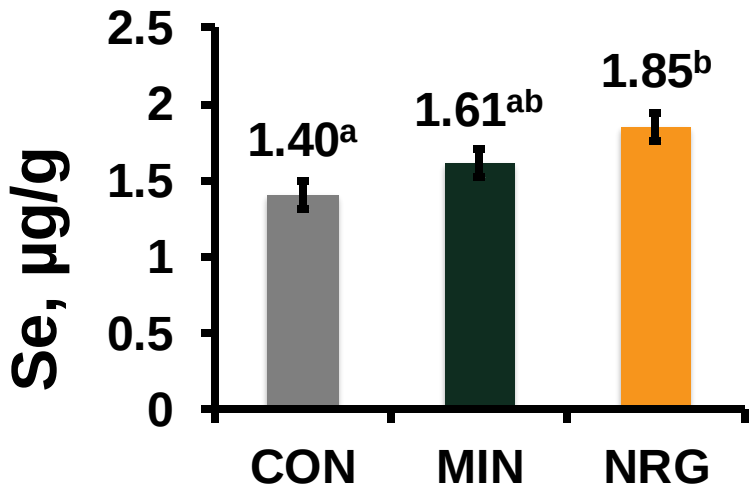
Materials and Methods

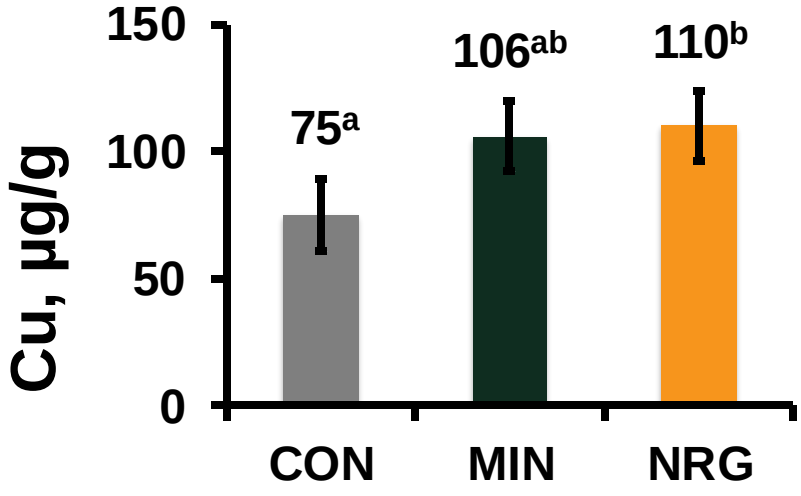
- Crossbred yearling Angus heifers (n = 60) were managed as a single pasture group with free access to native range grazing at the Central Grasslands Research Extension Center (CGREC)
-
- Randomly assigned to one of 3 dietary treatments:
- **CON**- no access to feed supplements
- **MIN**- free choice access to mineral supplement
- **NRG**- free choice access to energy supplement

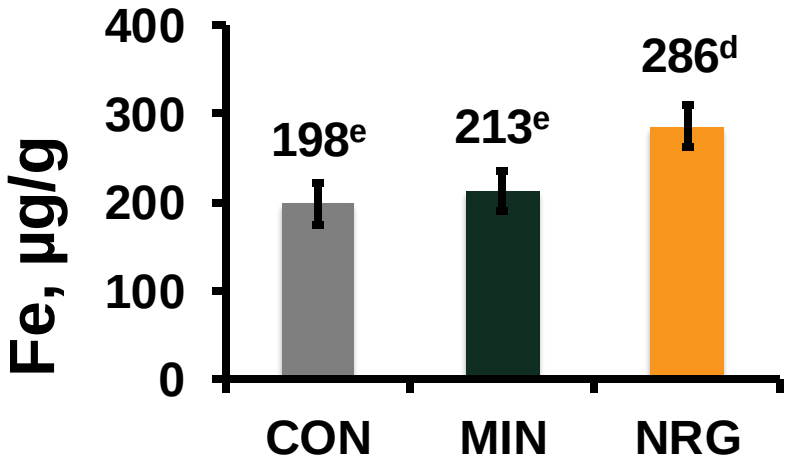
Intake of mineral and energy supplement over the grazing period

(McCarthy et al., 2019)



