Mineral Nutrition Concepts
in Whitetail Deer

R. Greg Stewart, DVM, MS, Ph.D
Many whitetail breeders have not had previous ruminant livestock experience. Maintaining a healthy rumen is the foundation of all wellness in this species. Metabolism changes occur in whitetails throughout the year. This can vary 250% during the year for bucks and does. Mineral nutrition must be adjusted to metabolism and growing conditions. Optimum mineral nutrition is required for efficiency in body and hair coat, antlers, wellness, immunity, parasite wars and reproduction. When animals are consuming growing roughage or harvested roughage they will consume trace minerals as needed. Frequently an increase in mineral consumption is evident during these times. If an animal is salt satisfied through its pelleted or textured diet it will not consume supplemental trace minerals presented to it.
DO NOT BE MISLED by studies performed in non-ruminant species that are extrapolated and used in ruminants.

TOPICS:

- sources of minerals – organic vs inorganic
- absorption of minerals - organic vs inorganic
- Does increased absorption correlate to increased performance? Ex: Se Me Ruminants

Effects and absorption of minerals is governed by type of roughage and carbohydrate constituents in the diet.

Co – the concept of the “sweet spot” Supplementation vs absorption and utilization

Co – (a) deprivation causes massive increases in succinate levels in Rumen (acidosis)

In other words– changes in rumen function as a result of mineral deficiency

(b) decrease in VFAs production (propionate) is the result. Propionate – main source of energy. Appetite . Growth.
Evaluate: Feeds / Forages / Soil in pens if growing crops

Who believes “If a little is good, a lot is better”?

MINERAL NUTRITION – weaning issues
  – stress resilience

No yellow sulfur salt blocks

Milk transfer efficiency

Cu –
Se ++
I – variable by season

Colostrum concentrations much higher for most microminerals
When you see Clinical Disease:
You already have experienced abnormalities in the “submerged” compartments
<table>
<thead>
<tr>
<th>SUBCLINICAL DEFICIENCY</th>
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<tbody>
<tr>
<td>↓↓  Immunity</td>
</tr>
<tr>
<td>↓↓  Reproduction Function</td>
</tr>
<tr>
<td>↓↓  Growth</td>
</tr>
<tr>
<td>Antler Development</td>
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<tr>
<td>↑↑  Higher Cost of Production</td>
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</table>

CLINICAL DEFICIENCY  ➔  DISEASE
<table>
<thead>
<tr>
<th>Metal</th>
<th>Required for</th>
<th>Deficiency</th>
<th>Toxicity</th>
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</thead>
<tbody>
<tr>
<td>Copper</td>
<td>Enzymes for repro</td>
<td>Immune Suppression</td>
<td></td>
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<tr>
<td></td>
<td>Metabolism of Fe</td>
<td>Repro:</td>
<td>Hemolytic crisis</td>
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<tr>
<td></td>
<td></td>
<td>• Fertility ▼</td>
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<td>• Twins</td>
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<td>• Implantation</td>
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<td>• semen quality</td>
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<td></td>
<td></td>
<td>• Libido ▼</td>
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<td>• Placenta necrosis</td>
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<td></td>
<td>Connective tissue maintenance</td>
<td>Newborns</td>
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<td>• Cold stress</td>
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<td>• CNS issues</td>
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<td></td>
<td>Hoof tissue maturity</td>
<td>Hoof problems</td>
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<td>Immunity (copper level into</td>
<td>Antler develop ▼</td>
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<td></td>
<td>milk are low)</td>
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<td>Hair coat/Antler development</td>
<td>Anemia</td>
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<td></td>
<td>Parasite resistance</td>
<td>Poor growth rate/weight loss</td>
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<td>Hair coat issues</td>
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<td>Antler issues</td>
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<td>Parasite resistance ▼</td>
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<td>Required for</td>
<td>Deficiency</td>
<td>Toxicity</td>
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<tr>
<td>Selenium</td>
<td>Antioxidant (w/ Vitamin E)</td>
<td>Immune Suppression</td>
<td>Abortion</td>
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<td>Tissue repair</td>
<td>Repro. function</td>
<td>Sperm defects</td>
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<td></td>
<td>Cellular damage and repair</td>
<td>Muscle degeneration (white muscle disease)</td>
<td>Newborn milk</td>
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<tr>
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<td>Immune function w thyroid hormone</td>
<td>Silent Heats</td>
<td>Blind staggers ? (Plants) Lameness, polioencephalomalacia</td>
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<tr>
<td></td>
<td>Metabolism</td>
<td>Cystic ovaries</td>
<td>Abnormal gait movement</td>
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<tr>
<td></td>
<td>Reproduction</td>
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<td>Respiratory distress</td>
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<td>Circulation</td>
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<td>Diarrhea</td>
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<td>Muscle function</td>
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<td>Emaciation (wasting)</td>
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<tr>
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<td>Complex w heavy metals to make harmless</td>
<td></td>
<td>Anemia</td>
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<tr>
<td></td>
<td>Very efficiently transferred into milk!!!</td>
<td></td>
<td>Poor repro. function</td>
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<td>Requirements increase with: High legume diets, high sulfur intake, low vitamin E intake, presence of heavy metals</td>
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<td>Metal</td>
<td>Required for</td>
<td>Deficiency</td>
<td>Toxicity</td>
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<tr>
<td>Zinc</td>
<td>Sexual maturity</td>
<td>Abortion</td>
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<td></td>
<td>Onset of Estrus</td>
<td>Fetal mummy</td>
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<tr>
<td>Zn</td>
<td>Skin integrity</td>
<td>Low birth weight</td>
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<td>Lining of repro tract</td>
<td>Poor sperm quality</td>
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<td>Repair after fawning</td>
<td>Prolonged labor</td>
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<td>Implantation of embryos</td>
<td>pica</td>
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<td>Hoof health w copper</td>
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<td>Antler development</td>
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</table>
Determinate of metabolic rate. Interacts with insulin, GH, corticosterone, and regulatory proteins of exocrine origin.

