

# Nutrition For the Equine Athlete

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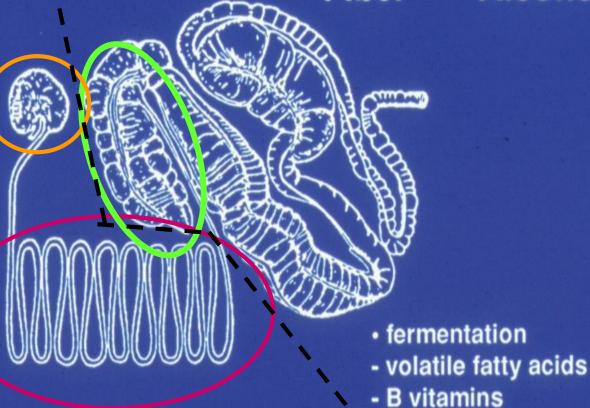
Primary Absorption
Site
Quality Glucose

Hindgut

Fiber Alcohol

#### **Enzymatic**

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



- 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

- 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

#### 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  $6.5 \sim 80\%$  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

- 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 (dry matter basis)

Qualit	y Standard <sup>a</sup>	ADF %	NDF %	DMI,°% of B. Wt.	$RFV^{\scriptscriptstyled}$
<b>Prime</b>	(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

- Quality Grading Standard assigned by Hay Market Task Force of AFGC.
- Analysis associated with each standard.
  - ADF =acid detergent fiber, and NDF = neutral detergent fiber
- <sup>°</sup> 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
  - Valine ~ muscle turnover and maintenance
  - **Threonine** ∼ prevents fat buildup in liver; constituent of collagen
  - **Tryptophan** ∼ increase feed intake; decrease nervous behavior
  - Isoleucine ~ protein synthesis and energy production
  - Methionine ~ Strengthens collagen; increases keritinization
  - Histidine ~ assists in controlling allergic diseases and arthritis
  - A Arginine ~ protein synthesis and energy production
  - L
     Leucine ~ muscle turnover and maintenance
  - L Lysine  $\sim 1^{st}$  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 <u>will not</u> give you much from an energy standpoint

# Percent Crude Protein in Different Grain Mixtures

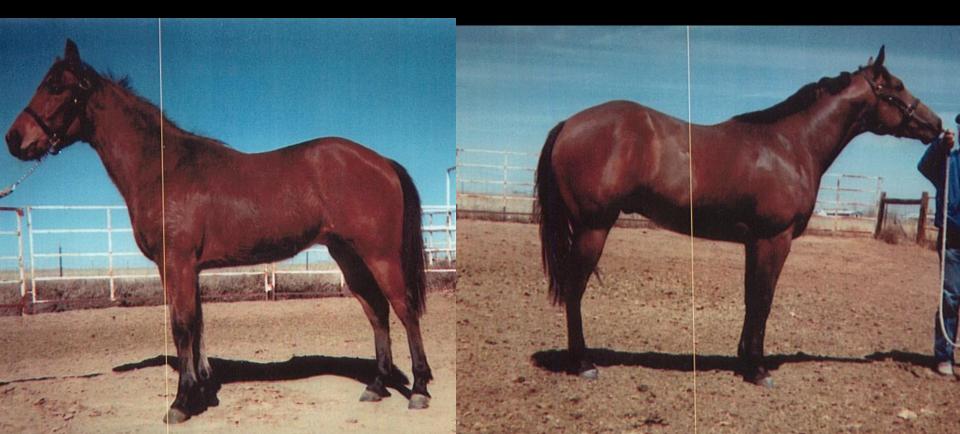
When feeding a grain mixture to a horse and you are looking at the percent crude protein, use the following example to determine how many pounds (or grams) of protein are being consumed/day:

<u>Ingredient</u>	% Protein	<u>lbs fed/day</u>	Amt. of Crude Protein
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 proinflammatory
- 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

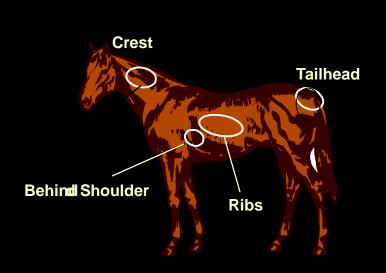
#### Fatty Acid Composition of Selected Oils

