Equine Digestive Principles

Compared to other livestock animals, the horse has a unique anatomical digestive design that promotes their evolution as a roaming forage grazer. To have a better understanding of equine digestive anatomy and physiology, let’s look at a few key principles that underlie equine digestion.

Principle #1 – Horses are non-ruminant herbivores

Let’s break down this statement in order to understand what these terms mean. Non-ruminant is also referred to as monogastric, which means single-chambered stomach. Horses, like us, are single-chambered stomach animals. Ruminant animals, which include cows, sheep, and goats, have a multi-chambered stomach.

Animals classified as herbivores are plant eaters. Horses are anatomically designed to be eating forage, which can come from pasture or hay. Forage contains fiber, a type of carbohydrate that meets many, if not all, of the horse’s nutrient requirements.

To put it more simply, horses are single-chambered stomach plant eaters!

Principle #2 – Horses have a small stomach for its size

When you picture a horse, you might assume that their organs are proportional in size to their body, ie. they are big! When it comes to the stomach though, this is not true. The stomach of the horse only provides 10% of digestive capacity and holds 1 – 3 gallons; compare this to a cow whose multi-chambered stomach can hold up to 39 gallons!

Why is a horse’s stomach small compared to its size? Well, think about the horse in its natural state – it is a roaming forage grazer, taking small bits of forage over a long period of time. The horse’s gastrointestinal anatomy is designed for this purpose, eating small amounts often. A horse does not require a large stomach because it should only be ingesting small amounts of feedstuffs at a time.
Principle #3 – Water is essential for digestion

Saliva, digestive juices, and transportation and absorption of digestive material rely on adequate water intake. A dehydrated horse is at risk for not only decreased nutrient absorption, but also gastrointestinal issues such as **coli**c.

Principle #4 – Horses are hindgut fermenters

Fiber carbohydrates found in forage are very difficult to break down; many of the chemicals and enzymes present in various digestive structures are unable to break down, or digest, forage matter. As an herbivore, breaking down forage matter is a crucial part of the digestive process. To aid this process, the horse’s **hindgut** contains a large microbial (bacterial) population that helps break down forage matter. These good bugs in the hindgut eat away at the fibrous material through a process known as **fermentation**.

**Digestive Terminology**

**Digestion**

**Digestion** refers to the breakdown of feed into basic/usable nutrients. Remember that the flake of hay or scoop of grain you give contains various nutrients (water, carbohydrates, protein, fat, minerals, and vitamins) – these nutrients need to be extracted from the feed in order to be usable.

The type of digestion that occurs depends on the digestive structure(s) involved:

<table>
<thead>
<tr>
<th>Digestive Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>Mechanical Digestion</td>
<td>Done by the teeth and tongue</td>
</tr>
<tr>
<td>Chemical Digestion</td>
<td>Use of acids</td>
</tr>
<tr>
<td>Enzymatic Digestion</td>
<td>Use of enzymes, ex. pancreas secretions</td>
</tr>
<tr>
<td>Microbial / Fermentative Digestion</td>
<td>Bugs in the hindgut</td>
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</table>
Absorption

Absorption is the removal of nutrients from the digestive tract. Once feedstuffs have been properly broken down, they can be absorbed into the bloodstream through various digestive structures.

Metabolism

Metabolism is the utilization of nutrients for body needs. Once nutrients have been absorbed into the bloodstream, they travel to various areas of the body that will use, or metabolize, them for various life functions.

Foregut & Hindgut

A horse’s digestive tract can be divided into two sections – foregut and hindgut. The foregut of the horse consists of the esophagus, stomach, and small intestine; this section of the gastrointestinal tract carries out chemical and enzymatic digestion. The hindgut of a horse consists of the cecum, large colon, small colon, and rectum. Remember that horses are hindgut fermenters, so this section of the GI tract carries out microbial/fermentative digestion.
Digestive Structures – Oral Cavity

Oral Cavity

The oral cavity of the horse consists of the lips, mucous membranes, soft palate, hard palate, tongue, cheeks, and the teeth. All of these structures carry out the initial phase of digestion via mechanical means. The salivary glands in the oral cavity assist with this mechanical digestion by producing saliva, which moistens feedstuffs to make them easier to chew.

