Nutrition For the Equine Athlete

By
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Progressive Nutrition
Primary Absorption

Site Quality Glucose

Hindgut Fiber Alcohol

Enzymatic
- Carbohydrates - glucose
- Protein - amino acids
- Fat - fatty acids

- fermentation
- volatile fatty acids
- B vitamins
Feeding Principles related to Anatomy

- Digestive system divided into two parts
  - Foregut
    - Enzymatic Digestion
      - Carbohydrates-Glucose
      - Proteins- amino acids
      - Fats- Fatty Acids
  - Hindgut
    - Fermentation
    - Volatile Fatty Acids produced
    - B-vitamins produced

- Stomach
  - Very small in relation to the rest of the digestive system
    - Only holds about ½ % of the horses bodyweight at any given time
  - Impaction at sphincter valve- stomach ruptures
  - Improper digestion of grains
    - Passing to hindgut
      - Leading to loose stools
      - Colic or founder
Feeding Principles related to Anatomy

- Constant acid secretion in stomach
  - Feed forage every 2-3 hours
  - Eliminate or limit whole grains
    - Lactic acid production upon digestion

- Small Intestine
  - Very long but small in diameter
    - Feed Hay free choice or every few hours 24 hrs/day
      - Keeps intestine full
        - Limits risk of twist, torsion, displacement type colics
      - Absorption takes place here
        - Forage can slow rate of passage allowing for increased absorption
Feeding Principles related to Anatomy

- Cecum
  - Organ primarily responsible for forage breakdown
    - Houses the microbial population of the horse
    - The microbes break down the forage and convert it into VFA’s and b-vitamins
  - Microbial population needs to remain healthy mainly by keeping pH level balanced
    - Normal pH is around 6.6-6.8
    - If pH falls to 6.5~ 80% of horses’ stools loosen
    - If pH falls to 6.0~ 80% of horses may founder
    - Undigested grain or high levels of starch
      - Can make it back to the hindgut if basic feeding practices are ignored
      - Lowers the pH as it further breaks down
      - Many times is responsible for disrupting gut pH as a high level of lactic acid accumulates
Feeding Principles related to Anatomy

• Continuous Grazers
  – Average horse will graze 18 hours per 24 hr day
  – When allowed to graze, can produce up to 30 gallons of saliva in 24 hrs

• Maintain Normal Gut Function
  – During chewing, saliva is produced
    • An excellent buffer to stabilize intestinal pH
      – Helps to keep ulcers in check
      – New research shows periodontal impact

• Reduces Boredom and Vices
  – Especially in Stress Situations like competition

• Can and does supply many of the necessary nutrients for your performance horse
  – Hay should be a min. of 50%, by weight, of your horses’ diet
    • Shoot for MINIMUM of 1.5-2% of body weight on performance horses
  – Hay is what will keep your horse warm in the winter
  – Choose highest quality hay when possible
Determining Forage Quality

• Maturity of the plant affects
  – Digestibility of the fiber
  – Availability of the protein, calories, major minerals, trace minerals and vitamins

• To determine quality visually
  – Look at the length of the seed head in grasses
    • Ideally want less than 2 inches
  – The percent of blossoms in bloom in legumes
    • Lesser amounts of bloom means higher quality
As all plants prepare to bloom, the Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) increase.

Unfortunately, as the fiber portion increases, all other nutrients decrease and become less digestible and available to the horse.

The stems become larger and fill with a substance called lignin

- Lignin is 100% non-digestible to horses
- If consumed it will continue to sit and/or build up in the cecum
Maturity of the plant when harvested will determine:

- Palatability
- Digestibility
- Availability of the nutrients
- The true value (RFV) of each type of forage
Relative Feed Value (RFV) of Grass, Mixed and Legume Forages

Hay Quality Standards For: Grass, Grass/Legume Mixed and Legume Forages:

<table>
<thead>
<tr>
<th>Quality Standard</th>
<th>ADF (%)</th>
<th>NDF (%)</th>
<th>DMI, % of B. Wt.</th>
<th>RFV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime (Prime)</td>
<td>&lt;30</td>
<td>&lt;40</td>
<td>&gt;3.0</td>
<td>&gt;151</td>
</tr>
<tr>
<td>1 (Premium)</td>
<td>31-35</td>
<td>41-46</td>
<td>3.0-2.6</td>
<td>150-125</td>
</tr>
<tr>
<td>2 (Good)</td>
<td>36-40</td>
<td>47-53</td>
<td>2.5-2.3</td>
<td>124-103</td>
</tr>
<tr>
<td>3 (Fair)</td>
<td>41-42</td>
<td>54-60</td>
<td>2.2-2.0</td>
<td>102-87</td>
</tr>
<tr>
<td>4 (Poor)</td>
<td>43-45</td>
<td>61-65</td>
<td>1.9-1.8</td>
<td>86-75</td>
</tr>
<tr>
<td>5 (Reject)</td>
<td>&gt;46</td>
<td>&gt;66</td>
<td>&lt;1.8</td>
<td>&lt;74</td>
</tr>
</tbody>
</table>

a Quality Grading Standard assigned by Hay Market Task Force of AFGC.
b Analysis associated with each standard.
c ADF = acid detergent fiber, and NDF = neutral detergent fiber
d Dry matter intake (DMI), % of body weight. **This is for mature horses only. Young growing horses will consume lesser amounts of this forage.**
d Relative Feed Value (RFV)
Minimum Amounts of Forage to Feed