<u>Oil Sources</u>	Percent Oil in the <u>Seed</u>	Percent Omega 3s in <u>the Oil</u>	Omega 6:3 <u>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

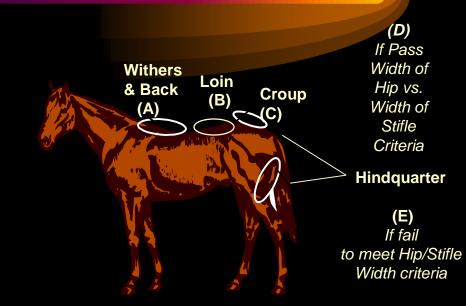
#### Flesh (calories) vs. Muscle (amino acids)

- 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)
  - A<u>mino acids</u> ~ to maintain muscle and aid in muscle function
- Body Condition Scoring (BCS) is the best way to determine if you are meeting their individual <u>caloric</u> 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**



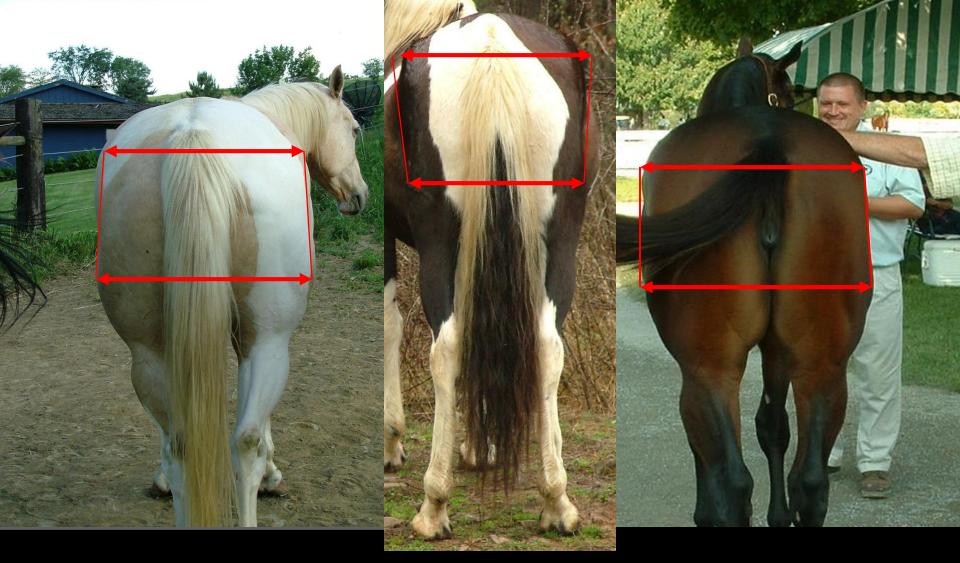
BODY CONDITION SCORE (BCS)
Score 1-9
Calories



MUSCLE AND TOP LINE (MDS)