The Teeth

You might have heard that horses’ teeth are constantly growing, but this is not exactly the case. Permanent teeth are fully formed in the first few years of life, but most of the tooth is below the gum line. As the horse eats, the chewing surface of the tooth is worn away and more tooth emerges or erupts from below the gum line. Teeth will continue to erupt until no more tooth is remaining, which is typically around 20 – 25 years of age; this is why older horses often have a difficult time chewing.

Like humans, young horses start with baby teeth, also called deciduous or milk teeth. As the horse ages, these baby teeth will be pushed out and permanent teeth will take their place. If you are lucky enough, you might even find a cap or two while working around young horses! A horse’s full mouth of adult teeth will be present by age five; a horse may have anywhere from 36 – 44 adult teeth. The number of adult teeth ranges because certain types of teeth may not appear in certain sexes or have been removed.
Types of Teeth - Incisors

Incisors are located in the front of the horse’s mouth; a horse has a total of 12 incisors – six on the top and six on the bottom. The purpose of these teeth is to cut and nip at grass, hay or grain.

Types of Teeth – Canines

Canines are located in an area of the mouth referred to as the “bars”. These teeth serve no function in eating as they are used for fighting, which is why they are more commonly seen in males rather than females. A horse may have anywhere from 0 – 4 canines present.

Types of Teeth – Premolars / Molars

Premolars and molars are referred to as “cheek teeth” and are the primary grinding surface for feedstuffs. A horse will have 12 – 16 premolars and 12 molars. The presence of premolars range is because of a specific type of premolar, the wolf tooth. Wolf teeth, also called the 1st premolar, serve no function in the modern horse and are sometimes absent altogether. If present, it needs to be removed from horses that will be ridden because it can interfere with the bit.

Anatomy of the Mouth – Click to Watch Video

Return to Table of Contents
Teeth Concerns

Dental health is extremely important when it comes to nutrition because a horse that cannot chew will not be able to break down its food as effectively, which can decrease nutrient absorption and utilization. A characteristic of the jaw that we need to be aware of is the upper jaw is wider than the lower – this results in the teeth wearing unevenly. This uneven wear causes points on the teeth, which can result in discomfort, lacerations, and inefficient chewing due to pain.

To combat this, an equine dentist is hired to float a horse, a procedure that helps even out dental wear through filing, similar to how you might file your nails. A horse should have this procedure done 1 – 2 times per year depending on age.
Digestive Structures – Foregut

Esophagus

The esophagus is a soft-walled, elastic muscular tube that allows food to move from the mouth to the stomach. A unique feature about the esophagus is that the distal end has a one-way valve which prevents regurgitation; this is why horses are unable to vomit!

Stomach

As discussed earlier, a horse’s stomach is small compared to its overall body size. The role of the stomach is to assist with digestion by secreting fluids that result in the chemical breakdown of feed into nutrients.

A key aspect of the stomach that can influence nutrition is that it empties into the small intestine when 2/3 full – this means that a rapid intake of feed, primarily grain products, can cause the stomach to empty quickly before digestion occurs. This will then interfere with nutrient absorption, which decreases the energy the horse would have received from the feed. By understanding the physiology of the stomach, we know then the horse should receive small amounts of grain in one sitting.

Small Intestine

The small intestine plays a crucial role in the digestion and absorption process. Secretions from itself, as well as the liver and pancreas, help break down feed further and then the majority of nutrients, except for fiber, are absorbed through the intestinal wall into the bloodstream. Fiber, a type of carbohydrate which primarily makes-up forage, must be digested and absorbed more thoroughly in the hindgut.
Digestive Structures – Hindgut

The hindgut of a horse consists of the cecum, large colon, small colon, and rectum. Collectively, you might also see the term large intestine refer to the hindgut of the horse. This section of the horse’s digestive tract primarily consists of microbial digestion to break down fiber for absorption into the bloodstream.

