

Chewing behaviour of Holstein steers fed diets containing different levels of non-forage fibre in a low forage diet

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Introduction Sugar beet pulp (SBP) is fed to ruminants as a non-forage fibre source (NFFS) ingredient. Early work by Ronning and Bath (1962) demonstrated that SBP was similar in feeding value to barley grain for lactating dairy cattle, supporting classification of beet pulp as an energy concentrate. Sugar beet pulp contains approximately 40% neutral detergent fibre (NDF) and is unique in its high concentration of neutral detergent soluble fiber, especially pectic substances (~25% of dry matter (DM)). However, the effects of SBP when substituted with different feed sources in ration are variable that depend on chemical composition, types and physical characteristics. The time which cows spent eating and ruminating (total chewing time) is a measure of the physically effective fibre value of a feed. The objective of the present experiment was to evaluate the effect of substitution of barley grain with SBP as a NFFS on chewing activity of Holstein steers.

Materials and methods Four Holstein steers with initial body weight of 368 ± 8 kg were used in a 4×4 Latin square design (28 days of each period). Basal experimental diet consisted of 15% maize silage, 20% lucerne hay, 33% barley grain, 17% soyabean meal, 13.8% wheat bran, 0.5% calcium carbonate, 0.2% salt, and 0.5% mineral and vitamin premix on dry matter basis. Barley grain was substituted with SBP as 0.0%, 33%, 66% or 100% named SBP0, SBP33, SBP66, and SBP100, respectively. Steers were housed in individual pens, and fed 9.5 kg of diet DM as total mixed ration twice daily at 0800 and 1600 h. Eating and ruminating activities of individual cows were visually observed and recorded at 5 min intervals for 24 hours on day 27 of each period. Feed samples were analysed for NDF according to Van Soest *et al.*, (1991) and NDF was expressed as the ash free residue after extraction with boiling neutral solutions of sodium lauryl sulphate and EDTA. Data were analysed using the mixed model procedure of SAS (2001) ($Y = \text{Mean} + \text{Treatment} + \text{Animal} + \text{Period} + \text{Residual}$) and the means compared by the Duncan test ($P < 0.05$).

Results Substitution of SBP increased physically effective NDF (peNDF) of rations from 22.77 to 28.71 % DM ($P < 0.05$, Table 1). No differences ($P > 0.05$) were observed between treatments for eating time per day, per kilogram of DM intake (DMI) and per kilogram of NDF intake ($P > 0.05$, Table 1). As diet peNDF was increased, with added SBP, ruminating activity as according to all the evaluated indices was increased ($P < 0.05$), but similar for SBP0 and SBP33. Similarly, time spent in total chewing (eating + ruminating) as according to all the evaluated indices was increased with inclusion of SBP in treatments, but similar for SBP0 and SBP33.

Table 1 chewing behaviour of steers fed diets containing different levels of sugar beet pulp as non-forage fibre source

Items	Treatments [†]				s.e.m.	P-value
	SBP0	SBP33	SBP66	SBP100		
peNDF [‡] , %	22.77 ^c	24.15 ^c	26.25 ^b	28.71 ^a	0.36	**
Eating time, min						
per day	111.2	123.7	128.8	143.7	23.9	ns
per Kg of DMI	12.2	13.6	14.1	15.7	2.6	ns
per Kg of NDF intake	37.9	39.9	40.1	42.7	7.6	ns
Ruminating time, min						
per day	232.5 ^b	267.5 ^b	365 ^a	391.2 ^a	41.3	**
per Kg of DMI	25.5 ^b	29.3 ^b	40 ^a	42.9 ^a	4.5	**
per Kg of NDF intake	79.3 ^b	86.8 ^b	113.3 ^a	116.4 ^a	13.06	**
Total chewing time, min						
per day	343.7 ^b	391.2 ^b	493.7 ^a	535 ^a	40.1	**
per Kg of DMI	37.7 ^b	42.9 ^b	54.1 ^a	58.7 ^a	4.4	**
per Kg of NDF intake	117.3 ^b	126.9 ^b	153.3 ^a	159.2 ^a	12.6	**

[†] Barley grain was substituted with SBP as 0.0%(SBP0), 33%(SBP33), 66%(SBP66) or 100%(SBP100).

[‡] PeNDF = Ration NDF multiplied by amount of DM >1.18 mm (Kononoff *et al.* 2002).

a, b, c Means in row with different superscript letter are different, ** $P \leq 0.01$.

Conclusions It was concluded that inclusion of SBP had a positive effect on ruminating and total chewing time as reported per day, per kilogram of DMI and per kilogram of NDF intake. Results of previous study demonstrated no effect of SBP substitution for maize grain on time eating per day or per kilogram of DMI (Clark and Armentano, 1997). Taken together, results of this study suggest that SBP might be a source of physically effective fibre by the definition of increasing chewing time.

References

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