

Trace Mineral Considerations







Jen Taylor DVM

Just One Component

- ▶ Nutrition
- ▶ Herd Health Program
- ▶ Management
- ▶ Genetics
- ▶ Environment
- ▶ Disease Challenge
- ▶ Mineral Supplementation

Goals

- ▶ Challenge you to evaluate your mineral program
- ▶ Offer some options for:
 - ▶ Supplementation
 - ▶ Testing
 - ▶ Troubleshooting

 80% 0.19"	 10% 0"	 10% 0"		 50% 0.06"	 10% 0"	 10% 0"	 20% 0"
THU 22	FRI 23	SAT 24	SUN 25	MON 26	TUE 27	WED 28	THU 01
							
51° 26°	52° 28°	57° 32°	59° 34°	55° 29°	53° 28°	53° 29°	53° 31°
 8	 9	 6	 5	 7	 8	 6	 12

Macrominerals

- ▶ Calcium
- ▶ Magnesium
- ▶ Phosphorous
- ▶ Potassium
- ▶ Sodium
- ▶ Chloride
- ▶ Sulfur

Microminerals

- ▶ Copper
- ▶ Zinc
- ▶ Selenium
- ▶ Manganese
- ▶ Chromium
- ▶ Cobalt
- ▶ Iodine
- ▶ Iron
- ▶ Molybdenum
- ▶ Nickel

Trace Minerals

- ▶ **Required at concentrations less than 100 parts per million (ppm) or mg/kg of diet**
- ▶ **National Research Council recognizes 10 trace minerals**
- ▶ **Four considered most important in grazing beef cattle**

Zinc-Zn

Manganese-Mn

Copper- Cu

Selenium-Se

Copper

- ▶ Absorbed in the small intestine
- ▶ 5% absorbed
- ▶ Stored in the liver
- ▶ Functions

Reproduction

Immune System

Collagen synthesis and maintenance

Enzyme function

Red Cell Maturation

Pigment



Copper

Nutrient	Range	Jakes Aug	Jakes Mar	Flat Aug	Flat Mar	Gas Aug	Gas Mar
Ca	0.2-0.8	0.79	1.1	0.7	1.2	1.12	1.24
Iron	50-100	434	348	274	507	196	251
Sulfur	.15-.40	0.08	0.31	0.09	0.29	0.1	0.24
Mo	<1	2.46	1.52	1.18	1.11	0.43	1.02
Copper	10-15	5.67	10.6	4.3	7.95	4.11	8.47

- ▶ Requirement in Beef Cattle

 - 10 mg/kg (ppm)

- ▶ Breed differences

 - Simmental, Charolais excrete in urine making them more likely to be deficient

- ▶ Common Antagonists

 - Calcium

 - Iron

 - Sulfur-Binds Copper in rumen

 - Molybdenum-Binds Copper in rumen prevent absorption

 - need Cu:Mo ratio >2:1 or results in secondary deficiency

Signs of Copper Deficiency

- ▶ Early embryonic loss/Infertility
- ▶ Weight loss and diarrhea
- ▶ Anemia
- ▶ Poor immunity
- ▶ Joint issues
- ▶ Hair color changes
- ▶ Tendon and ligament changes
- ▶ Serum levels <0.8 ppm
- ▶ Liver <25 ppm



