Equine Nutrition
And Basic Supplementation

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Equine Nutrition and Basic Supplementation

Topics

- Equine Physiology
- Nutritional Requirements
- Hay Analysis
- Supplementation

Equine Physiology

Physiology Nutritional Reqs Hay Supplements

The Foregut:
Mouth, Stomach & Small Intestine

The Mouth

- Teeth grind and break up feed into boluses
  - Dentition major role
- Salivary glands produce 35-40L saliva daily
  - Higher with grass and hay
  - Lower with grains and pellets
- Saliva functions:
  - Acid Buffer
  - Lubrication
  - Electrolytes
  - No Enzymes

The Foregut:

Mouth, Stomach & Small Intestine

The Stomach

- 8-15L Capacity
- Mucous and Acid Production
- Liquifies Feed
- Partial Breakdown of Proteins
- No Digestion or Absorption of Nutrients

The Foregut:

Mouth, Stomach & Small Intestine

Small Intestines

- 20m long, 60L capacity
- Rate of passage 45-120 min
- Neutralizes acid from stomach
- Enzymatic digestion of protein, starch, sugar, fat
- Absorption of amino acids, fats, simple sugars, vitamins, minerals

Equine Nutrition and Basic Supplementation

The Foregut:

Mouth, Stomach & Small Intestine

Accessory Organs

Pancreas

- Produces Acid Buffer, Releases into SI
- Produces Digestive Enzymes, Releases into SI
- Produces Insulin, Releases into Bloodstream

Liver

- Produces Bile Salts for Fat Emulsification
- Glucose and VFA Processing
- Fat and Protein Processing
- Some Vitamin synthesis

The Hindgut:
Fermentation Organs

- Site of Microbial Digestion thru Fermentation
- Incl Cecum, Large and Small Colon
- 7m long, 125L Capacity
- Rate of passage 24-48hr
- Relatively Neutral pH (6-7)
- Fiber Fermentation, not Digestion
- End products:
  - Volatile Fatty Acids (VFAs)
  - Vitamins B and K
  - Gas

The Hindgut:
Fermentation Organs

Caecum

- 1.2m long, 30L capacity
- Fermentation of Fiber: Structural CHO
- Fermentation of excess Non-Structural CHO
- VFA Production and Absorption
- All B Vitamin and Vitamin K Synthesis

The Hindgut:
Fermentation Organs

Large Colon
- 3-3.5m long, 75L capacity
- Same functions as Caecum
- Water Absorption

