Horse Nutrition

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General information

- Horse are used for riding, racing, pleasure, polo, work etc.
- Light horse- riding, racing, shows, games
- Large horses- draft purpose

Anatomy of digestive tract

- **Teeth** are covered with cement like layer and high crowned teeth which grow continuously throughout the life to prevent wear and tear

- **Esophagus**
  - Can't vomit, strong cardiac sphincter muscle in stomach prevents it

  - Digestive upset = Colic

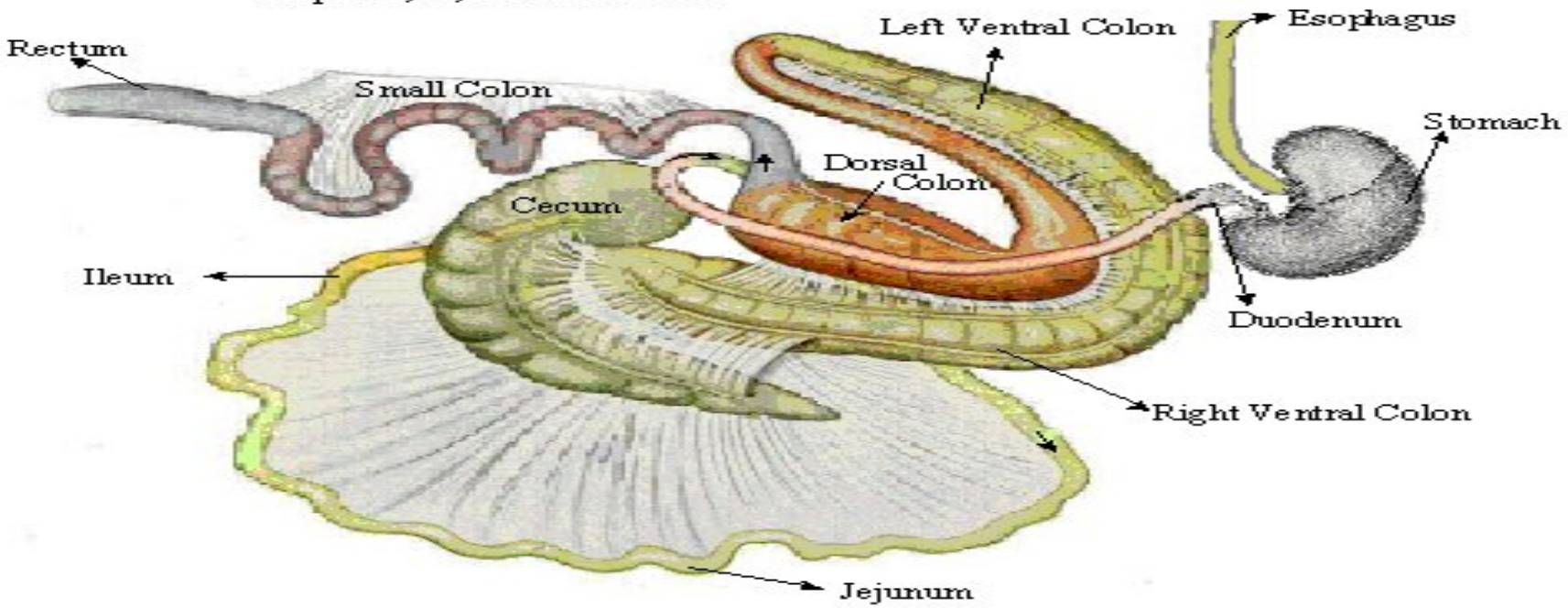
Anatomy of digestive tract

- Choke
  - Obstruction within esophagus
  - Fast eaters

- **Gall bladder** is absent

Equine Digestive Tract

Reference: Adapted from Atlas of Topographical Anatomy of the Domestic Animals, Popesko, P., W. B. Saunders



