CAMDAIRY - A COMPUTER PROGRAM FOR PERFORMANCE PREDICTION, RATION ANALYSIS AND RATION FORMULATION TO MAXIMISE PROFIT FROM DAIRY COWS

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SUMMARY

Applications of a computer model CAMDAIRY are described. An example is given of how it can be used to predict the performance of lactating cows, identify limiting nutrients and formulate maximum-profit rations. Examples are also given of how it can be used to simulate management options in order to determine their effects on profitability.

Key words: computer model, lactating cows, feeding management

INTRODUCTION

CAMDAIRY is a computer model containing a package of programs designed to help advisers, farmers, students and research workers who are involved in the feeding of dairy cows. Details of the model are given by Hulme et al. (1986). The core program incorporates functions to predict nutrient requirements, feed intake, substitution effects when feeding concentrates, tissue mobilisation and partition of nutrient utilisation between milk production and growth. Nutrient partitioning is described by a series of asymptotic curves relating energy intake to milk production, such that energy requirements per litre increase progressively with level of milk production. When the user specifies feed intake and composition and information on cow liveweight and condition score, potential peak milk production and stage of lactation, cow performance is predicted and limiting nutrients identified. Alternatively, when feed intake is not specified, the model predicts intake from plant and animal factors and uses linear programing to formulate rations for up to two groups of cows in a herd in a way which maximises income above feed costs, whilst meeting nutrient requirements and satisfying constraints on feed supply and milk production requirements.

PREDICTION OF PERFORMANCE

Prediction of performance is often appropriate as the first step in determining factors which are limiting the productivity of dairy cows. When predicted performance is similar to actual performance, it may be assumed that factors which are not considered by the model, such as trace elements, or stress due to disease or environment factors, are unlikely to be limiting performance. However, when predicted performance does differ from current performance, the accuracy of inputs relating to animal and plant factors should be checked. If correct, it may be assumed that performance could be limited by one or more of the factors above which are not considered by the model. Inputs required for this prediction are given in Table 1. Information on the amount of pasture eaten may be estimated using a meter, e.g. the Ellinbank plate meter. Information on the nutrient content of pasture feeds, is contained in the "feed library", a data file in the program which may be edited to conform with local information. Pasture meter readings, taken before and after grazing, may be used to predict the nutrient content of pasture eaten, following calibration of the meter. Performance is predicted on the basis of these inputs, as shown in Table 2.

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OPTIMISATION OF RESOURCES TO INCREASE PROFITABILITY

Daily feeding practice

Following the prediction of performance, the next step towards increasing profitability is to consider alternative feeding strategies. As an example of this, consider a dairy farm on the Central Coast of NSW in summer. There' are 100 Holstein Friesian cows calving year round, grazing kikuyu grass ($17/t as fed), with a commercial concentrate available ($150/t). The farm has a quota of 1000 L/ day ; milk prices are 36 cents/L for quota milk and 14 cents/L for milk produced above the quota. It is assumed that 30 of the cows in herd 1 are in early lactation and the remainder in herd 2 are in mid-late lactation. Animal inputs are the same as 'those in Table 1, and nutrient information on the feeds is taken from the feed data file. CAMDAIRY is then used to formulate a maximum-profit ration. A summary of predictions and recommendations is given in Table 3.

TABLE 1. Inputs required for performance prediction

Breed	Holstein Friesian	Week of conception	12
Average cow weight kg	500	Weeks post-calving	6
Condition score (1-8; thin-fat)	5	Activity - % maintenance	20
Average butterfat %	3.9	% 1st calf heifers	20
Potential peak milk yield L/day	35	% 2nd calf heifers	18
Average milk price cents/L	29.9		

Feeds kg/cow/day (as fed)

	Amount	$/tonne as fed
Concentrate mix	5.0	150
Grazing oats	76	15
Ryegrass hay	3	150

TABLE 2. Performance prediction and limiting nutrients

Energy required for gain in condition		37.5 MJ ME/day
Adequate ME	for	28.7 kg milk/day
Adequate Crude protein	for	31.1 kg milk/day
Adequate Ca	for	54.4 kg milk/day
Adequate P	for	38.4 kg milk/day

Maximum milk production is 28.7 kg/day, limited by ME, limiting income from milk to $8.58/day and income above feed costs to $6.24/day

Predicted liveweight change	6.0 kg/week
Predicted change in condition	0.14 units/week

Detailed information is also produced on the nutrient composition of the rat ion in relation to nutrient requirements. Information in Table 3 shows that, with the resources available, profit is maximised when concentrates are fed at rates of 6.7 and 5.0 kg/day to cows in herds 1 and 2 respectively, It is predicted that it is profitable to produce 967 litres/day in excess of the quota of 1000 litres/day.

