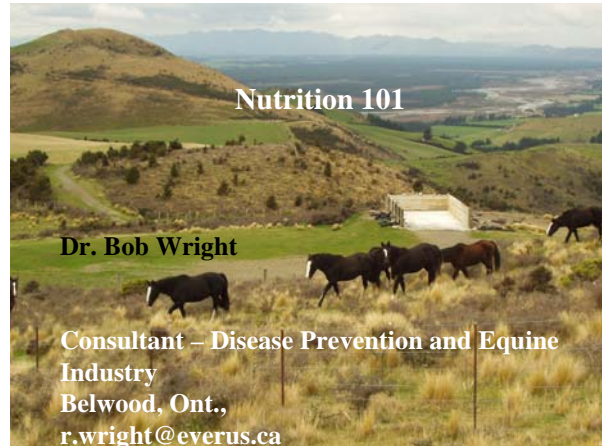




What plant are we now seeing in our pastures as a result of feeding supplements to our horses?



Nutrition 101

Dr. Bob Wright

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Topics to be covered

- ▲ Knowing your Nutrients
- ▲ Body condition scoring
- ▲ Introduction to reading a hay analysis
- ▲ Plant species identification
- ▲ Expected nutrient content of plant species and hay samples
- ▲ Evaluation of individual horses (using photographs) for;
 - body condition score, estimated weight, expected feed intake, housing needs and matching hay to nutrient needs
- ▲ Examples will cover the main body types including;
 - The over weight horse, thin horse, old horse and the Cushinoid prone horse

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Essentials of Nutrition – Knowing the Nutrients

- **Water**
- **Dry matter** – fibre (digestible and non digestible)
- **Protein** and essential amino acids (e.g., lysine, methionine)
- **Energy** sources
 - Starches
 - Digestible fibre
 - Fat and lipids
 - (Protein)
- **Macro minerals**
 - Calcium
 - Phosphorus
 - Potassium, Sodium
 - Chloride
 - Magnesium
 - Sulfur
- **Micro minerals**
 - Cobalt
 - Copper
 - Zinc
 - Fluorine
 - Iodine
 - Iron
 - Manganese
 - Selenium
- **Vitamins**
 - Water soluble – B complexes, C
 - Fat soluble – A & carotenes, D, E, K
 - Vit D – from sun cured hay/pasture,

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Water

- Important:
 - in fluid balance,
 - digestive functions



How much does a horse drink?




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How much does a horse drink?

- Clean fresh and free and access 24 hours per day
- 500 lb horse consumes 5 kg or 11 lbs of dry matter and requires 10 to 15 L of water or the equivalent from all sources (water, wet pasture, hay)
- 2-3 L. fresh water per kg of feed

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- How much dry matter can a 225 kg (500) lbs consume;
 - as a percentage of body weight
 - or lbs per 100 lbs (45 kg.) of body weight
 - or kg per 45 kg

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Dry Matter

- ▲ How much dry matter can a 225 kg (500) lbs consume;
 - 2- 2.2% of body weight
 - 2.2 lbs per 100 lbs of body weight
 - Approx. 1 kg per 45 kg. of body weight
 - 500 lb horse consumes 5 kg or 11 lbs of dry matter
- ▲ Dry matter has to be digestible
 - Horses fed poorly digestible feed because of obesity e.g., very mature hay or straw are prone to impaction

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- Energy sources
 - Starches
 - Digestible fibre
 - Fat and lipids
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Protein

- ▲ Main component of most body tissues second only to water
- ▲ Protein is made of sequence of amino acids (AA's)
- ▲ There are 20 common amino acids
- ▲ 10 essential AA's – must be supplied by the diet
 - include; arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine
- ▲ Protein digested into amino acids occurs in foregut (stomach & small intestines)

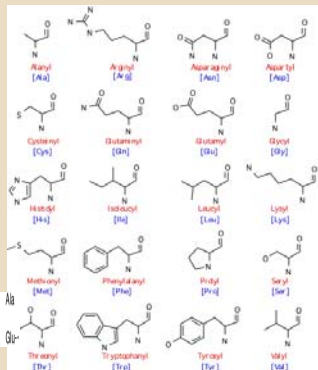
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Protein

