Management for milkfat or protein, does it differ?

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ABSTRACT

The effect of management on milk, milkfat and protein production was assessed by analysing information collected from 16 different experimental farmlets run over a 9 year period on the Waimate West Demonstration Farm and the Taranaki Agricultural Research Station. In these trials a wide range of stocking rates (2.7 to 4.5 cows/ha), pasture types (ryegraa, lucerne, tall fescue and phalaris) and management systems were used.

Comparisons of production and regression analysis between and within years and treatments failed to detect any significant effects of variations in grazing management, stocking rate and cow condition at calving on milkfat or protein production.

Information from a relatively wide data base, covering a range of seasons, management systems and pasture types suggests that herd management for maximum protein production needs to be no different than for systems already researched and adopted for milkfat production.

Keywords Milk production; milk composition; management systems; stocking rate.

INTRODUCTION

Payment for dairy production has historically been based on milkfat but at present, concern is being expressed that payment should be directed more by market trends and be made on protein as well as milkfat. If payment for dairy products does swing more in favour of protein then the suitability of management systems advocated for milkfat production (high stocking rates, and intensive grazing) should be examined with regard to their suitability to also maximise protein production.

Two recent reviews of published work (Bryant and Trigg, 1982; Wilson and Davey, 1982) and information presented by Macmillan *et al.* (1985) conclude that underfeeding will reduce protein production to a greater extent than milkfat.

The management systems currently recommended to achieve maximum milkfat production (Thomson, 1985a; Bryant and Sheath, 1987) involve early calving and high stocking rates. As a result, especially over early and late lactation, a moderate level of underfeeding will occur. To determine if management has a differential effect on protein and milkfat production, information recorded from experimental farmlets run under low intensity and intensive management systems over a number of years is examined.

EXPERIMENTAL

Data from 4 major grazing studies run in South Taranaki from 1978 to 1987 were examined. The studies comprised, (1) an evaluation of grass grub tolerant pastures (lucerne, tall fescue, phalaris) for dairy production, (2) an evaluation of insecticide use for grass grub control in dairying, (3) the timing and the intensity of conservation on dairy production and (4) the effect of withholding phosphate fertilizer and adopting a no-conservation policy on dairy production.

Studies 1, 2 and 4 were conducted on the Taranaki Agricultural Research Station and study 3, was run for 4 years on the Waimate West Demonstration Farm. Each comparison was conducted at a low (LS) and a high (HS) stocking rate, ranging over the 9 years from 2.9 to 4.5 cows/ha. The average stocking rate for all LS farmlets was 3.6 cows/ha and the HS farmlets 4.3 cows/ha.

The effect of level of feeding and management on milkfat and protein production was examined by the following methods.

1. A comparison of production within and between years when extreme differences in production occurred.
   (a) A comparison of milk yield and compostion for the same 4 farmlets run on Taranaki Agricultural Research Station from calving to December in the poorest (cold wet spring of 1986) with the best (1983) spring and from January to drying-off for the poorest (dry summer of 1987) with the best (wet summer of 1986) summer.
   (b) Comparison of fat production, protein production and milk composition recorded on Taranaki Agricultural Research Station in the best of the 9 years (1984-85 season) with the worst (pasture growth 38% below

that recorded in 1984-85) of the 9 years (1986-87 season).

(c) For the 2 extreme treatments in the time x intensity of conservation trial (the high stocked early conservation treatment (HSE) and the low stocked late conservation treatment (LSL),) regression analysis was conducted within each herd of milkfat on protein production.

2. Analysis was conducted on all the farmlet data to establish:
   (a) The relationship between milk yield, milkfat and protein production and stocking rate.
   (b) Regression of cow live weight 1 week before calving on milkfat and protein production for the subsequent lactation.

