Refining our Mineral Nutrition Program

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Objective of Supplementation

Provide for animal needs
Low cost
Livestock do not read the labels

Types of Minerals

Macro
Ca, P, K, Mg, S
Required in %
.1 to .7%

Micro
Zn, Se, Co, Cu,
Mn, I, Fe
PPM or mg/kg

Do I have a problem?

Mineral Interactions

<table>
<thead>
<tr>
<th>Copper Antagonist</th>
<th>Deficient</th>
<th>Ideal</th>
<th>Marginal</th>
<th>High</th>
<th>MYC*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace (ppm)</td>
<td>&lt;50</td>
<td>50-200</td>
<td>&gt;200-400</td>
<td>&gt;400</td>
<td>1000</td>
</tr>
<tr>
<td>Molybdenum (ppm)</td>
<td>&lt;1</td>
<td>1-5</td>
<td>&gt;20-30</td>
<td>&gt;30</td>
<td>.40</td>
</tr>
<tr>
<td>Sulfur (% DM)</td>
<td>&lt;.15</td>
<td>.15-.20</td>
<td>&gt;20-30</td>
<td>&gt;30</td>
<td>.40</td>
</tr>
</tbody>
</table>

*Maximum Tolerable Concentration
**Levels above these can potentially affect copper availability
Iowa Beef Center Forage Survey 2010

<table>
<thead>
<tr>
<th>Type</th>
<th>Region</th>
<th>Mn</th>
<th>Zn</th>
<th>Cu</th>
<th>Co</th>
<th>Fe</th>
<th>Cu</th>
<th>Mn</th>
<th>Zn</th>
<th>Co</th>
<th>Fe</th>
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</thead>
<tbody>
<tr>
<td>Grass</td>
<td>SD</td>
<td>77.1</td>
<td>53.3</td>
<td>31.5</td>
<td>6.4</td>
<td>8.6</td>
<td>2.3</td>
<td>312.7</td>
<td>242.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grass</td>
<td>SD</td>
<td>77.1</td>
<td>21.1</td>
<td>27.1</td>
<td>5.7</td>
<td>9.8</td>
<td>2.4</td>
<td>532.2</td>
<td>297.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grass/Legume</td>
<td>SD</td>
<td>108.6</td>
<td>53.3</td>
<td>31.5</td>
<td>6.4</td>
<td>8.6</td>
<td>2.3</td>
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<td>2.3</td>
<td>312.7</td>
<td>242.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legume</td>
<td>SD</td>
<td>45.9</td>
<td>6.8</td>
<td>27.7</td>
<td>2.2</td>
<td>14.8</td>
<td>10.6</td>
<td>492.8</td>
<td>137.5</td>
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<td></td>
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<tr>
<td>Legume</td>
<td>SD</td>
<td>45.9</td>
<td>17.5</td>
<td>28.6</td>
<td>5.8</td>
<td>8.8</td>
<td>0.9</td>
<td>444.7</td>
<td>296.6</td>
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<td></td>
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<tr>
<td>Legume</td>
<td>SD</td>
<td>65.5</td>
<td>17.0</td>
<td>28.9</td>
<td>1.1</td>
<td>9.3</td>
<td>0.8</td>
<td>551.2</td>
<td>181.3</td>
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<td></td>
</tr>
</tbody>
</table>

Region 1: north of I-80; Region 2: southwest IA; Region 3: southeast IA

n = 3 per type per region

Mod. def

Mod. to high antagonism

IBC & ISWPB Micro mineral Survey 2016

<table>
<thead>
<tr>
<th>Type</th>
<th>2016 Average</th>
<th>2016 SD</th>
<th>1994 Average</th>
<th>1994 SD</th>
<th>Sheep Req.</th>
<th>Toxic</th>
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</thead>
<tbody>
<tr>
<td>Copper</td>
<td>9.7</td>
<td>3.5</td>
<td>11.2</td>
<td></td>
<td>11.0</td>
<td>5 to 8</td>
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<tr>
<td>Iron</td>
<td>351</td>
<td>222</td>
<td>174</td>
<td></td>
<td>158</td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>26.4</td>
<td>8.0</td>
<td>37.7</td>
<td></td>
<td>92.1</td>
<td></td>
</tr>
<tr>
<td>Manganese</td>
<td>90.2</td>
<td>43.1</td>
<td>97.7</td>
<td></td>
<td>6.8</td>
<td></td>
</tr>
<tr>
<td>Molybdenum</td>
<td>1.9</td>
<td>1.1</td>
<td>2.2</td>
<td></td>
<td>6.8</td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
<td>.24</td>
<td>.21</td>
<td>.71</td>
<td></td>
<td>.32</td>
<td></td>
</tr>
<tr>
<td>Cobalt</td>
<td>.44</td>
<td>.47</td>
<td>&lt;.5</td>
<td></td>
<td>&lt;.5</td>
<td></td>
</tr>
<tr>
<td>Iodine</td>
<td>.35</td>
<td>.21</td>
<td>.31</td>
<td></td>
<td>.32</td>
<td></td>
</tr>
</tbody>
</table>

