Substitution of Fructose For Grain Decreases Ruminal pH in an Induced Acidosis Protocol

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Ruminal acidosis is an important nutritional disorder of dairy cattle, associated with the consumption of large amounts of readily fermentable carbohydrates (Bramley *et al* 2008). Histamine is produced in the rumen by decarboxylation of the amino acid histidine. Ruminal production and accumulation of histamine is associated with low pH. The aim of this study was to measure rumen pH and histamine concentrations of dairy cattle fed at a level designed to induce subacute acidosis.

The study consisted of 30 Holstein heifers randomly allocated into 5 treatment groups; i) Control (no grain), ii) Grain (1.2% liveweight (LW) rolled triticale)(GR), iii) Grain (0.8% LW) + fructose (FR)(0.4% LW), iv) GR + histidine (6g/hd, administered via stomach tube) and v) Grain (0.8% LW) + FR + histidine in an incomplete factorial design. Heifers were fed 1kg of grain daily and had *ad lib* access to mixed silage and lucerne hay for a 10 day adaptation period, and then feed was withheld for 14 hours prior to challenge. On the day of challenge each heifer was fed and ate 200g of lucerne hay, immediately after heifers were fed their allocated diet. Rumen samples were collected 5 minutes after diet ingestion, 60 minutes later and 3 subsequent 50 minute intervals. Rumen samples were analysed for rumen pH immediately after collection and histamine concentrations following storage at -20^{o}C within four weeks of collection using a histamine ELISA (IBL, Hamburg, Germany).

The results were tested by repeated measures analysis of variance using *heifer* as a random effect (Stata V11, StataCorp. LP). The interactions between FR and histidine, and GR and histidine, and the effect of time were not significant for ruminal pH. The effect of day ($P < 0.01$), FR ($P < 0.001$) and GR ($P < 0.05$) were significant. The substitution of fructose for some grain resulted in a marked drop in ruminal pH irrespective of the presence of histidine. The interactions between histidine and FR ($P < 0.01$) and histidine and GR ($P < 0.05$) and the effect of day ($P < 0.001$) and time ($P < 0.001$) were significant for ruminal histamine. The interactions between FR and GR ($P > 0.05$) were not significant. Differences between groups were significant with greater histamine concentrations in the GR compared to Control group. For all groups histamine concentrations peaked at 65 minutes and declined thereafter, with a marked decrease in the Control group. This study demonstrates that profound declines in ruminal pH are caused by the substitution of fructose for grain and that ruminal histamine concentrations increased with addition of grain and grain and fructose, irrespective of the presence of histidine.

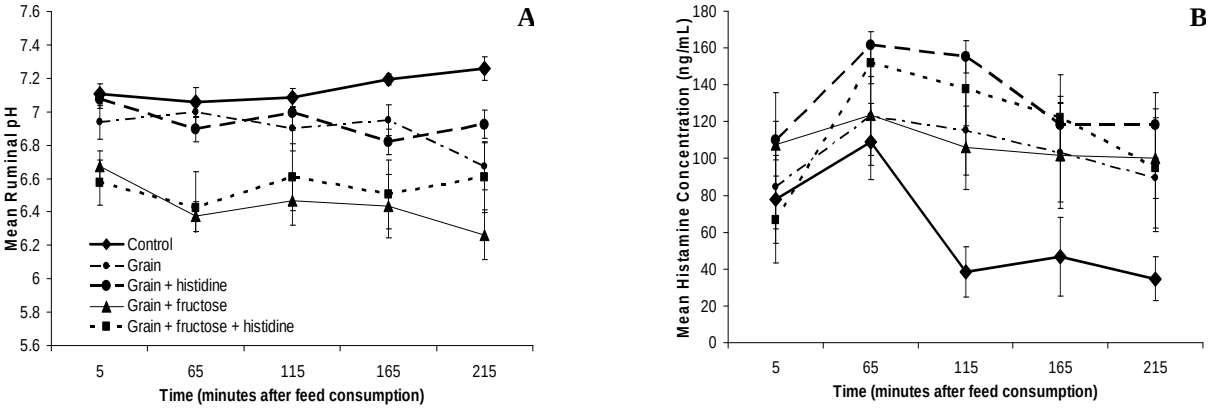

Figure 1. (A) Mean ruminal pH (B) Mean ruminal histamine concentration (ng/ml) in heifers (n = 6 heifers/treatment) taken at 5 time periods ± SEM

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