



Original Research

Digestion characteristics of two forms of preserved lucerne forage fed to mature horses

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Summary

A trial was conducted, using 12 mature thoroughbred horses as a cross-over design, to compare the water and energy intake and the digestibility of dry lucerne chaff (LC) against a controlled fermented lucerne (CFL) product (HNF Fiber®; Fiber Fresh Feeds Ltd, Reporoa, New Zealand). Significant ($P < 0.05$) increases in dry matter intake (20%), energy intake (20%), retained energy (32%) and digestible energy (22%) were observed for the CFL compared to the LC. In a concurrent small scale study within the trial, numeric improvements in water intake (18%) for the CFL were recorded. The results demonstrated that the standard reference values underestimate the digestibility and nutritional contribution made by CFL when fed to horses, and that this type of forage has increased nutritional benefits.

Keywords: Lucerne: controlled fermentation: chaff: horses: digestion

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Introduction

Lucerne *Medicago sativa* (also known as alfalfa) is a legume forage fed to horses in many forms, ranging from ground, pelleted, hay, dry chaff and fermented or ensiled product. Currently there is little data available regarding how the preservation processing of lucerne impacts its energy availability and digestibility characteristics in horses. The current NRC nutrient requirements do not specifically include lucerne (NRC 2007), but do state digestible energy (DE) values for ensiled legumes. Previous NRC recommendations list specifications for lucerne hay and dehydrated meal (pelletised form), but not ensiled lucerne products (NRC 1989). Researchers have reported that lucerne chaff contains a higher level of calcium and protein compared to grass hay (Cuddeford, 1994). Additionally, there is anecdotal evidence that feeding lucerne can improve electrolyte imbalances and hoof problems, most likely due to its high

mineral (especially Ca) and protein levels, and is thought to be a good feed material for older horses. Other researchers have reported that lucerne may be useful in the prevention of gastric ulceration in horses (Andrews *et al.*, 2005; Nadeau, 2006). Lucerne hay has been found to have higher dry matter and protein digestibility, and enhanced mineral absorption compared to grasses (Crozier *et al.*, 1997). Legume forages, such as lucerne, contain a larger proportion of soluble carbohydrates (Fonnesbeck, 1968) making lucerne hay more digestible than grass hay, however the impact of preservation method on these parameters has not been investigated.

Research comparing digestion of dehydrated forage across grazing species showed that horses and ponies have poorer forage digestion compared to ruminants and donkeys (Pearson *et al.*, 2006), which suggests that the extrapolation of lucerne digestibility parameters from ruminants to horses questionable. Horses have

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been shown to retain lucerne for longer than oat straw in their gut, which may affect overall digestibility (Cuddeford *et al.*, 1995). Trials where horses have been fed either pelleted or hay forms of lucerne have shown that processing does affect intake, with pelleted lucerne providing less digestible fibre, requiring higher daily intakes and resulting in a higher incidence of wood chewing (Haenlein *et al.*, 1966). The following trial was conducted to elucidate the feeding characteristics and digestibility of a controlled fermented lucerne (CFL) product and standard dried LC in order to determine whether processing method (drying or controlled fermentation) had a bearing on energy digestibility.

Materials and methods

Twelve adult non-racing thoroughbred horses, seven mares and five geldings, ranging in size from 15 to 16.1 hands (mean \pm SEM: 15.6 ± 0.13 hands) and body condition score average of 4 (on a 1–9 scale) were kept in 3.6 x 4 m pens, bedded on wood chips. Following a seven day adaptation period, where dry LC (8.24 kg per day split into two feeds) was fed alongside decreasing amounts of a complete and balanced commercial feed (Dunstan Coolfeed; Dunstan Nutrition Ltd, Hamilton, New Zealand) split into two feeds (3 kg on days one to three, 2.25 kg on days four and five, 1.5 kg on day six and 0.75 kg on day seven) were supplied to each horse. This was done to ensure all horses were on the same nutritional regime before the trial diets were introduced, to limit any effects of previous diet, and to introduce lucerne into their daily ration over time. On day eight each animal received one of either of the treatment forages; either 18.8 kg of the controlled fermented lucerne (CFL: HNF Fiber®; Fiber Fresh Feeds Ltd., Reporoa, New Zealand) or 8.24 kg of dry lucerne chaff (LC; sourced from a single batch harvested from one site in Wairarapa, New Zealand) per day, split into two feeds given 12 hours apart morning and evening. These diets were fed for seven days in a cross-over design, to give 12 replicates per diet.

Horses were monitored throughout the trial for body weight (by weigh tape) and condition score. These amounts were based on an isoenergetic daily intake according to standard lucerne DE and dry matter (DM) levels (NRC, 1989). Any feed refused was weighed and recorded on a daily basis. Faecal score (1–5 scale, where 1 = diarrhoea and 5 = hard pellets), body condition score (1–5, where 5 = obese) and faecal samples

were taken at the end of each seven-day forage feeding period. Samples of both feed and faeces were analysed for dry matter using a convection oven at 105°C (AOAC 930.15, 925.10), gross energy by bomb calorimetry, total ash using a furnace at 550°C (AOAC 942.05), and acid insoluble ash (AOAC 941.12). Total digestibility was calculated from the acid insoluble ash analysis according to the methodology proposed by Bergero *et al.* (2005).