Selenium

▶ Absorbed in small intestine

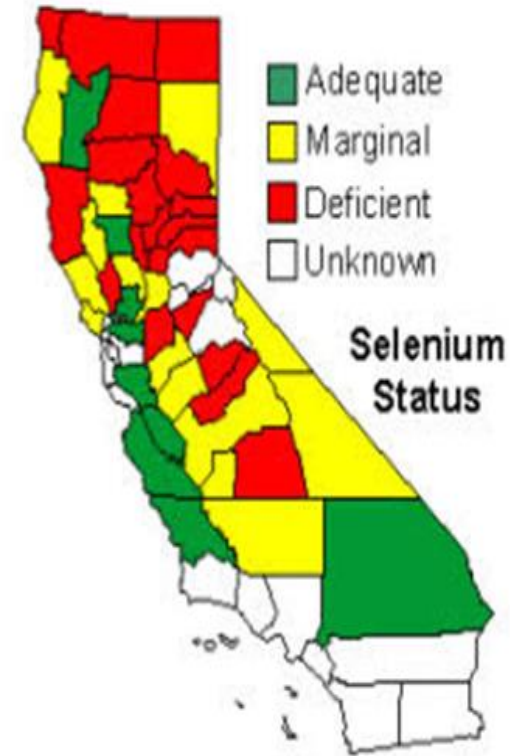
▶ Functions

Immune Response

Reproduction

Component of Glutathione Peroxidase-prevent oxidative damage

Thyroid hormone metabolism



Selenium

- ▶ Requirements
0.1-2 mg/kg (ppm)

- ▶ Common Antagonists

Sulfur

Calcium

Iron

Nutrient	Range	Jakes Aug	Jakes Mar	Flat Aug	Flat Mar	Gas Aug	Gas Mar
Ca	0.2-0.8	0.79	1.1	0.7	1.2	1.12	1.24
Iron	50-100	434	348	274	507	196	251
Sulfur	.15-.40	0.08	0.31	0.09	0.29	0.1	0.24

Signs of Selenium Deficiency

- ▶ Impaired immunity
 - White Blood Cell
- ▶ Poor reproduction
 - Late term abortion
 - Early embryonic death
 - Lowered motility of sperm
- ▶ Retained placentas
- ▶ Poor performance
 - Decreased feed efficiency
- ▶ Poor stress tolerance
- ▶ Muscular cramping
- ▶ White muscle
 - Muscle weakness

Liver < 0.25 ppm
Blood < 0.08 ppm



Zinc



- ▶ Absorbed in the small intestine
- ▶ 70% absorbed from diet
- ▶ Functions
 - Immune System
 - Reproduction
 - Skin and hoof health
 - Protein Synthesis
 - Vitamin A utilization

▶ Requirement

20-30 mg/kg (ppm)

▶ Common Antagonist

Calcium

Phosphorous

Iron

Sulfur

Nutrient	Range	Jakes Aug	Jakes Mar	Flat Aug	Flat Mar	Gas Aug	Gas Mar
Ca	0.2-0.8	0.79	1.1	0.7	1.2	1.12	1.24
Iron	50-100	434	348	274	507	196	251
Sulfur	.15-.40	0.08	0.31	0.09	0.29	0.1	0.24
Zinc	20-40	23.2	30	20	24.5	11.8	30.9

Signs of Zinc Deficiency

- ▶ Poor fertility
 - Sperm dysfunction
 - Loss of libido bulls
- ▶ Bone and joint problems
- ▶ Abnormal Skin and hooves
 - Thickened skin
 - Hair loss
- ▶ Poor wound healing
- ▶ Liver <25 ppm
- ▶ Serum <0.8 ppm



CAHFS Final Version 1		Accession # D1800761					January 19, 2018	
Analyte	Calcium	Copper	Iron	Magnesium	Phosphorus	Potassium	Sodium	Zinc
Ref. Range	80-110	0.8-1.5	1.3-2.5	18-35	45-60	3.9-6	135-150	0.8-1.4
Rep. Limit	4	0.05	0.1	1	2	0.1	5	0.1
Units	PPM	PPM	PPM	PPM	PPM	mEq/L	mEq/L	PPM
Specimen:	Result:	Result:	Result:	Result:	Result:	Result:	Result:	Result:
803	90	0.75	0.92	21	48	5.3	139	2
117	89	1	1.4	24	47	5.4	141	1.4
123	91	0.6	1.3	21	49	5.4	141	2.4
1151	95	0.51	1.4	23	58	4.6	143	1.7
137	94	0.73	1.3	28	63	5.5	143	1.6
167	95	0.75	1	23	62	5.7	138	1.8