Cecum

The cecum contains a microbial population. These microbes break down feed that was not digested in the small intestine, particularly fibrous feeds like hay or pasture. As the microbes break down this feed material they release a byproduct called volatile fatty acids (VFAs), which is a source of energy.

Large Colon

The large colon continues the microbial break down of feed and is where the feed will stay the longest – anywhere from 48 – 65 hours. A consideration to think about when it comes to the large colon is that this structure consists of a series of regions and flexures (turns), many of which are at acute angles and go upward. The horse is at a great risk for an impaction (blockage) colic in the large colon, especially if dehydrated!
Cecum and Large Colon Health

The hindgut and its microbial population need a specific environment to survive. Sudden changes to a horse’s diet can change the environment, causing the microbes to die. Also, keep in mind the main function of the hindgut – microbial digestion to break down fibrous plant material. This means that the hindgut is not meant to digest large volumes of sugars and starches; these are other types of carbohydrates found in large quantities in grain products. A high grain diet can be very detrimental to hindgut health if not properly rationed.

Small Colon

While the small colon of the horse does not contain a microbial population like the cecum and large colon, it is responsible for extracting water from waste and forming the remaining feed material into solid fecal balls. Once feed material has reached the small colon, most of the nutrients have been digested and absorbed.

Rectum

The rectum is the last structure of the large intestine. It is responsible for holding the fecal material that will be eliminated through the anus.

You should always be aware of your horse’s manure characteristics, as changes in smell, color, and texture can indicate a potential issue. For example, manure that is very dry may be indicative that the horse has not been consuming much water and could be at risk for dehydration.

Return to Table of Contents
Digestive Anatomy & Physiology Images
Self-Knowledge Checks

1. _____ is the removal of nutrients from the digestive tract.
   a. Digestion
   b. Absorption
   c. Fermentation
   d. Microbial

2. The hindgut consists of microbial digestion.
   a. True
   b. False

3. Which of the following is a true statement about the horse’s digestive anatomy and physiology?
   a. Horses have a microbial population in the foregut
   b. Horses are able to regurgitate feedstuffs
   c. Horses have a small, single-chambered stomach
   d. Horse’s breakdown fiber chemically and enzymatically

4. Which type of teeth are the primary grinding surface?
   a. Incisors
   b. Premolars / Molars
   c. Canines

5. What is the name of the dental technique that helps smooth the uneven wear of horses’ teeth?
   a. Floating
   b. Filing
   c. Grinding
   d. Milling

6. Which foregut structure absorbs the majority of nutrients except for fiber?
   a. Stomach
   b. Cecum
   c. Small Intestine
   d. Small Colon

7. The stomach empties when 2/3 full
   a. True
   b. False

8. Which section of the hindgut is a major colic risk area due to numerous flexures (turns)?
   a. Cecum
   b. Large Colon
   c. Small Colon
   d. Rectum

9. Which digestive structure has the role of absorbing water?
   a. Small Intestine
   b. Esophagus
   c. Stomach
   d. Small Colon

10. Sudden changes to a horse’s diet can upset the health of the hindgut
    a. True
    b. False
Lecture – Digestive Anatomy & Physiology

Answers

1. _____ is the removal of nutrients from the digestive tract.
   
   b. Absorption

2. The hindgut consists of microbial digestion.
   
   a. True

   The horse is a hindgut fermenter – this means there is a large microbial population in the hindgut that helps break down fibrous, forage material

3. Which of the following is a true statement about the horse’s digestive anatomy and physiology?

   c. Horses have a small, single-chambered stomach

   Horses are monogastric herbivores with a stomach small to its overall body size as the horse was intended to be grazing on small amounts of plant material over time

4. Which type of teeth are the primary grinding surface?

   b. Premolars / Molars

   Premolars and Molars are known as the “cheek teeth” and are the primary grinding surface

