



Nutrition For the Equine Athlete

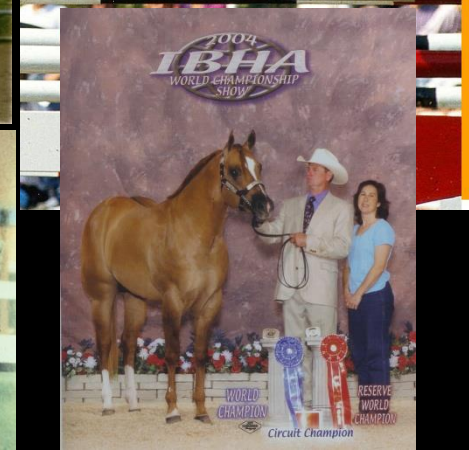
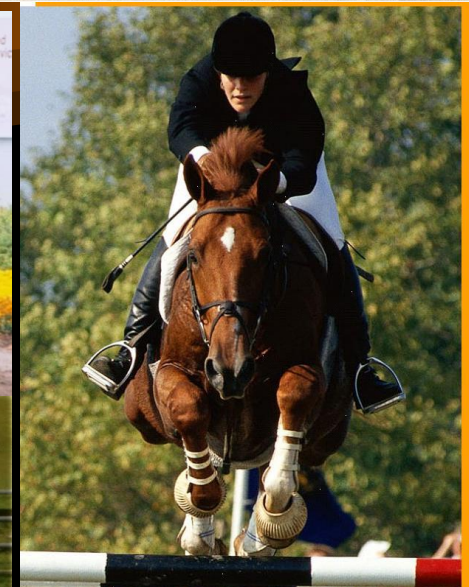
By