Manganese

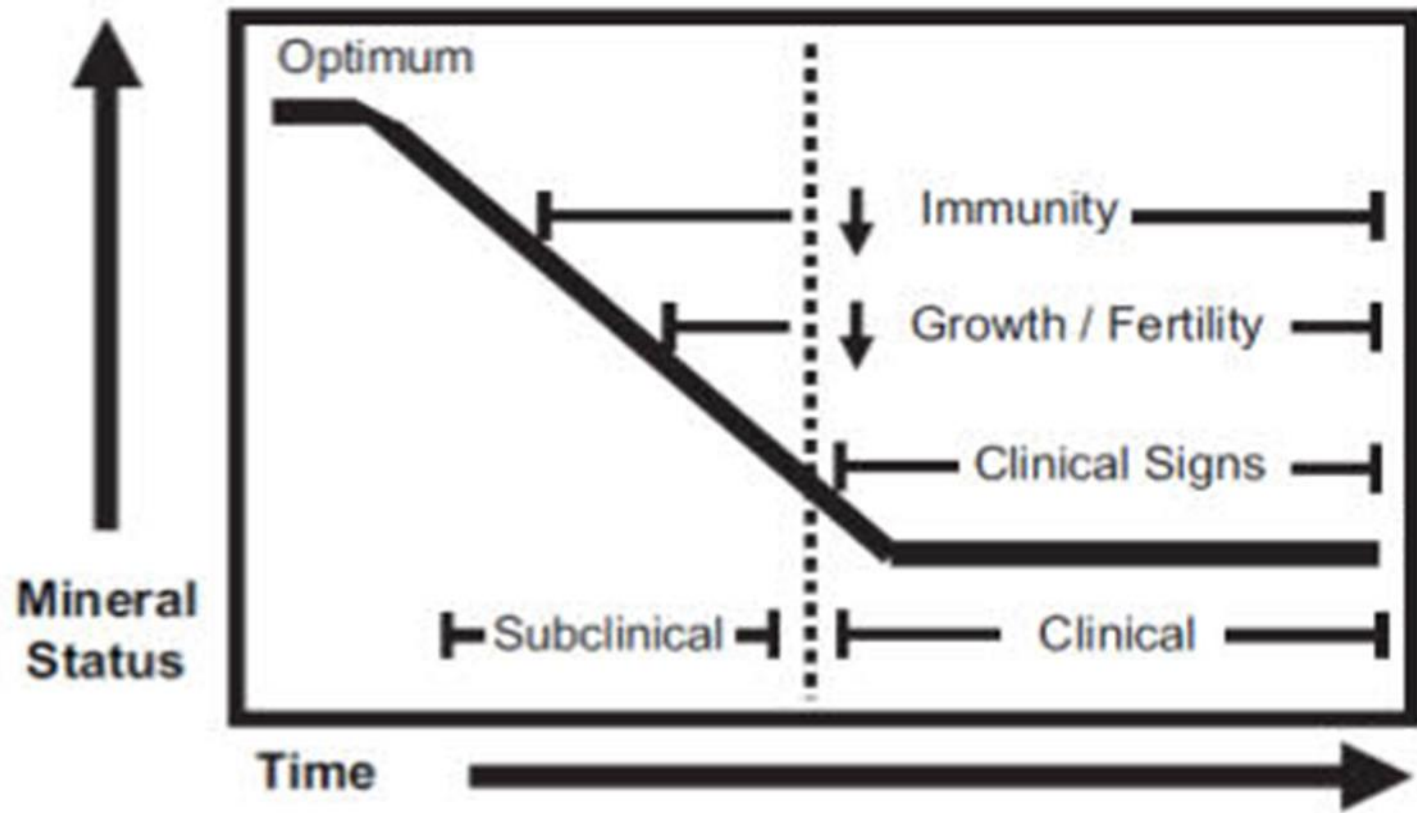
Functions

Immune Response
Reproduction
 Spermatogenesis
 Ovulation
Embryo Survival
Bone and cartilage synthesis