Equine Digestive Tract - Function

Type	Fore Gut	Capacity	% of Gastrointestinal System
Enzymatic Digestion	Stomach	8 - 15 litres	8%
	Duodenum, Jejunum, Ileum (70 ft. or 21 meters)	68 litres	30%
Type	**Hind Gut**	**Capacity**	**% of Gastrointestinal System**
Microbial Digestion	Cecum (4 ft. or 1.2 meters)	28 - 36 litres	15%
	Large Colon (Right Ventral, Left Ventral and Dorsal Colons) (10 - 12 ft. or 3 - 3.6 meters)	86 litres	38%
	Small Colon (10 - 12 ft. or 3 - 3.6 meters)	16 litres	9%

Weight of digestive tract

- Ruminants- 37.5 %
- Horse- 20%
- Pigs- 14 %
- Humans- 8 %
- Dogs- 3.7 %

Horse is in between ruminants and pig for digestion of complex carbohydrates

Comparisons of digestion

	Human	Ruminant	Equine
Stomach	30%	70%	9-10%
Sm. Intestine	33%	19%	30%
Cecum	7%	3%	16%
Lg. Intestine	30%	7%	45%

Digestion in Horse

- Due to smaller size horse needs to take frequent meals.
- Feeds and nutrients not digested in stomach and small intestine pass to large intestine where anaerobic fermentation takes place.
- VFAS- supply ¼ of horse energy need, amino acids and vitamins.

Digestion in Horse

- VFAS get absorbed through caecum and colon and glucose through Small Intestine.

- Caecum does not get fully developed up to the age of 15-24 months in foal so they can not utilize course fibrous material.

Digestion in Horse

- Protein digestion starts in abomasum and small intestine is the major site for amino acid conversion and absorption but amino acids produced in caecum are not efficiently absorbed.

- Especially young horses need to supply indispensable amino acids externally like lysine.

Carbohydrates

- Soluble CHO gets digested in S.I. and provide burst of energy to horse (Oat and barley)
- But, if provided at higher level
  - Produce Heating effect on temperament of horse
  - Some soluble CHO may pass to caecum produces higher content of acid causes digestive upset and laminitis.
  - Complex CHO gets digested in caecum and do not have heating effect.

Fats and Energy

- Fats provide energy on non heating form
- Normally 5- 10 % of fat may be added in the diet of high level performing horses and up to 20 % also added.
- Linoleic acid as essential fatty acid requirement should also get fulfilled.
- E.g. sunflower oil

Protein and Amino acids

- Protein is needed as a source of indispensable amino acids and nitrogen as a source for synthesis of dispensable amino acids
- Lysine is indispensable AA for young horse, methionine and threonine also under certain conditions
- Increased energy levels also increase need of proteins in diet.

Protein and Amino acids

- Utilization of protein produces 3-6 times the heat in body as compare to CHO or fat.

- Allergies to specific proteins in certain diets produce urticaria or hives on certain parts or all over the body and is known as "protein bumps"

Urticaria or hives

Water Needs

- A loss of 10 % water from body will leads to disorder like colic and founder.
- While 20 % losses will lead to death
- 2-4 kg water per kg feed and water needs increase due to physical activities, high temperature and humidity, life cycle etc.

Water Needs

- Horse needs to be cooled before giving water after exercise.
- Electrolyte supplementation should be given to horse with heavy works other will cause fatigue and weakness.

A guide to the ratio Roughage to Concentrate

Work Level	% Roughage	% Concentrate
Resting	97-100	0-10
Light (light competition)	75-80	20-25
Moderate (Regular competition)	65-70	30-35
Hard (hunting, advanced competition)	55-65	35-45
Intense (racing)	40-50	50-60

Formulation of diets for horse

- Selection of feed to the horse depends up on
  - Nutrient content
  - Availability and price of feed ingredient
  - Preference of horse owner
- All diets should contain adequate amount of roughage and rule of thumb is that horse should fed with good quality roughage at least one per cent of their body weight

Feedstuffs

Concentrate

- Bengal gram is the most popular feed of horse in Indian subcontinent

- Usually considered as single concentrate feed after soaking in water overnight

Feedstuffs

Cereal grains-

- Oat, barley and maize are principal cereal grains
- Oats are preferred as they have less energy content and highest fibre level
- Oats are fed whole, bruised or crushed as they are soft and easily get ruptured during mastication