TABLE 3. Predicted milk yields, milk income, amounts of roughage and concentrate, feed costs and predicted liveweight change

	Herd 1	Herd 2	Total
Number of cows milked	30	70	100
Potential milk yield this week L/cow/day	32.5	22.9	
Predicted milk yield L/cow/day	23.0	18.2	
Predicted total milk production L/day	691	1276	1967
Predicted over quota production L/day			967
Predicted liveweight change per week kg	-0.3	1.7	
Income above feed costs $/cow/day	3.97	3.01	
Income above feed costs $/herd/day	119.13	210.38	329
Brief Ration Information on "as fed" basis			
Amount of concentrate per cow kg	6.7	5.0	
Cost of concentrate per tonne $	150.00	150.00	
Cost of concentrate per cow $	1.01	0.75	
Amount of kikuyu pasture per cow kg	46.9	47.8	
Cost of kikuyu pasture per tonne $	17.00	17.00	
Cost of kikuyu pasture per cow $	0.82	0.84	

Feed management strategies

CAMDAIRY can be used to simulate various management options in order to determine their effects on profitability. The effect of potential peak milk yield (genetic merit) on requirements for concentrates and gross profit is illustrated in Table 4. Apart from potential peak milk yield, all other assumptions are the same as those in the previous example.

TABLE 4. Effects of potential peak milk yield on concentrate requirements for maximum profit, and gross profit*

Potential peak milk yield L/day	kg concentrate/cow/day Herd 1	Herd 2	Gross profit from 100 cows $/day
35	6.7	5.0	330
30	6.7	2.2	318
25	5.0	2.2	303
20	2.2	2.0	277

* Milk returns less feed costs.

On the basis of the information presented in Table 4, the cost of improving the genetic merit of the cows may be compared with the potential returns. With a better quality pasture, the potential intake of nutrients would be higher, so that incremental changes in gross profit would be greater.

At the present time there is much interest in the role of white clover in pastures for dairy cows in Victoria. A unique characteristic of clover is its high edibility relative to that of ryegrass of similar digestibility. A simulation study of farms in the Gippsland area of Victoria was made, to determine the effect of increasing the proportion of white clover in the pasture. Assumptions on the main resources and returns were as follows:- cows: 100

Holstein Friesian x Jersey, 450 kg liveweight; pastures: perennial ryegrass, late vegetative, costing $30/t DM; white clover costing $30, $36 or $48/t DM, assumed edibility 26% higher than that of ryegrass (Rogers et al., 1982); milk: no quota; 14 cents/L.

Higher costs of clover are based on the assumption that clover yields are usually lower than those of perennial ryegrass in the same environment.

TABLE 5. Effects of pasture costs and stage of lactation on gross profit* ($/day) from 100 cow herd with seasonal calving

		Pasture cost ($/t DM)							
White clover (%)	Ryegrass	30		30		30		30	
	Clover	30		36		42		48	
	Lactation wk	6	20	6	20	6	20	6	20
		Gross profit ($/day)							
20		242	217	240	215	239	213	237	211
40		251	222	247	218	243	214	239	210
60		259	228	253	221	247	215	241	209
80		268	233	259	225	251	216	243	207

* Milk returns less pasture costs.

Output from the model (Table 5) indicates that, on the basis of the assumptions made, gross' profit decreases with increases in the amount of white clover in the pasture, when clover costs 60% or more than ryegrass, and cows are 20 weeks or later in lactation. To the feed costs must be added animal health costs associated with, grazing clover, such as drugs used in bloat prevention and losses associated with cows succumbing to bloat. Without considering these costs, it appears that it would be useful to increase the percentage of white clover in the . pasture, provided that costs of production ($/t DM) are no more than 20-40% higher than 'those of producing perennial ryegrass.

CONCLUSION

The model integrates what 'is thought to be the most accurate information available relating to the feeding of dairy cows, and applies this, to maximising profit from feed and animal resources. Currently it is being used by advisers, farmers, feed manufacturers, research workers and students . There is scope to improve the model by increasing the accuracy of prediction of feed intake,. yield of absorbed nutrients from different feeds and partition of absorbed nutrients into milk and body tissue.

REFERENCES

HULME, D.J., KELLAWAY, R.C., BOOTH, P.J. and BENNETT, L. (1986). Agric. Systems 22:. 81:

ROGERS, G.L., PORTER, R.H.D. and ROBINSON, I. (1982). In: Dairy Production from Pasture. Eds. K.L. Macmillan and V.K. Taufa, N.Z. Soc; Anim. Prod.