Deficiency

Reproduction issues
Abnormal bone and joint development
Abnormal skin, hair and hooves
Liver <2.5 ppm
Serum-Heavy metal screen from CAHFS-
Davis doesn't include Mn

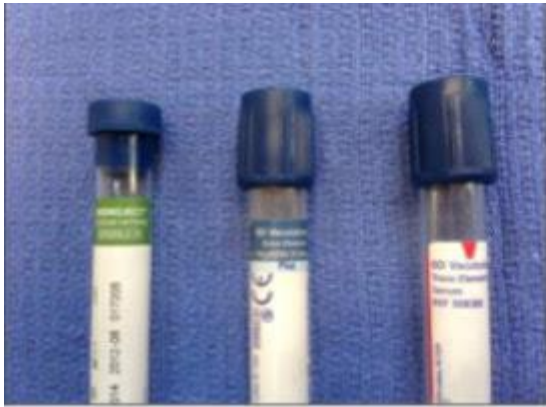
Nutrient	Range	Jakes Aug	Jakes Mar	Flat Aug	Flat Mar	Gas Aug	Gas Mar
Ca	0.2-0.8	0.79	1.1	0.7	1.2	1.12	1.24
Iron	50-100	434	348	274	507	196	251
Sulfur	.15-.40	0.08	0.31	0.09	0.29	0.1	0.24
Mn	20-50	94	258	97.6	136	64.1	115



Olson et al, VCNA, 2007

Testing for Trace Minerals

- ▶ Necropsy
 - ▶ Liver sample=Gold Standard sample
 - ▶ Can take a piece of liver from any animal that dies and freeze to send off
- ▶ Liver Biopsy
- ▶ Blood Sample





Heavy Metal Screen	Trace Mineral Panel
Arsenic	Calcium
Cadmium	Copper
Copper	Iron (unbound)
Iron	Magnesium
Mercury	Potassium
Manganese	Phosphorous
Molybdenum	Sodium
Lead	Zinc
Zinc	

Test	Sample	Price
Selenium	Purple Top EDTA Blood	\$18 ea
	10g Liver	\$24 ea
Trace Mineral Panel	Royal Blue Top EDTA/Heparin	\$18 ea
Heavy Metal Screen	10g Liver	\$32 ea

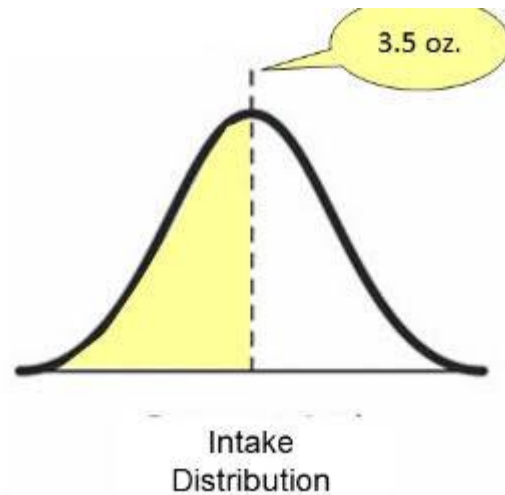
Trace Mineral Supplementation Options

- ▶ Loose mineral
- ▶ Blocks
- ▶ Tubs +/- combination with protein supplementation
- ▶ Liquid protein supplementation with mineral pack
- ▶ Injectable
- ▶ Bolus



Challenges With Mineral Supplementation

- ▶ Consumption varies- up to 20% of the cows will not consume supplement
- ▶ Absorption varies between trace mineral -organic versus inorganic
- ▶ Time and Labor to put out loose/blocks/tubs
- ▶ Facilities and labor to put in boluses or multiple injections



