Equine Nutrition

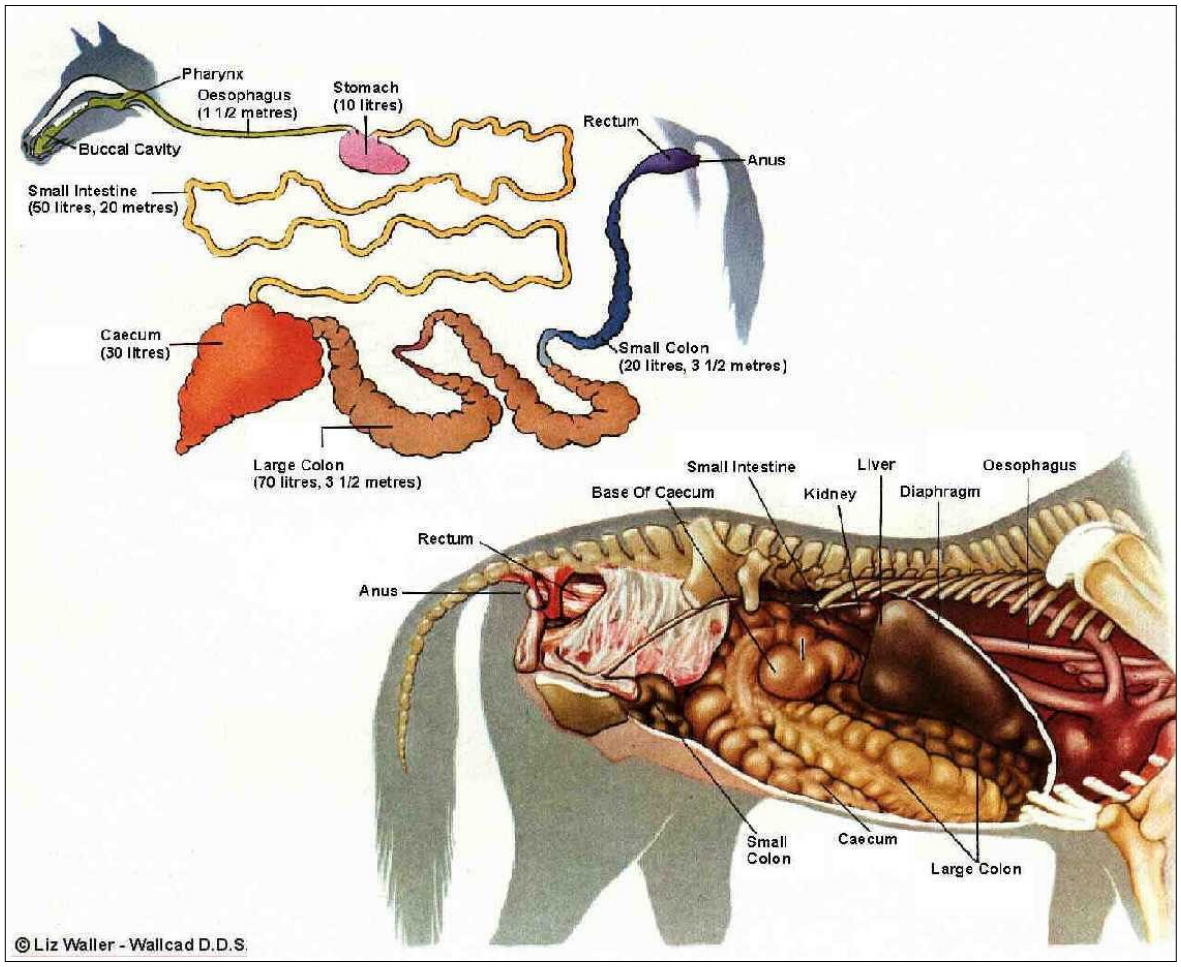
The horse continually moves and eats.

Which part of the digestive system does what?
How much time does the horse spend on feeding?
How much does a horse eat?
What does it need for proper nutrition?
These are the fundamental questions to be answered in this lecture

U N O A L L A V O L T A — O N E A T A T I M E

Structure and function of digestive organs

Following are several slides of the same theme: The anatomy of the digestive tract.



The horse has evolved to eat plant fiber material. The digestive organs have been designed for this purpose.

1. Head
This is the start of digestive system.
With its strong, flexible lips the horse can select the type and part of the plant that it needs.
The food is ground between the molars as they have a broad surface with many ridges and grooves on them (don't allow a dentist to rasp them smooth!). This allows the material ingested to be broken down into smaller components and squashed flat. Horse teeth are designed to erupt slowly throughout the horse's life as they are vital to the digestive process.
Precise chewing is normal.

