Effects of Soaking Hay on Nutrient Content and Hygiene Quality

Soaking hay in water is a method commonly employed by horse owners to reduce the sugar content of hay and, for many people with horses diagnosed with laminitis, insulin resistance, polysaccharide storage myopathy (PSSM) or obesity, soaking hay in water may have become a routine part of their daily horse-keeping duties. But, have you considered what the effects of soaking are on the hay’s nutrient profile and hygiene quality? Fortunately for us, some researchers from the United States and United Kingdom have done just that. Research conducted by Martinson et al (2012) examined “The effect of soaking on carbohydrate removal and dry matter loss in Orchardgrass and Alfalfa hays” and “The effect of soaking on protein and mineral loss in Orchardgrass and Alfalfa hay”. The researchers used four different types of hay of varying maturity, including a second cutting early bud alfalfa (alfalfa bud), a first cutting flowering alfalfa (alfalfa flower), a second cutting vegetative Orchardgrass (vegetative Orchardgrass) and a first cutting flowering Orchardgrass (mature Orchardgrass).

Sections of hay were randomly assigned to each treatment, which included soaking for 15 minutes, 30 minutes, 60 minutes or 12 hours in 25 litres of cold (22°C) tap water or for the same durations (but not 12 hours) in warm (39°C) tap water. Hay sections were then drained for 30 minutes and, for the purposes of the nutrient analysis, were dried at 60°C for 72 hours in an oven.

Carbohydrates

Reducing the carbohydrate content of the diet, specifically sugars and starch (also referred to as non-structural carbohydrates or NSC), is particularly important for horses diagnosed with laminitis, insulin resistance, PSSM or obesity. When feeding such horses, it is recommended the dietary intake of non-structural carbohydrates (NSC) be less than 10% for PSSM-affected horses and less than 12% for obese, laminitic or insulin resistant horses. Previous studies have shown that such (lower) levels of NSC elicit a low or negligible glycemic response (insulin and glucose rise following sugar ingestion), whereas hay with higher NSC levels does elicit a glycemic response.

Current recommendations for soaking hay to reduce the NSC content are 30 minutes in warm water or 60 minutes in cold water. This study confirmed that soaking hay in warm or cold water for 15 minutes, 30 minutes, 60 minutes, or 12 hours significantly reduces the NSC content of the hay compared to unsoaked hay.

How effective is soaking hay at reducing NSCs?

Percent loss of NSCs from Orchardgrass hay ranged from ~25% (15 minutes, cold water) to ~80% (12 hours, cold water), and from alfalfa hay ranged from ~17% (15 minutes, warm water) to ~70% (12 hours, cold water). Between 40 and 50% of NSCs were lost after 60 minutes soaking in cold or warm water for all types of hay, with the exception of flowering alfalfa, which lost approximately 30% when soaked in cold water.

The Equi-Analytical feed profile database reports the NSC content of alfalfa hay to have a normal range of 8.7-13.2% NSC and grass hay to have a range of 8.0-17.6% NSC. Particularly for grass hay, the upper ranges are well above the recommended level of 10-12% NSC content for affected horses. This study, therefore, confirmed the current soaking recommendations are sufficient to reduce the non-structural carbohydrate content of alfalfa and Orchardgrass hays to ‘safe levels’ for horses affected by NSC content.

However, the great variability in NSC content emphasises the importance of having hay tested by a laboratory prior to feeding or being prepared to routinely soak hay prior to feeding.

What about the minerals?

Martinson et al conducted a second study to determine the effect of soaking on the mineral content. They found that while calcium was largely unaffected, other minerals, such as phosphorus, magnesium and potassium, were significantly reduced. This is an important finding because we know that mineral ratios are important when developing a balanced diet.

Calcium and phosphorus ratio

This is particularly so with calcium and phosphorus. The recommended Ca:P (calcium to phosphorous ratio) for mature horses is between 1:1 and 3:1. In this study, while calcium content was largely unaffected irrespective of water temperature or soaking duration, the phosphorus levels did decrease. Soaking alfalfa hay for greater than 30 minutes resulted in a Ca:P of greater than 6:1 and as high as 10:1 when soaked for 12 hours. This change in Ca:P would have implications for accurately balancing diets and additional phosphorous may be needed to appropriately balance the calcium to phosphorous ratio.

Potassium

This study also showed soaking hay in cold or warm water leads to a reduction in the total amount of potassium in alfalfa and Orchardgrass hays. For both types of hay, percent potassium loss ranged from 29-54% when soaked in cold water for 30 minutes, 31-61% when soaked in warm water for 30 minutes, 40-65% loss when soaked in cold water for 60 minutes and 72-80% loss when soaked in cold water for 12 hours.