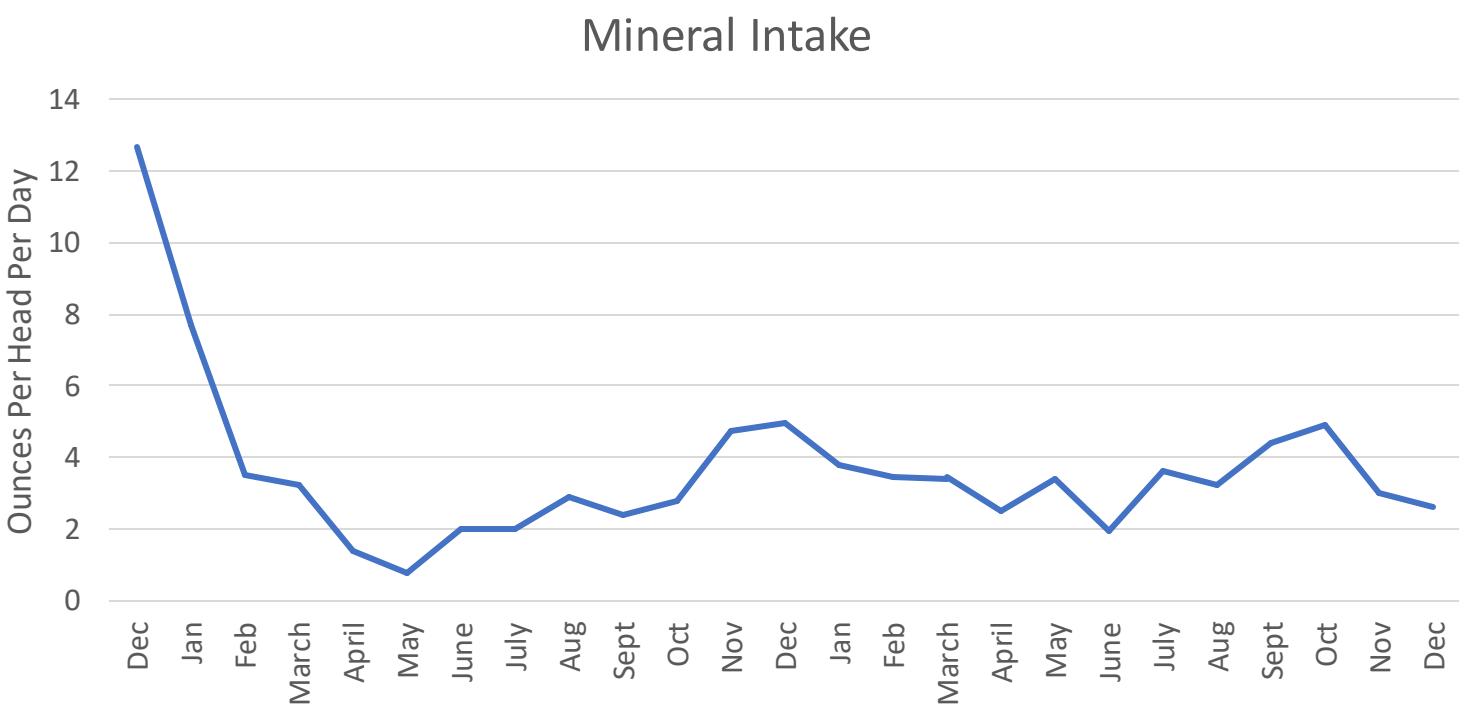






(McCarthy et al., 2019)

Free-Choice Mineral Intake



Summary

Deficiencies typically arise two ways:

Primary deficiency occurs when dietary intake of minerals does not meet the requirements of the animal

Secondary deficiency occurs when antagonisms reduce the availability of the mineral to the animal

Mineral sources differ in bioavailability and not all sources are absorbed to the same extent

Mineral content of forages is variable

Summary

Mineral deficiencies can result in reduced animal performance

Make sure the mineral supplement being used has adequate levels of trace minerals for your operations (environment and available feedstuffs)

Monitor intake and adjust if needed

Results can be variable → Insurance policy

Important Considerations

Cattle do not have the nutritional wisdom to consume the right mineral at the right amount needed.

“Cattle are consuming a lot of mineral so they must need it.” This is not true!

Cattle only have the nutritional wisdom to consume salt at the level of requirement.