Small Colon
- 3-3.5m long, 20L capacity
- Water Absorption
- Segmentation

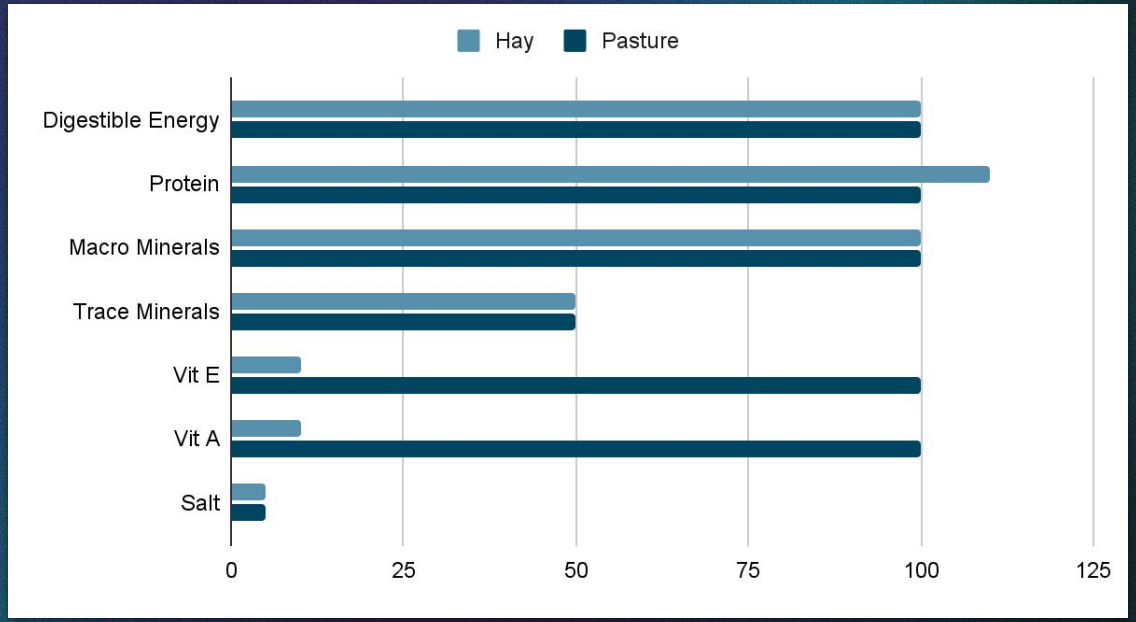
The Hindgut:
Fermentation Organs

Microbiology

- Each mL caecal fluid contains
  - 10-50 bil bacteria, 1 mil protozoa, yeast and fungi
  - ~400 species of microbes
- Complex interactive web of organisms
  - Changes to populations, affect other populations
  - Waste products of some are food for others

Nutritional Requirements

Daily Nutrient Requirements met by Hay vs Pasture



Digestible Energy DE

The amount of energy in the diet that is absorbed by the horse.

DE requirements are calculated based on the horse's energy required for maintenance + energy expended during exercise.

Components of DE

- Simple sugars
- Non Structural CHO
- Structural CHO (Fiber)
  - VFAs by-products
- Crude Protein
- Fats

Non-Structural CHO & Simple Sugars

- Digested and absorbed in SI
  - Glucose end product
- Source of quick onset energy
- Important for our competitive horses
- Triggers Insulin release from pancreas
- Excess should be avoided in our EMS horses
- Excess is fermented in caecum/colon

- Feeding Requirements
  - <13% Non-EMS & senior horses
  - <15% Growing and high-performance horses
  - <11% EMS horses

Sources

Hay, pasture
Grains
Pellets and binding agents
Treats, apples, carrots

Structural CHO & Fiber

- NOT digested or absorbed in SI
- Fermented in Caecum/Colon
- Rate depends on type of fiber
  - Starch and fructans rapidly ferment
  - Hemicellulose and pectins
  - Cellulose and pectins
  - Lignins, silica and some cellulose not fermented

- VFA end products of fermentation
- Ratios vary with plant cell structure
- VFA converted to energy or glucose
- Source of slow release energy

Sources

Hay, pasture
Grain hulls
Beet pulp
Soy hulls

Crude Protein (CP)

- Digested and absorbed in SI only
- Excess CP is fermented in Caecum/Colon

- Composed of 22 amino acids
- Poor quality/imbalanced amino acids are metabolized and excreted thru kidneys
    - Analysis can be misleading

- Feeding excess should be avoided in horses with kidney disease and seniors*
- Seniors have increased need for CP but also may have kidney function loss

Sources

Hay, pasture
‘Meals’

Amino Acids

- Non-essential vs Essential Amino Acids
  - 12 of 22 AAs are synthesized by horse (Non EAA)
  - 10 others need to be in feed (EAA)
- Essential vs Limiting AAs
  - Some EAA are bountiful in feed
  - Most deficient EAA are called ‘Limiting EAAs’
- Quality protein source is one that includes limiting EAAs
  - Lysine
  - Methionine
  - Threonine
- Quality vs Quantity
  - Barrel Analogy

Fats

- No specific requirements for fat in horses
- Typical diet of pasture, hay and concentrate is generally low in fat (2-4% of DE)

- No bile duct to store bile salts
- Horses can tolerate more fat if introduced slowly
- Liver needs time to adjust to additional bile salt production