The seasonality of reproduction (ov) is related to seasonal changes in thyroid activity.

Male cooperation is likely facilitated by a thyroid response to change in day length.

Thyroid dysfunction: fertility, embryo/fetal development, postnatal mortality, growth depressions, skin, low milk yield.

Not predicted by traditional methods T4, T3, T4:T3

Interaction with Se deficiency.
- High legume diets
- S
- Low vitamin E
- Heavy metals

Se
## Mineral References

Source: DCPAH/CVM/MSU 2015
Dr. Tom Herdt

<table>
<thead>
<tr>
<th></th>
<th>Whitetail Deer</th>
<th>Sheep (all)</th>
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<tbody>
<tr>
<td></td>
<td>ug/g or ppm</td>
<td>Dry liver sample weight</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.39</td>
<td>0.30-0.60</td>
</tr>
<tr>
<td>Copper</td>
<td>347</td>
<td>75-300</td>
</tr>
<tr>
<td>Fe</td>
<td>733.3</td>
<td>200 - 600</td>
</tr>
<tr>
<td>Mn</td>
<td>8.77</td>
<td>6.0 - 12.0</td>
</tr>
<tr>
<td>Mo</td>
<td>0.832</td>
<td>1.5 - 3.0</td>
</tr>
<tr>
<td>Se</td>
<td>*4.28</td>
<td>1.0 – 2.5</td>
</tr>
<tr>
<td>Zn</td>
<td>189.11</td>
<td>60 -- 270</td>
</tr>
</tbody>
</table>

* comment

Source: DCPAH/CVM/MSU 2015
Dr. Tom Herdt
Nutrient Pool

Storage

1. Transport

2. Function

3. Marginal Supply

4. Clinical signs

Depletion

Deficiency

Dysfunction

Disease

Time

Suttle 2010
Dietary Mineral Concentration

- Deficient
- Adequate
- Toxic

Marginal Deficiency

Minimum
Safe allowance
Marginal Toxicity

Response

Suttle 2010
Causes of Death Cervids (ILL.)
169 captive accessions
Katie Maples, DVM 2014 NADEFA, Birmingham. Al

Multisystemic
N=90

Nervous system
N=13

Cardiovascular
< 5%

Respiratory Pneumonia
N=20

Gastrointestinal
N=23

Musculoskeletal
N=13

Repro.
< 5%

Urinary
< 5%

< 5%

Unknown
< 5%
Multisystemic (90) (most under 1 year)

- EHD
- Sepsis (50% respiratory, 50% GI)
- Lepto
- Trauma
- Johne’s
- Other

GI (23)

- Nutritional
- Infectious
- Parasites

Respiratory (20)

- Pneumonia

Nervous

- Infection
- Trauma

Musculoskeletal

- Fracture
- Trauma
- Infection
- Capture Myopathy (may show up as unknown)
<table>
<thead>
<tr>
<th>Macro Minerals</th>
<th>Micro Minerals</th>
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<tbody>
<tr>
<td>Na</td>
<td>I</td>
</tr>
<tr>
<td>Cl</td>
<td>Fe</td>
</tr>
<tr>
<td>Ca</td>
<td>Cu</td>
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<td>P</td>
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<td>K</td>
<td>Mn</td>
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<td>S</td>
<td>Zn</td>
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<td></td>
<td>Se</td>
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<td>Fl</td>
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</tbody>
</table>
**Reduced Appetite**
- feed intake
- Co
- Zn

**Reduced Growth**
- Weight Loss
- Cu
- Se
- Zn

**Anemia**
- Co
- Cu
- Fe
- Se

**Suppressed**
- Immunity
- Cu
- Co
- Mn
- Se
- Zn

**Impaired**
- Immunity
- Cu
- Co
- Mn
- Se

**Reproduction**
- Impairment
- Cu
- Zn

**Muscle Function**
- Body Condition
- Ca
- Co
- Cu
- I
- Se
- (Vit E)
- Zn

**Reduction of Growth**
- Weight Loss
- Cu
- Se
- Zn

**Immunosuppression**
- Immunity
- Cu
- Co
- Mn
- Se
- Zn

**Reproduction Impairment**
- Cu
- Zn

**Muscle Function**
- Body Condition
- Ca
- Co
- Cu
- I
- Se
- (Vit E)
- Zn

11/19/2015
Goiter/Growth Rate
Thyroid function/
Inflammation
Body Temperature
Heart rate
Protein Production
(inc. calcitonin)

Antlers
Haircoat
Zn
Se
Cu

Nerve Function
Skin
Ca
Mg
Zn
Cu

Cu
Mg
Zn
Se
P
Mn