THE EFFECT OF FEEDING CHOPPED ROUGHAGE WITH STARCH ON THE INSULINAEMIC AND GLYCAEMIC RESPONSE IN THE EQUINE.

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Reasons for study:

It is common practice to recommend the addition of roughage to a meal of concentrates to increase chews and subsequent saliva production to offset problems such as rapid consumption and gastric ulcers. However, addition of fibre to starch meals in humans has been shown to lower blood glucose levels (the glycaemic response). The glycaemic response is a measure of how well and how quickly carbohydrates are digested in the small intestine. The effect of mixed diets on the glycaemic response in equines is unclear. Some researchers (Stull and Rodiek, 1998; Harris et al, 2005) did not report any effect of adding fibre to a starch meal on carbohydrate digestion, whereas Radicke at al (1974) and Pagan and Harris (1999) found that adding fibre to a starch meal significantly reduced starch digestion (glycaemic response). Some of the results might have been confounded by differences in dry matter intake and quantities of starch.

This trial therefore investigated the effect of adding standardised quantities of fibre to specified quantities of starch so that the only variable was the order of feeding.

Aims:

To investigate the effects of feeding starch alone, before, after or with chopped roughage on the insulinaemic and glycaemic responses of healthy horses.

Methods:

Horses with a mean body weight of 560 +/- 36kg and a body condition score of 3.5 were used in a change over trial. The horses were individually housed in stables and bedded on wood shavings with free access to water.

Diets fed were 0.5g crude fibre/kgBW (1.6g chopped alfalfa/kgBW/meal) and 2g unprocessed starch/kgBW (4.5g oats/kgBW/meal).

The diets were fed as follows:

Oats alone (control)

Alfalfa followed by oats (A/O)

Oats followed by alfalfa (O/A)

Oats and alfalfa mixed (O+A)

As soon as the horse had finished the first part of the feed, the second portion was given. In addition the horses received 1kg hay/100kgBW three times a day.

Each horse was adapted for 13 days to the change in feeding order and on sampling days was fed the hard feed without hay. Using a catheter, blood samples were collected ½ hour before feeding and then every ½ hour after feeding for the first 5 hours and thereafter hourly until 8 hours had passed.

Serum glucose was determined by glucose oxidase[1] assay

Serum insulin was measured using radio-immunoassay kit. The hypothesis that fibre has no effect on starch digestion was tested using analysis of variance. Incremental area under the curve was calculated for the different diets using the trapezoid model.

[1]Unimate 7 GLUC GDH Roche diagnostics

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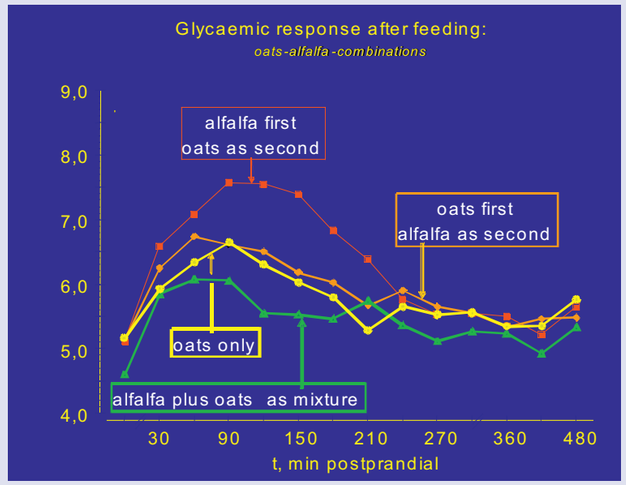
Results:

Graph 1. The glycaemic response to feeding set amounts of fibre and starch in different combinations

The order of feeding the set amounts of starch and fibre had an effect on the horses' ability to digest the starch as measured by their glycaemic response.

When forage was fed first, the glycaemic response to the starch was significantly higher ($p<0.05$) than when the same quantity of starch was mixed with the forage.

Whichever food was fed first was eaten faster than when the food was presented as the second part of the meal (Table 1)



Discussion:

A high glycaemic response indicates efficient small intestine digestion of starch. Horses which were fed forage first were less hungry for the starch meal and subsequently ate it more slowly allowing better digestion in the small intestine. It appears that the additional saliva produced in response to the fibre being mixed with the starch may have resulted in bigger boluses which allowed better peristalsis. Thus the fibre/starch mixture passed through the small intestine before all the starch was digested resulting in a lower glycaemic response to the same amount of starch. In addition, fibre fed after a concentrate meal may push the starch bolus through the small intestine before all the starch has been digested. Undigested starch in the hind gut can be problematical for the equine.

Clinical relevance:

Owners should consider feeding forage before they give a concentrate feed. This may simply be a case of feeding hay adlib. In the performance horse, if the owner is feeding more than 2g starch/kgBW (e.g. 2.5kg feed for a 500kg horse) the starch should be fed separately to the fibre.

A high glycaemic response to a starch meal indicates good small intestine digestion and is desirable; however it is advisable to recommend that horses which need a high calorie intake are fed small meals frequently rather than 2 large meals.

If the horse is obese, insulin resistant or suffering from laminitis or Cushings then they will need a low calorie diet which is unlikely to promote a glycaemic response.

A glycaemic response is a normal physiological response to starch and causes no clinical problems in fit, exercised horses.

Table 1. The effect of order of feeding on the time taken to eat 1kg of starch, (0.2gstarch/kgBW) and fibre, (0.5gcrude fibre/kgBW)

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