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Progressive Nutrition

Thanks to Raccoon Valley Pony Club



Primary Absorption

Site

Quality Glucose

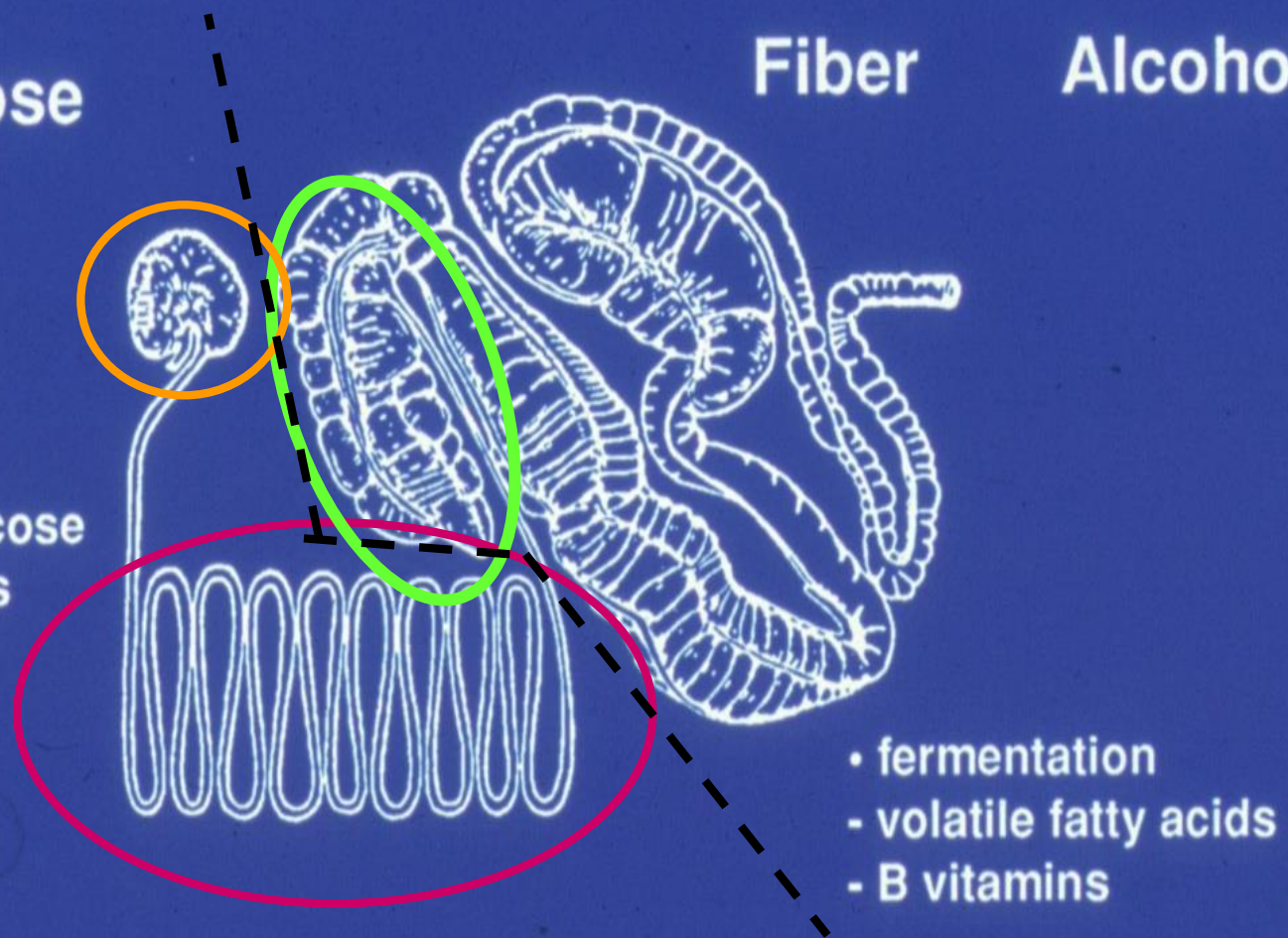
Enzymatic

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

Hindgut

Fiber

Alcohol



- 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

Determining Forage 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: Analysis^b (dry matter basis)

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

^a Quality Grading Standard assigned by Hay Market Task Force of AFGC.

^b Analysis associated with each standard.

ADF = acid detergent fiber, and NDF = neutral detergent fiber

^c 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 keritinization

 - **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**

Percent Crude Protein in Different Grain Mixtures

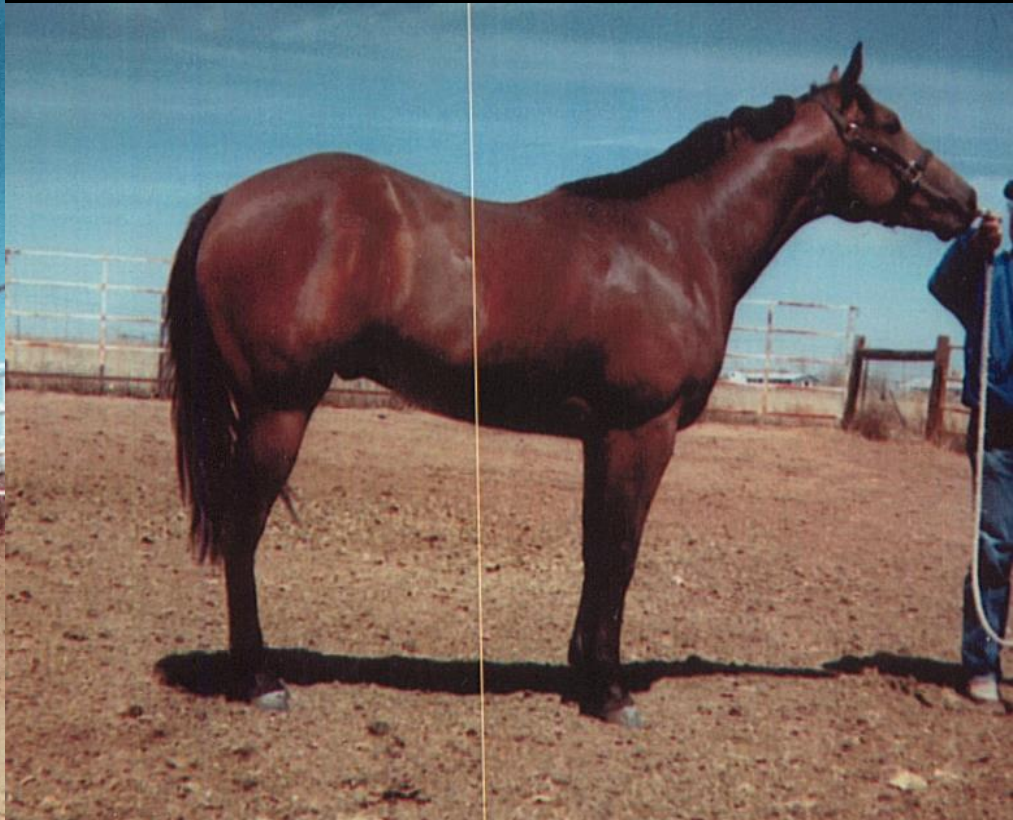
When feeding a grain mixture to a horse and you are looking at the percent crude protein, use the following example to determine how many pounds (or grams) of protein are being consumed/day:

<u>Ingredient</u>	<u>% Protein</u>	<u>lbs fed/day</u>	<u>Amt. of Crude Protein</u>
Diet Balancer	30 %	1	.30 lbs. (136 gms)
Grain Mixture	15 %	2	.30 lbs. (136 gms)
Grain Mixture	10 %	3	.30 lbs. (136 gms)

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
- Rice hulls
- oat hulls
- ground straw

- Generally lower starch, but have to be careful of digestibility

- **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**

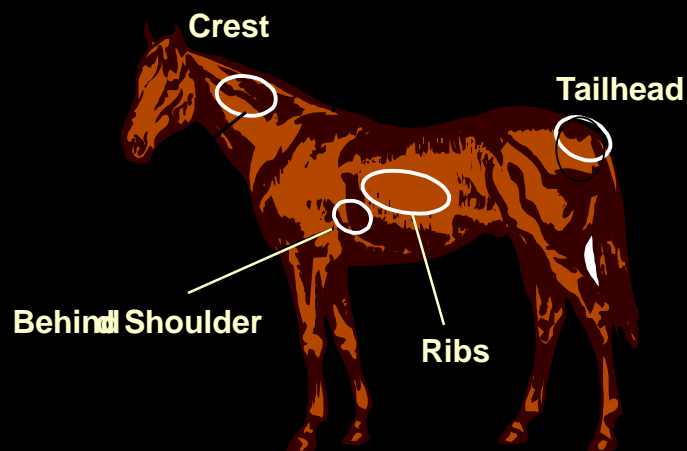
Fatty Acid Composition of Selected Oils

<u>Oil Sources</u>	<u>Percent Oil in the Seed</u>	<u>Percent Omega 3s in the Oil</u>	<u>Omega 6:3 Ratios</u>
Flaxseed (Linseed)	36.0%	53.3%	1:4
Menhaden (fish oil)	100%	31.0%*	1:15
Canola (Rapeseed)	28.0%	12.9%	2:1
Soybean	18.0%	7.0%	7:1
Rice Bran	20.0%	0.8%	29:1
Corn (Maize)	3.6%	0.7%	84:1
Sunflower	19.0%	0.2%	199:1

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**

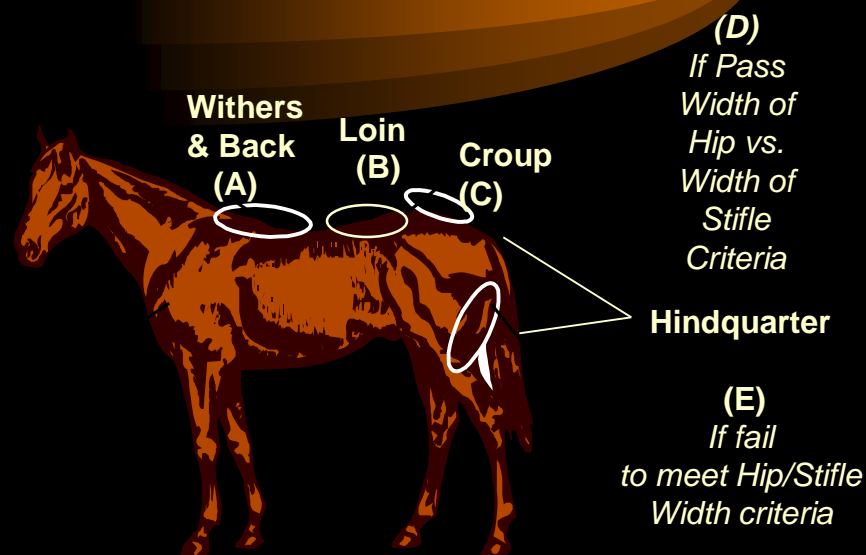
Body Condition Score and Muscle Score To Help Evaluate Condition and Nutrition