- ▲ Excess protein and AA's e.g., from feeding alfalfa
 - the nitrogen radical is split from the molecule and excreted in the urine
- ▲ First 26 amino acids in sequence for haemoglobin

NH₂ Val His Leu Thr Pro Glu Ala Val Thr
Leu Trp Gly Lys Val Asn Val Asp Glu Val Gly Glu



<http://chemistry.ubt.edu.au/~dliberto/Biochemical/Structure/Proteins.html>

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Protein Sources

- Methionine and lysine are the only 2 essential AA's that have been researched and are important in for growth
- Protein deficiency results;
 - Poor growth in foals
 - in weight loss in adult horses,
 - fetal loss in pregnant mares
 - decrease in milk production in lactating mares
 - Loss of muscle mass in exercising horses

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Protein Sources (100% dry matter basis) Source: NRC 1989	Feedstuff	Crude protein %	Lysine %
Concentrates	Soybean oil meal	49.9	3.22
	Flax seed	22	.92
	Wheat bran	15.4	.56
	Rice bran	14.4	.63
	Wheat grain	14.2	.4
	Oats	13	.44
	Corn	10.4	.28
	Beet pulp	10	.54
Forages	Alfalfa hay	18-30	1.24
	Mature timothy full head	9-11	.55
	Fresh clover pasture	18-30	
Fats and Oils	Vegetable oil	0	0
	Canola oil	40.9	2.29
Other	Carrots	10	

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Essentials of Nutrition – Knowing the Nutrients

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 - Starches
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 - Fat
 - (Protein)
- Macro minerals
 - Calcium
 - Phosphorus
 - Potassium, Sodium
 - Chloride
 - Magnesium
 - Sulfur
- Micro minerals
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Energy or digestible energy (DE)

- 1 calorie = energy to raise 1 gram of water 1 degree C
- 1,000 calories = 1 kilocalories
- 1 million calories or 1,000 kilocalories = 1 megacalorie (Mcal)

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Energy sources

- Carbohydrates (starch, simple sugars)
- Digestible fibre
- fat (lipids)
- Protein (amino acids)
- are metabolized to molecular acetyl coenzyme A and enter the Krebs' cycle to produce ATP (Adenosine triphosphate) for cell metabolism

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Energy Sources (100% dry matter basis) Source: NRC 1989	Feedstuff	Digestible energy (DE) Mega calories /kg
Concentrates	Soybean oil meal	3.14
	Flax seed	3.6
	Wheat bran	3.3
	Rice bran	2.6
	Wheat grain	3.8
	Oats	3.2
	Corn	3.38
	Beet pulp	2.56
Forages	Alfalfa hay	2.2
	Timothy grass full bloom	1.7 -2
	Fresh clover pasture	2.5
Fats and Oils	Vegetable oil	9
	Canola oil	3.11
Other	Carrots	3.78

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Nutrition 101- Matching Hay to Horses Needs

Protein Sources (100% DM) Source: NRC 1989	Feedstuff	Calcium %	Phosphorus %	Ca:P ratio
Concentrates	Soybean oil meal	.48	.17	2.8:1
	Flax seed	.23	.58	1:2.5
	Wheat bran	.14	1.27	1:9
	Rice bran	.10	1.73	1:17
	Wheat grain	.04	.41	1:10
	Oats	.09	.38	1:4
	Corn	.05	.31	1:6
Forages	Beet pulp	.68	.10	6.8:1
	Alfalfa hay	1.71	.30	5.7:1
	Timothy grass mature full bloom	.38	.18	2.1:1
Fats and Oils	Fresh clover pasture	1.27	.25	5:1
	Vegetable oil			
	Canola oil			
Other	Carrots	.40	.35	1.1:1