During chewing the food is mixed with saliva. The saliva glands behind the jaw are stimulated by chewing. Incorrect jaw alignment can stimulate too much or insufficient saliva production.
The amount of saliva produced can be a huge amount! (Heavy horses: 40-90ml/min, small horses: 20-60ml/min.) More saliva is produced with roughage than with concentrated rations.
The horse's saliva does not contain any enzymes. The saliva saturates the bolus of food and makes it easy to swallow. In the stomach the digestive fluids can break down the food bolus further. The saliva may have other as yet unknown functions.

2. The Stomach
The food mass comes from the mouth via the esophagus into the stomach. The stomach is bean-shaped and is relatively small, therefore the horse has to constantly intake small amounts of food. The esophagus has a slanted insert into the stomach and the opening has a strong contracting muscle which closes according to the pressure of the food in the stomach. It is not possible to regurgitate food that has entered the stomach (a horse cannot throw up).

During the ingestion process the stomach empties into the small intestine to prevent overloading. The stomach can rupture if the pressure in it becomes too great as a result of gas production, for example when the horse is stressed, too much concentrated food is given, moldy food is ingested or food loses its correct consistency. The more saliva that is mixed with the food the better the passing of the food stuff through the system. Hay mixes with saliva better than concentrated food as it needs more time spent on chewing it. Not more than 0.4kg concentrated feed per 100kg living weight should be fed per meal. This should be good quality!

As soon as the stomach has filled to 2/3rds of its capacity, it starts to empty. When the amount of concentrated feed is too great, there is a danger that not enough stomach fluid is mixed with the food before it leaves the stomach and enters the small intestine. This can lead to colic. When too much water enters the stomach, the stomach contents get flushed into the small intestine too soon, and may not be in a suitable state for that part of the digestion yet.

Stomach fluid is very acidic, so the food mass is very acidic. In the middle part of the stomach, the pH is 5-6, and on the exit to the small intestine it is 2.6.

There is some breakdown of sugars, carbohydrates and protein before the food enters the small intestine. During this process lactic acids, gas and toxic waste products such as ammonia and other substances are produced. Any food flushed out of the stomach too soon can be too acidic or the breakdown can be incomplete, leading to problems with further stages of digestion later.

3. The Small Intestine
The SI is 20 meters long and has a capacity of about 55-70 liters.
It is divided into various parts, such as the duodenum.
Inside the intestine are finger-like structures which enlarge the surface area.

The pancreas and the liver each have a channel which converge and enter the duodenum together as one tube.
Pancreatic secretions helps to break down proteins, fats, sugars, starch, fat soluble vitamins and some minerals in order to allow them to be absorbed by the mucus from the wall of the intestine and from there sent to the liver. The liver is the central place in the body where the fat and protein is processed and changed to carbohydrates. Also, in the liver, toxic substances are neutralized.
The liver serves as an energy reserve for glycogen, which is used by the body for energy.
The so far undigested parts of the food stuffs contain a lot of water and are flushed through to the large intestine from the last part of the SI.
More than 90% of fat is digested in the small intestine. Too much fat in the total intake of food leads to too much fat entering the large intestine and this in turn disturbances in the gut flora of the LI.
Roughage type substances are not able to be digested in the SI and pass through to the LI without any breakdown.
At the end of the SI, 60-95% of starch is digested (corn starch 80%, oat starch 95%). With too much concentrated feed, there can be wrong fermentation occurring and disturbances in the small intestine digestion result. Also too much concentrated food can lead to undigested starch going to the LI, and this disturbs the bacterial flora.

4. The Colon
The colon is a complete tube, but the outer walls are waved/corrugated to give sections that have an individual volume, and the walls are muscular, the purpose being to help push the mass along.
Along the length of the wall the diameter reduces in places to produce this narrowing.
A large Warmblood has a colon which contains 110-180 liters. A part of this is the cecum, which contains 25-30 liters.
The cecum, which is the beginning of the colon, has less wavy walls. There is relatively less pushing of food in the cecum, so food could get stuck in this area quite easily. In total the colon is about 62% of the digestive system. The small intestine and stomach together have 38%.
The colon is divided into different parts. The cecum, the ascending colon, the small colon, and the rectum.
The cecum and the large colon contain millions of micro-organisms or bacteria and these break down non-carbohydrates and crude fiber and non- volatile fatty acids, for example acetic acids, propionic acid, butyric acid. A reserve energy source comes from this breakdown. The micro-organisms in the colon need the correct food for survival. If this is lacking, the colon is unhealthy. The number and type of micro-organisms are dependant upon the type and amount of food that comes from the small intestine.
The pH of the food coming into the colon affects the micro organisms greatly. It is VERY important that the colon is healthy as the horse should get 75% of its energy requirement from the fermentation of the colon symbiotic activity of the microbes.