5. What is the name of the dental technique that helps smooth the uneven wear of horses’ teeth?

   a. Floating

   Floating is a type of equine dental procedure that files the uneven wear of horses’ teeth – without floating, a horse may develop points

6. Which foregut structure absorbs the majority of nutrients except for fiber?

   c. Small intestine

   The small intestine plays a major role in digestion and absorption of nutrients with the exception of fiber – remember that fiber, a type of carbohydrate found in forage, needs to be broken down and absorbed in the hindgut

7. The stomach empties when 2/3 full

   a. True

   The horse’s stomach is very small for its size and it empties when 2/3 full. Due to this design, providing too much feed material at one time could overload the stomach and decrease nutrient digestion, absorption, and utilization

8. Which section of the hindgut is a major colic risk area due to numerous flexures (turns)?

   b. Large Colon

9. Which digestive structure has the role of absorbing water?

   d. Small Colon

10. Sudden changes to a horse’s diet can upset the health of the hindgut

    a. True

   The microbial population residing in the horse’s hindgut need a specific environment to survive. Sudden changes to a horse’s diet can upset this delicate environment and kill microbes, leading to gastrointestinal upset
Glossary

Absorption – The removal of nutrients from the digestive tract
Anus – A sphincter that allows for feces and gas to leave the body
Canines – Teeth located in the area of the bars; original purpose was for fighting
Cap – Deciduous teeth that have not shed/fallen out and sit on top of adult/permanent teeth
Cecum – A structure of the hindgut that contains a microbial population
Colic – Refers to abdominal/gastrointestinal pain
Deciduous – Commonly known as baby teeth or in a horse, milk teeth
Digestion – The breakdown of feed into basic/usable nutrients
Esophagus – Soft-walled, elastic muscular tube that allows food to move from the mouth to the stomach
Fermentation – A type of digestion that is carried out by microbes/bugs in the hindgut; also called microbial
Fiber – A type of carbohydrate (specifically a structural carbohydrate), primarily makes-up forage, which can come from pasture or hay
Flexures – A bending or curving
Floating – A procedure that evens out dental wear through filing
Foregut – The portion of a horse’s gastrointestinal tract that contains the esophagus, stomach, and small intestine; primarily carries of chemical and enzymatic digestion
Herbivores – An animal that feeds on plants
Hindgut – The portion of a horse’s gastrointestinal tract that contains the cecum, large colon, small colon, and rectum; contains a microbial population that breaks down and absorbs fibrous plant material
Incisors – Teeth found at the front of the horse’s mouth; used for cutting and nipping
Large Colon – A structure of the hindgut that contains a microbial population; contains a series of regions and flexures (turns) which makes it a major risk area for colic
Large Intestine – A collective term that refers to the structures of a horse’s hindgut
Liver – An organ that assists the digestive process through the secretion of bile, which helps break down and absorb fats
Microbial – Also referred to as fermentation; a type of digestion that is carried out by microbes/bugs in the hindgut
Molars – Also called “cheek teeth”; primary grinding surface located behind premolars

Monogastric – Single-chambered stomach

Non-ruminant – Without a rumen, also referred to as monogastric, which means single-chambered stomach

Oral Cavity – Consists of the lips, mucous membranes, soft palate, hard palate, tongue, cheeks, and the teeth; carries out mechanical digestion

Pancreas – An organ that assists the digestive process through the secretion of enzymes that break down proteins, fats, starches and sugars

Points – Sharp edges that form on teeth due to uneven wear

Premolars – Also called “cheek teeth”; primary grinding surface

Rectum – A holding chamber for fecal material that will be expelled through the anus

Small Colon – A structure of the hindgut that is responsible for extracting water from waste and forming solid fecal balls

Small Intestine – Structure of the foregut, responsible for chemical and enzymatic digestion as well as absorption

Stomach – Structure of the foregut; responsible for chemical digestion

Tooth Eruption – A process in which the teeth enter the mouth and become visible; occurs due to the constant grinding away of the tooth surface

Wolf Teeth – Also called the 1st premolar; serve no function in the modern horse and are often removed if present due to interference with the bit