

EFFECT OF DIET ON THE ENERGY REQUIRED TO IMPROVE MILK PROTEIN CONTENT IN DAIRY COWS

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Milk protein is seen as an important commodity produced by dairy cows, however, it has been suggested that it is difficult to alter by manipulating nutrition although it is well recognised that energy intake is the most important aspect in its control. A large number of experiments have been conducted by the dairy research centres at Kyabram and Ellinbank. This paper summarises the influence of diet on responses in milk protein content from 27 experiments where a wide range of feedstuffs have been used.

The use of starch-based supplements, such as cereal grains and compounded concentrates, is the best way to improve milk protein content; an average of 17.9 (s.e. $\pm$ 1.8) MJ of metabolisable energy gave a 1 g/kg improvement in the Victorian experiments. This is not greatly different to the 22 MJ reported by Gordon (1977). These high energy supplements result in the production of large amounts of volatile fatty acids in the rumen and propionate, in particular, has been shown to increase milk protein content.

Quality of pasture *per se* has less effect on milk protein content. Experiments involving either white clover (*Trifolium repens*), perennial ryegrass (*Lolium perenne*), paspalum (*Paspalum dilatatum*) or mixtures of these species have shown that an average of 29.5 (s.e. $\pm$ 3.0) MJ of metabolisable energy is required to improve milk protein content by 1 g/kg; this is taken across feeding levels, variations in body condition and stages of lactation, but excluding gross underfeeding when cows are approaching drying off. Using maize (*Zea mays*) silage as a supplement resulted in a similar response to that obtained from pasture, with 28.8 (s.e. $\pm$ 2.1) MJ of additional energy being required to increase milk protein content by 1 g/kg. These results are similar to those of Spörndly (1989) and Coulon and Rémond (1991), who report that 33 and 29 MJ are needed to increase milk protein content by 1 g/kg, respectively.

A variation to the association between energy intake of pasture and milk protein content was a response recorded by Stockdale (1992, 1993) for cows eating top quality subterranean (*Trifolium subterraneum*) or Persian clover (*Trifolium resupinatum*) pastures with more than 200 g protein/kg DM. Over ranges of intake from 7.5 to 22.5 kg DM/cow.day, milk protein content was not affected by extra feeding in early lactation. It is unclear why this occurred although it has been contended that milk protein can be reduced by excessive dietary protein. The reduction in non-protein energy content associated with the increased protein level may result in reduced amounts of volatile fatty acids being absorbed. The result will be little change in the effective balance of precursors reaching the mammary gland and, in fact, Gordon and McMurray (1979) found that high dietary protein actually reduced the protein content of milk. Also, there is an energy cost in converting rumen ammonia to urea and excreting it in urine; for example, this could be about 3 MJ/day if dietary protein increases from 190 to 230 g/kg.

To conclude, 18-30 MJ of additional energy will improve the protein content of milk by 1 g/kg. Starch-based supplements give the best results while high quality annual clover pastures have very little effect. These dietary influences need to be considered when attempting to manipulate milk protein.

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