Reducing the potassium content of hay would be of benefit to horses diagnosed with hyperkalemic periodic paralysis (HYPP) requiring a low potassium diet.

The magnesium content of all hay types was reduced by soaking, with greater loss occurring with longer soaking times. Temperature had a greater affect on the magnesium loss for alfalfa bud and flowering Orchardgrass hays.

Magnesium

The importance of having hay tested by a laboratory, particularly when feeding horses prone to laminitis and other metabolic issues. Photo source: shutterstock.com.

NSC content of hay varies greatly from batch to batch, and this emphasises the importance of having hay tested by a laboratory, particularly when feeding horses prone to laminitis and other metabolic issues. Photo source: shutterstock.com.

Not all hays are created equal.

Unfortunately, there is a down-side to soaking hay. Researchers have previously reported that soaking hay for prolonged periods increases the bacterial contamination and ‘bacterial load’ of hay, which contributes to the growth of viruses, bacteria and harmful yeast.

Soaking hay is a daily routine for many horse and pony owners. Photo by Cristina Wilkins.
Dry matter

What about other nutrients?

Soaking the hay in water had variable effects on the crude protein content of the hay. There were no changes in crude protein content, compared to the control samples when alfalfa bud and flowering Orchardgrass hays were soaked. When flowering alfalfa was soaked, the crude protein content decreased slightly. In contrast, the crude protein content of the vegetative Orchardgrass increased with soaking. This was believed to be related to dry matter loss, increasing the relative concentration of crude protein.

Dry matter

Dry matter refers to the material remaining once all water has been removed from the feed during the preparation for analysis. Nutritionists will often refer to quantities of feed being fed on a ‘dry matter basis’ and this definition allows all feed types to be compared without the confounding effect of the variations in water content. (The water content is relevant for other aspects as it will affect the actual quantity being fed.)

This is especially important for horses on hay-based diets (no pasture). Not accounting for the loss in dry matter over the long-term may lead to unwanted weight loss, digestive tract disorders, and potentially to the development of behaviours associated with low levels of forage in the diet, such as bed eating, coprophagy (eating manure), wood chewing and crib-bit ing.

What about hygiene and microbial contamination?

Unfortunately, there is a downside to soaking hay. Research has previously reported that soaking hay for prolonged periods increases the bacterial contamination load and a recent study confirmed this. Moore-Colyer et al (2014) took samples of Timothy mix meadow hay, Italian Rye Grass seed hay, pure Timothy seed hay, medium-cut Meadow hay and late-cut Meadow hay, and subjected the samples to soaking and/or steaming treatments.

Their soaking treatment involved immersing the hay in 30 litres of clean tap water (16°C) for nine hours, followed by 10 minutes hanging in the air to drain. The researchers reported the average bacterial contamination for the five hay types was increased five-fold following the nine hour soak.

Previous research by Moore-Colyer reported a 1.5-fold increase in bacterial contamination following a 10 minute soak in water. This rise in bacterial contamination is due to resident bacteria on the hay being washed into the soak water, where it is able to survive and rapidly multiply.

The researchers explained this is a great concern because an increase in bacterial contamination could increase levels of bacteria being ingested to above the recommended safe limit of 20 µg/L. Furthermore, they explained the "digestion of feed-associated bacteria will also mean the ingestion of significant levels of lipopolysaccharides, (the lipoglycans found in the outer membrane of Gram-negative bacteria), which can elicit undesirable strong immune responses in animals".

In contrast, soaking the hay for nine hours in 30 litres of clean tap water (16°C), followed by air drainage for 10 minutes, and then steamed for 40 minutes led to a reduction in the bacterial contamination by 98-99%.

The researchers emphasised the steam needs to be maintained at a temperature above 90°C for a minimum of 10 minutes and completely penetrate all the hay to be effective at killing all the mould and most of the bacteria. Furthermore, they cautioned insufficient steam treatment could lead to increases in pathogenic bacteria, especially Thermotaxisinum spp, which thrive at temperatures of between 18-40°C.

In summary

Soaking hay using the currently recommended guidelines of 30 minutes warm water or 60 minutes cold water is sufficient to reduce NSC content to levels safe for horses with laminitis, insulin resistance, polycaccharide storage myopathy (PSSM) or obesity.

However, soaking hay for prolonged periods of time compromises the hygienic quality of the hay by increasing bacterial contamination, leading to substantial dry matter loss and increases the calcium to phosphorous ratio.

Ideally, hay should be analysed, so the non-structural carbohydrate content can be taken into consideration prior to soaking. If you have any concerns or questions regarding soaking hay, you should consult a qualified equine nutritionist.

References