- Fats should be avoided in horses with liver disease

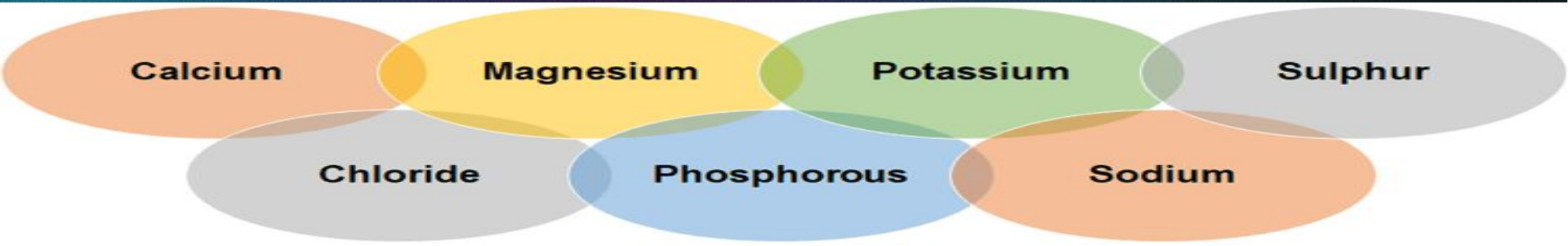
Sources

Oils
Ground seeds

Macrominerals

Ca & P

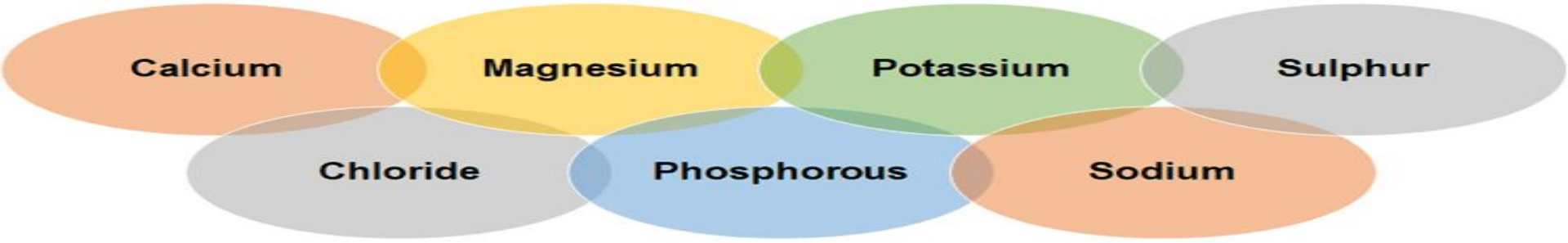
- Ratio is important : ~1.5-2:1
- Important for bone development, muscle function and growth
- Increased need in young (2x), late pregnancy (2x) and lactation (3x)
- Seniors require more P and less Ca (kidney disease)
- Deficiencies can lead to nerve and muscle dysfunction, orthopedic issues, lameness



Macrominerals

Na & Cl

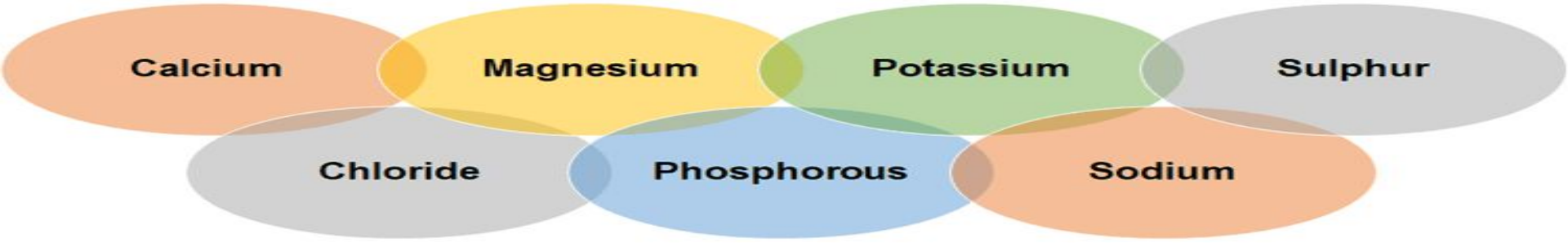
- Req ~ 50gm per day *varies with work and sweating
  - Can lose > 30gm (2 Tbsp) salt in 1-2 hrs heavy work
  - Mod exercise (2x), heavy exercise (4x)
- Important electrolytes, maintain fluid balance, acid/base balance, nerve and muscle function, and support digestion
- Deficiencies can lead to fatigue, tying up, muscle spasms, anhydrosis