Feedstuffs

- Oat also contains 5 % oil which though provide energy is also get affected by rancidity

- Oats (without hulls) contains more amount of crude protein and ether extract as compare to hulled oats

Feedstuffs

- Barley and maize as hard grains should not be fed whole and may be rolled, flaked or boiled
- Flaking causes gelatinization of starch and increase its digestibility
- Overheating can also be avoided due to gelatinization

Feedstuffs

- Wheat causes colic in horses because of its high gluten content causes dough formation in stomach
- Should be fed at very low level in horse
- Freshly harvested grains also causes digestive disturbances so should be avoided and stored for at least couple of months before feeding

Maize versus Oats

- Horse performing high intensity work need higher level of grain such as maize to supply more starch and simple sugars
- It decreases total volume of diet and intestinal tract and improves racing time
- Caution is essential as it may cause digestive disturbance

Why oats are preferred over cereals

- Good palatability, high fibre and oil content and better protein quality (lysine content) compared with other cereals

- Good population of lacto bacillus is present in stomach of horse and oat prevents lactic acidosis

- Starch content of oat is 46-47 % and oat starch is easily digestible as due to different morphology of starch granules

Brans

- Fibre in the diet of horse is essential to maintain stable hind gut environment
- It has less energy but more protein, fibre and minerals than wheat
- High level- Big Head Disease or Miller's disease in mature horses

Brans

- Wheat bran is higher in phosphorus and low in calcium causes deficiency of Ca and mobilisation of Ca from bone results in replacement of bone by fibrous connective tissue.

Brans

- This leads to increase in size of bone at skull and jaw
- In growing horse it causes enlarged joints, splints and epiphysitis syndrome
- Bran draws water into digestive tract and have luxative action

Big Head Disease or Miller's disease

Protein supplements

- Soyabean meal is protein supplement of choice due to high lysine content
- GNC is alternative but linseed must be boiled or use ghani pressed before feeding
- Linseed gives glossy coat (blooming hair coat) due to relatively high level of unsaturated fatty acids
- Maize oil, olive oil or sunflower oil give same result

Other feeds

- Young grass is relished by horses as it have high sugar content and they like it
- Molasses, molassed sugar beet pulp or dries sugar beet pulp are used to reduce dust and to enhance the palatability of feed
- Succulent feeds such as carrot 2kg per day can be given

Roughages

- Horse can be eat fresh grass @ 10 % of its body weight
- Maintenance and production requirement can be fulfilled through good quality single fodder or mixture of fresh leguminous and cereal fodders in the ratio 3:1

Roughages

- Lucerne leaf meal is good source of protein, Ca, P carotene etc.
- Lucerne, cow pea, berseem, oats and maize green fodders as fresh or their hay are excellent
- Pasture grass such as doob, timothy, orchard are popular while straws and stovers are low quality roughage
- Soy hulls can replace 75 percent of total forage in horse as they are higher in fibre content

Systems of feeding horses

- **Stall feeding**
  - Daily allowance of concentrate mixture is devided into 2 to 3 parts and fed to horse at 6-8 hours interval
  - Working horse are generally fed twice while growing foals and lactating mares fed thrice a day
  - Afterwards mixture of cereal and leguminous fodders are offered

Systems of feeding horses

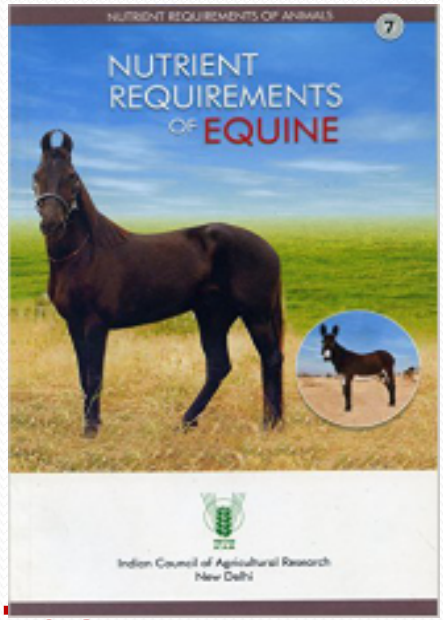
- **Grazing**
  - Animals are allowed for grazing 6-10 hours daily
  - Depending upon availability of herbage and physiological stage supplement feed offered

