Vitamin A

Importance

- Maintenance
- Growth
- Reproduction

- Thus if no Vitamin A, animal will stop growing and die
Vitamin A

- Animals store Vitamin A in their liver.
  - Especially when grazing green grass because they can convert carotene to vitamin A.
Vitamin A

Conversion rates vary with species:

- Rats/Poultry: 1 mg beta carotene = 1667 IU
- Cattle, sheep, horse: 1 mg beta carotene = 400 IU
- Swine: 1 mg beta carotene = 200-500 IU
- Cat's can't convert beta carotene to Vit A
Vitamin A deficiency

Most deficiencies occur in late winter when no green grass is available

- Feeding corn stalks
Vitamin A deficiency

- Most deficiencies occur in late winter when no green grass is available
  - Feeding corn stalks

- Eye problems
  - Epithelial tissues of the eye affected
  - Watery eyes
  - Night blindness
Vitamin A deficiency

- Rough hair coat, swollen legs in cattle

Photo courtesy of Irlbeck (CSU)
Vitamin A deficiency

- Incoordination followed by posterior paralysis in growing pigs

Photo courtesy of Irlbeck (CSU)
Vitamin A deficiency

- Reduced egg production and hatchability

Photo courtesy of Irlbeck (CSU)
Vitamin A Toxicity

Of all the vitamins, Vitamin A is the most likely to present toxicity problems

- Monogastrics
  - 4-10 times the requirements
- Ruminants
  - 30 times the requirements

Symptoms
- Skeletal malformations; reduced growth; reproductive failure
Vitamin A Sources

- Green plants contain carotene
  - Alfalfa hay is high in Vitamin A
    - But does leach out so 2-year old hay is low

- Mineral mixes

- Vitamin A injections

- Vitamin A and carotene are susceptible to destruction by oxidation
Vitamin D Importance

- Bone formation
- Growth
- CHO metabolism
- Absorption of calcium and P from the small intestine
Vitamin D Deficiency - Rickets

Photo courtesy of Irlbeck (CSU)
Vitamin D Deficiency

- Soft egg shells
- Reduced growth and leg weakness

Photo courtesy of Irlbeck (CSU)
Vitamin E Importance

- **Strong antioxidant**
  - Along with Se it prevents the breakdown of cell membranes by free radicals

- **Immune system**
  - Primarily in monogastrics

- **Muscle structure**

- **Reproduction**
Vitamin E Deficiency

Nutritional muscular dystrophy

Related to Selenium

- White muscle disease in calves and lambs
- Vit E (and Se) can prevent and correct WMD
Vitamin E Deficiency

- Liver necrosis in swine
- Brain degeneration in poultry
- Retained placentas
- Low fertility
Vitamin E Toxicity

- Relatively nontoxic
- Utilization dependent upon adequate Se

Research is looking at feeding high dietary levels of Vit E to improve meat quality

- More Vitamin E in tissue
- Longer shelf life because of decreased oxidation
Vitamin K Importance

- **Blood clotting**
  - If feeding sweet clover, need Vitamin K
  - Warfarin
    - Rat poison that produces internal bleeding

- **Activation of prothrombin (plasma protein)**
  to create calcium binding sites
Vitamin K

- **Deficiency**
  - Spontaneous hemorrhages
  - Increased blood clotting time

- **Toxicity**
  - Relatively non toxic
Vitamin K Sources

- Synthesized in rumen
- Swine and poultry need Vitamin K
  - Coccidiosis increases K requirement
- Green forage, well cured hays; fish meal
Thiamine - B1

- Conversion of pyruvate to acetate
- CHO Metabolism
Thiamine - B1

- Usually not deficient unless thiaminases are present in digestive tract to destroy thiamine
Sources of Thiaminases

- **Ferns**
  - Bracken fern poisoning causes thiamine deficiency in horses

- **Bacteria**
  - *Clostridium sporogenes* are high in gut of animals on high concentrate diets
Symptoms of Thiamine Deficiency

Polioencephalomalacia (PEM)

- Induced thiamine deficiency
- Rubbing head on post
- Wasting away appearance

“Applied Animal Nutrition” by Cheeke

This case was caused by Bracken Fern poisoning
Symptoms of Thiamine Deficiency

- Scours
- Weight loss
- Head retraction

Photo courtesy of Irlbeck (CSU)
Prevention of PEM

- Primarily in Feedlots
  - Add 1 mg thiamine per head per day
  - Feeding ionophores may help prevent PEM

