Effect of short (<2CM) lucerne chaff addition on the intake rate and glycaemic response of a sweet feed

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Introduction

The nature of feeds fed to horses can influence the chewing rate and speed of ingestion dramatically (*Harris* et al 2005). Work in Germany in the 1970's showed that chopping or grinding of hay increased the duration of intake. Later work confirmed that adding chaff can extend the eating time, but suggested that the optimal chaff length may vary between horses and ponies. In one study the consumption rate was lowest with a chaff length of 11 cm for ponies, and 4 cm for horses (*Cuddeford* 1996). Currently it is commonly recommended that chaff is added to the rations of horses, in particular those that bolt their feed. However, it has been suggested that the addition of large amounts of chaff to a cereal meal may increase the risk of starch reaching the hind-gut.

In Australia, chaff addition is very common, and rations that contain 50% chaff or more are not unusual. However, Australian chaff is always very short in length (typically less than 2 cm), and to our knowledge no studies on the effect of this chaff on intake rate of a sweet concentrate mix have been published. Therefore, in this study we investigated the effect of adding typical Australian short chaff to a cereal based sweet feed, on intake rate as well as the glycaemic response to that meal.

Material and methods

To establish the baseline rate of intake, eight light-horse geldings (BW 564±26 kg) were fed clover hay twice a day according to maintenance energy requirements (NRC 1989: ~10 kg per day) for a 2 week adaptation period. Following this, the rate of intake for hay was measured on three successive mornings. Each morning residual hay was removed and a fresh meal of 2 kg hay was offered 2 h later. Feed intake was observed over the next 2 h after which time any residual feed was weighed. The time taken for each horse to finish its meal was recorded, and any interruptions in feed intake were noted. On the fourth morning, indwelling jugular catheters were inserted 1 h before feeding, and blood samples were collected every 30 min over a 7 h period thereafter. Whole blood was analysed immediately for glucose concentration using a portable glucometer calibrated for use in the horse.

After determining the baseline rate of intake for hay, the morning meal was gradually replaced, over a three day period, by a sweet concentrate mix (SF: 300g/100kgBW), either alone or with the addition of lucerne chaff (less than 2cm in length), at a 6% or 35% addition rate. The evening hay meal was adjusted accordingly. Each horse received each diet according to a Latin square design, with rate of intake and the glycaemic response being measured as described for the hay diet after the adaptation period.

Results were analysed by one-way ANOVA or ANOVA for repeated measures as appropriate, followed by Dunnett's test to compare each SF diet to hay, then each chaff diet to SF alone. Significance was taken at $P<0.05$.

Results

Horses maintained body weight and condition score throughout the study. No feed remained 2 h post feeding on any diet, and no interruptions to feeding were observed. Replicate observations showed no effect of time.

The rate of intake was slowest for the hay diet (Table 1). The SF was ingested at more than twice the rate of hay, when expressed on a time or mass basis ($P<0.05$), and this was not altered by the addition of 6% chaff. Relative to SF alone, adding 35% chaff increased the total time taken to consume this larger meal ($P<0.05$). However, a greater volume of feed was consumed per minute when 35% chaff was added to the SF ($P<0.05$; Table1). Therefore, when rate of intake was calculated in g/min the value for SF with 35% chaff was intermediate between the values observed for SF alone or hay alone and not significantly different from either diet.

Table 1 Effect of chaff on rate of intake for a sweet feed concentrate mix (mean±SE).

Rate of intake	Hay	Sweet feed mix		
		0 % chaff	6 % chaff	35 % chaff
Whole meal, min	66.6 ± 5.05	23.9 ± 2.07 ^{a}	27.8 ± 2.94 ^{a}	46.1 ± 4.04 ^{ab}
By mass, g/min	31.4 ± 2.52	77.2 ± 8.14 ^{a}	69.0 ± 5.80 ^{a}	49.3 ± 4.39
By vol., mL/min	210 ± 16.8	138 ± 14.5 ^{a}	138 ± 11.5 ^{a}	183 ± 16.3 ^{b}

Table 2 Glycaemic response to hay and a sweet feed concentrate mix (mean±SE).

	Hay	Sweet Feed mix		
		0 % chaff	6 % chaff	35 % chaff
Area under curve, mmol/L/min	1479 ± 42	1662 ± 43	1732 ± 61^{a}	1699 ± 61^{a}
Peak concentration, mmol/L	4.4 ± 0.1	5.5 ± 0.2^{a}	5.8 ± 0.2^{a}	5.8 ± 0.3^{a}
Time to peak, min	111 ± 11.3	105 ± 7.3	103 ± 8.8	123 ± 8.0
Time to return to baseline, min*	258 ± 7.5	285 ± 23.4	293 ± 19.4	375 ± 16^{ab}

Rate of intake did not correlate with area under the curve (AUC) for blood glucose concentration. Peak glucose concentration was higher with SF at all chaff inclusion rates than with hay ($P<0.05$). There was no evidence of a decrease in AUC, peak glucose concentration, or time to peak, with chaff addition (Table 2), although with 35% chaff the glucose did apparently take longer to return to baseline ($P<0.05$).

Discussion

The addition of 35% short chaff to the SF did extend the total eating time (almost double), but with less effect on the rate of intake expressed on a g/min basis. Furthermore, with the 35% chaff the horses increased significantly the volume of feed ingested per minute. This may reflect the very short nature of the chaff, and may increase the risk of adverse sequelae such as impactions if it is accompanied by a decrease in the efficacy of chewing. However, this increase in the volume ingested per minute was not as great as when the same type of chaff was added to oats (~ 33% Vs ~64%: *Harris* et al 2005b) and therefore the risks may be less when such chaff is added to sweet feed. The current data also show that the addition of short chaff up to 35% does not decrease the glycaemic response to sweet feed. Further work is needed to explore this further.

Conclusions

When horses are offered SF alone, it is ingested rapidly. The addition of 35% short Australian chaff (<2cm length) increases the period of eating and decreases the mass of feed ingested per min (but not significantly). This may support the animal's ethological needs but further work would be needed to confirm any benefit on behaviour. This level of short chaff allows a greater volume of intake per min, which may be undesirable. However, it did not alter the glycaemic response to the SF and so our data do not support the likelihood of any adverse effect on starch digestion in the small intestine, at this level of chaff inclusion. Further work is needed to evaluate the potential implications of this work, as well as the effect of longer length chaffs and larger inclusion rates, on intake and glycaemic responses.

References

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