Macrominerals

K

- High forage rations do not req supplementation
  - Exception: acute large losses (endurance)
  - K greater (1.5-1.8x) to replace loss in milk, sweat and urine due to kidney failure
- Important electrolyte, maintains fluid balance, nerve and muscle function, and cell function
- Deficiencies can lead to fatigue, weakness, muscle tremors, anorexia



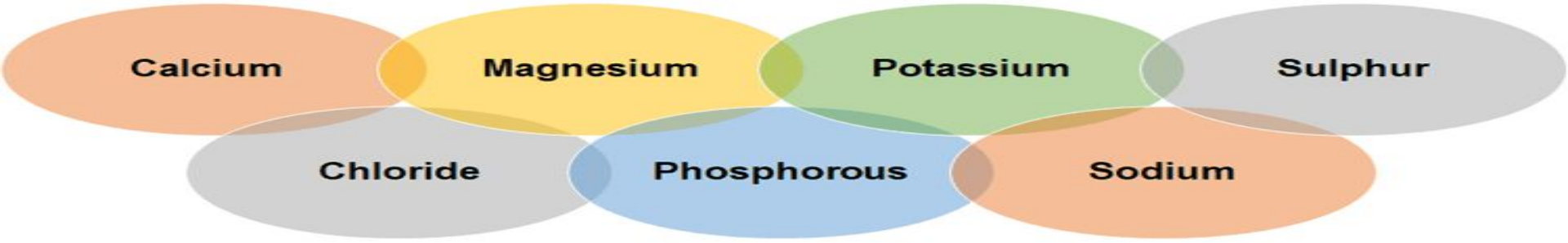
Macrominerals

Mg

- High forage rations usually meet Req
- Mg greater for exercising (2x) due to loss in sweat and lactating (3x) due to loss in milk
- Important for muscle and nerve function, energy metabolism, insulin sensitivity and bone formation
- Deficiencies are rare but low Mg can cause excitation, GI issues

S

- Usually adequate if CP Req met
- S containing aa (methionine) and vitamins (biotin) essential for hoof growth
- Deficiency may contribute to poor hoof quality



Trace Minerals

Co

- Important in B12 synthesis, RBC formation, metabolism
- Incorporated into Vit B12 in Caecum/Colon

Cu

- Low levels found in our pastures, soils, water
- Important antioxidant, hoof and coat quality
- Req ~100-200 mg/day, more for performance, pregnancy, lactation
- Cu deficiency may cause OCDs in young, aortic rupture in adults, anemia and pigmentation loss

Zn

- Low levels found in our pastures, soils, water
- Important antioxidant, hoof and coat quality
- Req ~400-800 mg/day, more for performance, lactation
- Deficiency can cause poor growth rates, hair loss, skin lesions, white line disease, hoof cracks and inappetance

Trace Minerals

I

- Iodized salts in feeds and blocks fulfill requirements
- Req 35 mg/kg feed or 40 mg/kg pregnant mares
- Excess can cause goiter in mares and foals

Fe

- High levels found in our pastures, soils, water
- Reg 40 mg/kg feed, 50mg/kg for pregnant/lactating mares