- Avoid Ferns
Riboflavin - B2

- **Importance**
  - CHO and protein metabolism
  - Most likely to be deficient in swine and poultry
    - Grains and plant proteins are low in B2

- **Synthesized in rumen**
B2 Deficiency Symptoms

- Curled toe paralysis in chicks
- Reduced egg production and hatchability

Photo courtesy of Irlbeck (CSU)
B2 Deficiency Symptoms

- Skin lesions, reduced growth, high neonatal mortality in pigs
  - Hairless dead piglets
- Moon blindness in horses
  - Horses more susceptible when fed poor quality hay
Niacin

- **Importance**
  - Energy metabolism (along with Riboflavin)
  - Enhances protein synthesis

- Also known as Nicotinic Acid
Niacin Deficiency

- Cereal grains (esp Corn) are low in niacin

- Humans - Pellegra
  - Fiery red tongue
  - 3 D’s - diarrhea, dermatitis, dementia
Niacin Deficiency

- **Swine**
  - Poor growth
  - Dermatitis, diarrhea, intestinal lesions

- Litter mates where the smaller pig did not receive nicotinic acid in its ration
Niacin Deficiency

- **Poultry**
  - Dermatitis (poor feathering), leg problems

- **Dogs** - black tongue

Photo courtesy of Irlbeck (CSU)
Notes on Niacin

- Not available from grains for swine
  - Must be synthesized from surplus tryptophan in body tissue
    - Raw soybeans contain a tryptophan inhibitor

- Used in dairy rations during post-partum period
  - Research indicates it may prevent ketosis in dairy cattle
  - 12 g / cow per day
Pyradoxine - B6

- **Importance**
  - Protein metabolism
  - Red blood cell formation

- **Deficiency**
  - Seldom deficient except when feeding linseed meal
B6 Deficiency Symptoms

- Convulsions, dermatitis, impaired reproductions

Photo courtesy of Irlbeck (CSU)
Pantothenic Acid

**Importance**
- Metabolic role in forming Vit A

**Sources**
- High in barley, wheat, and SBM
- Low in corn and sorghum
- Commonly deficient for swine or poultry
Pantothenic Acid Deficiency

- Reduced growth, dermatitis, neurological defects
- Loss or graying of hair

Photo courtesy of Irlbeck (CSU)
Pantothenic Acid Deficiency

- Goose-stepping gait in swine

Photo courtesy of Irlbeck (CSU)
Biotin

**Importance**
- CHO and Fat metabolism

**Sources**
- Widely available but low in wheat, barley, sorghum and oats
Biotin

Deficiency

- Wheat based diets in poultry
- Raw egg whites contain avidin - a biotin antagonist
- Can be used to induce biotin deficiency
Biotin

Symptoms

- Dermatitis and cracks in feet
- Poor growth
- Loss of hair or feathers
- Poor reproduction

Photo courtesy of Irlbeck (CSU)
Folic Acid Importance

- Synthesis of hemoglobin
- Related to B12 metabolism
- Reproductive performance in swine
- Increase in litter size
Folic Acid Deficiency

- Anemia
- Poor growth
- Unlikely to be deficient for livestock
Vitamin B12

Importance

- Synthesis of hemoglobin (with Folic Acid)
Vitamin B12 Sources

- **Synthesized by rumen**
  - Cobolt needed for synthesis in rumen
  - New born calves need 45-60 days to have functional rumen so it can be synthesized
    - Usually get enough from mother’s milk
    - Stressed/weaned calves can be helped with a Vitamin B12 shot.

- **Essential for swine and poultry**
Vitamin B12 Deficiency

- **Symptoms in Monogastrics**
  - Reduced growth
  - Anemia
  - In humans it is called pernicious anemia
  - Poor reproduction
  - Hatching problems in chicks
Vitamin C - Ascorbic Acid

Importance
- Only essential for primates and guinea pigs
Vitamin C - Ascorbic Acid

- **Deficiency Symptoms**
  - Usually not deficient unless animal is under great stress
  - Egg shell quality
  - Resistance to heat stress

- **Sources**
  - Used very little in feed industry