Systems of feeding horses

- **Use of feeding bags**
  - Working horses and ponies used for traction needs to be fed away from home
  - Concentrate mixture is moistened and filled half of the bag and tied behind the pole after putting in mouth of the horse
  - Buckets are also used for tonga ponies
  - Race and working horse are also fed with bags at working interval

Nutrient Requirement

The nutrient requirement given by NRC (1989) is followed in most of the countries.



Nutrient requirements of Equines

Is given by ICAR (2013).

Based on studies conducted at NRC Equine

Energy requirement (Maintenance)

- Maintenance -

  DE (Mcal/ d)= 1.4 + 0.03 BW

- Stalled horse has lower energy requirement but have to fed continuously with some low quality roughage to avoid voices.

Estimation of Protein requirement

- Maintenance CP = 40 X Mcal of DE/d

Estimation of Protein requirement

- Maintenance CP = 40 X Mcal of DE/d

Feeding of Foal

Feeding of foal

- Starts *in utero* before birth with feeding of mare a well balanced diet to supply all nutrients to developing foal in womb and also for better milk production after foaling.

- Mare's milk meets the requirement of foal for first 3-4 weeks

- Fat content of mare's milk is lower than cow (1.21 & 3.61% respectively)

Feeding of foal

- But lactose content is higher than cow (6.37 & 4.88 % respectively)
- Protein content is higher in milk cow while energy content is less in case of mare
- Antibodies can not pass thick placenta of foal so only available through colostrum to foal

Feeding of foal

- Colostrum should be fed immediately after birth within 1-2 hours as intestinal tract is permeable to colostral antibodies for only first 24-36 hours of foal's life

- This process of transfer of antibodies from mare to foal is termed as passive transfer

- If blood antibody levels are low then 1 litre of plasma can be administered over a period of 30-60 minuets

Feeding of foal

- Milk of mare is deficient in iron, copper and foal restricted to milk can develop anaemia
- Crude protein of mare's colotrum to milk also decrease from 19.1% to 3.85 within 12 hours and 2.2 % in next 2 months
- So, good creep feeding programme is recommended from 4 days of age

Creep Feeding of foal

- Should be started from 14 days of age
- Kept in enclosure where foal can enter but not the mare
- It should be offered at least once a day and should be balanced after taking into account nutrient intake from milk
- Use helps to ensure that inherent potential of growth and development can be achieved

Creep Feeding of foal

- At 5-6 weeks of age foal should be consuming creep feed @ 0.5% of body weight and by weaning time foal should be consuming 2.27 to 3.64 kg of creep feed

- One of the most important advantage is accomisiting foals with eating concentrate before they are weaned due reduce their susceptibility to stress of weaning

Example of Creep ration for foal

Sr. No.	Feed	Percent in diet
1	Oats dehulled	15
2	Oats rolled/flaked	20
3	Maize/barley/sorhgum rolled or in combination	35.75
4	Soyabean meal	15
5	Dried skim milk	05
6	Molasses	05
7	Dicalcium phosphate	02
8	Ground limestone	0.75
9	Trace Mineral	1.00
10	Vitamin supplement	0.50

Feeding of orphan foal

- First Try for foster mother
- If not found should get hand reared- First allow the foal to suckle milk of finger then immerse the fingers in bucket this will encourage foal to follow the fingers and discover the milk
- If foal has not got colostrum from its mother hypodermic injection of horse serum can be given

Feeding of orphan foal

- Mare's milk contains less fat and more sugar than cow. So first get cow with low fat level and then add 150 ml of lime water to 600 ml milk along with ne teaspoon full of sugar