Fig 2.2. Concentrations of cobalt and manganese in plants decrease markedly as soil pH increases, while those of molybdenum increase and those of copper and zinc show little change. Values at pH 6.0 were (mg kg⁻¹ CDM): Cu 0.03, Zn 3.1, Mn 51.0, Mo 2.7 and Zn 23 and given a relative value of 1.0. Data are for progress in Abendonnesi (from CISAC, 1982).

Suttle, 2010

Biologically Critical Times for Trace Minerals

Stress increases urinary excretion of Cu, Zn

Weaning, transport/shipping, parasitism, lactation and cold stress

Reproduction (conception and fetal development, including fetal liver mineral storage)

Immune response (vaccination titer response, neutrophil function, other mechanisms?)

Requirements, 07 NRC

Stage of production

Other mineral levels

Age

Level of production

Problems with copper deficiency will happen way below this level. Copper:molybdenum ratio 6:1 up to 10:1. Must also monitor sulfur levels.

Iodine level is based on high milk and high intakes. Requirement increases dramatically (up to 150%) in cold weather.

This level is way above FDA approved supplementation rate of .69 mg per head per day.
Ewe Lambs vs Ewes

<table>
<thead>
<tr>
<th></th>
<th>Lambs</th>
<th>Ewes</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. Lactation Ca</td>
<td>8.6g</td>
<td>12g</td>
</tr>
<tr>
<td>E. Lactation P</td>
<td>7.9g</td>
<td>11g</td>
</tr>
</tbody>
</table>

Doing the math

Lactating ewes
4.5 lbs alfalfa hay and 2 lbs corn

\[
4.5 \times 0.24\% \text{ P} = 0.01 \text{ lb P}
\]

2.0 corn \times 0.35\% \text{P} = 0.007 \text{ lb P}

\[
0.017 \text{ lb P} \times 454 \text{ g/lb} = 7.7\text{g provided vs 11g req.}
\]

Meeting animal needs

Mineral Consumption
Salt driven
- grain byproducts
- molasses

Mineral Density
- Se 10-90 PPM
- controlled by FDA .69mg intake/d

Mineral Sources

Feedstuffs
- ex. alfalfa hay high calcium

Sheep Mineral contains
- macro and micro minerals
- 10-12% calcium
- 6-10% phosphorous
- 10-35% salt
- expensive $20-50 per bag

Sheep Mineral, Kansas

**GUARANTEED ANALYSIS**
- Calcium 7%
- Phosphorous 5%
- Salt 45%
- Sulfur 1%
- Magnesium 1%
- Zinc 150 PPM short
- Iodine 125 PPM okay
- Cobalt 150 PPM okay
- Selenium 10 PPM super, super short

Mineral Sources

Trace mineral salt
- 95-98% salt
- only micro minerals
- lower intake required
- lower cost
  - approx. half price w/ lower intake (mostly salt)
- total cost of mineral supp. 25%

Water may also provide minerals
**Big Gain T.M. SALT w/ Selenium**

**GUARANTEED ANALYSIS**

<table>
<thead>
<tr>
<th>Component</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt</td>
<td>90.00%</td>
<td>92.00%</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.45%</td>
<td>4500 PPM</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.45%</td>
<td>4500 PPM</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.19%</td>
<td>1960 PPM</td>
</tr>
<tr>
<td>Iron</td>
<td>0.25%</td>
<td>2500 PPM</td>
</tr>
<tr>
<td>Iodine</td>
<td>0.025%</td>
<td>250 PPM</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.0022%</td>
<td>22 PPM</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.009%</td>
<td>90 PPM max.</td>
</tr>
<tr>
<td>Vit A</td>
<td>235850 IU/lb</td>
<td></td>
</tr>
<tr>
<td>Vit D</td>
<td>78375 IU/lb</td>
<td></td>
</tr>
<tr>
<td>Vit E</td>
<td>2500 IU/lb</td>
<td>39 IU/hd/d</td>
</tr>
</tbody>
</table>

PPM = mg/kg (four decimal places)

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**What should You do?**

- Test forages
- Macro minerals
- Micro MSU ($60 to $150)
- Monitor mineral intake
  - put out set amounts, ex. Week's supply
  - monitor how long it lasts

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**Selenium Deficiency**

- Reproductive failure
- Embryonic mortality (wks 3-4)
- White muscle disease
- Poor suckling reflex
- Indirectly hypothermia/goiter
  - Deiodinase enzyme
    - I4 to I3 which is the biologically active form
  - BAT activity
- Reduced growth
- Reduced disease resistance

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**BMP Selenium**

- Read mineral tag
- Monitor mineral intake
- Add to grain mix and force feed
- Eliminates animal to animal variation

**Needed year round**

Pre-caution, some is good more may not be better.