RESULTS AND DISCUSSION

Effect of Feeding Level on Milk Production and Composition

The average milk production, and composition for 4 experimental farmlets recorded in a good and poor spring are presented in Fig. 1. The graphs clearly show that for the first 8 weeks of lactation a severe level of underfeeding (milk production depressed by 43%) had little effect on fat content but protein content showed a marked decline. The average protein content in the good spring (1983) was 4.45% compared with 3.55% in the poor spring (1986). Following an improvement in the level of feeding (after 8 weeks milk production increased to be only 19% below that recorded in the good spring) protein content returned to a level similar to that recorded in the good spring. With the prolonged period of underfeeding milkfat content declined and showed a slower recovery than protein. The results presented in Fig. 1 are similar to the effects of underfeeding in early lactation reported by Bryant and Trigg (1982) and Macmillan *et al.* (1985). From mid October to mid December (mid lactation) milk production in the poor spring remained depressed but fat content and protein appeared unaffected compared those recorded in a good spring.

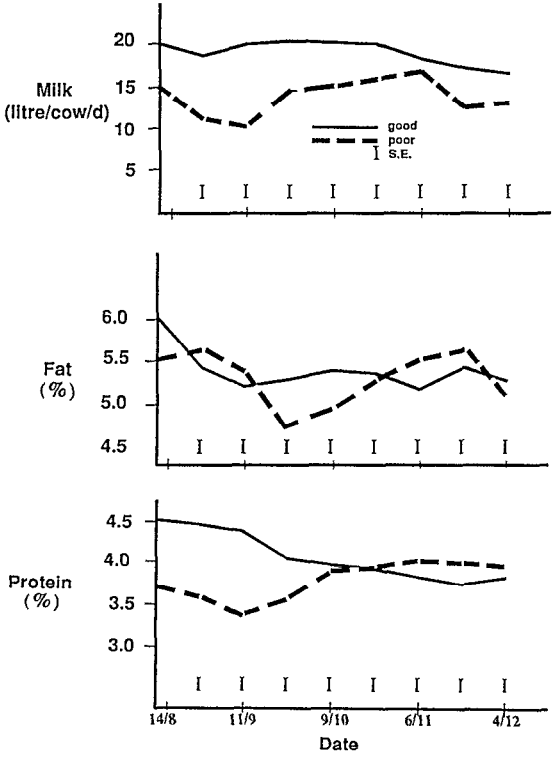

FIG. 1 Changes in milk yield and composition recorded in a *good* and *poor* spring period.

In Fig. 2 the effects of a good compared with a poor season on milk production and composition for the later half of lactation are presented. The difference in milk production between the 2 years reflects the level of underfeeding which occurred in the poor season. Despite this there was no difference in fat and protein content in the mid lactation period. This observation is contrary to the effects reported by Wilson and Davey (1982) and Macmillan *et al.* (1985). These authors clearly stated that during underfeeding in mid lactation fat content increased and protein content decreased. Towards the end of lactation the effects measured in both good and poor seasons were similar to the drying-off effects previously reported.

To put the effects observed in Figs. 1 and 2 into perspective - the production of the various milk constituents recorded in a good (1984-85) and poor (1986-87) season are presented (Table 1). From calving until December the production of protein appeared to be affected more in a poor season than was the production of milkfat. However from December until drying-off, there was an apparent greater recovery in protein than milkfat. The effect on total protein production was not as great as indicated from the initial effects observed. From this it could be concluded that despite a fairly severe feeding restriction experienced in a poor season (milk production down 26%) the effect on protein production was not as marked as would be expected from the reports of short term feeding trials in early lactation by Bryant and Trigg (1982) and in mid and late lactation by Wilson and Davey (1982).

In the trial conducted at the Waimate West Demonstration Farm evaluating the effect of early and late conservation at 2 stocking rages (3.7 and 4.5 cows/ha), marked difference in pasture allowance and in milkfat production were recorded between the LSL treatment (high pasture allowance throughout