Loose Mineral Comparison

	AFS BEEF ENERTONE WINTER (1.6 ounces) \$200/ ton	BEEF ELITE BREEDER \$1200/ton (4 ounces)
Calcium min. %	9.26	17.4
Calcium max. %	21.60	20.9
Phosphorous %	6.26	6.0
Sodium Chloride min. %	18.07	19.4
Sodium Chloride max. %	22.09	23.3
Magnesium min. %	0.12	1.0
Potassium min. %	0.12	
Zinc min. ppm	3008.30	7500
Selenium min. ppm	19.91	22.0
Selenium max. ppm	26.55	26.0
Copper min. ppm	1674.81	3000
Manganese min. ppm		4400
Iodine min. ppm		405
Cobalt min. ppm		150
Vitamin A min. IU	224535	400000
Vitamin D3 min. IU		40000
Vitamin E min. IU		400

Ingredient Comparison

	AFS BEEF ENERTONE WINTER (1.6 ounces)	BEEF ELITE BREEDER (4 ounces)
Calcium	Monocalcium phosphate	Limestone ground
Calcium	Calcium carbonate	Mono and dicalcium phosphate
Sodium Chloride	Salt	Salt
Magnesium	Mg Sulfate/Mg Oxide	Magnesium oxide
Potassium	Potassium chloride	
Zinc	Zinc oxide	Zn oxide/ Zinc amino acid complex
Selenium	Sodium selenite	Selenium yeast
Selenium		Sodium selenite
Copper	Copper Sulfate	Cu chloride/Cu sulfate/ Cu amino acid complex
Manganese	Manganous oxide	Manganous oxide/ Manganese amino acid complex
Iodine	Calcium Iodate	
Cobalt	Cobalt Sulfate	Co sulfate/ Co glucoheptonate
Vitamin A	Vitamin A acetate	Vitamin A Supplement
Vitamin D3	Vitamin D3 Supplement	Vitamin D3 Supplement
Vitamin E	D-Alpha Tocopherol	Vitamin E supplement

Why \$1000/Ton Cost Difference

Inorganic

- ▶ Oxides
- ▶ Sulfates
- ▶ Blocks, Basic least cost loose mineral

Organic

- ▶ Amino acid
- ▶ Proteinate
- ▶ More bioavailable than inorganic
- ▶ Utilizes different carriers
 - ▶ Example bound to amino acid
 - ▶ More amino acid channels out of gut
 - ▶ Greater uptake of mineral

Mineral Feeding Loose, Blocks and Tubs

- ▶ Place in high traffic areas
- ▶ 1 feeder/tub per 40 cows
- ▶ Extra consideration to palatability if high mineral content in water source
- ▶ Requirements of the animals your are supplementing
- ▶ Bioavailability of minerals to cow

Ranch: Mariposa

Field: Gas

Calculation

Number of head in field

250

hd

Ounces per head per day

4

ounces

Total ounces per day

1000

#head x ounces

Total pounds per day

63

Ounces per day/16

Total pounds per week

438

pounds x 7 days

Total number of bags per week

9

pounds per week/50

Injectable Mineral

Trace Mineral per mL

- ▶ Zinc 60 mg
- ▶ Copper 15 mg
- ▶ Selenium 55 mg
- ▶ Manganese 10mg

Recommended Use

- ▶ Bulls 3 times per year
- ▶ Cows
 - 4 weeks before breeding
 - 4 weeks before calving
- ▶ Calves
 - At birth
 - At 3 months and or weaning
- ▶ Heifers
 - Every three months especially 4 weeks before breeding



Kansas State Study Multimin vs. Saline

Cow/Calf Production

A recent study conducted at Kansas State University injecting **MULTIMIN® 90** at pregnancy diagnosis and again 30 days before start of breeding indicated that:

- Conception to Fixed Time AI was greater in cows receiving **MULTIMIN® 90** ($P=0.05$) (60.2% vs. 51.2%).
- Overall pregnancy rate was better in cows receiving **MULTIMIN® 90** (93% vs. 89.9%).
- Cows receiving **MULTIMIN® 90** had greater body condition score gain between calving and breeding.
- **MULTIMIN® 90** benefits calving distribution – 77.49% calves were born during the first 20 days of the calving season.

