SUPPLEMENTARY FEEDING OF GRAZING DAIRY COWS

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Summary

Supplementation of pasture-fed cows differs, in many respects, from that of silage concentrate--fed cows. The intake of energy of pasture-fed cows is often low because of the low metabolisability of pasture. Many dairy systems in Australia also involve tropical pastures and supplementation can overcome some of the shortfalls in minerals and energy of this pasture type.

Responses to the feeding of supplementary energy are generally lower in short-term experiments than longer whole lactation studies. In the longer studies, responses have ranged from 0.94 kg milk/kg concentrate to 2.3 kg milk/kg concentrate.

Large responses have also been obtained with pasture-fed cows to the feeding of protected proteins.

I. INTRODUCTION

In general,, pastures are the cheapest form of feed for dairy cows in Australia and it is only during periods of exceptional feed shortage that cows get more than 50% of their intake from supplementary concentrates. Concentrates, however, are widely used to fill pasture feed gaps. Pastures vary widely throughout the year in quality as well as quantity and, in many circumstances, the feeding of supplements to grazing cows is necessary and economical.

This review will concentrate on Australian conditions and I will draw attention to the differences in nutrition between pasture-fed cows, and those of most other countries where cows are housed and fed silage concentrate rations. Pasture-fed cows have a low milk production; it is rare for one to produce 30 kg milk/day even at peak lactation. Thus, only the very best pasture-fed cows attain the 30 to 35 kg/day category, defined as high producers by Oldham and Alderman (1981).

This low production is mainly due to the low metabolisable energy concentration in pasture, but the difference between dairying in Australia and that of most other countries is not only the difference between pasture--fed animals compared with housed animals, but also a significant proportion of dairy systems in Australia involve subtropical pasture species. These species have specific problems for dairying in that they have lower contents of some minerals than many of the temperate species.

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II. TYPES OF SUPPLEMENT

(a) Mineral supplements

The dairy cow has a high requirement for minerals and they should not be overlooked when dealing with supplementation since a common symptom of a deficiency of most minerals is the occurrence of reduced appetite (Reid 1956).

Deficiencies of sodium, phosphorus, sulphur and calcium are likely to occur with subtropical pastures (Gartner et al. 1980). The cereal grains oats, barley and maize are also low in sodium and calcium, so the common practice of feeding those grains as energy supplements is likely to accentuate deficiencies in those minerals.

Sodium is of particular interest to dairying. The recommended desirable sodium concentration in pasture for lactating cows is 0.15% in the dry matter (Butler and Jones 1973), but many subtropical species have very low sodium contents, e.g. paspalum 0.06%, kikuyu 0.05%, sudax 0.01%, maize 0.01% (Smith et al. 1978). Furthermore, a sodium deficiency can be precipitated in lactating animals because of the high loss of sodium in milk in animals suffering from mastitis or even subclinical mastitis (Schalm et al. 1971).

Very large responses have been obtained to supplementation of cows grazing tropical grass legume pastures with some minerals. Sodium chloride resulted in an increase of 1.2 kg milk per day (Davison et al. 1980) and supplementation with phosphorus resulted in an increase of 1.1 kg/day (Davison et al. 19823.

Cows grazing forage sorghum have shown an increase in milk production due to supplementation with elemental sulphur (Stobbs and Wheeler 1977).

Although there is not a lot of data in Australia on the response of dairy cows to mineral supplements, there have been other animal production responses to mineral supplements, with cattle grazing improved pastures, that are likely to he used for dairy. A 27% increase in liveweight gain by young calves was obtained when they were given a mixed sodium, phosphorus, calcium supplement (Kaiser 1975). Liveweight responses to sodium and sulphur have also been reported by Archer and Wheeler (1978) with steers grazing forage sorghums.

(b) Rumen buffers and bentonite

There has been a considerable amount of work, in the USA with housed cows, on the effect of rumen buffers in reducing some of the deleterious effects of high grain-silage rations. Mineral salts, such as sodium and potassium bicarbonate, magnesium oxide and magnesium carbonate, have been shown to have some buffering effect in the rumen and have been used to increase milk fat content (Emery et al. 1964; Snyder et al. 1983), to raise rumen pH and to improve the adaptation of cows to high-energy rations following an abrupt change post partum (Erdman et al. 1980).

The buffers have been most effective when milk fat of control cows has been below 3.00%. This situation is not often encountered with pasture-fed cows and the results of feeding buffers have little applicability to grazing dairy cows.

In an Australian study with cows at pasture, Kaiser et al. (1982) increased milk fat content from 3.09% to 3.31% by feeding 4.50% sodium bicarbonate in cracked wheat. The level of feeding of wheat of 8 kg/cow/day, however, is a high level under grazing in Australia.

Bentonite, a diatomaceous earth with a high exchange capacity, is often added to dairy concentrate rations. It was originally used as an anti-caking and pellet binding agent, but Rindsig and Schultz (1970) found that it increased the fat content of milk when concentrate rations low in roughage were fed.

Similar to the results from rumen buffers, bentonite appears to have been most effective when milk fat content of cows that have not been fed the bentonite was low, sometimes as low as 1.7% (Bringe and Schultz 1969).

Under conditions of cows fed temperate pastures, with grain supplements up to 6 kg/head/day, bentonite has not been effective in increasing total milk production, milk fat or bodyweight gain. Lemerle et al. (1984) fed a range of levels of concentrate to pasture-fed cows and obtained no production responses to the addition of bentonite. Similarly, Hamilton and Kempton (1984), with sows grazing temperate pastures, found no benefit in including bentonite in maize grain supplement fed at either 4 or 6 kg/head/day.

