Buffers and Probiotics in maintaining equine gut health

Kayley Barnes,
Equine Technical Manager
GB&I

Horses are hindgut fermenters which have evolved to ingest small quantities of fibrous feeds on an almost continual basis, yet in current practices horses aren't fed or managed in this way. Due to reduced access to forage, plus higher concentrate feeding to meet energy demands, horses are typically fed infrequent, large concentrate-based meals which they're much less able to efficiently digest and utilise.

"It is now common for dietary concentrates to make up as much as 40% of the horse's diet," explains Ms Barnes, AB Vista's Equine Technical Manager. "These concentrates are essential for meeting the horse's energy requirements when forage intake is limited, but can seriously compromise horse health, performance and behaviour unless carefully managed.

"Because the equine digestive tract is not designed to digest high levels of these starchy concentrates, a number of issues can arise. Both the pH balance in the foregut (particularly the stomach) and the microorganism population as well as the pH in the hindgut can be negatively impacted, which in turn disrupts systems linked to digestive health as well as reducing nutrient utilisation."

It's the symbiotic relationship with fibre-degrading microorganisms in the hindgut that makes horses such efficient fibre digesters. Any disruption to this relationship will both reduce the amount of beneficial microorganisms present and reduce the energy extracted from fibre in the hindgut. Additionally, a sub-optimal pH in the stomach will limit digestion and absorption in the foregut, whilst potentially damaging the stomach lining causing ulceration.

Stomach health

The diet therefore has a huge impact on the health and function of the stomach. Horses provided ad libitum forage have fewer gastric health issues than those fed high concentrate diets. The stomach is the starting point for a number of pH-dependent processes including protein digestion, particle breakdown and feed fermentation, so optimising gastric health – and pH in particular – is critical to optimising feed utilisation and horse health.

"The equine stomach actually has two regions, defined by their differing pHs and roles in digestion," adds Ms Barnes. "The upper non-glandular region has a more neutral pH of between pH 5–7, whereas the lower glandular region is more acidic, ranging between pH 2–3."

The more acidic glandular region has a protective mucus coating that prevents the acid from causing damage to the stomach lining. However, this isn't present in the less acidic non-glandular (upper) region. This means that when the pH drops below 5 in this area, which often happens with reduced access to forage, the stomach lining is susceptible to damage and ulcers can form.

AB Vista, 211 Castle Rd, Randalstown, Antrim, BT41 2EB
Kayley.barnes@abvista.com abvista.com/contactus

"Equine gastric ulcer syndrome (EGUS) has been reported to affect one in two horses, with both leisure and performance horses – including foals – being at risk," Ms Barnes explains. "Symptoms of EGUS vary from irritability and other behaviour changes to weight loss and feed refusal, all of which negatively affect horse health."

Stabilising stomach pH

In practice it isn't always possible to provide ad-libitum forage, so the horse often requires assistance to maintain gastric health and pH. The inclusion of feed ingredients that have a positive effect on the pH of the non-glandular (upper) region of the stomach, for example, can help support gastric function and reduce the prevalence of EGUS.

"Traditionally, calcium carbonate (limestone) has been added to the concentrates to help maintain stomach pH," Ms Barnes states. "However, the limestone doesn't dissolve effectively at the higher pH in the critical upper region of the stomach, so provides little support in maintaining the correct pH in this area.

It also has a higher buffering ability in the lower acidic region, where the pH needs to remain acidic (not be buffered) for effective gastric digestion."

Acid titration studies have shown that at pH 2 (the pH of the lower, glandular region) it takes over five hours for limestone to completely dissolve. In comparison, the average time for feedstuffs to flow through the stomach is less than two hours.

In contrast, an alternative buffer like 'Acid Buf' is not only highly effective at maintaining the pH of the upper region of the stomach, it also dissolves completely in the acidic lower region. In the same acid titration study, it was found that Acid Buf, which is derived from calcareous marine algae, dissolved within one hour at pH 2.

"An effective gastric buffer needs to be able to have a positive impact on pH in the non-glandular region without extensively buffering the acid in the glandular region" emphasises Ms Barnes. "Although Acid Buf is rapidly dissolved if it passes into the acidic lower region of the stomach, its slow release at higher pHs means that if some of the product remains in the non-glandular region between meals, it can continue to act positively.