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Macro minerals

required in grams/kg

- ▲ Potassium (K)
 - Found in skeletal muscle
 - Major intracellular cation involved in maintenance of acid-base balance and neuromuscular excitability
 - Sources include forages and oilseeds
- ▲ Sodium - electrolyte involved in acid-base balance, & important in transport of many substances e.g., glucose
- ▲ Chloride (Cl)- extracellular anion (electrolyte) involved in acid-base balance, found in bile
- ▲ Sulfur – found in the sulfur containing amino acids – cysteine, methionine, vitamins – thiamin & biotin

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Nutrition 101- Matching Hay to Horses Needs

Calcium	OCD	Weak skeleton, (rickets) enlarged joints, crooked bones
Phosphorus	Nutritional secondary hyperparathyroidism (big head syndrome)	Weak skeleton, (rickets) enlarged joints, crooked bones
Ca:P ratio as well as adequate Ca and P is important. For growing horses maintain Ca:P = 1:1 to 2.5:1. Mature horses can withstand Ca:P = 6:1		
Magnesium	Renal insufficiency, hypocalcemia, compromise of intestinal integrity	Nervousness, muscle tremors, weakness, collapse, death
Potassium	Cardiac arrest HYPP horses are sensitive to high K in diet	Unthrifty, weight loss Deficiency a problem of endurance horse
Sodium	Excess is excreted provided water is available	Decreased skin turgor, licking of objects, decreased water intake, cessation of eating
Chloride	Excess is excreted provided water is available	Rare without deficiency of sodium, metabolic acidosis, leads to decrease appetite, weight loss, muscle weakness, dehydration depraved appetite
Sulfur	Lethargy, and colic, yellow frothy	Not described

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Micro minerals

those required in ppm or mg/kg

- Cobalt – used by cecal microbes use to synthesis B₁₂ along with iron and copper for blood cell formation
- Copper – essential for copper deficient enzymes involved in synthesis and maintenance of elastic tissue, mobilization of iron stores, mitochondria integrity, melanin synthesis
- Zinc – a component of many metalloenzymes e.g., alkaline phosphatase, found in choroid and iris of eye and prostate

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Micro minerals

those required in ppm or mg/kg

- Iodine – mostly found in the thyroid gland for thyroid hormone production
- Iron – found in hemoglobin, myoglobin, cytochrome enzymes
- Manganese – essential for carbohydrate and lipid metabolism
- Selenium – essential for detoxification of free radicals, thyroid hormone metabolism

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Micro Minerals	Signs of Excess	Signs of deficiency
Cobalt		B12 deficiency but none reported
Copper		Osteochondrosis, (OCD), lameness,, epiphysitis,
Zinc		Inappetance, reduced growth rate parakeratosis of lower legs, alopecia
Iodine	Hypothyroidism- goiter (enlarged thyroid gland) Alopecia,	Hypothyroidism – goiter (enlarged thyroid gland)
Iron	Especially in newborn diarrhea, icterus, dehydration and death	Microcytic hypochromic anemia of iron deficiency
Manganese	No known toxicities	Congenitally enlarged joints, twisted legs, shortened forearms assoc with excessive liming to offset smelter effluent
Selenium	Acute -Blind staggers, Chronic - alkali toxicity	Myopathy, weakness, impaired locomotion, difficulty suckling impaired cardiac function

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Water Soluble Vitamins

- ▲ Water soluble vitamins are not stored in body
- ▲ Thiamin (B1)
 - important in carbohydrate metabolism
 - Found in cereal grains
- ▲ Riboflavin (B2)
 - Important in ATP synthesis, drug & lipid metabolism
 - Found in legume forages
- ▲ Niacin (B3)
 - Produced from microbial fermentation in the hindgut. The amino acid tryptophan can be converted to niacin. Important in glucose metabolism

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Water Soluble Vitamins

- ▲ Folate (B9)
 - Important in biosynthesis particularly for tissues with rapid cell turnover
 - Produced by microbial fermentation in hindgut
- ▲ Pantothenic acid (B5), B12, B6 – information limited and are produced by microbial fermentation in the hindgut
- ▲ Vit C (ascorbic acid)
 - Synthesized from glucose
- ▲ Biotin (Vitamin H)
 - is a co-enzyme for 4 carboxylase enzymes involved in fatty acid synthesis. Important for cell proliferation.

