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THE INFLUENCE OF PROTEIN SUPPLEMENTS ON MILK YIELD AND COMPOSITION

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SUMMARY

Two experiments were conducted in which supplements (0.45 kg/day) of lactic casein and casein, which had been "protected" from ruminal degradation by treatment with formaldehyde, were fed to milking cows grazing pasture.

There were some changes in milk yield or composition attributable to the type of casein consumed, but it was concluded that protecting dietary protein from ruminal breakdown is unlikely to provide a practical means of increasing milk production under New Zealand conditions.

THE RUMINANT depends for its protein supply on the digestion and absorption in the intestine of microbial protein and of food protein which has escaped ruminal breakdown (see McDonald, 1968). While high-quality pasture does lead to high concentrations of ammonia in the rumen and hence high losses of nitrogen in the urine, on the basis of feeding standards the protein requirements for milk production would be expected to be more than adequately provided from pasture. On the other hand, because more efficient utilization of protein (Chalmers *et al.*, 1954; Little and Mitchell, 1967) and increased wool growth (Ferguson *et al.*, 1967) have been obtained by making protein available directly to the duodenum rather than the rumen, the possibility of using such a technique to increase protein uptake and hence increase milk protein synthesis clearly warranted investigation.

In the present study, two experiments were undertaken in which ordinary lactic casein and formaldehyde-treated casein (resistant to ruminal breakdown) were fed as supplements to lactating cows grazing pasture.

EXPERIMENTAL

In the first experiment (June, 1968), groups of seven Friesian cattle were fed a concentrate mixture (1.125 kg/head/milking) containing 20% (225 g) ordinary casein or 20% "protected casein" for a period of a fortnight. A third group received no supplement.

In Exp. 2 (November, 1968) the two types of casein, suspended in water, were given twice daily (225 g) for two weeks to groups of eight monozygous twin cattle grazing 'Grasslands Ruanui' ryegrass. This pasture in some previous experiments (Wilson and Dolby, 1969) had led to abnormally low solids-not-fat contents in milk, a change which was apparently not due to underfeeding — the most common cause of low solids-not-fat contents (mainly protein variation) in milk.

Milk yields were measured at individual milkings and milk composition data, from daily composites, were obtained using an infra-red milk analyser. The data were examined in covariance analyses using data from preliminary periods as independent variables. The effectiveness of the formalin treatment in protecting the casein from proteolysis and deamination was studied *in vitro* by measuring ammonia production (Conway and O'Malley, 1942), following incubation of the caseins with rumen fluid.

RESULTS AND DISCUSSION

The concentrations of ammonia produced by the incubation of the caseins (Fig. 1) clearly indicated that the formaldehyde treatment was effective in preventing pro-

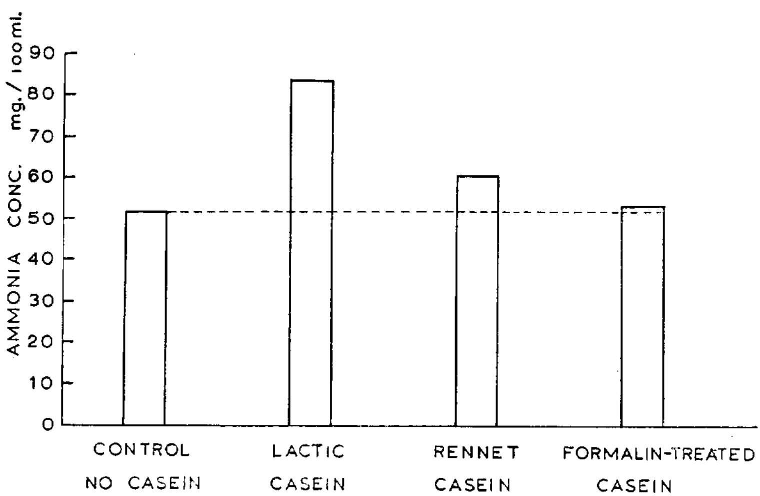

FIG. 1: *Production of ammonia from the incubation of casein (0.5 g) in rumen liquor for 24 hours.*

