

## Effect of substitution barley grain with dried sugar beet pulp on ruminal pH and ammonia nitrogen concentration of Holstein steers

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**Introduction** Grains are often substituted for forage in ruminant diets to increase feed intake, diet fermentability, and animal growth rate. However, greater dietary starch concentration can lead to digestive disorders, such as ruminal acidosis and reduce performance (Owens *et al.*, 1998). Adding non-forage fibre source, such as sugar beet pulp (SBP), to low-forage diets might reduce the negative effects of increased starch fermentation without increasing the filling effect of the diet to the same extent as forage fibre. So, substituting SBP for barley grain in a diet with moderately low forage content should alter ruminal fermentation and might increase mean or minimum ruminal pH. Thus, the objective of this study was to evaluate the effect of the substitution of barley grain with SBP on ruminal pH and ammonia nitrogen (NH<sub>3</sub>-N) concentration in Holstein steers.

**Materials and methods** Four Holstein steers with initial body weight of  $368 \pm 8$  kg fitted with ruminal fistulae 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% (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. At day 28 of each experimental period, rumen fluid samples were collected, from fistulae by suction, before the morning feeding and 1, 2, 3, 4, 6 and 8 hours post feeding. Sample pH was immediately recorded using a portable pH meter (Metrohm 744). For samples designated for NH<sub>3</sub>-N analysis, 5 ml of ruminal fluid from each collection were acidified with 5 ml of 0.2 N HCl. Samples were analysed for NH<sub>3</sub>-N concentration using distillation method (Kjeltec 1030 Analyzer tecator). Data were analysed using the GLM procedure of SAS ( $Y = \text{Mean} + \text{Treatment} + \text{Animal} + \text{Period} + \text{Time} + \text{Time} \times \text{Treatment} + \text{Residual}$ ), while including the sampling time as a repeated measurement.

**Results** The ruminal pH and NH<sub>3</sub>-N concentration at different sampling time are shown in the Table 1. Results indicated that both ruminal pH and NH<sub>3</sub>-N concentration were significantly influenced by the treatments and sampling time. Rumen pH of the animals fed SBP0 and SBP33 was minimum and maximum respectively, but similar for SBP66 and SBP100. In contrast rumen NH<sub>3</sub>-N concentration decreased by inclusion of SBP in the diets ( $P < 0.05$ ). Ruminal concentration of NH<sub>3</sub>-N for animals fed SBP0 was maximum, but similar for SBP33, SBP66, and SBP100.

**Table 1** Ruminal pH, and ammonia-N concentration (mg/dl) of steers fed diets containing different levels of sugar beet pulp

Items	Time(h)	Treatments <sup>†</sup>				Treatment effect		Time effect	
		SBP0	SBP33	SBP66	SBP100	s.e.m.	P	s.e.m.	P
pH	0.0	6.76	6.93	6.72	6.76	0.107	**	0.117	**
	1.0	6.23	6.22	6.22	6.24				
	2.0	6.17	6.28	6.12	6.29				
	3.0	6.08	6.43	6.21	6.31				
	4.0	5.98	6.51	6.35	6.34				
	6.0	6.22	6.50	6.37	6.36				
	8.0	6.32	6.60	6.40	6.50				
NH <sub>3</sub> -N	0.0	22.9	18.73	19.85	18.58	0.73	**	1.56	**
	1.0	32.52	31.95	30.56	30.21				
	2.0	36.42	33.78	34.28	31.59				
	3.0	37.35	31.87	32.08	29.86				
	4.0	37.75	28.65	26.43	26.93				
	6.0	26.87	22.08	21.14	18.48				
	8.0	24.76	18.43	19.29	14.8				

<sup>†</sup> Barley grain was substituted with SBP as 0.0%( SBP0), 33%( SBP33), 66%( SBP66) or 100%( SBP100).

\*\* $P \leq 0.01$ .

**Conclusions** Results of the present study demonstrated that the increasing inclusion of SBP in the diets caused an increase in rumen pH and decrease NH<sub>3</sub>-N concentration. Rumen pH of the steers fed basal diet (SBP0) was markedly decreased during 2 to 4 hours after morning feeding. Marounek *et al.* (1985) reported that unlike starch, pectin fermentation produces very little lactate as pectinolytic bacteria are inhibited at low pH. Decreasing of rumen NH<sub>3</sub>-N concentration with inclusion of SBP might be due either to a slower release of ammonia from the diet or more rapid uptake by microorganisms in the presence of a fermentable source of carbohydrate, such as pectin. Overall, the results of the present experiment suggested that substitution of barley grain with SBP had a significant effect on rumen synchronising as observed in increased pH and decreased ammonia-N concentration.

## References

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