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Water Soluble Vitamin	Signs of Excess	Signs of deficiency
Thiamin B1	Not reported	Anorexia, ataxia, bradycardia, muscle fasciculations. Seen with thiaminase containing plants e.g., bracken fern, equisetum (horsetail) and amprolium poisoning,
Riboflavin B2	Not described	Not described
Niacin B3	Not described	Not described
Biotin	Not described	Severe dermatitis in other species. Implicated in poor hoof quality .
Folate B9	Non toxic	Not described
Vit C	None toxic	Not described

Fat Soluble Vitamins

Requirements for A, D, E, Thiamine, riboflavin are estimated

- ▲ Fat soluble vitamins are stored in body
- ▲ A – the provitamin A is beta carotene & is found in forages
 - Levels decrease with maturity and storage
- ▲ D – important in bone structure & Ca absorption; high in sun cured hay/pasture,
- ▲ E – muscle structure and fertility, antioxidant
 - Natural sources highest in forage
- ▲ K – blood clotting mechanism
 - found highest in forages
- ▲ Coenzyme Q10 – powerful anti-oxidant

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Fat Soluble Vitamin	Signs of Excess	Signs of deficiency
A (Retinol)	Bone fragility, hyperostosis, exfoliated epithelium, teratogenesis. OCD	Night blindness, lower immunity and reduced reproduction efficiency
D	Rickets – bone deformities	Calcification of soft tissue
E alpha-tocopherol	Not reported	White muscle disease is responsive to Vit E and selenium supplementation
K	Not reported except possible in IV injections	Not identified except in dicumarol (moldy sweet clover hay) toxicity

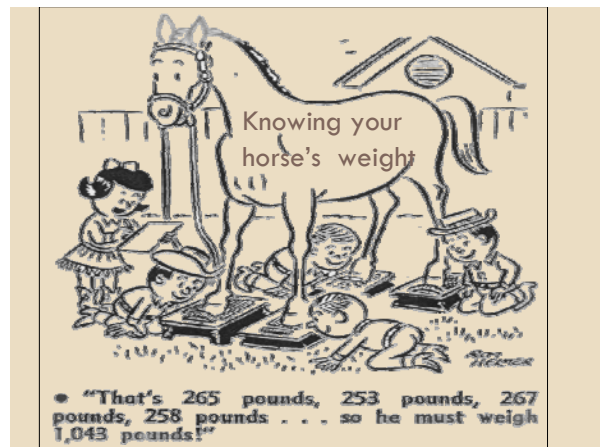


What you need to know about your horse

- ▲ Weight
 - Growing horses – current weight, mature weight, average daily gain e.g., 1.25 lbs per day
- ▲ Body Condition (score)
- ▲ Nutrient needs for maintenance
 - Plus additional nutrient needs for;
 - Levels of activity or work, ambient temperature, stage of growth, pregnancy' lactation

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Measuring Progress

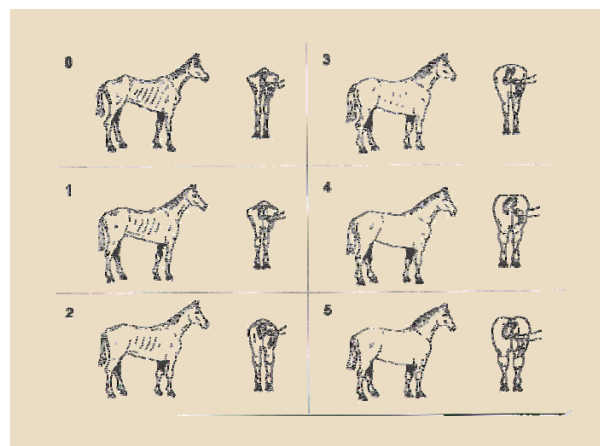
- Tapes are more accurate than most horse owners.



