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Effect of supplemented diet by sucrose or starch on ruminal pH and ammonia-N concentration in Holstein steers

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Introduction High producing dairy cows are often fed large quantities of high quality proteins, and because ruminal protein degradation is not directly coupled to microbial protein synthesis, ruminal $\text{NH}_3\text{-N}$ production is always excessive and ultimately lost by urinary N excretion. Increasing the supply of ruminally fermentable carbohydrates can reduce ruminal ammonia-N concentration and increase milk protein yield (Sannes *et al.*, 2002). The addition of sugar has increased ruminal and whole animal N efficiency in sheep and steers, reportedly to a greater extent than starch (Chamberlain *et al.*, 1993). The objective of this work was to investigate the effect of diets containing different non fibre carbohydrates (NFC, sucrose or starch) on ruminal pH and ammonia-N concentration in Holstein steers.

Materials and methods Four fistulated Holstein steers (BW=280, SD 15kg) were assigned to a 4X4 Latin square with 21 day periods; 17 days diet adjustment and 4 days sample collection. The basal diet contained lucerne hay, barley grain, soybean meal and sugar beet pulp (400, 290, 190 and 50g/kg respectively). Starch (St) or sucrose (Su) or a 1:1 mixture of starch and sucrose (St+Su) was added to the basal diet at the rate of 70g/kg DM. Diets were offered at 2-2.5 times maintenance requirements (7kg DM/day). Animals were fed twice daily at 08:30 and 16:30H. Rumen liquids were sampled before and 0.5, 1, 2, 3, 4, 5, 6, 7, and 8hrs after the morning feed. Rumen pH was measured directly (691 pH meter) and rumen ammonia-N determined by steam distillation (Kjeltec Auto, 1300, Foss Electric, Copenhagen, Denmark). Data were analyzed using general linear model procedure of SAS (2003) with Duncan's test for the comparison of means ($P < 0.05$). Statistical model was: $Y_{ijk} = \mu + T_i + C_j + P_k + \varepsilon_{ijk}$, where Y_{ijk} is dependent variable, μ is the overall mean, T_i is treatment effect, C_j is cow effect, P_k is period effect, and ε_{ijk} is error.

Results A significant effect of supplemental NFC on ruminal ammonia-N concentration was detected. However, no effect on ruminal pH was observed (Figure 1). Generally, ruminal ammonia-N concentration was higher when steers were fed the basal diet compared with St and Su ($P < 0.01$).

Conclusions Results of the present experiment indicated that ammonia-N concentration was lower when steers were fed St or Su than only the basal diet. It has been proposed that when energy is a limiting factor in the rumen, micro-organisms degrade feed protein to ammonia and ammonia uptake by ruminal bacteria is inhibited (Nocek and Russell, 1988). A previous study demonstrated that water soluble sugars caused decreased ammonia concentration in the rumen, through decreased ammonia production, while starch caused increase in the uptake of ammonia for microbial protein synthesis (Hristov *et al.*, 2005). Results of the present study confirmed the finding of Chamberlain *et al.*, (1993) that addition of sugars decreased N losses. This positive effect of NFC on ruminal ammonia concentration decreased the metabolic effect of ammonia in host animal.

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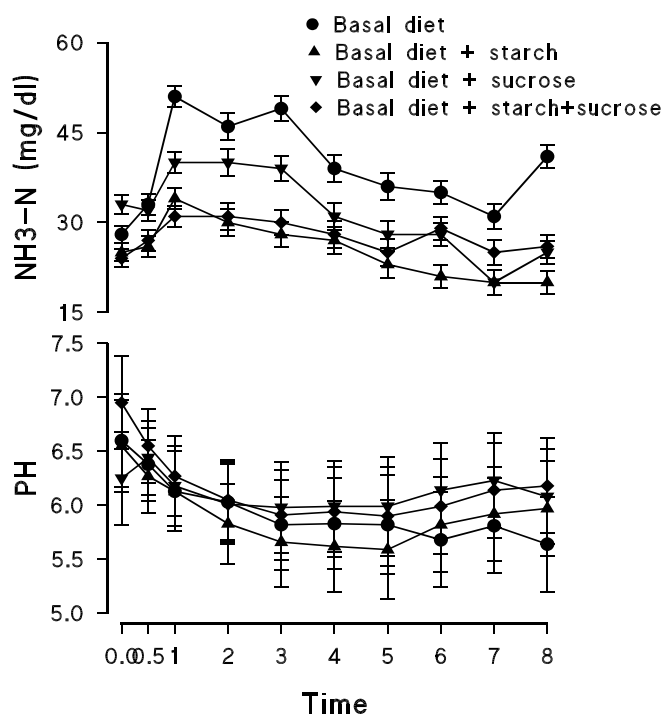


Figure 1 Hourly ruminal pH and ammonia-N concentration (mg/ dl) measured in steers fed starch or sucrose supplemented diets