– Average flake of Grass Hay weighs 3 lbs.
– Average flake of Alfalfa Hay weighs 4 lbs.

• Example:
  – 500 lb pony X 1.5-2.0% of Weight = 7.5-10 lbs/hay/day/min

• Example:
  – 1000 lb horse X 1.5-2.0% of Weight = 15-20 lbs/hay/day/min
• Calorie levels between excellent quality forages and cereal grains can be similar.

• Cereal grains average 3.0% and 4.0% fat, while forages will contain between 1.5% and 5.0% fat, depending on their maturity.

• Don’t overlook the fact that good quality forages can and do provide a significant amount of calories in a very economical fashion.
Protein and Amino Acids

• Horses truly don’t have a protein requirement, they have an amino acid requirement!!

• Meet at least minimum protein requirement from a high quality protein source
  
  – This means that the protein source is high in the “essential amino acids”
  
  – Soy based ingredients work great
    • full fat soybean, soybean meal, etc
    • Added essential Amino acids can also be beneficial
  
  – Amino acids are essential for muscle function, tissue turnover, hair and hoof quality, hormone production and balance, enzymes and anti-body production, etc…
Protein and Amino Acids

- There are 22 amino acids
- Only 10 of these are considered the Essential Amino Acids

- **P** Phenylalanine ~ prevents loss of pigment in skin/hair; CNS
- **V** Valine ~ muscle turnover and maintenance
- **T** Threonine ~ prevents fat buildup in liver; constituent of collagen
- **T** Tryptophan ~ increase feed intake; decrease nervous behavior
- **I** Isoleucine ~ protein synthesis and energy production
- **M** Methionine ~ Strengthens collagen; increases keratinization
- **H** Histidine ~ assists in controlling allergic diseases and arthritis
- **A** Arginine ~ protein synthesis and energy production
- **L** Leucine ~ muscle turnover and maintenance
- **L** Lysine ~ 1st limiting amino acid for growth; bone ossification
Protein and the Performance Horse

• Meet at least minimum protein requirement from a high quality protein source
  – Soy based ingredients (full fat soybean, soybean meal, etc)
    • Added Amino acids (lysine, methionine, cystiene, etc) can be beneficial
    – Necessary for muscle function, tissue turnover, hair and hoof quality, etc…
• Excess protein is not necessary
• Protein over and above what is utilized is deaminated and then converted into urea and fatty acids
  – Fatty acids are converted into energy
  – Urea (ammonia) removed from the body in the urine
    • Takes water to complete this process
      – Wetter stalls
    • Takes energy for this process to occur
      – Burns calories…. Therefore a wash as far as energy
      – Heat is also produced in this process
• Therefore: extra protein **will not** give you much from an energy standpoint
When feeding a grain mixture to a horse and you are looking at the percent crude protein, use the following example to determine how many pounds (or grams) of protein are being consumed/day:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>% Protein</th>
<th>lbs fed/day</th>
<th>Amt. of Crude Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet Balancer</td>
<td>30 %</td>
<td>1</td>
<td>.30 lbs. (136 gms)</td>
</tr>
<tr>
<td>Grain Mixture</td>
<td>15 %</td>
<td>2</td>
<td>.30 lbs. (136 gms)</td>
</tr>
<tr>
<td>Grain Mixture</td>
<td>10 %</td>
<td>3</td>
<td>.30 lbs. (136 gms)</td>
</tr>
</tbody>
</table>

The real question is, “What is the QUALITY of amino acids”? 
Effect of Quality Protein

Same Horse - 30 Days into Feeding Program with a Change to Good Quality Proteins (amino acids) in his Diet
Effect of Quality Protein

Same Filly - 30 Days into Feeding Program with a Change to Good Quality Proteins (amino acids) in her Diet
Calories in Horse Nutrition

• Forage Products
  – Most natural
    • Pasture or hay
    • Also alfalfa meal, grass meal, etc

• Cereal grains
  • Oats, corn, barley, wheat
  • Offers an energy dense feedstuff
  • Generally highest in starch and sugars of the calorie sources