Tape for measuring height



Weight tape



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BODY CONDITION SCORING

Body Condition Scoring (BCS) is an indicator of a horse's overall health and well-being. It is a visual assessment of the horse's body condition, based on the amount of fat and muscle covering the ribs, spine, and pelvis. The BCS scale ranges from 0 (emaciated) to 5 (very fat).

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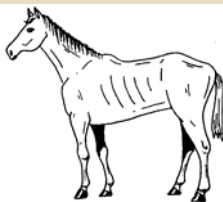

SCORE	Illustration	Photograph	Description
0			SCORE 0 - Emaciated Horse emaciated with extreme ribbing and sharp points. The horse has lost most of its muscle and fat. The ribs, spine, and pelvis are very prominent. The horse is severely underweight and may have difficulty maintaining body temperature.
1			SCORE 1 - Poor Horse emaciated with visible ribs, spine, and pelvis.
2			SCORE 2 - Moderate Horse with moderate emaciation. Ribs, spine, and pelvis are visible. The horse has lost most of its muscle and fat. The ribs, spine, and pelvis are visible. The horse is severely underweight and may have difficulty maintaining body temperature.
3			SCORE 3 - Good A horse in good body condition. The ribs, spine, and pelvis are visible. The horse has lost most of its muscle and fat. The ribs, spine, and pelvis are visible. The horse is severely underweight and may have difficulty maintaining body temperature.
4			SCORE 4 - Fat A horse in fat body condition. The ribs, spine, and pelvis are not visible. The horse has lost most of its muscle and fat. The ribs, spine, and pelvis are not visible. The horse is severely underweight and may have difficulty maintaining body temperature.
5			SCORE 5 - Very Fat A horse in very fat body condition. The ribs, spine, and pelvis are completely hidden. The horse has lost most of its muscle and fat. The ribs, spine, and pelvis are completely hidden. The horse is severely underweight and may have difficulty maintaining body temperature.

B. C. - 0

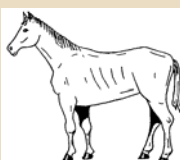

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B.C. - 1


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B.C. - 2

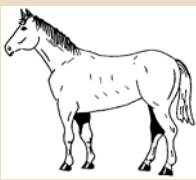

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B.C. - 2.5



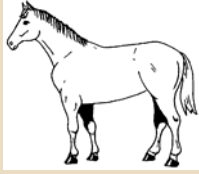
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B.C. - 3

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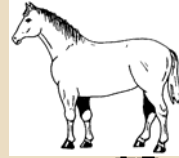
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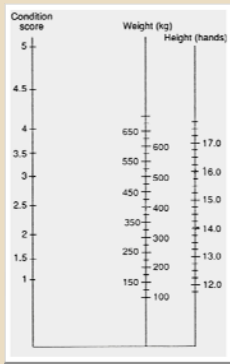
B.C. - 5



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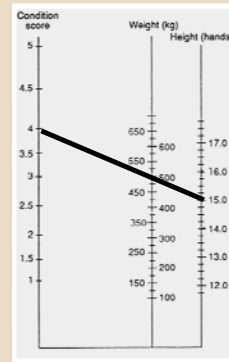
Evaluating Your Horse's Response to Your Nutrition Program



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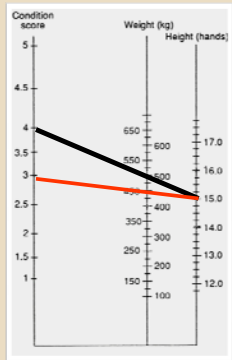
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Evaluating Your Horse's Response to Your Nutrition Program



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Hay and Hay Quality



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Hay

Factors affecting

- ▲ What is quality;
 - Green (not weathered)
 - Leafy
 - Sweet smell not musty
 - Dust free
 - Weed and poisonous plant free
 - Plant type (legume & grass content)
- ▲ Value - presence of timothy heads
- ▲ Quality
 - Date of cut – the later the cut the more mature less leaves = woody = lower protein and energy content
 - Rain and humidity
 - Moisture content when baled
 - Storage issues
 - Heating
 - Raccoon feces

