BRIEF COMMUNICATION

Differences in the concentrations of glucose and related metabolites in the milk of Jersey and Friesian cows

S.J. EICHLER AND S.R. DAVIS

Dairying Research Corporation Ltd, Ruakura Agricultural Centre, Private Bag 3123, Hamilton, New Zealand.

Keywords: Glucose, cows, milk, mammary gland

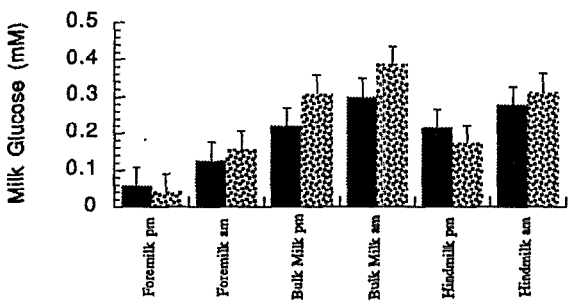
Jersey cows characteristically produce a more concentrated milk (percent solids) than Friesian cows. Differences between the breeds in the volume of water secreted are associated with differences in lactose secretion, as lactose is the major osmotic component of milk. Secretion rate of lactose, relative to fat and protein can be up to 40% lower in Jersey relative to Friesian cows (L'Huillier *et al.*, 1989).

The biochemical nature of the breed difference in lactose yield, relative to other solids, was investigated using two herds of Jersey cows selected (L'Huillier *et al.*, 1989) for high (HP) or low (LP) protein content in milk (low and high volume producers, respectively) and a Friesian herd (F), all cows being of high genetic merit. As the concentrations of metabolites in bulk milk are thought to be indicative of their intracellular concentrations (Faulkner *et al.*, 1980, 1981), milk samples were analysed for glucose, glucose-6-phosphate, glucose-1-phosphate, UDP-glucose and UDP-galactose in order to try and identify the source of the breed difference in lactose output. The cows were kept under similar feeding and management regimes. Bulk milk samples were collected from 10 HP, 10 LP and 10 F cows at two 8 a.m. and two 4 p.m. milkings (Experiment 1). A second group of samples (Experiment 2) was collected from groups of 12 Jersey (unselected) and 12 Friesian cows where, in addition to the bulk milk sample, samples of foremilk and hind milk were collected at each of the four milkings. Tail blood samples were collected from both groups directly after the second a.m. and p.m. milkings. Metabolite content of milk samples was analysed by specific bioluminescence assays, plasma and milk glucose concentration by a glucose oxidase method and milk composition by infra-red reflectance spectrometry.

In Experiment 1, milk glucose concentration was significantly higher ($p<0.05$) in LP (0.55 mM) than HP (0.44 mM) but not F (0.50 mM) cows at the a.m. milkings only. Glucose-6-phosphate and glucose-1-phosphate content of milk showed no significant genetic group effects, while UDP-glucose and UDP-galactose were both present in milk below the limit of detection (4 mM).

In Experiment 2, milk glucose concentration was significantly ($p<0.05$) higher in F than J milk for the bulk milk samples (a.m. and p.m.; Fig. 1). Milk glucose content was lower in hind milk than bulk milk and lower still in foremilk (Fig. 1).

FIGURE 1: Glucose concentration of milk from Jersey (grey bars; n=12) and Friesian (speckled bars; n=12; Experiment 2) cows. Samples of foremilk, bulk milk and hind milk were taken at a.m. and p.m. milkings. Standard errors are shown. Differences between the breeds were significant ($p<0.05$) in both bulk milk samples.



In both experiments plasma glucose concentration was highest at the time of the a.m. milking (a.m., 3.43±0.07 mM; p.m., 3.00±0.09 mM; $p<0.01$).

In conclusion, significant differences in milk glucose concentration associated with breed or strain became manifest at milkings where plasma glucose concentration was highest. In both experiments cows producing a more dilute milk (LP and F) showed higher milk glucose concentration, suggesting that differences between breeds and strains may have arisen from differences in intracellular glucose content. The lack of repeatability, in terms of the overall magnitude of milk glucose results in Experiments 1 and 2, may have arisen from sampling errors and/or effects of differences in plasma glucose concentration. The marked difference between foremilk, bulk milk and hind milk in glucose concentration (Fig. 1) demonstrates that the aqueous phase of milk is not of constant composition.

REFERENCES

L'Huillier, P.J., Davis, S.R., Carruthers, V.R., Morris, C.A., Bryant, A.M. 1989. Development of cattle of superior genotypes: novel approaches to increasing tolerance of dairy cows to extended milking intervals. Proceedings of the New Zealand Society of Animal Production 49: 57-63.

Faulkner, A. 1980. The presence of cellular metabolites in milk. Biochimica et Biophysica Acta 630: 141-145.

Faulkner, A., Chaiyabutr, N., Peaker, M., Carrick, D.T., Kuhn, N.J. 1981. Metabolic significance of milk glucose. Journal of Dairy Research 48: 51-56.