- Toxic at 2 ppm
- High S decrease absorption (DDGS)
- also heavy metals

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**Iodine**

- Lactation Ration = .8 ppm or mg/kg
- Most mineral mixtures are short
  - needs to be 120 ppm mineral
  - with .5 oz intake
- Solution free choice iodized salt in LG
- Add eddi to trace mineral .1 in 10 pounds

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**Copper Toxicosis**

- Breed Susceptibility
  - (Suffolk and Texels)
- Mineral interactions-Mo & Su,
  - along with high Zn & Ca
- Normal copper, low molybdenum
### Copper Toxicosis...continued

**Prevention**
- Sheep specific feeds
- No additional copper
- Feed some Mo
- CU & MO are both toxic

**CU:MO ratio range** 6-1 up to 10-1

### Vitamins

#### Fat Soluble
- A, night blindness, green feeds
- D, rickets, sunshine
- E, white muscle, immune issues
- K, blood clotting, body synthesis

#### B vitamins and C
- No concern with healthy rumen
- C is synthesized by the sheep

### Vitamins in mineral sources

- Vitamins are inactivated during storage
- Half life 14-21 days
- Do not count on them to help.

**EX. 10 IU E per pound of mineral**

### Critical Nutrient, Vitamin E

- **White muscle disease**
- Interacts with Selenium
- Oxidative stress and free radicals
  - Cellular level metabolism
  - Free radicals are a product of energy metabolism
  - Accumulation creates cell/muscle damage
  - ex. White muscle disease

### ISU Results - Serum E levels in ewes

<table>
<thead>
<tr>
<th></th>
<th>E-G</th>
<th>E-L</th>
<th>E-GL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretreatment</td>
<td>1.27</td>
<td>1.26</td>
<td></td>
</tr>
<tr>
<td>Pre-lambing</td>
<td>1.51&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.91&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Post-lambing&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.93&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.13&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Mid-lactation&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.95&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.28&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Milk e at 3 days</td>
<td>10.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.1</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a,b</sup> Row means with different superscripts differ (p<.05).

Base ration was excellent alfalfa hay and corn

### Results - Serum E lambs

<table>
<thead>
<tr>
<th>Age</th>
<th>E-G</th>
<th>E-L</th>
<th>E-GL</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 days</td>
<td>1.08</td>
<td>1.08</td>
<td></td>
</tr>
<tr>
<td>28 days</td>
<td>.41</td>
<td>.38</td>
<td>1.33</td>
</tr>
</tbody>
</table>

<sup>a,b</sup> Row means with different superscripts differ (p<.05).
**BMP Vitamin E**

Feed ewes >100 IU/hd/d  
late gestation and lactation  
Creep feed minimum 40K IU/ton  
Up to 100K IU per ton  
**Do not count on E in mineral**  
Concentration is way too low.  
**Grazing on green grass no problem**

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**Late gestation**

**Stressful which leads to reduced immunity**

- Cold stress
- **Milk fever**
  - inadequate calcium or too much other minerals
  - cation-anion imbalance, see Dairy Nutritionist
- Reduced immunity leads to more health issues, (mastitis, respiratory, uterine infections)
- Reallocation of nutrients

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**On farm vitamin fortification**

- 50 ewes free choice mineral with .5 ounce intake
- ADE premix 2 million A, .5 million D and 4000 E / lb
- Vitamin E 20,000 iu/lb
- Ewes need 3500 IU A and 150-300 IU E

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**Mineral recipe**

- .5 oz X 50 head X 7 days / 16oz = 10.9 lbs
- add
- .7 pounds Kent ADE Premix (storage)
- 2.5 pounds Vitamin E (20K IU/lb)
- .1 pound EDDI

Provides ewes 3800 IU A, 960 D and 138 E  
Cost per week $3.00 or $3.00 per ewe per year

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**What should You do?**

- Harvest kidney and liver from deads.
- Sample forages
- Trace minerals are around $35-50 per sample
- Read mineral tags
- Monitor mineral intake
- **Plain salt is not enough**
- Sheep have zero nutritional wisdom
- Consult a nutritionist

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**Good Scales**