Results and Discussion

Change in cow BW and BCS from initiation of the study to calving and from AI breeding to weaning did not differ ($P \geq 0.15$) between TM and SA cows (Table 2). Conversely, TM cows had greater ($P = 0.04$) BCS increase than SA cows between calving and AI. Proportion of cows with estrus cycles before ovulation synchronization was similar ($P = 0.51$) between treatments. Conception to fixed-time AI was greater ($P = 0.05$) for cows receiving TM (60.2%) than for cows receiving SA (51.2%); however, overall pregnancy did not differ ($P = 0.24$) between treatments and averaged 92%.

Calf BW at birth was not different ($P > 0.91$) between treatments (data not shown). Calf ADG from birth to 06/16, from 06/16 to weaning, and from birth to weaning were not different ($P \geq 0.36$) between TM and SA (Table 3). Similarly, adjusted 205-day BW was not different ($P = 0.48$) between treatments.

Research

- ▶ Daugherty et al. (2002) Crossbred beef cows treated with injection of trace minerals (Cu, Zn, Mn and Se)
 - Injected cows had greater serum concentrations of copper than controls
 - No effect on conception rate, survival rate of calves, or passive transfer
- ▶ Ahola et al. (2004) Supplemented grazing beef cows with Copper, Zinc and Manganese
 - Increased liver concentrations of the three supplemented minerals in the first year
 - Only increased liver concentration of Copper in the second year
 - Greater AI pregnancy rates than un-supplemented cows
- ▶ Stanton et al. (2000) Supplemented supra-nutritional amounts of organic trace mineral compared to cows receiving inorganic trace mineral supplements alone.
 - Organic trace mineral cows had greater pregnancy rates
 - Increased ADG by organic trace mineral calves
 - No difference in BW change, BCS change, calf BW at birth, or calf immune function

Boluses

Copasure 25 g (Copper Oxide)- 6 months



THE PROBLEM
65 % of California cattle are at risk of selenium deficiency, which can cause health problems such as White Muscle Disease, abortions, retained placenta, infertility, poor immune system function and other problems.

THE SOLUTION
One Se365 Selenium bolus, per animal, prevents selenium deficiency for one year.

DATA GRAPH

Blood Selenium Concentration | ug/ml (ppb)

Day	PTM (ug/ml)	Control (ug/ml)
Day -28	~10	~10
Day 0	~10	~10
Day 14	~80	~10
Day 28	~110	~10
Day 49	~150	~10
Day 63	~160	~10
Day 121	~170	~10
Day 183	~140	~10
Day 283	~80	~10
Day 365	~70	~10

CLICK TO ENLARGE

The above graph represents data from a one-year study on selenium-deficient heifers done at University of California Sierra Foothill Research and Extension Center, Browns Valley, CA. All the heifers were run together on pasture or foothill range and exposed to exactly the same conditions. There were 19 control heifers and 18 heifers given one PTM Se365 bolus on Day 0.

Blood samples were taken at the intervals shown and analyzed for selenium concentration. The control heifers remained very selenium-deficient for the entire year. The PTM-treated animals showed immediate increases in blood Se levels by Day 14 and remained above the 40 ppb level for the entire year (below 50 ppb [parts per billion] is considered selenium-deficient).

Reference: Renquist, B.J., JW Otten, M.L. Sween, et al. Efficacy of a New Sustained-Release Intramuscular Selenium Bolus. BOV PRACT, vol 41(2), pp 134-137, 2007

With
RELOADER 250[™] MINERAL BOLUS,
all cattle receive the trace minerals and vitamins they need. **Guaranteed.**