Se

- Low levels found in our pastures, soils, water
- Important antioxidant, muscle function and immune function
- Req ~ 1-3 mg/day
- Deficiency can cause white muscle dz, tying up, retained placenta, fertility issues, heart failure

Vitamins

Vit A & E

- Requirements easily met in fresh green pasture
- Horses grazing for 3-4 mths/year store enough Vit A or E for another 3-6 months
- Rapid degradation in hay

Vit A

- Req 30 IU/kg BW (15,000 IU/500kg horse)
- Increased needs for pregnant/lactating mares (2x)
- Converted from beta-carotene in green forage
- Important for immune function, vision, reproduction
- Deficiency can cause impaired growth, infertility, eye disease, susceptibility to infection

Vitamins

Vit E

- Req 1-5 IU/kg BW (500-2500 IU/500kg horse)
- Increased need for sport, lesson, endurance horses (2x)
- Important antioxidant, inflammation modulator, nerve and muscle function
- Deficiencies can cause Equine Motor Neuron Disease, Equine Degenerative Myeloencephalopathy, muscle tremors, weakness, abnormal sweating
- Enhances absorption of Se

Vitamins

Vit D

- Horses exposed to > 4 hrs sunlight per day or consume sun-cured hay do not have dietary requirement for Vit D
- Req 500 IU/kg feed adults or 1000 IU/kg feed young
- Important for bone, muscle and immune function

Vit K and B Vitamins

- Synthesized in adequate amounts in the digestive tract, caecum and colon
- B Vitamins important for energy generation, nervous system function and RBC formation
- Vit K important for blood clotting, bone health, immune function

Biotin

- Req 15-25 mg/day
- Improves hoof growth and quality, skin and coat health

Hay: How to Choose

Feeding Requirements

- 2% Body Weight rule of thumb
- Higher (3% BW) for ‘Hard-keepers’
- Lower (1.5% BW) for ‘Easy-Keepers’ and EMS
- Fed as hay (with functional dentition)
- Fed as hay cubes or pellets (with poor dentition)
- Can supplement with other fiber sources (if needed)

NSC in hay types

Alfalfa ~ <11% NSC
Timothy ~ 10-15% NSC
Local grass ~ 12-18% NSC
Teff ~ < 11% NSC

Feeding Requirements

- <13% Non-EMS & senior horses
- <15% Growing and High-performance horses
- <11% EMS horses

NSC Too high?

Soaking for 60 min in cold water or 30 min in hot water

Study showed soaking can reduce NSC between 3%-30% **BIG RANGE**

Drain water after soaking

Soak once daily then hang all meals to dry

Do not over-soak - will ferment

Spraying doesn’t help

Does not affect protein concentration

Will leach Vitamins and Minerals

Structural Fibers

Acid Detergent Fiber (ADF)

- Least digestible part of the plant
- More mature plants have higher ADF (1st cut hay)
- High ADF +% = Lower Digestibility
- Recommend ADF <40%

Neutral Detergent Fiber (NDF)

- Represents total cell wall content
- High NDF % = Lower palatability
- Includes ADF + Hemicellulose
- Recommend NDF between 50-60%

CP in hay sources

- Grass ~ 9-11% CP (Range 6-14% CP)
  - Local grass hay 6-10% CP, high NSC
  - Usually needs other supplemental hay
- Teff ~ 11-13% CP (Range 10-14% CP)
- Timothy ~ 12-14% (Range 10-16% CP)
  - Good single hay source
  - Often good choice for allergenic or EMS horse
- Alfalfa ~ 20-22% CP (Range 18-24% CP)
  - Excess is fermented in Caecum/Colon

