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Editorial

Intermediary Metabolism in the Dairy Cow

Current feed evaluation systems for ruminants include very simple models of intermediary metabolism – either single, static coefficients or simple equations to describe the efficiency with which the energy and nitrogen available for absorption are converted into milk and meat. For example, the revised UK system 'Feed into milk' defines a fixed efficiency of utilization of metabolizable protein (MP) for milk production of 0·68 (Thomas, 2004). Such a simple 'efficiency' coefficient is the tip of the tip of a rather large iceberg, representing the metabolism of the end-products of digestion between the point of their absorption into the animal and their use for the synthesis of milk and meat. The complex biochemistry of metabolism in the tissues of the gut (the portal-drained viscera, PDV), the liver and other internal organs, the adipose tissue, muscle and mammary gland: all reduced (a term used non-pejoratively) to single coefficients or simple equations. Simple and very useful – up to a point.

A Working Party established by the Agricultural and Food Research Council (AFRC) Technical Committee on Responses to Nutrients wrote, in 1998, *'The present state of knowledge on the nutritional and hormonal interactions* [in intermediary metabolism] *is considerably inferior to the knowledge which exists with respect to the processes of ruminal and intestinal digestion, and thus to develop a satisfactory model of metabolism requires research not only in model construction but also in the physiology and biochemistry of animals.'* (AFRC, 1998). Perhaps contrary to the common perception of a contracting research base in farm animal science, the required research in physiology and biochemistry is continuing, research which is summarized and put in context by two review articles in this issue of *Animal Science*.

Kristensen (2005) focuses on a key aspect of the 'energy economy' of the cow: the metabolism of volatile fatty acids (VFA) in the tissues of the digestive tract and the liver. Using novel techniques, Kristensen and colleagues have re-examined (and overturned?) one of the key paradigms of ruminant physiology, that a large proportion of the VFA generated by fermentation in the rumen is metabolised during absorption.

Researchers from Canada and the UK are untangling factors affecting the partitioning of absorbed amino acids between use for protein synthesis and catabolism and this topic is reviewed by Lapierre *et al*. (2005). This paper emphasizes the important concept that 'efficiency of utilization' of absorbed amino acids is as much a function of demand (in the lactating cow, principally from the mammary gland) as it is of supply.

The statement from AFRC (1998), quoted above, demands two activities, physiological research and model construction. These authors continue: *'It is likely, however, that the best progress will be achieved if both types of research are undertaken in parallel.'* In a third review article in this volume, Hanigan (2005) summarizes the 'state of the art' in the simulation of PDV and hepatic metabolism, demonstrating how a computer model is a quantitative library in which to store new knowledge as well as a driver of future research.

All three papers are based on presentations given to the 2004 annual meeting of the British Society of Animal Science. They demonstrate 'the current state of the art' for these important topics in ruminant physiology, offering a below the water-line look at these rather large and often forbidding icebergs. The reviews should serve as a valuable summary for those already working in this field of research, a concise and convenient introduction for those entering the field, and a window onto the future of practical systems for predicting the responses of dairy cows to the feedingstuffs they are offered.

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