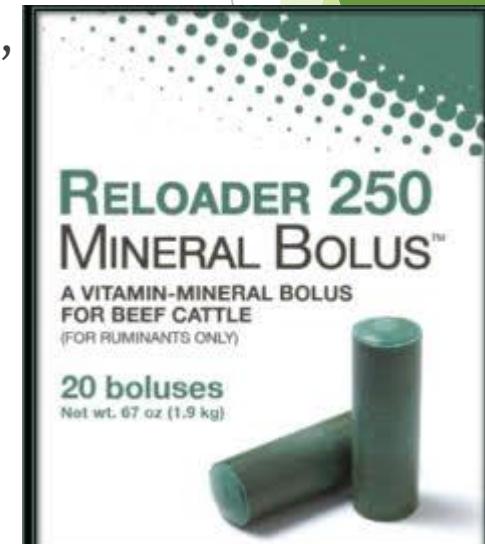
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ReloaderBolus.com

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Reloader 250 Mineral Bolus-\$15 for 2 boluses

- ▶ Delivers 250 days of essential trace minerals and vitamins to every cow
- ▶ Eliminates intake variability
- ▶ Six trace minerals and three vitamins (Zn, Cu, Mn, Se, I, and Co, Vitamin A, Vitamin D3 and Vitamin E)
- ▶ Not a replacement for a complete year-round mineral program



Bolus Application Timing

	Production Calendar											
	Calving			Breeding			Late Lactation			Last Trimester		
Month since calving	1	2	3	4	5	6	7	8	9	10	11	12
Branding/Bull Turnout												
AI Breeding												
Weaning/Palpaton												

Primary Recommendation: Months 4, 5, 6, 7, 8, 9, 10, 11

Alternate Application: Months 4, 9

- ▶ 22 month old, 7 month pregnant heifer
- ▶ Irrigated pasture year round
- ▶ Hay in dormant season
- ▶ +/- Liquid protein supplement
- ▶ Irregular vaccine program
- ▶ Marginal BCS

CAHFS Final Version 1		Accession # D1716238			December 08, 2017		
Iron	92	ppm	1	ppm	45-300		
Mercury	Not Detected	ppm	1	ppm	<1.0		
Arsenic	Not Detected	ppm	1	ppm	<1.0		
Molybdenum	1.5	ppm	0.4	ppm	<1.4		
Zinc	36	ppm	0.3	ppm	25-100		
Copper	4	ppm	0.3	ppm	25-100		
Cadmium	Not Detected	ppm	0.3	ppm	<2.0		
SELENIUM - TISSUE/OTHER							
Animal/Source	Specimen	Specimen Type	Results	Units	Rep. Limit	Ref. Range	
1	(1) 1	Liver Tissue	0.064	ppm	0.020	0.25-0.5	

A507- 1st Calf heifer

Moved to native pasture and supplemented for 4 months

Loose mineral supplement

Contained organic and inorganic

Moved home 1 week prior to death

B400- 3 year old

Same supplement history as previous slide

HEAVY METAL SCREEN						
Animal/Source	Specimen	Specimen Type				
A-507	A	Liver Tissue				
Analyte	Result	Units	Rep. Limit	Units	Ref. Range	
Lead	Not Detected	ppm	1	ppm	<1.0	
Manganese	2.7	ppm	0.1	ppm	2.5-6.0	
Iron	120	ppm	1	ppm	45-300	
Mercury	Not Detected	ppm	1	ppm	<1.0	
Arsenic	Not Detected	ppm	1	ppm	<1.0	
Molybdenum	1.4	ppm	0.4	ppm	<1.4	
Zinc	66	ppm	0.3	ppm	25-100	
Copper	42	ppm	0.3	ppm	25-100	