Requirements vary with age

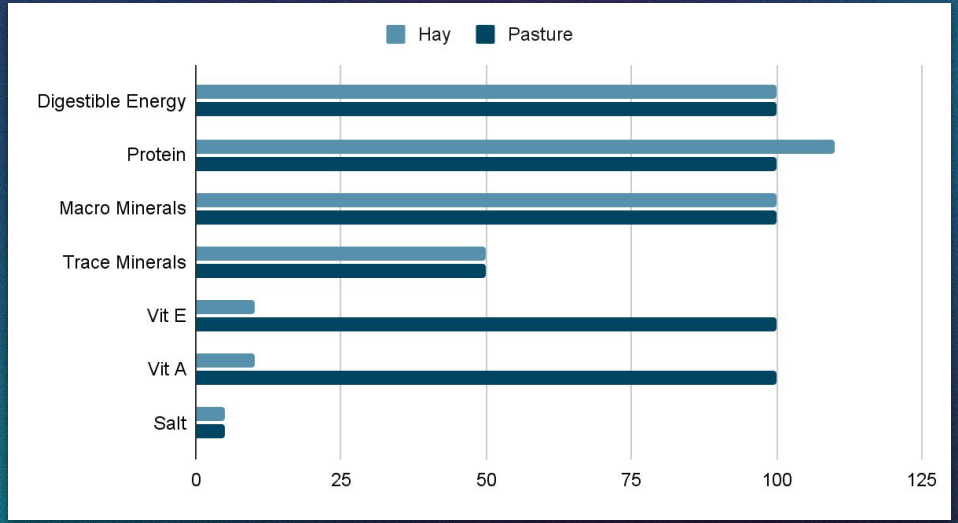
- Young/growing/pregnant 14-16%
- Adult performance 10-14%
- Adult maintenance 10-12%
- Senior 12-14%

Suboptimal protein or amino acid levels in the diet can cause:

- Loss of muscle mass
- Poor growth
- Slow recovery from illness
- Poor performance
- Rough coat
- Weak hooves
- Early pregnancy loss
- Impaired immunity
- Poor wound healing

Basic Supplementation

Daily Nutrient Requirements met by Hay vs Pasture



Basic Requirements:

- Good quality hay
  - adequate DE and Protein
- Some vitamins and trace minerals
- Salt

Now what?

Protein Supplementation

Alfalfa

- Should not exceed 50% hay by weight
- Avoided in horses with EMS/IR
  - Leaves high in NSC/Simple sugars
- Avoided in horses with allergies

Fat Supplementation

- For weight gain
  - No-sugar calorie source
  - Horses with poor dentition or ‘hard-keepers’
- Max 2 cups oil /day in divided meals
  - Increase by ¼ cup weekly

Omega FA

- Omega 3 FA : Anti-inflammatory
- Omega 6 FA : Skin and coat health
- Ratio is important : 2-4:1

Type of Feed	Amount	Omega 3 FA (g)	Omega 6 FA (g)	Tocopherol (IU)
Pasture	22lbs	100-150	25	1100
Hay	22lbs	18-100	5	0
Fresh Ground Flax	100gm	22	5	20
Soaked Chia Seeds	15gm	10	3	
Flax Oil	15mL (1 Tbsp)	8	2	75
Hemp Oil	15mL (1 Tbsp)	3	7.5	15
Camelina Oil	15mL (1 Tbsp)	4	3	15
Canola Oil	15mL (1 Tbsp)	1.5	2.8	
Corn Oil	15mL (1 Tbsp)	0	8	

Electrolyte Supplementation

Na Cl
- Will seek out and consume NaCl to meet their needs
  - May consume excess due to boredom (fresh water!)
  - May eat dirt if no salt source is available

K
- Soaking hay with leach K as well as sugars
- Forced doses of large quantities can trigger fatal cardiac arrhythmias

Mg
- Higher doses can cause sedation and/or diarrhea

Ca
- Legume hay high in Ca
- Higher doses can lower Vit A levels

Electrolytes lost in sweat
- Major : Na, Cl, K
- Minor : Ca & Mg

Selenium Supplementation

- Daily requirement is 1-3 mg/day
- Two main formulations
  - Salt-based / “Inorganic” - 50% absorption
  - Yeast-based / “Organic” - 90% absorption (Greater bioavailability)