• Roughage Products
  • Soy hulls
  • Beet pulp
  • Alfalfa meal
    – Generally lower starch, but have to be careful of digestibility
  • Rice hulls
  • oat hulls
  • ground straw

• Grain By-products are becoming more common
  • Wheat midds- excellent source of calories and fat; excellent pellet binder; poor source of protein
  • Distillers dried grains- excellent source of calories and fat; very low in non-structural carbohydrates; poor source of protein
The Facts on Fat as a Calorie Source

• Fat provides over twice as many calories per pound as grain
  – Many horses (intense work, lactating mares, etc) may not safely be able to eat enough grain to maintain body condition
  – Use fat products (vegetable) to increase calories and reduce the amount of grain
    • Reduces chances of digestive upsets

• Fat digested more efficiently than grain
  – Fat escaping digestion in small intestine does not upset the fermentation process like over graining will

• Adding fat to performance horse diets should help to increase stamina

• Horses showing signs of tying-up may benefit from using fat as a calorie source instead of grain
  – Can be helpful also on PSSM horses and Laminitic Horses that are underweight
  – These horses may need calories, but should not be fed any cereal grain
The Facts on Fat

• Using fat as an energy source as opposed to grain may help to keep your horses attitude more consistent
  – Replace cereal, starchy grains with vegetable fat

• When fat is added, there is less heat production during digestion which can be beneficial during hot weather

• Coat and skin condition should improve with the addition of fat
  – Degree dependent on source of fat- Omega 3 fatty acid sources have the greatest benefit.
Essential Fatty Acids

- Omega-3 and Omega-6 fatty acids yield distinct by-products with different biological activities.

- By-products derived from omega-6 fatty acids are more pro-inflammatory.

- By-products derived from omega-3 fatty acids are naturally anti-inflammatory.

- Imbalance of omega-6:omega-3 consumption can lead to altered physiological state:
  - Joint issues
  - Reproductive issues

- Most horse diets have sufficient omega-6 fatty acids, but are deficient in omega-3’s.
<table>
<thead>
<tr>
<th>Oil Sources</th>
<th>Percent Oil in the Seed</th>
<th>Percent Omega 3s in the Oil</th>
<th>Omega 6:3 Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flaxseed (Linseed)</td>
<td>36.0%</td>
<td>53.3%</td>
<td>1:4</td>
</tr>
<tr>
<td>Menhaden (fish oil)</td>
<td>100%</td>
<td>31.0%*</td>
<td>1:15</td>
</tr>
<tr>
<td>Canola (Rapeseed)</td>
<td>28.0%</td>
<td>12.9%</td>
<td>2:1</td>
</tr>
<tr>
<td>Soybean</td>
<td>18.0%</td>
<td>7.0%</td>
<td>7:1</td>
</tr>
<tr>
<td>Rice Bran</td>
<td>20.0%</td>
<td>0.8%</td>
<td>29:1</td>
</tr>
<tr>
<td>Corn (Maize)</td>
<td>3.6%</td>
<td>0.7%</td>
<td>84:1</td>
</tr>
<tr>
<td>Sunflower</td>
<td>19.0%</td>
<td>0.2%</td>
<td>199:1</td>
</tr>
</tbody>
</table>
Flesh (calories) vs. Muscle (amino acids)

- The largest increase in nutrient needs for horses in work are:
  - **Calories** ~ to maintain desired body condition
    - Calories can be provided through cereal grains, fats and digestible fibers (forage, by-products)
  - **Amino acids** ~ to maintain muscle and aid in muscle function

- Body Condition Scoring (BCS) is the best way to determine if you are meeting their individual caloric needs

- Muscle Development Scoring (MDS) can help us determine protein/amino acid status
Body Condition Score and Muscle Score
To Help Evaluate Condition and Nutrition

BODY CONDITION SCORE (BCS)
Score 1-9
Calories

MUSCLE AND TOP LINE (MDS)
Score A-E
Amino Acid Balance

(D) If Pass
Width of Hip vs.
Width of Stifle
Criteria

(E) If fail
to meet Hip/Stifle
Width criteria
• Width of hips vs. width of stifle

• Width of stifle should always be as wide or wider than the width of hip; if not, amino acids status in diet should be examined
• Obvious muscle deficiency around wither, back, loin & croup
• However, horse DOES have adequate BCS (no visible ribs)
• Muscle filled around wither, back, loin & croup (note muscle crease)
• Similar rib cover to last horse, BUT with a good MDS also
• Note the very sharp, hollow wither
• Note the tent shaped appearance of the topline.
• Notice the hollow areas on either side of the spine.
• Note the prominent spine and bony croup
• Muscling starts halfway between croup and tailhead
• Note the covered muscled wither

• Note the more rounded appearance of the topline as a whole

• Note the muscle surrounding the spine

• No more spinous processes visible
• The Recommended Allowances (RA) for protein, major and trace minerals and vitamins do not increase at the same rate as their calorie requirements.