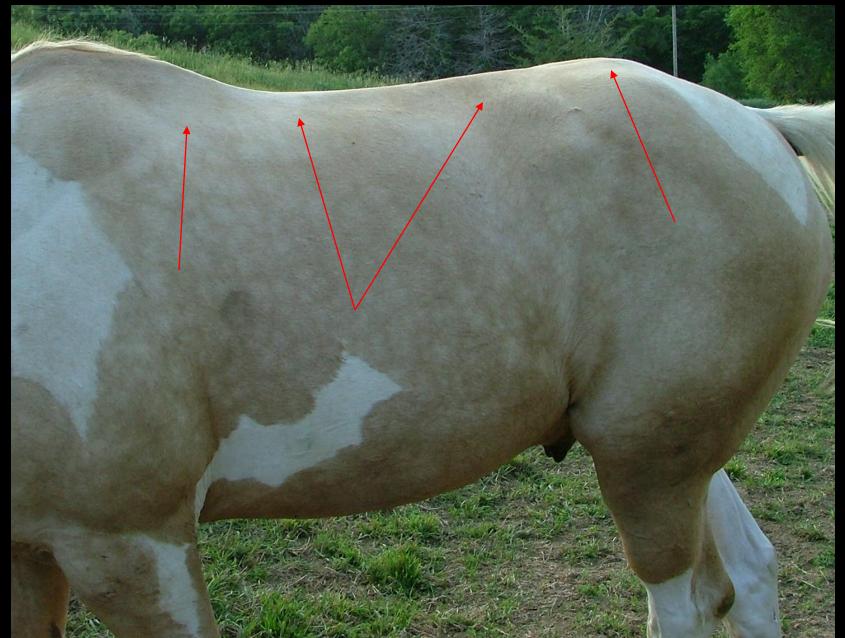
Score A-E

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

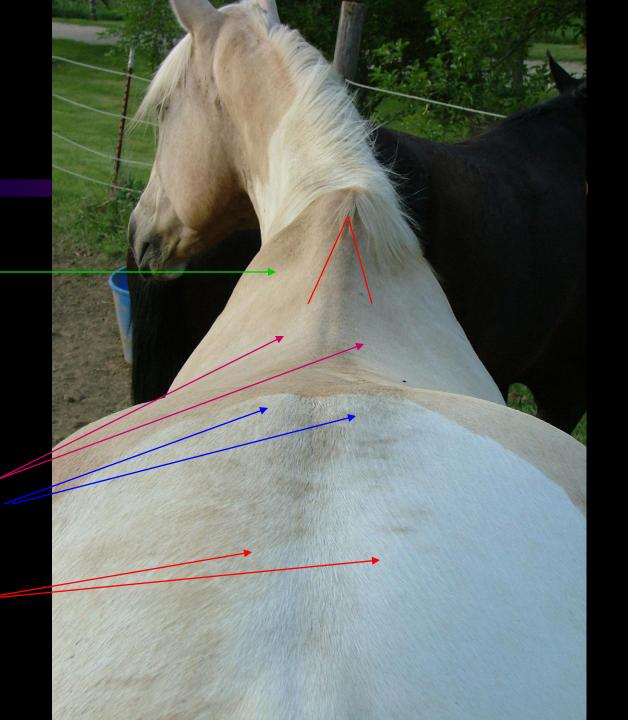
- •Obvious muscle deficiency around wither, back, loin & croup
- •However, horse DOES have adequate BCS (no visible ribs)



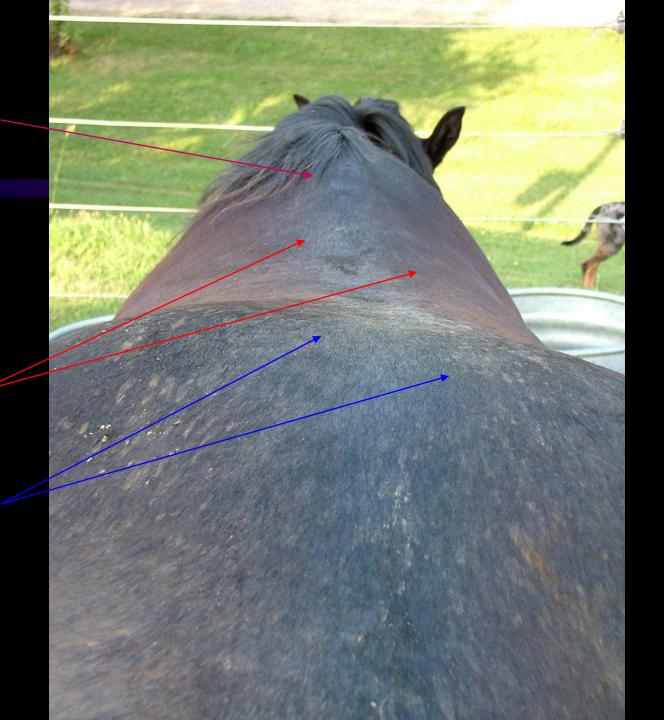
- •Muscle filled around wither, back, loin & croup (note muscle crease)
- •Similar rib cover to last horse, BUT with a good MDS also



- •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	.23%	.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

CA	T				
			儿	V	

.25-.80%

1.2-1.8%

**PHOSPHOROUS** 

.20-.30%

.25-.35%

POTASSIUM

.8-1.5%

2.0-3.5%

 $1\overline{00}$ - $2\overline{00}$ PPM

**IRON** 

COPPER

4-10<sub>PPM</sub>

 $80-200_{PPM}$ 

6-10<sub>PPM</sub>

ZINC

15-26ррм

 $15-28_{PPM}$ 

# 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