In the intestine, there is a part of the immune system. The intestine protects the whole organism from invasion by foreign microbes. For example, the mucus inside the intestinal wall stops unwanted germs from ingested and subsequently digested substances from entering the body. Certain waste products will be denied entry to the blood stream as well. The bacteria in the intestine work on fermentation as well as defense. The intestine can activate defensive cells which can travel through the whole body.
Cellulose is the food substance that benefits most from fermentation in the colon. Cellulose is the crude fiber from hay. Furthermore the intestinal bacteria requires protein, minerals and vitamins for their own metabolism. Plant protein is partially transformed into bacterial protein in the colon and cecum, and the bacteria themselves are later digested and thereby ensure a further

protein supply to the horse. The whole process is very efficient or should be! These microbes also synthesize vitamin B, H (biotin), C, nicotinic acid and folic acid.

If the horse consumes large amounts of food containing mostly ligneous fiber (straw) which lacks protein, minerals and vitamins, then the bacterial flora will degenerate. This results in an inability to properly digest the next food substance (which may be correct) as the microbes are not present in sufficient numbers. This leads to malnutrition as well as an accumulation of undigested ligneous substance which can lead to pressure and blockage due to the body being unable to push the bolus along with peristaltic pressure (different pressures exist along the intestinal wall according to the substance the body is expecting to appear at any given point).
The bacteria in the colon do not like too much starch. It affects the acidity in the intestine and the digestion in the colon, and the microbes may die and poison the organism.

Sudden changes in food are dangerous as the bacteria have not adapted to the new food. The change needs to be slow in order to allow the bacteria to gradually adapt.

The passage of food stuffs through the intestine requires 35-50 hours and 85% of this time is needed for the digestion in the colon alone.

General Horse Feeding Rules
Provide plenty of clean fresh water. A horse will drink between 2 to 4 lbs of water for each pound of ration consumed.
Ensure your horse has enough feed to eat.
Feed all feeds by weight, not by volume.
Have the hay analyzed and develop the rest of the ration based on the forage quality. If this is not possible, feed hay that smells clean, has fine stems, lots of leaves with minimal seed heads or blossoms and is not damp or weedy.
Feed at least 1.0 - 1.5 lbs of forage for each 100 lbs of body weight.
Total daily feed should be about 2.5 - 3.0 lbs per 100 lbs of body weight.
When needed, feed concentrates at least twice daily.
Use top quality feeds and choose rations that are balanced to your horse's nutrient requirements.

Feed horses individually if possible to prevent aggressive horses from overeating and submissive horses from under eating.
Feed at regular time intervals and make major changes in the ration gradually over several days. Do not increase grain feeding faster than 1/2 lb per day.
Allow horses one hour after feeding concentrates to digest the meal before forced exercise.
Allow a hot horse to drink frequent small amounts of water after exercise.
Never give grain or water to a hot horse in large quantities.
Watch your horse closely as it eats for changes in appetite. Sudden changes alert you to potential health or feed problems.
Avoid overfeeding

Nutrient Requirements
With its small, simple stomach and large fiber-digesting hindgut, the horse is designed to eat small portions in a continuous fashion.
By design, forages should predominate the horse's diet.
Grain, fat, supplemental protein, vitamins and minerals are important, but should make up a smaller portion of the ration.
A mature 1000 lb horse will eat about 25 to 30 pounds of feed each day.
Ideally, horses should consume a minimum of 1% of their body weight in hay or pasture each day.
As a general rule, forages should comprise at least 1/2 of the total weight of daily feed consumption for optimum growth and development.