Narrow safety range - toxicity is possible

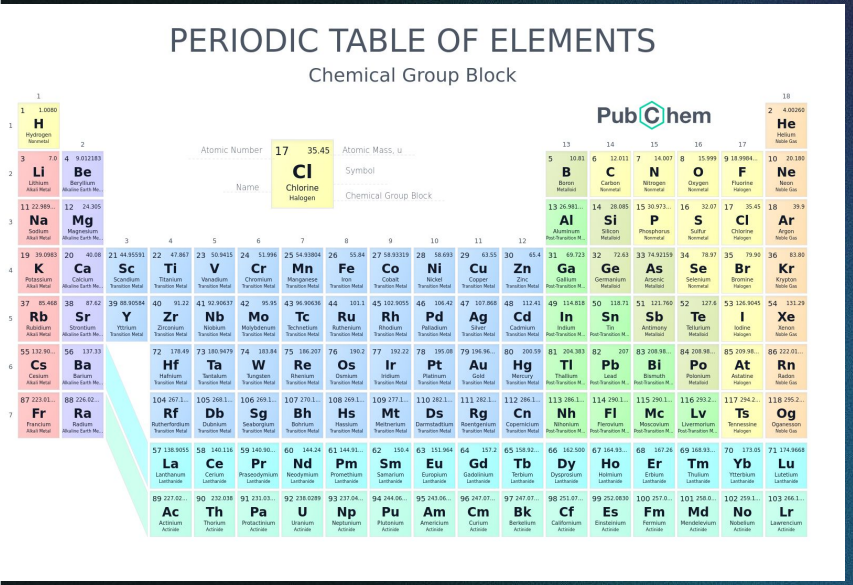
Selenium Toxicosis signs:
Blindness, head pressing, hoof deformities, hair loss, colic, diarrhea, sweating, lethargy, elevated heart and respiratory rates

Zn & Cu Supplementation

- Daily Requirements are 400-800mg Zn and 100-200mg Cu
- Ratio of 4:1 is important
- Two main formulations
  - Salt-based / “Inorganic” (Sulfates & Oxides)
  - Protein-based / “Organic” / Chelated
    - Methionine > Glycine

    (Greater bioavailability)

Trace Mineral Supplementation



Competition for absorption by divalent ions (2+): Fe, Cu, Zn, Ca, Se

Excess Fe & Ca in our feeds and waters may impair absorption of already deficient trace minerals

- Excess Fe (water/soil/forage) may inhibit Se, Cu, and Zn absorption
- Excess Ca (alfalfa) may inhibit Se, Cu, and Zn absorption
- Excess Cu suppl may inhibit Zn absorption
- Excess Zn suppl may inhibit Cu and Se absorption

So what should we mix our supplements in?

Vit A Supplementation

Usually supplemented as Retinol compounds
    Stable in feeds and supplements

Converted to Vit A in the liver

Rec'd 15,000-30,000 IU/day
Maximum is 16,000 IU/kg feed

Vit A toxicity is possible but unlikely
    can cause bone fragility, skin lesions, bone spurs, developmental orthopedic defects

Usually added to a general vitamin & mineral supplement

Vit E Supplementation

Highly susceptible to degradation/oxygenation
Unstable in feeds and supplements

Two forms:
Artificial dl-alpha-tocopherol - poor absorption
Natural d-alpha-tocopherol - good absorption

Two formulations:
Powder form - less stable
Oil form - more stable and better absorption

Rec'd dose 500-1000 IU/day
Maximum of 10,000 IU/day

Vit E toxicity is possible but unlikely
can cause spontaneous bleeding

Biotin and B Vitamins Supplementation

- Beneficial to add to Zn-Methionine and Cu for hoof growth and quality, skin and coat quality
- Supplementation helpful after diet change or major GI disturbances
- Rec dose 15-25 mg/day