BODY CONDITION SCORE (BCS)

Score 1-9

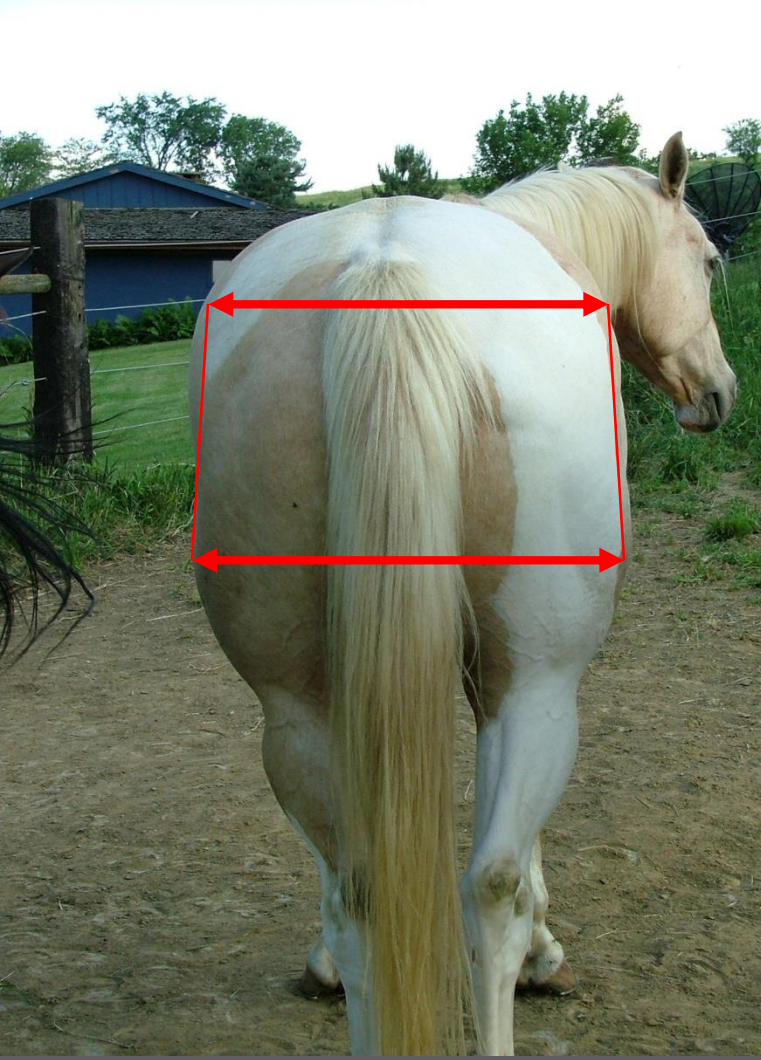
Calories



MUSCLE AND TOP LINE (MDS)