TABLE 1: DAILY MILK PRODUCTION FROM FRIESIAN COWS FED CONCENTRATES

	Treated Casein (TC)	*Casein (C)*	*Control (c)*	*Significance* $P < 0.01$	$P < 0.05$
Milk yield (kg)	16.6	15.8	14.9	TC > c	C > c
Fat %	3.77	3.95	3.80	—	C > TC; C > c
Protein %	3.33	3.44	3.25	C > c; C > TC	—
Lactose %	4.97	4.91	4.91	—	—
Protein yield (g)	554	540	481	TC > c; C > c	—

TABLE 2: DAILY MILK PRODUCTION FROM TWIN COWS FED CASEIN

	Treated Casein (TC)	*Casein (C)*	*Control (c)*	*Significance* $P < 0.05$
Milk yield (kg)	13.1	13.2	13.4	—
Fat %	5.45	5.45	5.35	—
Protein %	4.15	4.08	4.00	TC > c
Lactose %	5.26	5.25	5.22	—

tein degradation. On the other hand, there was only indirect evidence such as the change in milk composition in Exp. 2 to show that the protected casein was made available for intestinal absorption.

The milk yield and composition data for the two experiments are given in Tables 1 and 2.

In Exp. 1 the milk yield produced by the treated casein group was slightly higher than that from the ordinary casein group and both supplemented groups produced significantly more milk than the non-supplemented (control) group. Butterfat and protein percentages were highest in the milk from the casein supplemented group, but the milk protein percentage from the cows which received the protected casein was also higher than that from the control group ($P < 0.05$). The yields of fat and protein were similar for the two casein groups and higher than the corresponding values from the control group (protein yield, + 15%; fat yield, + 8%). The principal comparison of interest was the data from the two casein groups and the protein yields and percentages did not support the hypothesis that milk protein synthesis may be limited by the amount of one or more amino acids reaching the intestine. A possible explanation for the higher protein percentage in the milk from the group fed ordinary casein was that the barleymeal and bran fraction of the concentrate mixture provided a source of readily available carbohydrate which improved the utilization of the casein to form a larger microbial population which was subsequently available for digestion.

The low protein percentage in the milk from the control group (3.25%) confirmed that the basic forage ration was deficient in respect to quality or quantity available, while both supplements clearly helped to rectify the situation. In fact, the extent of the change in milk yield and protein percentage was generally greater than for several previous experiments carried out at the University (Taparia, 1966) in which up to 4.5 kg/cow/day of concentrates were fed during the winter.

In the second experiment, milk yield and composition, with the exception of protein percentage, were similar for all treatments. The protein percentages for the respective groups in the decreasing order were protected casein, casein and control, with only the difference between the extremes being statistically significant ($P < 0.05$). These results, in contrast to those from Exp. 1, suggested that the amount of dietary protein that reaches the abomasum may have at least a small influence on milk protein production. The response to the protected casein varied considerably between individual twin pairs (-0.09% to $+2.7\%$ protein), which indicated that differences may occur between cows in their ability to obtain sufficient protein, or particular amino acids, to increase milk protein synthesis.

It is well known (Martin and Blaxter, 1960) that more energy (40%) is provided by casein administered via the duodenum than the rumen, and hence the cows which received protected casein in this experiment were probably on a higher plane of nutrition than the cows in both the other two groups. Although milk yields were similar from the three groups, a higher energy uptake may in itself be an alternative explanation for the change in the milk protein percentage. While it is not possible in this experiment to differentiate between the above explanations for the changes obtained, because the absorbed protein may be used directly for protein synthesis or deaminated and used as a source of energy, it is clear from both these experiments that protecting dietary protein from ruminal breakdown is unlikely to lead to greatly increased production of milk protein under New Zealand conditions.

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