Report 4.35-CAHFS Standard Report - 11/2/2017 Page 3 of 4

CAHFS Final Version 1							Accession # T1800120		February 06, 2018		
Cadmium		Not Detected	ppm	0.3	ppm	<2.0					
B-400	B	Liver Tissue									
Analyte	Result	Units	Rep. Limit	Units	Ref. Range						
Lead	Not Detected	ppm	1	ppm	<1.0						
Manganese	3.2	ppm	0.1	ppm	2.5-6.0						
Iron	61	ppm	1	ppm	45-300						
Mercury	Not Detected	ppm	1	ppm	<1.0						
Arsenic	Not Detected	ppm	1	ppm	<1.0						
Molybdenum	1.3	ppm	0.4	ppm	<1.4						
Zinc	38	ppm	0.3	ppm	25-100						
Copper	2.9	ppm	0.3	ppm	25-100						
Cadmium	Not Detected	ppm	0.3	ppm	<2.0						
NITRATE CONFIRMATION											
Animal/Source	Specimen	Specimen Type									
A-507	A	Vitreous humor									
Analyte	Result	Units	Rep. Limit	Units							
Nitrate	11	ppm		ppm							
B-400	B	Vitreous humor									
Analyte	Result	Units	Rep. Limit	Units							
Nitrate	17	ppm		ppm							
NITRATE SCREEN											
Animal/Source	Specimen	Specimen Type									
A-507	A	Vitreous humor									
Analyte	Result	Units	Rep. Limit	Units							
Nitrate	Confirmation Required	ppm		ppm							
Nitrite	Positive	ppm		ppm							
B-400	B	Vitreous humor									
Analyte	Result	Units	Rep. Limit	Units							
Nitrate	Confirmation Required	ppm		ppm							
Nitrite	Not Detected	ppm		ppm							
T1800120-03	Sudan Hay	Feed									
Analyte	Result	Units	Rep. Limit	Units							
Nitrate	Positive	ppm		ppm							
Nitrite	Not Detected	ppm		ppm							
SELENIUM - TISSUE/OTHER											
Animal/Source	Specimen	Specimen Type	Results	Units	Rep. Limit	Ref. Range					
A-507	A	Liver Tissue	0.25	ppm	0.020	0.25-0.5					
B-400	B	Liver Tissue	0.22	ppm	0.020	0.25-0.5					

Serum and Blood Mineral Levels

Herd Health
Monitoring
-Loose Mineral
-Protein tubs with a
mineral pack
-Bolus
Copasure
Se 365

	11/26/13		3/18/2014		8/5/2014	
	Se	Cu	Se	Cu	Se	Cu
925	0.2	0.9	0.22	0.88		
926	0.03	1.1			0.1	0.77
1116			0.18	0.72	0.15	0.8
1117	0.09	1.3	0.15	0.86	0.1	0.54
1119	0.14	1.4			0.16	0.67
1120	0.09	1.2	0.13	0.92	0.14	0.82
1122	0.13	1.3			0.15	0.8

Selenium 0.08-0.5
Copper 0.8-1.5

Research

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 - Organic trace mineral cows had greater pregnancy rates
 - Increased ADG by organic trace mineral calves
 - No difference in BW change, BCS change, calf BW at birth, or calf immune function

Summary

- ▶ Several Options for supplementation
- ▶ Be aware of antagonists
- ▶ Know the signs of deficiency
- ▶ Consider testing live or post-mortem

Merced Mariposa Cattlemen's Association

Beef Quality Assurance Certification



Wednesday, March 14th - 2 PM
Henderson Park in Snelling



Certification Training presented by the
California Beef Council

Applied Beef Quality Assurance
presented by Natalie Koopman-Zoetis

Injection site tissue reaction demonstration on a carcass

Sponsored by:



Please stay after the seminar and join us for the Spring Tour Meeting

Please RSVP to Jen Taylor - (530) 514-1610

Merced-Mariposa Cattlemen's Association

Please Join us on
Wednesday March 14, 2018

Annual Spring Tour Dinner

Social Hour - 5:30pm
Dinner & Presentation - 6:00pm

Speakers will include:

CCA Representatives

John Garino - Trasic SeY

**Dr. Roselle Busch - New Antibiotic Use
& Stewardship Law**

Turlock Livestock's Steven Faria - Market Report
Natalie Koopman - Zoetis

Dinner Prepared by Mid Valley Cowbelles



Henderson Park
Community Recreation Building
3335 E. Merced Falls Road
Snelling, CA

Sponsored by: John Garino - Trasic SeY & Natalie Koopman - Zoetis

RSVP to Sarah Bell (209) 769-4698 by Monday March 5th

Questions?