"In addition, the rapid breakdown before leaving the stomach enables complete release of the highly bioavailable calcium (100% bioavailable) and magnesium (99% bioavailable) contained within Acid Buf. It really is much more than just a buffer!"

Calcium and magnesium are known to have positive effects on muscle tone, immune function and skeletal strength. Cross-species studies have also shown the positive effect of calcium on stomach wall integrity, which can help support gastric recovery after any period of stress.

The benefits of feeding Acid Buf can typically be seen after just a week of dietary inclusion. According to Ms Barnes, many horse owners are surprised by how quickly the positive benefits in both performance and behaviour occur.

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"But while the direct effects of improved foregut health and function are significant, optimising conditions in the foregut is also essential for maintaining the health of the hindgut," she adds. "This is critical, because horses get their primary source of energy from the fermentation of fibre in the hindgut."

Hindgut health

In order to maximise energy extraction from fibre, the horse relies on the symbiotic relationship with microorganisms within the hindgut. These microorganisms allow the horse to use the otherwise indigestible fibre in the diet, releasing volatile fatty acids (VFAs) which can then be utilised by the horse as a source of energy.

"Hindgut microorganisms require an anaerobic environment at pH 6.5-7," adds Ms Barnes.

"When the hindgut environment is not at these ideal conditions, then it can have detrimental effects on both horse health and performance."

The challenge is that with modern feeding practices, horses are often unable to maintain these conditions. A good example is when undigested concentrates from the small intestine enter the hindgut, with the starch then fermented to produce lactic acid, rather than VFAs.

"Not only does this lower the pH of the hindgut below the optimum pH 6.5-7, but it also promotes the proliferation of lactic acid-producing microorganisms at the expense of fibre-digesting microorganisms," explains Ms Barnes.

"This change in the microorganism population then amplifies the pH drop as more lactic acid is produced, resulting in a further reduction in fibre digestion and making it more difficult for the horse to recover."

In these situations, it's relatively common for the pH to drop as low as pH 5 or lower, at which point hindgut acidosis occurs. This can lead to poor appetite, recurrent colic and the display of stable vices such as stall walking or cribbing. it's important to note that even if no symptoms are seen, there can still be a pH drop resulting in sub-clinical acidosis.

In addition, the death of fibre-digesting microorganisms can release harmful toxins into the bloodstream causing further health issues such as starch-induced laminitis.

Aiding hindgut health

Despite the clear importance of maintaining hindgut health, nowadays it isn't always possible to reduce starch intake. Finding alternative ways to aid hindgut health is therefore critical, such as the use of Vistacell live yeast to help promote a more stable hindgut environment and improve fibre digestion.

"Vistacell works by both competing with lactic acid-producing microorganisms to reduce the additive acid load, and also removing oxygen from the hindgut," states Ms Barnes. "This makes

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the hindgut environment more suitable for fibre-digesting bacteria, which then encourages their proliferation and activity.

"This increases energy supply via VFAs to the horse, improving both nutrient utilisation and performance."

These claims are supported by a feed digestibility study which compared the use of Vistacell against a control diet. The horses were fed a 70% hay and 30% concentrate diet, with the only difference between the two treatment diets being the inclusion of 2g/head/day of Vistacell in the treatment group. Faecal samples were collected three times daily and analysed for a variety of digestibility parameters, with the results shown in Table 1.

Table 1: Improvement in equine feed digestibility with Vistacell live yeast supplementation.

Digestibility	Control	2g/head/day Vistacall live yeast
DMd (%)	58.8[a]	67.6[b]
CPd (%)	66.4[a]	72.9[b]
NDFd (%)	45.6[a]	56.3[b]
ADFd (%)	40.3[a]	49.8[b]

[a-b] $P<0.01$

"The trial results show that the Vistacell group had significantly better digestibility values across all the parameters that were measured," Ms Barnes continues. "These improvements suggest that the hindgut is more stable when Vistacell is included, leading to improvements in the populations of fibre-digesting bacteria in the hindgut.

"The risk of the horse experiencing hindgut acidosis is also reduced, further improving the supply of energy to the horse from fibre. Combined with the use of Acid Buf to improve foregut function, the overall result can be a substantial improvement in nutrient utilisation, behaviour and performance," she concludes.

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