Score A-E

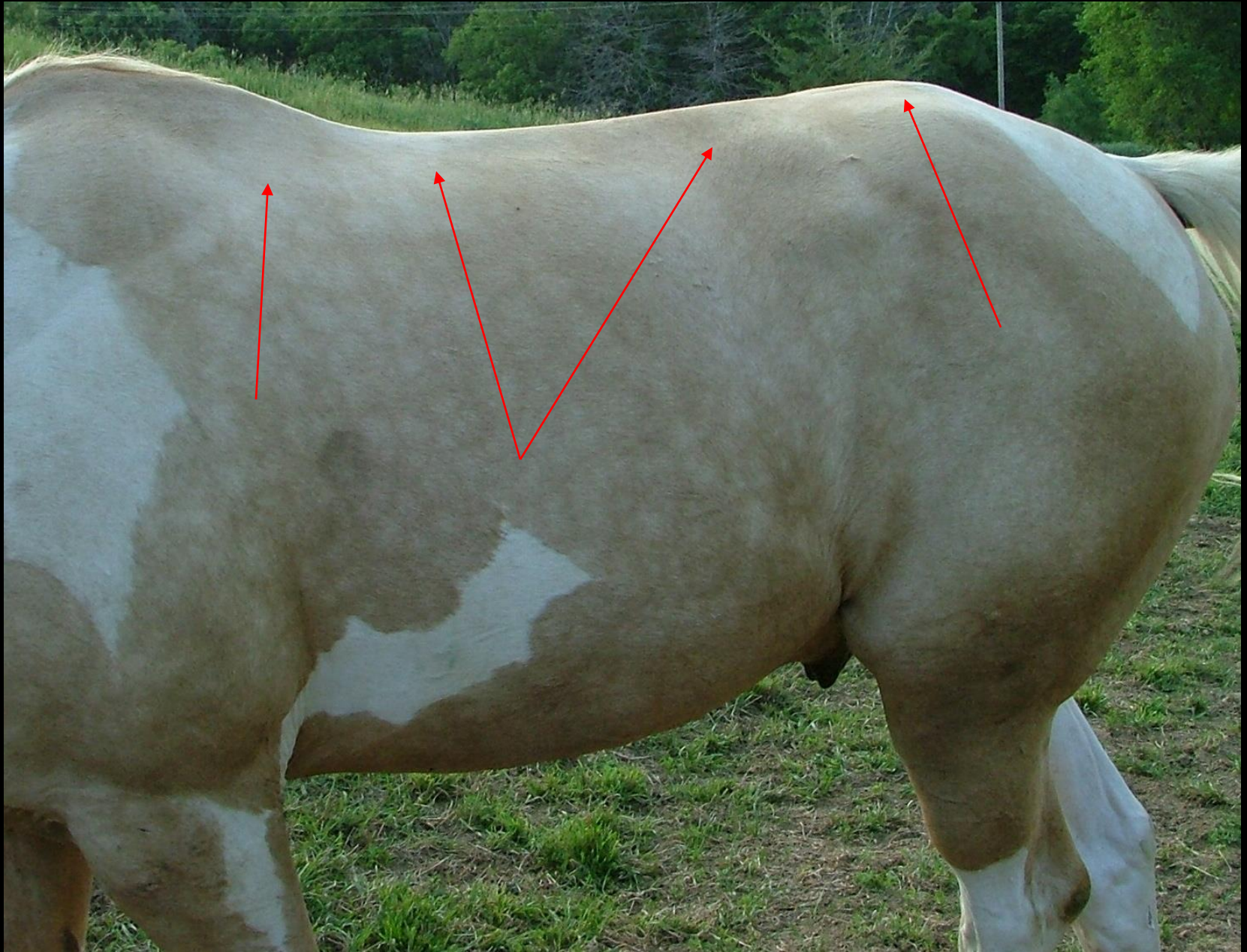
Amino Acid Balance



- 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



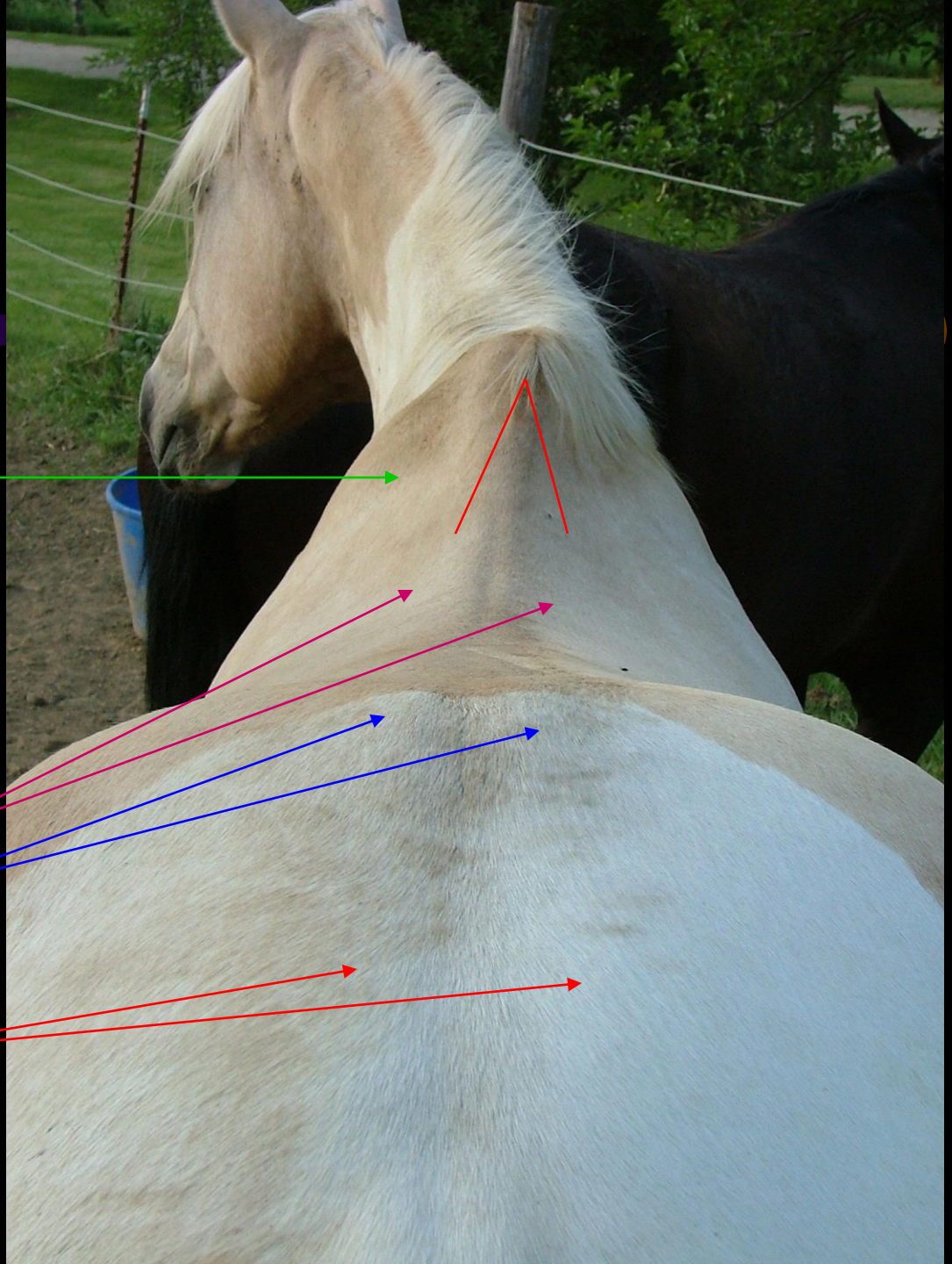
- Note the very sharp, hollow wither

- 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

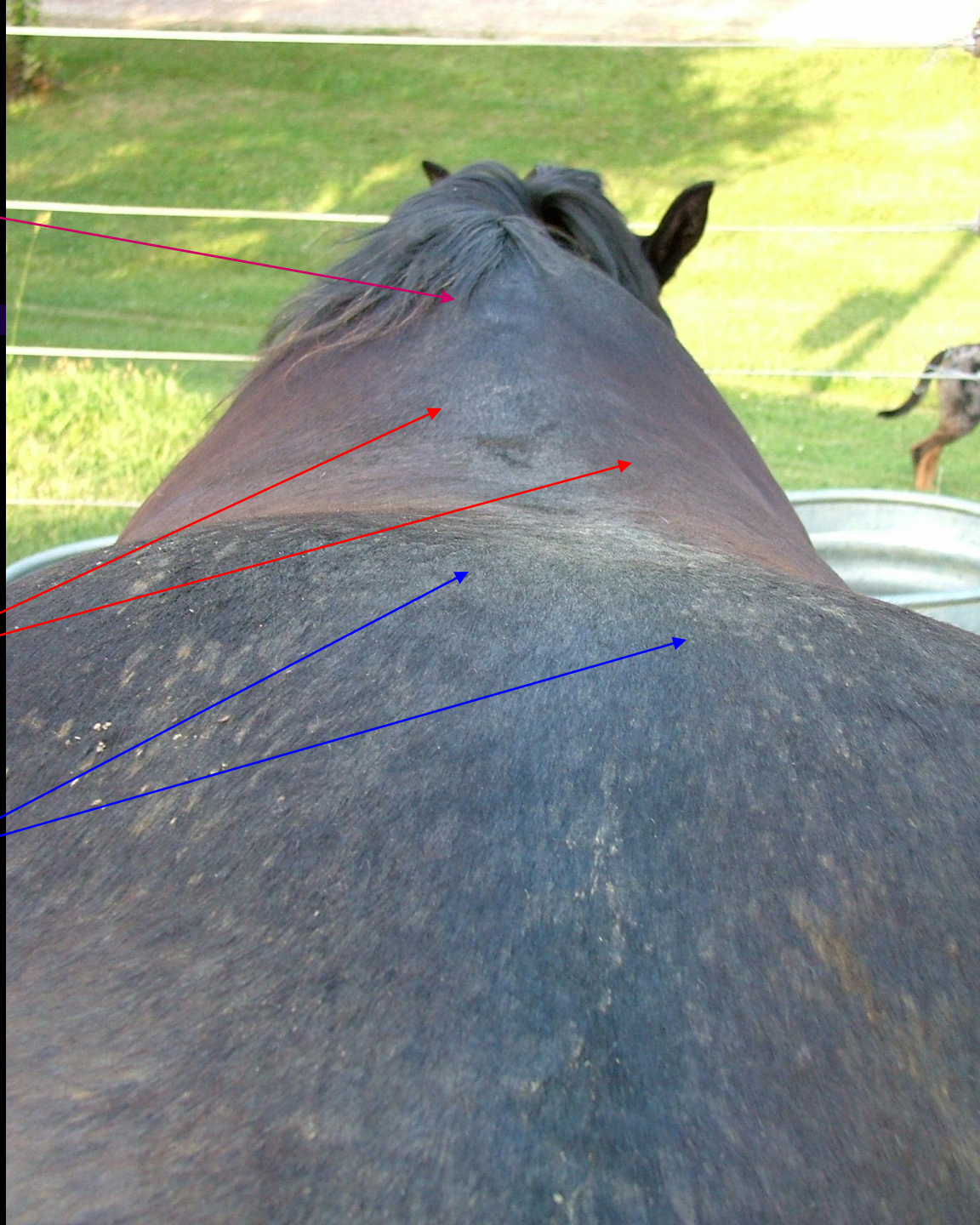


- Note the covered muscled wither

- 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!!