Within this study, it was decided to make a preliminary investigation into the influence of water intake due to the two diets, as one was a dry form and the other had much lower dry matter content. Water intake was monitored over a 12 h period in the daytime, with an ambient temperature varying between 21–23°C, by adding known amounts of water to a spill proof vessel in order to maintain *ad libitum* supply to each animal. The amount remaining after the 12 h period was weighed back to allow calculation of water intake over the period.

Data was analysed by the GLM procedure of Unistat 5.5 (Unistat UK Limited), with the cross-over designated as a time replicate.

Results and Discussion

Horses fed CFL had significantly higher dry matter intakes ($p < 0.001$), due to less feed refusal. There were no significant differences between faecal outputs on a dry matter basis. Faecal scores for both dietary treatments were consistently good (4 or higher on a 1–5 scale). Faecal ash levels were 37% higher ($p < 0.001$) for the CFL – indicating increased overall digestion and absorption in the gut, as the ash levels in the original forages were similar (10.5% for the dry LC and 10.8% for the CFL on a DM basis).

The gross energy for both forages was comparable, being 18.2 MJ/kg for the dry LC and 18.9 MJ/kg for the CFL. However, when horses were fed the CFL they consumed over 20% more energy ($P < 0.001$) than when fed LC. When the total amount of energy excreted in the total faecal output was measured, it did not vary significantly between the diets, even though there was 17% more gross energy per kg faecal material ($P = 0.003$) for the horses fed the dry LC.

These differences had a major impact on the retained energy (RE), which was calculated as energy intake – energy output to give the amount of energy retained in the body per day. The CFL product resulted in 32% more RE per day ($P = 0.0007$) compared to the dry LC.

Digestible energy (DE) for the CFL was 22% higher ($P = 0.021$) compared to the dry LC form. This demonstrated that the quoted levels of DE given by NRC (1989; 2007) for lucerne is dependent upon the form in which it is fed, with CFL being considerably higher in DE compared to standard values given for lucerne (either fresh or as hay). When total feed digestibility was calculated, using the acid insoluble ash method developed specifically for forages in horses (Bergero *et al.*, 2005); there were no significant differences between the forms of lucerne, although the total digestibility of the dry LC diet was numerically higher by 7%. This indicated a high level of variance in the digestibility of the other nutrients present in the forages. Further analysis is needed to elucidate which nutrients were most affected in overall digestibility, which is currently being undertaken.

Water intake varied considerably between individual horses, however there was an interesting numeric increase (over 5 litres, or 18%) in the amount of water consumed by horses on the dry LC compared to those fed the CFL forage. This may reflect the dryness in terms of percentage DM of the chaff, compared to the CFL. Indeed, when the amount of water in the forage was taken into account, the total water intake of the horses fed CFL was 3.6 litres more per day (an 8% increase). This additional water intake from feed, rather than directly from water containers, could be a useful mechanism to maintain hydration in horses.

Anecdotal observations regarding eating behaviour showed that the horses consumed the CFL more slowly and consistently throughout the day compared to the dry LC. This could be beneficial in terms of relieving boredom in horses kept in stables or yards for long periods of time.

Body condition improved during, but did not change significantly in the two groups of horses following the adaptation period. However, we observed improvements in muscling and top line, and reductions in 'hay bellies' (abdominal distension) when the horses were on either of the forage diets.

Conclusions

Dry matter intake (20%), energy intake (20%), retained energy (32%) and digestible energy (22%) were significantly higher for the CFL compared to the dry LC. The digestible energy (DE) of the CFL was much higher than the standard values given by the NRC (1989; 2007), demonstrating that nutritional values for lucerne that has been further processed need to be ascertained. The data presented in this paper will allow feed manufacturers and horse owners a more accurate inclusion of lucerne in equine rations, taking into account the higher energy contribution to the diet from CFL compared to other sources, and the relative increase in energy availability required for maintenance and performance.

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Declaration of interest

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Table 1. Consumption and excretion characteristics of controlled fermented lucerne (CFL) or dry lucerne chaff (LC) fed to non-racing thoroughbred horses for 7 days.

Parameter	CF Lucerne	Lucerne Chaff	SEM
Dry matter intake (kg/d)	7.88 ^A	6.53 ^B	0.300
Faecal output (DM, kg/d)	3.08	2.89	0.249
Faecal ash (%)	15.2 ^A	9.6 ^B	0.394
Gross energy faeces (GE, MJ/kg)	19.88 ^B	20.21 ^A	0.096
GE consumed (MJ/d)	148.90 ^A	118.64 ^B	5.511
GE excreted (MJ/d)	61.28	58.61	5.126
Retained energy (MJ/d)	87.64 ^A	60.00 ^B	6.968
Digestible energy (MJ/kg feed)	11.08 ^a	9.03 ^b	0.457
Total digestibility of feed (%) [*]	69.4	74.8	6.732
Fresh water intake/d (litres)	31.1	36.7	3.197
Total water intake per d (l)**	41.5	37.9	3.126

Means not sharing a letter differ significantly (lowercase: $P < 0.05$, uppercase $P < 0.01$)

^{*} Measured by acid insoluble ash methodology for forages (Bergero *et al.*, 2005)

^{**} including water intake from feed material

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