- On first it should be fed at hourly interval, during first two weeks foals should be fed every two hours and and next two weeks every four hours. First 150 ml of milk should be given and increase gradually

Feeding of orphan foal

- After that four times a day feeding should be followed until weaning
- Orphan foal should be given solid feed as quickly as possible to encourage gut development
- Some solid feed needs to be kept at the bottom of pail to teach foal to eat solid food

Feeding of orphan foal

- Later balance feed can be incorporated along with feeding on good pasture soon

Feeding of foal through stomach tube

- Soft tube is passed through foal's nostril down its throat into stomach
- Nostril should get greased and when it reaches back of throat the foal should swallow it so tube should passes down through oesophagus and not into the lungs
- Person must listen at end of tube before putting any milk
- Milk then can be added to the funnel attached to the tube

Feeding of weanling horses (6 months to 1 year)

- During this period fastest growth and elongation of bone happens
- So, after weaning foal should be increased the concentrate mixture to 1-1. 5 kg and 1 kg forage for 100 kg body weight
- The ration should provide minimum 18 % CP, 0.85 % Ca and 0.75 % P

Feeding of weanling horses (6 months to 1 year)

- The concentrate ration constitutes 65 to 70 % of total feed to the weanlings

- The remainder ration should be good quality hay with at least 12% of CP

Feeding of yearling horses (1 to 2 years old)

- Weight gain goes on decreasing during second year of foal's life but it is still growing and should be fed with high quality ration

- The horse should be placed on 1 to 1.5 kg of forage and 1 to 1.5 kg of concentrate mixture per 100 kg body weight

- Conc. Mix. Should contain 16% CP, 0.8 % Ca and 0.65 % P while forage should have at least 10 % CP

- Log yearling (1.5 to 2 years) require some less protein, Ca and P than yearling.
- Roughage intake should be 60 percent of total ration while concentrate intake should be 40 percent of ration
- Long yearlings not used for racing can be fed largely on roughages but it should contain at least 11 % protein

Formulation of rations:

BW Calculation

$HG^2 \times BL/330$

BW Calculation

HG 2x BL/330

BW =

(70”x70”) x 69”/330

BW = 1024 lbs

= 1024/2.2

= 465.5 kg

Mature Horses

Stages of life cycle	DMI % BW	Forages % BW	Concentrates % BW
Maintenance	1.5-2%	1.5-2% (80-100)	0-0.5% (0-20)

Forage requirement

= 1.5 x 465.5/100

= 7.0 kg

Concentrate requirement

= 0.5 x 465.5/100

= 2.3 kg

Stages of life cycle	DMI % BW	Forages % BW	Concentrates % BW
Young horse			
Nursing foal (till 3 months)	2.5-3.5%	0% (20)	1-2% (80)
Weaning foal (3-6 months)	2-3.5%	0.5-1% (30)	1.5-3% (70)
Yearling foal (6-12 months)	2-3%	1-1.5% (45)	1-2% (55)
Long yearling (12-18 months)	2-2.5%	1-1.5% (60)	1-1.5% (40)
2 years old	2-2.5%	1-1.5% (40)	1-1.5% (60)

Stages of life cycle	DMI % BW	Forages % BW	Concentrates % BW
Mature horse			
Maintenance	1.5-2%	1.5-2% (80-100)	0-0.5% (0-20)
Late Pregnancy	1.5-2%	1-1.5% (65)	0.5-1% (35)
Early lactation	2-3%	1-2% (45)	1-2% (55)
Late lactation	2-2.5%	1-2% (60)	0.5-1% (40)

Work level	DMI % BW	% Roughages	% Concentrates
Resting	1.5%	90-100%	0-10%
Light	2%	75-80%	20-25%
Moderate	2.5%	65-70%	30-35%
Intense	2.5-3%	55-65%	35-45%

