The GI tract of an adult horse (~500kg) is about 30 meters long and has a total volume of approximately 180 litres. The entire tract can be divided into two functional parts; the foregut and the hindgut (see figure 1). In part one and two (March and April issues) we described the digestive process in the foregut of the horse. In this, the last part of the series, we discuss the final stage of food digestion - the large intestine and fermentation process.

The large intestine

The large intestine (hindgut) of the horse has three parts: caecum, colon, and rectum (figure 1). Horses have an enlarged caecum, a blind sac at the junction of the small and large intestine and an enlarged and sacculated (lateral) colon (see figure 1). In the adult horse (500kg) the caecum is about 1 m long and has a capacity of about 30-34 litres. Nearly all of the non-starch polysaccharides (NSP) and undigested soluble carbohydrates in feed passes from the small intestine into the caecum. Together with the colon (large intestine) it contains micro-organisms that hydrolyse (break down with water) much of the fiber and soluble carbohydrates present in feed. This fermentation process in the foregut of the horse. In this, the last part of the series; the foregut and the hindgut (see fig 1). In part one and two, we described the digestive process in the foregut of the horse. In this part of the series, we discuss the final stage of food digestion - the large intestine and fermentation process.

Digestion in the caecum and colon depends almost entirely on the activity of microorganisms. In contrast with the small intestine, the walls of the large intestine contain only mucus-secreting glands, and do not produce digestive enzymes. However, high alkaline phosphatase activity is found in the large intestine. This is not seen in other species like cats, dogs and man and is known to be related to a high digestive and absorption action.

The colon consists of three parts; ascending, transverse, and descending. The first part of the colon has the greatest capacity and is known as the large colon. The large colon is 3 to 3.7 m long and has a capacity of 50 to 60 litres.

The large colon can be divided into four compartments; the right and left segments of the caecum and the left and right segments of the dorsal colon (see figure 1). The four parts of the large colon are connected by three flexures (bends) . The diameter of the segments of the different large colon vary (20 to 25 cm), but reaches a maximum in the right dorsal colon where it forms the large sacculation (sack) with a diameter of up to 50 cm. The small colon is about 3 m long with an average diameter of 7.5 to 10 cm and has a capacity of 18 to 19 litres. Together with the large colon it has a total capacity of 70 to 80 litres. The rectum is located at the end of the large colon and is about 0.3 m long and opens to the exterior at the anus.

Microbial population and fermentation

There appears to be little difference in the biochemistry of fermentation in all horses studied, either the animals of the animal or the site of fermentation chamber. The taxonomic composition of micro-organisms in the digestive system of all animals is also apparently broadly similar.

Microorganisms (e.g. bacteria, protozoa and fungi) can live in most segments of the animal gut. But the rumen and hindgut provide a unique environment for microorganisms, the anaerobic (without oxygen) system, (alkaline conditions and nutrients) are ideal for the growth of microorganisms. The pH (6-7) remains relatively constant because fermentation acids are absorbed rapidly across the rumen and hindgut wall or neutralized by saliva. The flora of the caecum and colon of horses and ruminants of cattle consist mainly of bacteria (see table 1). Protozoa and fungi are present in much lower numbers, because of the lower rates of turnover (see also table 1).

Table 1: Numbers of microbial species (per ml) in the rumen, caecal and colon of horses

<table>
<thead>
<tr>
<th>Microbial species</th>
<th>Rumen (cattle)</th>
<th>Caecum and colon (horse)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>10^6-10^9</td>
<td>10^9</td>
</tr>
<tr>
<td>Protozoa</td>
<td>10^6</td>
<td>10</td>
</tr>
<tr>
<td>Fungi</td>
<td>10^6-10^7</td>
<td>10</td>
</tr>
</tbody>
</table>

With increasing starch in the diet (e.g. grains) more proportions, lactate and lactic acid are produced within a short time compared to that of other NSP, which lead to a reduction of total pH. Studies have shown that excess intake of lush pastures, high levels of fructans can also cause digestive and metabolic disorders. Digestive and metabolic disorders are very common in the domestic horse population all over the world and as you now understand the majority of the cases it can be traced back to the way we manage and feed our horses. The horse is designed to eat large quantities of fibre on a continuous basis. The concentrate diet should be mixed with a fibre source such as low non-structural carbohydrate (NSC) chaff or super fibres. You can also offer roughage before the feeding of the concentrate diet to slow down the passage rate and facilitate fibre digestion. The main aim is that we maximise the fibre intake and minimise the NSC intake so that we promote healthy functioning of the digestive system of our horses.

Further reading

Davies, Z. 2009. Introduction to horse nutrition, Wisby-Blackwell, 1st edition, United Kingdom
Lewis, L.D. 1996. Feeding and care of the horse. 2nd edition, Uppercott Williams & Wilkes, USA.
Horses & People Magazine Aug 2010: Back 2 Basics; roughage & pasture management (part 1)
Horses & People Magazine Sep 2010: Back 2 Basics; roughage & pasture management (part 2)