A horse's nutrient requirement varies depending on its activity and function. Generally, nutrient requirements are presented according to the following classifications: maintenance, work, growth, gestation and lactation.
A maintenance ration allows a mature, idle horse to maintain its weight and body condition under average climate conditions.
Nonworking adult horses can be maintained on high quality forages without grain supplementation.
However, the horse's requirement for energy increases 25%, 50% and 100% as its work level increases from light, to moderate, to heavy.
Growing, breeding, working and performance horses require grain or concentrate supplementation to meet their additional nutrient requirements.
During the last three months of gestation, a mare's requirement for protein, minerals and vitamins increases.
As pregnancy moves through the ninth, tenth and eleventh month, the mare's need for energy increases 11%, 13% and 20%, respectively.
Lactation also means additional requirements for protein, minerals and vitamins.
Stress conditions associated with a horse's environment may also affect its nutrient requirements.
Changes in temperature, moisture and humidity as well as muddy lots with little or no housing are a few examples of situations that can lead to stress.
These and other factors can alter the horse's need for various nutrients.

How horses spend time

Horses spend about 16 hours per day grazing and foraging.

They choose feed in great detail.

Horses need a certain length of time for feeding regardless of the amount available.Genetic programming dictates a timeframe, even though a horse would probably take one or two hours longer to graze on poor pasture compared with rich pasture

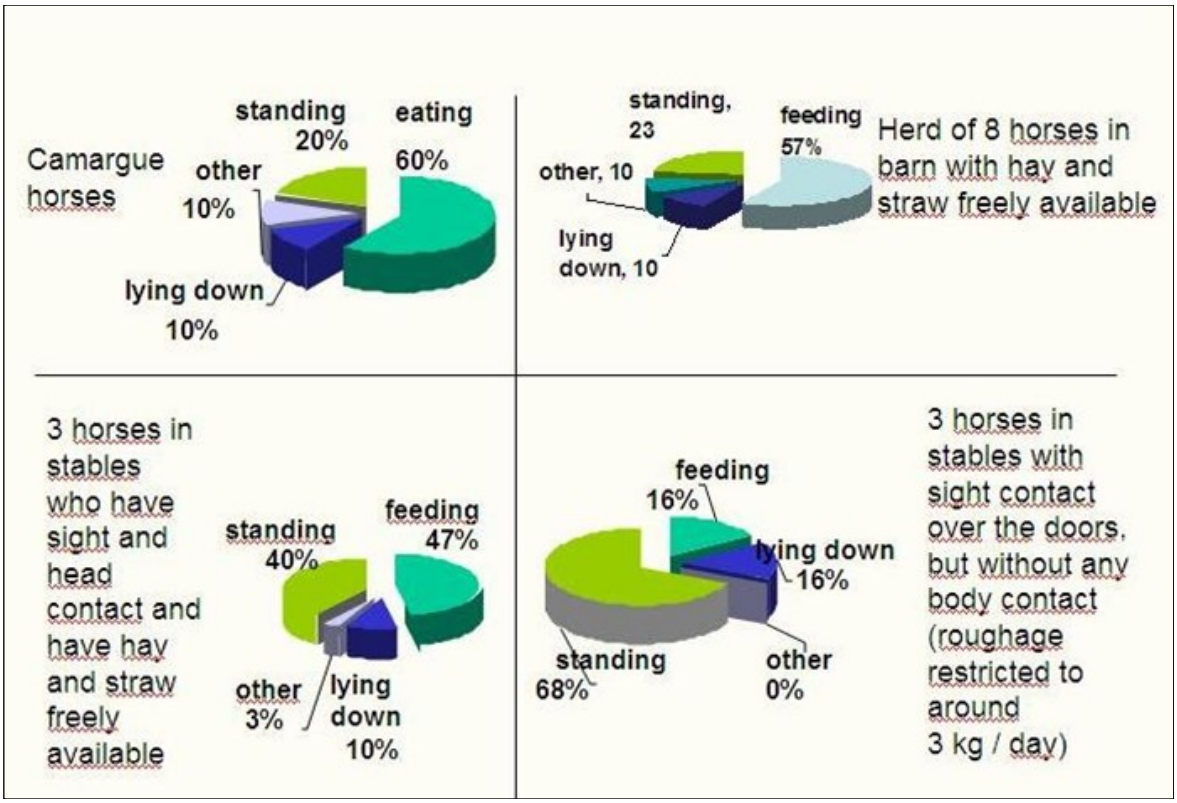
Horses living on very rich grass and herbs don‘t stop grazing before the genetically programmed time is up and therefore they get very fat
They are programmed to graze for 14-16 hours on very poor grazing
Horses living in a field with inadequate nutritional amount will stop looking for food after 18 hours and will loose weight
Assumption: Stereotypical behaviour (i.e. weaving or windsucking) evolves from lack of eating time or being hungry

