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A STUDY OF THE EFFECTS OF PLANE OF NUTRITION  
ON BOVINE MILK PROTEINS, WITH PARTICULAR  
EMPHASIS ON THE INDIVIDUAL WHEY PROTEINS

A THESIS PRESENTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
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SUMMARY

The work in this thesis consists of a short term study of the effects of plane of nutrition on the synthesis and secretion of milk proteins by dairy cows, with particular emphasis on the individual whey proteins.

The treatments comprised a high and low plane of nutrition and were imposed by strictly controlled stocking rates of the experimental animals. Six sets of identical twin cows were split between the two treatment groups.

The technique of discontinuous gel electrophoresis was used for the separation of the whey proteins and a method (called "Proportional Subdivision") was developed for the quantitative analysis of the individual proteins. The four major whey proteins ( $\beta$  lactoglobulin,  $\alpha$  lactalbumin, bovine serum albumin and immunoglobulins) were isolated and quantified.

1). The treatments were deemed effective as judged by the differences which were measured in the concentrations and yields of the major milk fractions. The yields of milk, fat and protein were significantly ( $P < 0.01$ ) affected by treatment as was the protein percentage measured in skim milk, but not in whole milk. Fat percentage did not alter significantly ( $P > 0.05$ ).

2). The mastitis status of the animals was monitored using the Wisconsin Mastitis Test. It was possible therefore to show that Mastitis infections were not influencing the responses to treatment.

3). Total whey and casein proteins, each expressed as a percentage of total protein, did not alter ( $P > 0.05$ ). The caseins, expressed as a percentage of whole milk differed significantly ( $P < 0.01$ ) between treatments whereas the total whey proteins expressed similarly did not ( $P > 0.05$ ). The yields of both classes of proteins altered significantly ( $P < 0.01$ ) with treatment.

4). The concentrations of the whey proteins which are synthesised in the mammary gland ( $\beta$  lactoglobulin and  $\alpha$  lactalbumin) decreased with the low plane of nutrition, but only the difference between treatments in  $\alpha$  lactalbumin reached significance ( $P < 0.05$ ). The yields of both these proteins were reduced significantly ( $P < 0.01$ ) by the low plane treatment.

5). The concentrations of the proteins entering the mammary gland pre-formed from the blood stream (Bovine Serum Albumin and the Immunoglobulins) moved in the opposite direction to the mammary synthesised proteins in response to the low plane treatment. The difference between treatments (increase in concentration under the low plane of nutrition) was highly significant ( $P < 0.01$ ) for Bovine Serum Albumin, but failed to reach significance for the Immunoglobulins. The change in concentration was sufficient to decrease the yield of Bovine Serum Albumin under the high plane relative to the low plane treatment. The yield of Immunoglobulin was not altered significantly by the treatments ( $P > 0.05$ ).

6). The separation of the individual  $\beta$  lactoglobulin proteins (A and B) in the cows heterozygous (AB) for  $\beta$  lactoglobulin indicated that no significant changes occurred ( $P > 0.05$ ) in the concentration of the proteins between treatments. Similarly, the ratio of the two proteins (A/B) did not alter significantly ( $P > 0.05$ ) with treatment.

The relevance of these results is discussed both in relation to the synthesis and secretion of milk proteins and in relation to observations on the influence of the effect of protein composition on the manufacturing properties of milk.

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