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Feed Analysis

Test	Dry Basis	As Is	Test	Dry Basis	As Is
Dry Matter %	88.86	11.76	ENERGY*		
MOISTURE			TDN (calculated) %	48.72	45.88
PROTEIN			Net Energy (use) MCAL/kg	1.11	0.98
Protein % (N x 6.25)	18.75	14.78	Net Energy (gain) MCAL/kg	0.88	0.84
Soluble Protein %	4.48	3.85	Net Energy (maint) MCAL/kg	0.58	0.62
SP % of CP	23.75	26.25	Non Fibre Carbohydrate	7.88	7.05
ADF - CP %	1.88	1.57	OTHER		
LIP System Est. % of CP	26.88	35.88	Relative Feed Value	78.10	78.10
FIBRE			WTOM	81.81	45.64
Acid Detergent Fibre %	47.25	42.88	WAMEL	0.88	0.88
Neutral Detergent Fibre %	63.25	55.88	WAMEG	0.36	0.31
NDF Digestibility (60h) %	41.43	41.43	WAMEH	1.07	0.88
Lignin %	8.88	8.78	Relative Feed Quality	84.70	84.70
MINERALS					
Calcium %	1.18	1.02			
Phosphorus %	0.18	0.14			
Potassium %	1.18	1.04			
Magnesium %	0.33	0.31			
Sodium %	0.32	0.31			
Zinc (ppm)	25.46	26.40			
Manganese (ppm)	20.72	17.88			
Copper (ppm)	8.53	4.88			

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Nutrition 101- Matching Hay to Horses Needs

MASTERFEEDS EQUINE DEVELOPER 16% RATION

M-601558

THIS FEED CONTAINS ADDED SELENIUM AT 0.200 MG/KG.

GUARANTEED ANALYSIS:		VITAMIN A (MIN. IU/KG)	8,800
CRUDE PROTEIN (MIN. %)	16.00	VITAMIN D (MIN. IU/KG)	2,200
CRUDE FAT (MIN. %)	3.00	VITAMIN E (MIN. IU/KG)	80
CRUDE FIBRE (MAX. %)	8.50	CALCIUM (ACT. %) 1.08	
SODIUM (ACT. %) 0.40			
PHOSPHORUS (ACT. %) 0.90			

A LIST OF THE INGREDIENTS USED IN THIS FEED MAY BE OBTAINED FROM THE MANUFACTURER OR REGISTRANT.

DIRECTIONS FOR USE:

1. FOALS: FEED 3/4 TO 1 KG OF EQUINE DEVELOPER RATION PER 100 KG BODY WEIGHT.
2. GROWING HORSES: FEED 3/4 TO 1 1/2 KG OF EQUINE DEVELOPER RATION PER 100 KG BODY WEIGHT.
3. BROOD MARES: FEED 3/4 TO 1 1/4 KG OF EQUINE DEVELOPER RATION PER 100 KG OF BODY WEIGHT DAILY. NURSING MARES AND STALLIONS IN BREEDING SEASON WILL REQUIRE HIGHER FEEDING LEVELS.
4. FEEDING LEVELS OF EQUINE DEVELOPER RATION WILL VARY ACCORDING TO THE WORK PERFORMED, THE CONDITION OF THE HORSE AND THE QUALITY OF HAY BEING FED.

CAUTIONS:

1. DIRECTIONS FOR USE MUST BE CAREFULLY FOLLOWED.
2. FEED IS PERISHABLE. STORE IN DRY AREA FREE FROM INSECTS.
3. DO NOT FEED MOULDY OR CONTAMINATED FEED AS IT CAN CAUSE ILLNESS OR DEATH.
4. PROVIDE CLEAN FRESH WATER AT ALL TIMES.