It is stressed that the work on these rumen modifiers has been carried out to overcome deleterious effects specific to high grain-silage diets; Silage has a low pH and, when combined with high levels of grain feeding, often leads to low rumen pH in cows. These conditions are not usually found with pasture--fed cows and there is usually no benefit in supplementing them with rumen buffers and bentonite.

(c) Energy supplements

Supplements that are high in energy and low in protein, such as cereal grains, are the cheapest and are most commonly used by dairy farmers in Australia. The majority of supplementary feeding research in Australia has also been carried out on these high-energy feeds.

Studies on supplementation in Australia have often used short feeding periods and the responses have generally been low with this type of an experiment. As an example, Rogers et al. (1983) reported the results of seven studies, of between five and ten weeks duration, with cows in early lactation. The mean response to crushed oats grain was 0.56 kg milk/kg oats.

Trigg et al. (1983) reported slightly higher responses to concentrate pellets in three studies. Concentrate pellets were fed for periods of 15 to 22 days and they reported responses in early, mid and late lactation cows of 0.90, 1.00 and 0.65 kg/kg concentrate respectively.

Other short-term studies have resulted in similar milk responses, ranging from 0.27 to 0.80 kg milk/kg grain fed (Jeffery 1970; Stobbs 1971; Jeffery et al. 1976; Cowan and Davison 1978; Sriskandarajah et al. 1980).

It is inevitable that short-term studies will underestimate the true response to supplementary feeding. Animals given supplements with high energy contents utilize a proportion of the energy for bodyweight rather than milk production, and this usually results in higher milk production of the supplemented cows after supplementary feeding ceases.

When feeding has been for long periods 'and milk production has been measured over the whole lactation, the responses are high, ranging from 0.94 to 1.22 kg milk/kg concentrate (Colman and Kaiser 1974; Jeffery 1970). Cowan (1985) suggested that a response during feeding of greater than 1.20 kg milk/kg concentrate was unlikely to occur. Higher responses than this are expected over the whole lactation if the concentrate increases the persistency of lactation, as happened with Cowan et al. (1975) who obtained a response of 2.30 kg milk/kg concentrate, or if the supplement stimulates an increase in intake of pasture.

(d) Protein supplements

There have been only a few Australian studies where the response of grazing cows to supplementary protein has been examined. This is probably a result. of a belief that protein intake is not a limiting factor on high--quality pastures (Brookes 1982).

The protein in young grass and legume pastures has a high degradability, and two studies suggest that cows grazing pastures with high protein contents may still respond to supplements of protein that resist degradation in the rumen. In Queensland, Stobbs, Minson and McLeod (1977) obtained a 3.3 L (20%) increase in milk production by feeding formaldehyde.-treated casein. Their cows grazed young, leafy, tropical grass pasture containing 20% crude protein, a level of protein which has traditionally been accepted as sufficient for high--producing dairy cows. Rogers et al. (1980) also obtained a significant increase of 2 L of milk by feeding formaldehyde--treated casein. Their cows were fed indoors with a mixture of ryegrass, cocksfoot and white clover with an overall mean crude protein content of 17.5%.

Although the above studies are a clear indication that pasture--fed cows will respond to rumen undegradable protein, the response in terms of milk product ion has been variable. Minson (1981) and Flores et al. (1979) obtained significant, but low, responses to formaldehyde--treated casein, 'whereas Kelloway (1974) conducted two experiments, in the first of which there was a significant increase in milk production due to formaldehyde-treated casein and, in the second, there was no effect. Brookes (1983) also reported no response of pasture-fed cows to formaldehyde-treated protein.

All the above studies used casein treated with 1 g formaldehyde/100 g crude protein, but the recent work of Ashes et al. (1984) indicates that there could be damage to some of the amino acids in meals treatetd at that level.

Formaldehyde reacts preferentially with specific amino acid side chains on the protein and the adsorption of individual amino acids can vary widely after treatment with formaldehyde. Ashes and his co-workers found, with casein treated with 1 g formaldehyde/100 g crude protein, that 19.2% of the lysine and 12.3% of the cystine were not absorbed by sheep.

From the above results, it appears that the level of formaldehyde added to proteins is important for optimum responses. Ashes and Hamilton (1983) fed lactating cows untreated casein or casein treated with any of three levels of formaldehyde (0.25, 0.50 or 0.75 g/100 g crude protein) and the highest response in milk production was obtained with the level of 0.50 g/100 g crude protein.

In a further experiment, Hamilton and Ashes (1984) fed 1.2 kg sunflower meal/head/day to dairy cows for eight weeks in early lactation. The sunflower meal was either untreated or treated with either 0.5 or 0.7 g formaldehyde/100 g crude protein and the cows grazed kikuyu grass pasture with a crude protein content of 14.0%. The mean milk production/head/day was 17.8, 18.9 and 18.4 for the treatments respectively. There was a significant increase in milk production due to formaldehyde treatment and, although there was no significant difference between the two levels of formaldehyde treatment, the 0.5 g treatment level was again the higher.

Taken together, there has been a high number of experiments with significant responses to formaldehyde-treated protein meals with pasture-fed cows. These responses have also occurred with cows that have been relatively low producers, by international standards, with production of less than 20 kg milk/head/day.

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