Feeding of high level performance horse/Race horse

- Energy need of racing at full speeed is 70 times greater than walking
- Feeding and training programmes are very important in optimum muscular activity performance
- Muscle glycogen and free fatty acids plays important role in supply energy to the muscles for work in both unconditional and conditional horses

Feeding of Race horse

- Conditioned horse adopt itself to utilise fat along with glycogen to meet the increased energy demand during exercise or training. While unconditioned horse mainly use glycogen as source of energy

- So, adding 5 to 10 % of fat in horse diet can be a benificial

- Also increase the level of protein ,vitamins and minerals along with increase in fat content of diet

Feeding of Race horse

- Sweating occurs on exercise. Any mineral such salt which contains Na and cl are lost in sweat upto the level of 0.7 % needs to be supplied at proper level through electrolytes in water or salt licks

- Mg is involved in energy release, iron is essential for Hb formation, Se is essential for muscle function, I is imporatant for general metabolism, Vit E and Vit B complex need increases during stress.
- So need of these minerals and vitamins increases in race horse

Feeding of Race horse

- Horse should not be allowed to much fatty.
- The ration should provide 18% CP, 0.95 % Ca and 0.85 % P
- Concentrate mix. Should be at the level of 40-50% and level can be increased during heavy exercise along with good quality hay
- If the horse is without exercise its conc. Part should be cut night before to reduce risk of tying-up or azoturia

Feeding of Race horse

- Slow release energy feeds that are broken down during exercise provide continuous supply of energy to working muscles
- Hence highly digestible fibres sources such as sugar beet pulp, lucerne chaff and high fat diets are better than grain diets
- Fibre in diets trap water in large intestine and can be source of water during dehydration while racing
- Electrolytes need to be given prior to and during exercise

Feeding the pregnant Mare

- Important period is last 90 days when most embryonic growth (60- 70% of fetus growth) takes place
- During last 90 days mare will gain 50 kh weight @ 0.55 kg/day
- Concentrate mixture should supply 16% CP, 10 % Ca and 0.9 % P
- Concentrate Should form 35 % of diet

Feeding of Lactating mare

- Peak milk production usually occurs at 6-12 weeks after foaling
- They should be fed on 12-14 % CP
- Concentrate part of complete ration should be 45 %
- After 3 months milk production decrease accordingly level of feed intake decrease. It should be 2.0 to 2.5 5 of weight and conc. Mix. 40 % of diet

Feeding of stallion

- During the non breeding season high quality pasture/ forage should supply large of feed to the stallion
- Conc mix should be fed in small amounts to keep stallion in thrifty condition
- Two to three weeks before breeding conc mix to the stallion should be increase to have good libido and fertile semen and also put on some weight
- Conc mix should be fed @ 1% of DM of body weight with 13% protein and remaining green and leafy forage

Feeding Adult horse

- Energy requirement of adult horse are low and can be met by feeding good quality roughage
- However salt and mineral mix should be provided at free choice
- If good quality roughage not available some amount of concentrate can also be fed

Composition of a Concentrate Mixture

Ingredients	% in mixture
Gram	20.0
Oat grain	25.0
Wheat bran	42.0
GNC	10.0
Mineral mixture	2.0
Salt	1.0
Total	100.0

Health Problems and Feeding in Horses

- Colic
- Laminitis
- Azoturia/Monday Morning Sickness

Colic

- Colic is defined as abdominal pain.

Colic

- **Common causes of colic include:**

High grain based diets/Low forage diets

Colic

- **Common causes of colic include:**

Mouldy/Tainted feed

Colic

- **Common causes of colic include:**

Abrupt change in feed

Colic

- **Common causes of colic include:**

Lack of water consumption

Colic

- **Other causes of colic include:**

5. **Parasite infestation**
6. **Sand ingestion**
7. **Long term use of NSAIDS**
8. **Stress**
9. **Dental problems**

Feeding Care to Prevent Colic

- **Match the horse's normal diet.**

Feed a high-quality roughage diet (1-2% of BW/day) with very few soluble carbohydrates.

Feeding Care to Prevent Colic

If grain must be fed to meet energy requirements, at least 50% of the total diet should be roughage.