A bit about liver and bile

A large proportion of the stresses that modern life puts on the horse have to be dealt with by his liver. The horse's liver weighs about 5 kilos (11lbs.) and is the largest gland in the body. It is capable of more than a hundred different functions and acts rather like a central sorting office - nutrients are sent there to be synthesized and either stored or sent off to where the body needs them.
Unlike humans, horses do not have a gallbladder to store bile. In humans the gallbladder releases the bile into the duodenum when food containing fat enters the digestive tract. This bile emulsifies (disperses) fats in partly digested

food. The gallbladder concentrates the bile during this storage, which increases its potency and intensifies its effect on fats.
The horse does not have a gall bladder, but the liver produces about 10 liters of bile a day. Any drop in this bile production (through a malfunctioning liver) will reduce the horse's ability to assimilate fats, thus negatively affecting digestion.
Because of the lack of the gallbladder and the concentration of the bile, horses cannot effectively digest high amounts of fats. The practice, for example, of feeding large amounts of oils in order to help horses gain weight, actually has a negative impact on the health of the digestive system as the fats are not properly emulsified and processed in the duodenum.

The liver also has the job of dealing with any toxins. Toxins can come from within (as in the pregnant mare or as a result of stress), but also from badly stored grain and hay and the obvious toxic plants like ragwort. Drugs like phenylbutazone, steroids and excessive use of 'wormers' present a challenge to the hard working liver of the horse, as does worm infestation, especially in young horses.
The healthy liver will recover from this onslaught in time but sometimes the toxin influx will exceed the livers ability to cope.



Impaired liver function will manifest itself in a variety of outward signs, The most dramatic signs are conditions like Jaundice and Laminitis but subtle indication may be just a lack of 'sparkle', lack of coat bloom, poor 'doers', photosensitive dermatitis, edemas, hives and a variety of little problems that you cannot find a real reason for but which tell you that things are just not "quite right".

A holistic approach to treating any malfunction of the body works by restoring the optimum physiological balance and efficiency. It does not treat the disease as such, but enables the body to treat itself.

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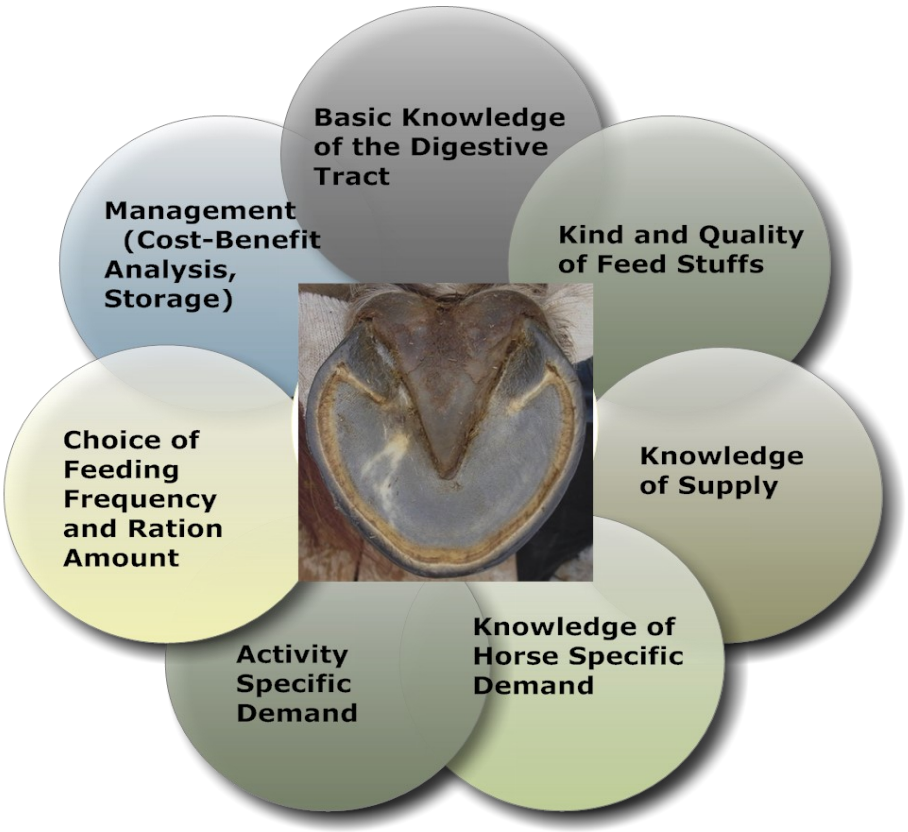

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