*GRASS
HAY*

*LEGUME
HAY*

PROTEIN

6-12%

18-24%

LYSINE

.2-.3%

.9-1.2%

FAT

1.8-5.5%

2 -4.0%

TDN (RUMINANT)

40-50%

60-65%

TDN (HORSE)

35-45%

55-60%

A.D.F.

35-45%

25-35%

*GRASS
HAY*


*LEGUME
HAY*

CALCIUM	.25-.80%	1.2-1.8%
PHOSPHOROUS	.20-.30%	.25-.35%
POTASSIUM	.8-1.5%	2.0-3.5%
IRON	80-200 _{PPM}	100-200 _{PPM}
COPPER	4-10 _{PPM}	6-10 _{PPM}
ZINC	15-26 _{PPM}	15-28 _{PPM}

Oats

Corn

*Soybean
Meal*



Protein	10-12%	7-9%	44-48%
Lysine	0.4%	0.25%	2.9-3.1%
Fat	4.0%	3.0%	1.0-1.4%
TDN	60-70%	80%	74-78%
Cr. Fiber	10-12%	2-3%	3-6%
St. Bu. Wt.	32 lb/bu	56 lb/bu	

Oats

Corn

*Soybean
Meal*



Calcium	0.05%	0.01%	0.35%
Phos	0.34%	0.25%	0.63%
Potassium	0.48%	0.36%	1.98%
Iron	75ppm	40ppm	100ppm
Copper	5ppm	2ppm	20ppm
Zinc	35ppm	10ppm	40ppm