Feeding Care to Prevent Colic

Fat (corn oil, vegetable oil, or rice bran) may be added to the diet to avoid overfeeding carbohydrates.

Feeding Care to Prevent Colic

- **Mimic the horse's natural feeding schedule**

Allowing free choice hay to horses kept in stalls or paddocks will mimic the horse's grazing behavior.

Feeding Care to Prevent Colic

Total feed of horse divided into two or three feedings.

Feed horses at the same times every day.

Feeding Care to Prevent Colic

- **Make diet alterations gradually.**

Make dietary changes over a period of one to two weeks.

Feeding Care to Prevent Colic

- **Provide good-quality feedstuffs**

All feeds offered to horses should be the highest quality.

Avoid feeding any concentrate that is spoiled or contaminated.

Feeding Care to Prevent Colic

- **Use only feeds formulated for horses.**

Cattle, pig, and chicken feeds are not suited for consumption by horses.

Nutrients requirements are different

Feed additives in these may toxic to horses

Feeding Care to Prevent Colic

- **Allow free access to fresh water**

Horses should have clean water available to them at all times.

Avoid water immediately after intense exercise

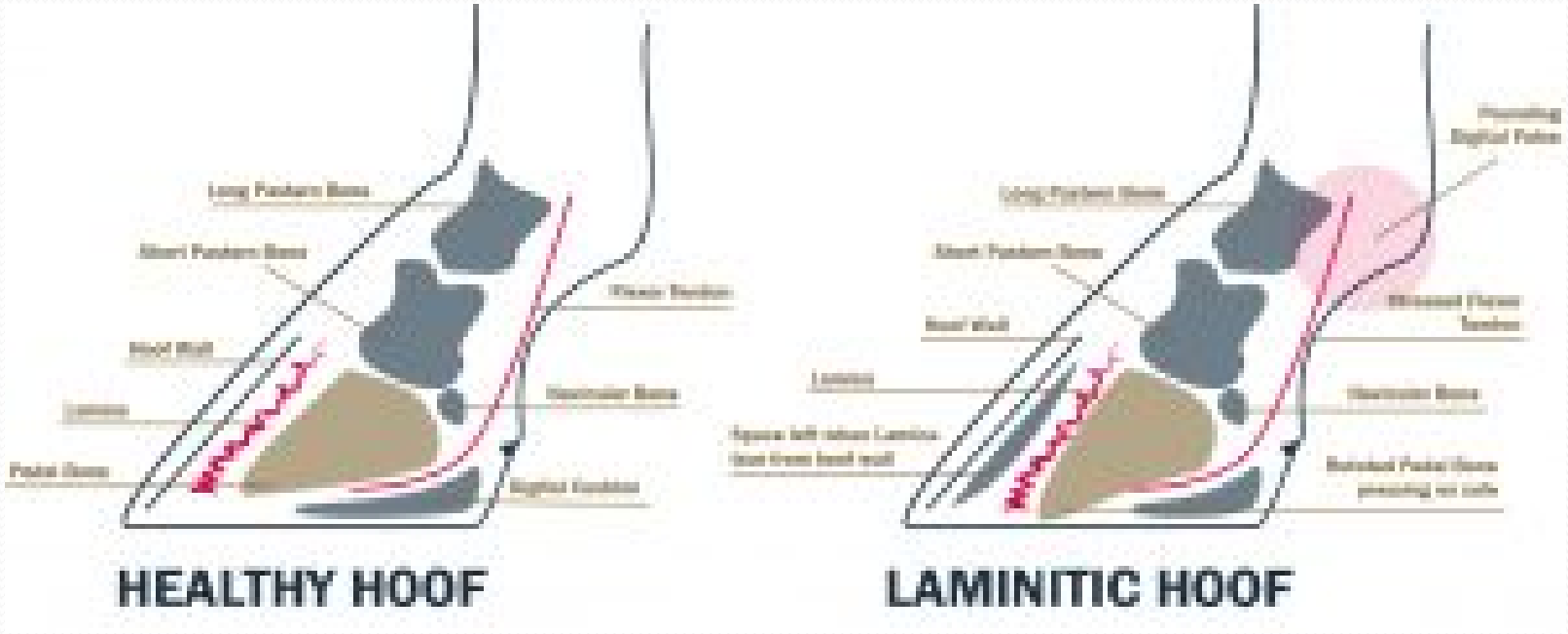
Laminitis

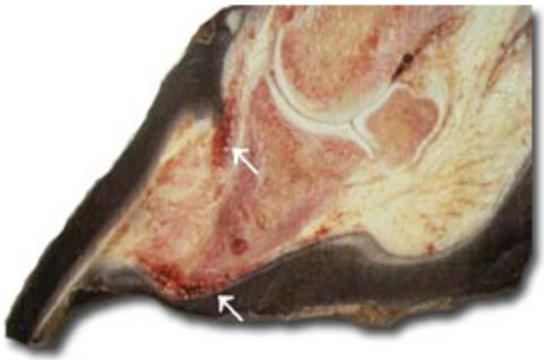
- **Laminitis:**
  - **An inflammation of the lamina on the inner hoof wall.**

It affects feet, causes extreme pain, high fever, and difficulty in moving and walking

Founder

Laminitis





Feeding Care to Prevent Laminitis

- **Allow free access to fresh water**

Horses should have clean water available to them at all times.

Avoid water immediately after intense exercise

Feeding Care to Prevent Laminitis

- **Restrict access to lush pasture**

Lush pasture access should be limited

Feeding Care to Prevent Laminitis

- **Avoid over-feeding or irregular feeding of grains**

Feeding Care to Prevent Laminitis

- **Provide good-quality forages**

All feeds offered to horses should be the highest quality.

Avoid feeding any concentrate that is spoiled or contaminated.

Feeding Care to Prevent Laminitis

- **Feed Supplements:**

- **Sulphur**