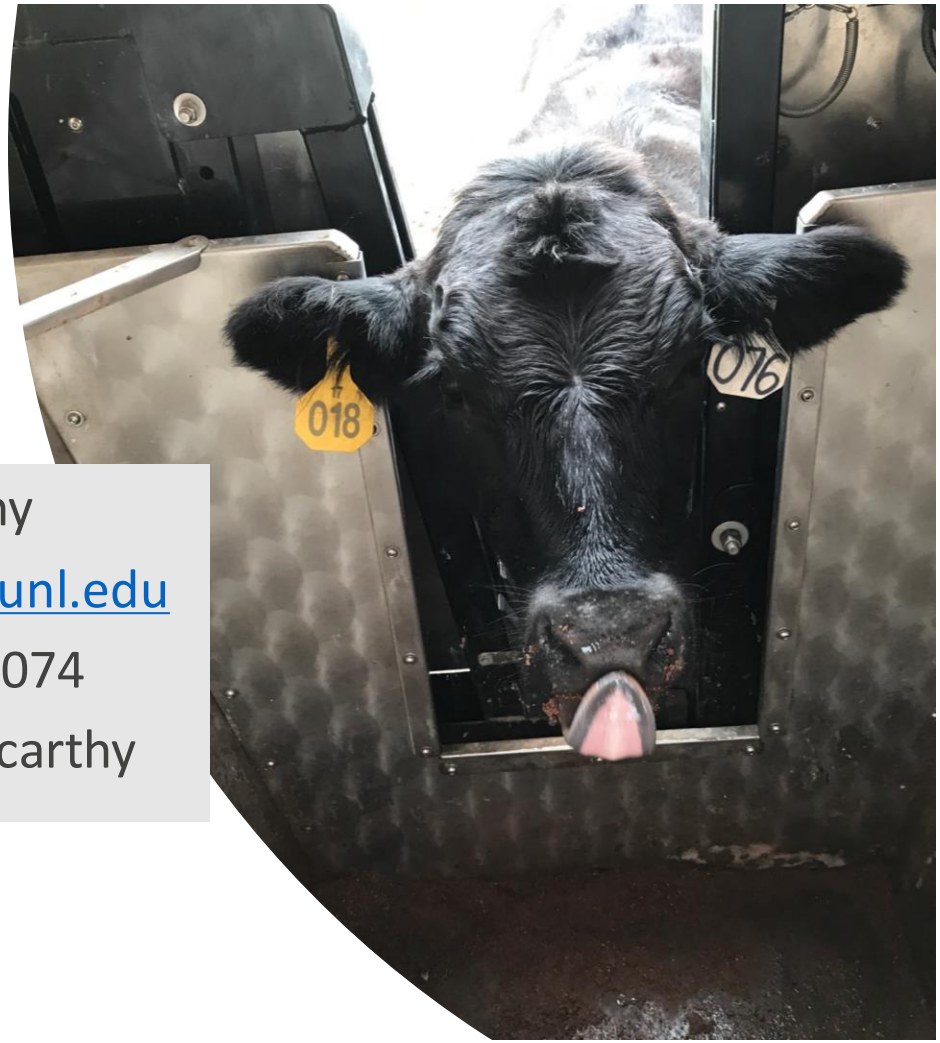
UNL Mineral Cow-Q-Lator (Coming Soon)

Mineral Forage and Water Intake Calculator

	Mineral Intake Amount				Requirement		
Mineral	Diet	Water	Total Intake	Units	NRC	Max Tolerable	Suggested Mineral Concentration
Calcium		-	0.000	%	0.22	4.80	42.49
Phosphorus	0.100	-	0.100	%	0.14	2.40	6.86
Potassium	1.000	-	1.000	%	0.60	3.00	0.00
Magnesium	0.100	-	0.100	%	0.10	0.40	0.00
Zinc	45.300	-	45.300	ppm	30.00	500.00	0.00
Iron	0.000	-	0.000	ppm	50.00	1000.00	9603.07
Manganese	65.000	-	65.000	ppm	20.00	1000.00	0.00
Copper	5.700	-	5.700	ppm	10.00	100.00	825.86
Sulfur	0.080	-	0.080	%	0.15	0.40	13.44
Sodium	0.040	-	0.040	%	0.07	--	5.76
Molybdenum	0.640	-	0.640	ppm	0.00	5.00	0.00
Cobalt	-	-	0.000	ppm	0.10	10.00	19.21
Iodine	-	-	0.000	ppm	0.50	50.00	96.03
Selenium	-	-	0.000	%	0.10	2.00	19.20
Vitamin A							
Vitamin D							
Vitamin E	-	-					

Mineral		
For Cattle		
Guaranteed Analysis		
Calcium	not less than	42.49 %
Phosphorus	not less than	6.86 %
Potassium	not less than	0.00 %
Magnesium	not less than	0.00 %
Sulfur	not less than	13.44 %
Cobalt	not less than	19.21 ppm
Copper	not less than	825.86 ppm
Iodine	not less than	96.03 ppm
Manganese	not less than	0.00 ppm
Selenium	not less than	19.20 ppm
Zinc	not less than	500.00 ppm
Vitamin A	not less than	

Questions



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