MAR112005

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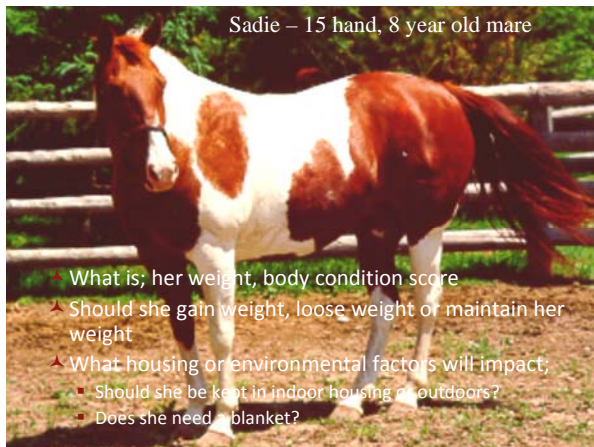
Dr. Bob Wright Veterinary Services

Nutrition 101- Matching Hay to Horses Needs

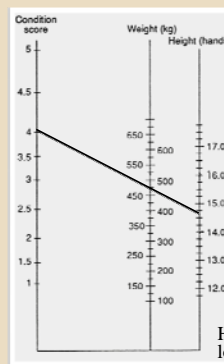
100%
Dry
matter
basis

	First Cut grass	Second Cut mixed	Second Cut alfalfa	Requ'd Maintenance	Requ'd Growth & Development
Crude protein %	11.43	16.28	18.6	8-10	12-16
DE Mcal/lb	.95	1	1.1	0.9	1.1-1.4
ADF %	36	32	28	35-38%	27-35
Calcium %	0.56	.64	1.62	0.6 - 1.4	.6 - 1.2
Phosphorus %	.22	.16	.27	.16 - 0.3	.16 - 0.3
Ca:P ratio	2.6:1	4:1	6:1	5:1	2:1
Copper ppm	3.2	6.87	8.8	10	10
Zinc ppm	15	17	20.7	40	40

Sadie – 15 hand, 8 year old mare



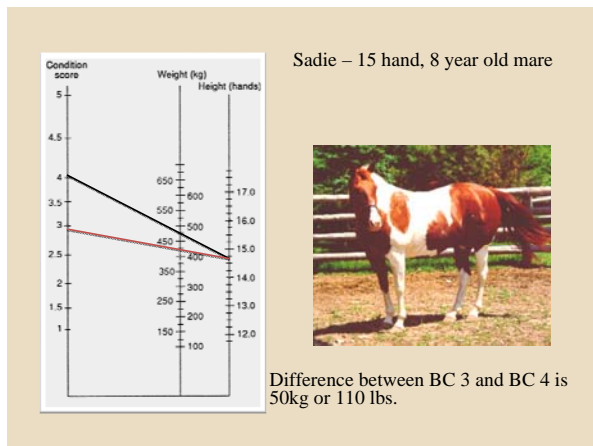
- What is; her weight, body condition score
- Should she gain weight, loose weight or maintain her weight
- What housing or environmental factors will impact;
 - Should she be kept in indoor housing or outdoors?
 - Does she need a blanket?



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How much weight does she need to loose?



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Questions

- ▲ Will she get pregnant?
- ▲ What if she is pregnant
 - Will her needs change?
 - What will change?
 - DE
 - crude protein
 - dry matter intake

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5 year old, 15.1 hand mare

What does she weigh and how much weight should she gain?

5 year old, 15.1 hand mare

Current wt. = 350 kg (770 lbs)
Ideal wt. BCs 3= 460 kg (1012 lbs)

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Questions

- ▲ What does she need to improve her condition?
 - DE
 - crude protein,
 - dry matter intake
- ▲ Could she get pregnant?
 - Will she cycle?
 - Will she resorb the embryo if the plane of nutrition doesn't improve?

Evaluating your horse's response to your nutrition program

Sassy- 6 month old weaned quarter horse

What is; her weight, body condition score?
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Does she have physical limitations?

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7 year old 15 hand gelding

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Principles

- ▲ Your not feeding a computer you need to look at the horse's response to the feed
- ▲ It is easier to match the hay to the horse than to try and balance and compensate for extremes
 - e.g., high Ca low P,
 - high protein and high DE in maintenance horses
 - Copper and zinc

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What plant are we now seeing in our pastures as a result of feeding supplements to our horses?

Flax from feeding whole flax seed