- **Chromium**
- **Biotin**
- **Methionine & cysteine**

Azoturia

- Azoturia, also known:
- Tying-up
- Monday Morning Sickness
- Equine exertional rhabdomyolysis

- It is a disturbance of muscle function, best compared with muscle cramp, which can happen suddenly when a horse is being exercised.

Azoturia

Symptoms

- The horse seems unwilling to go, may take short steps and feel unsteady or stiff on his back legs.

- The muscles of the hindquarters feel hot and hard.

Symptoms

- The horse can collapse and be unable to stand, so the condition can be confused with colic.

Feeding Care

- Hay should be offered because feeding the stressed horse often makes it relax.
- But avoid feeding concentrates, especially cereals.

Feeding Care

- Try to encourage the horse to drink water, if possible. Fluids will help flush out the kidneys and reduce the problems associated with muscle breakdown.

Feeding Care

- **Supplementation:**

- **Vitamin E**
- **Selenium**

Lactation tetany

- There are localized spasmodic contractions, twitching or cramps
- This is due to the fall in plasma magnesium and calcium concentration may occur in lactating animals as a result of loss in of Ca in milk
- Low magnesium and calcium diets should be fed to animals 2-5 weeks before foaling

Hypomagnesaemic tetany

- Highly fertilized spring grass may cause hypomagnesaemic tetany due to very poor availability of Magnesium

Wood chewing

- Mineral deficiency in the diet causes chewing of wood, eating of soil and other objects.
- Some horses chew rach other's tail when fed on completely pelleted diet might be due to lack of roughage.
- Boredom may also cause wood chewing.

Prussic acid poisoning

- Immature sorhgum, sudan grass contain a glycoside which on breakdown produces prussic acid or hydrocyanic acid in the digestive tract.

Nitrate toxicity

- Horses are less susceptible to nitrate toxicity than ruminants.
- Nitrates gets converted to nitrites. Nitrites are absorbed and covert blood hemoglobin into methhemoglobin.
- Methhemoglobin prevents blood from picking up oxygen form lungs which give blood chocolate- brown colour.

Thank You