• Many horse owners inaccurately base feeding levels solely on calorie requirements.

• Good flesh does not always mean proper nutrition as a whole.
Body vs. Muscle Scoring

Same Horse Day 1 and Day 100 of Feeding Trial
Other Nutrients Needed

In addition to forage (fiber), protein and calories... pay special attention to:

- Calcium, phosphorous, potassium, iron, selenium, Vitamins A and E, thiamine, Vitamin B12, and Folic Acid.
  - These have all been suggested to limit performance when deficient

Balance the TOTAL DIET

- Make sure horse needs nutrients being prescribed before adding and make sure you think through possible negative interactions
  - Sulfur (MSM) can interfere with selenium utilization and cause a physiological selenium deficiency even when proper dietary levels are provided.
  - Vitamin A excesses can impair formation of red blood cells and induce bone fragility (no more than 100,000 IU per day)
  - Vitamin D causes calcification of soft tissue such as blood vessels, tendons, kidney and heart tissue (no more than 10,000 IU per day)
  - Excessive Minerals may also interfere with absorption and utilization of other minerals.

- Look at the Whole Picture! Don’t add anything to the horses’ diet without considering how it affects the rest of the diet!
Trace Mineral Nutrition

- **Commonly Added:** zinc, copper, iron, manganese, iodine, cobalt, selenium, vitamins A, D, E, C and B vitamins

- **Functions:** Bone and cartilage formation, hoof, hair and skin health, reproduction, muscle and bone maintenance

- **Requirements:** Higher in horses that are pregnant, lactating, growing and training

- **Harmful Reactions:** High levels of trace minerals, major minerals, and vitamins can react with other nutrients making them unavailable
Minerals and Vitamins

• Amount of each mineral
  – Chelated vs. non-chelated
    • Proteinates/Polysaccharide Complexes
    • Sulfates and Oxides

• Balance between minerals
  – Ca:P Ratios
  – Other mineral interrelationships

• Over supplementation can be as detrimental if not more, than feeding a deficient diet!!
<table>
<thead>
<tr>
<th>Component</th>
<th>Grass Hay</th>
<th>Legume Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>6-12%</td>
<td>18-24%</td>
</tr>
<tr>
<td>Lysine</td>
<td>.2-.3%</td>
<td>.9-1.2%</td>
</tr>
<tr>
<td>Fat</td>
<td>1.8-5.5%</td>
<td>2-4.0%</td>
</tr>
<tr>
<td>TDN (Ruminant)</td>
<td>40-50%</td>
<td>60-65%</td>
</tr>
<tr>
<td>TDN (Horse)</td>
<td>35-45%</td>
<td>55-60%</td>
</tr>
<tr>
<td>A.D.F.</td>
<td>35-45%</td>
<td>25-35%</td>
</tr>
<tr>
<td>Nutrient</td>
<td>Grass Hay</td>
<td>Legume Hay</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.25-.80%</td>
<td>1.2-1.8%</td>
</tr>
<tr>
<td>Phosphorous</td>
<td>0.20-.30%</td>
<td>0.25-.35%</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.8-1.5%</td>
<td>2.0-3.5%</td>
</tr>
<tr>
<td>Iron</td>
<td>80-200 PPM</td>
<td>100-200 PPM</td>
</tr>
<tr>
<td>Copper</td>
<td>4-10 PPM</td>
<td>6-10 PPM</td>
</tr>
<tr>
<td>Zinc</td>
<td>15-26 PPM</td>
<td>15-28 PPM</td>
</tr>
<tr>
<td></td>
<td>Oats</td>
<td>Corn</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>Protein</td>
<td>10-12%</td>
<td>7-9%</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.4%</td>
<td>0.25%</td>
</tr>
<tr>
<td>Fat</td>
<td>4.0%</td>
<td>3.0%</td>
</tr>
<tr>
<td>TDN</td>
<td>60-70%</td>
<td>80%</td>
</tr>
<tr>
<td>Cr. Fiber</td>
<td>10-12%</td>
<td>2-3%</td>
</tr>
<tr>
<td>St. Bu. Wt.</td>
<td>32 lb/bu</td>
<td>56 lb/bu</td>
</tr>
<tr>
<td></td>
<td>Oats</td>
<td>Corn</td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.05%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Phos</td>
<td>0.34%</td>
<td>0.25%</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.48%</td>
<td>0.36%</td>
</tr>
<tr>
<td>Iron</td>
<td>75ppm</td>
<td>40ppm</td>
</tr>
<tr>
<td>Copper</td>
<td>5ppm</td>
<td>2ppm</td>
</tr>
<tr>
<td>Zinc</td>
<td>35ppm</td>
<td>10ppm</td>
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</table>