

Proteins



EQUINE NUTRITION #16
CREATED FOR CANADIAN PONY CLUB
EDUCATION
BY LEZAH WILLIAMSON

Proteins



- Proteins are structural - for building muscle, skin, and hair
 - Builds and repairs muscle tissue
- Other functions:
 - Produces enzymes
 - Catalysts that affect rate of reactions
 - Hormones
 - Transport compounds and nutrients around body
 - Formation of blood cells

Protein builds and repairs muscle tissue



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Proteins and amino acids



- The raw materials for synthesizing proteins come from the foods that are eaten
- Proteins are:
 - High weight molecules inevitable for all cell functions
 - Composed of long polymer chains of smaller molecules held together by peptide bonds
 - ✦ These are called **amino acids**
- There are 20 amino acids in protein synthesis
 - 8 are essential amino acids
 - ✦ An essential amino acid is one the body is incapable of synthesizing from other compounds

Amino Acids



- The most important factor in the digestibility of protein is the amino acid content
 - This determines the protein-to-energy ratio (PER) of the ration
- Amino Acids (A/A) are the building blocks of proteins
 - Proteins are made up of polymers or chains of amino acids in a unique sequence
- Two types:
 - *Essential*
 - ✦ Need to be supplied in the diet
 - *Non-essential*
 - ✦ Synthesized by the horse
 - ✦ Do not need to be provided in the diet

Essential Amino Acids



- Lysine – first limiting A/A
- Methionine
- Tryptophan
- Histidine
- Phenylalanine
- Leucine
- Isoleucine
- Threonine
- Valine
- Arginine

First Limiting Amino Acid



- First limiting A/A
 - Barrel analogy:
 - ✦ Imagine a wooden barrel with vertical slats. If one slat is shorter than the rest, the amount of anything that is stored in the barrel can only be contained to the height of the shortest slat. This shortest slat represents the limiting A/A
- A/A are present in the diet in the least amount relative to the requirements of the horse
 - *Lysine* is the first limiting amino acid
- **Protein quality is determined by the amount of *lysine* present**

Lysine and Methionine



- Lysine is the first limiting amino acid; methionine is a close second
- Supplemental lysine and methionine can be offered
 - Excess methionine can deplete copper and zinc
 - ✦ Copper and zinc deficiency can cause problems with the hoof wall

Protein Synthesis and the Limiting A/A



- If a diet is inadequate in any essential A/A, protein synthesis cannot proceed beyond the rate at which A/A is available (N. Carolina State University)
 - ✦ www.ncsu.edu/.../protein%20and%20amino%20acids/protaa.htm
- “If the rate of protein synthesis is lowered due to an inadequate supply of a limiting A/A then increasing the limiting A/A should increase protein synthesis” (Mitchell et al, 1946)

Ideal Protein



- Optimal performance (feed intake, weight gain) is achieved when feed contains an ideal amount and proportion of essential A/A
 - This is called an ‘ideal protein’

Availability of Amino Acids



- Availability of amino acids can be adversely affected by denaturing or oxidation due to long storage
- Worse if:
 - warm or if in sunlight
 - if improperly heated (pellets/extruded)
 - inadequately dried
- Therefore some feed companies add supplemental lysine (and other AA)

Crude Protein



- Crude protein (CP) is the level noted on a feed bag
 - This is based on the overall nitrogen content of feed
 - ✦ Not all nitrogen is protein bound
 - ✦ Nitrogen is also found in purines, creatinine, ammonium salts, nucleic acids, and urea
 - Urea is commonly found in cattle feed as it helps them digest
 - It does not harm horses but does not help them either
- Proteins contain 16% nitrogen +/- 2%
 - Nitrogen content of feed divided by 0.16 (or multiplied by 6.25) = crude protein
 - ✦ E.g., feed has nitrogen of 1.6% X 6.25 = 10% protein
- Most grain products are 2-5% lower in Digestible Protein (DP) than the crude protein numbers that are stated
 - Therefore 14% crude protein is actually 9-12% DP
- With hay, depending on the stage of bloom, sometimes only 50% of the protein is digestible

Protein Digestion



- Protein digestion starts in the stomach
- Protein is not stored, it is **degraded**
 - Degradation produces energy
 - Urea is also produced and excreted in the urine
 - ✦ This is added work for the kidneys
 - ✦ Causes water loss
 - ✦ May affect the acid-base balance
 - ✦ May affect calcium retention
- Breakdown of proteins is done by the enzyme pepsin
 - Enzymes from the pancreas and lining of the small intestine are capable of digesting proteins into individual amino acids, thereby permitting absorption into the bloodstream
- Proteins associated with the plant cell wall
 - Are not digested in small intestine
 - Go to large intestine, are broken down by microbes

High protein



- The horse needs an approximately 10% protein intake
- High protein intake can cause increased fluid loss through sweating and urination

Protein digestion in intestines



- Most proteins are decomposed to single A/A by digestion in the GI tract
- Biological value (BV) is the measure of the proportion of absorbed protein from food which becomes incorporated to proteins of the horse's body
- Protein digestion and absorption in the small intestine is of biological value to the horse
 - Contributes to amino acids in horse
 - There is no/very little absorption in large intestine
 - ✦ Supports microbial growth
 - ✦ Necessary part of diet

Protein and Exercise



- Exercise only uses proteins as an anaerobic fuel when carbohydrates are low
- Exercise only uses proteins as an aerobic fuel when lipid resources are low

Protein deficiency



- Protein makes up 80% of a horse's body (once fat and water weight is removed)
- Therefore a protein deficiency is very detrimental
- Decrease in protein intake results in:
 - Weight loss, poor hair coat, decreased size
 - Fertility problems
 - Plasma protein and albumin levels may be decreased in severe deficiencies

Questions



- 1. What is protein?
- 2. What is an amino acid?
- 3. Compare and contrast the two types of amino acids.
- 4. Define limiting amino acid?
- 5. Which amino acid is the first limiting amino acid?
- 6. How much protein does a horse need in its diet?
- 7. Where in the digestive system is protein digested?
- 8. What are the symptoms of protein deficiency?