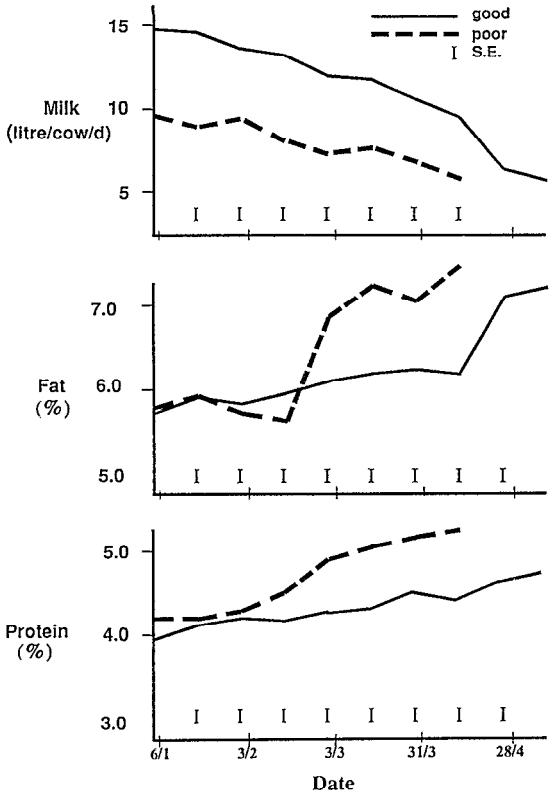

FIG. 2 Changes in milk yield and composition recorded in a *good* and *poor* summer and autumn period.

the season) and the HSE treatment (low pasture allowance throughout the season). However despite the differences in pasture allowance, pasture quality and milkfat production (Thomson *et al.*, 1984) the within herd regression coefficients (Table 2) of milkfat on protein production for each herd did not differ significantly. This suggests that milkfat and protein production in 2 contrasting management systems were similarly affected. The above results suggest that protein production is relatively insensitive to reasonably severe levels of underfeeding and to different management practices.

Cow condition or cow live weight at calving has been identified as a critical factor affecting subsequent milkfat production (Hutton and Parker, 1973). Over a number of years the relationship between live weight and both milkfat and protein was examined for all cows on the Taranaki Agricultural Research Station.The results of this analysis presented in Table 3 show that cow live weight at calving affects protein production and milkfat, similarly.

TABLE 2 Regression analysis of fat yield/cow with protein yield/cow for a high nutrition (LSL) and low nutrition (HSE) farmlet.

Parameter	High stocked early conservation (HSE)	Low stocked late conservation (LSL)
Regression coefficient	0.67***	0.67***
r	0.94	0.92

Effect of Stocking Rate on Production and Composition of Milkfat and Protein

The production and composition of milk from farmlets averaging 3.6 and 4.3 cows/ha (Table 4) showed the decline in production per cow at the higher stocking rate was similar for milk, fat and protein such that milk composition was unaffected by an increase in stocking rate. The information presented in Table 4 was averaged from a range of low and high stocked farmlets run over a number of years possibly masking the more sensitive effects of stocking rate on milk composition and production.

TABLE 1 Comparison of dairy production between a *good* and *poor* season (average production for 4 farmlets in each year at an average stocking rate of 4 cows/ha).

Season	Production component	Calving to December	December to drying-off	Total production
Good	Milk (ℓ/cow)	1755	1565	3320
	Fat (kg/cow)	92	91	183
	Protein (kg/cow)	70	65	135
Poor	Milk (ℓ/cow)	1440	1015	2455
	Fat (kg/cow)	77	60	137
	Protein (kg/cow)	55	44	99
Difference	(Poor — good)/good %			
	Milk yield	—18	—35	—26
	Fat yield	—16	—34	—25
	Protein yield	—21	—32	—27

TABLE 3 The relationship between live weight at calving and milkfat and protein production (n=180).

Year	Fat on live weight		Protein on live weight	
	Regression coefficient	r	Regression coefficient	r
1978/79	0.32	0.40	0.27	0.43
1980/81	0.26	0.36	0.20	0.32
1981/82	0.19	0.28	0.14	0.32
1982/83	0.18	0.31	0.14	0.32
1983/84	0.28	0.43	0.24	0.49
1984/85	0.19	0.33	0.21	0.50

All values significant ($P<0.01$)

TABLE 4 Average milk production and composition recorded over a 9 year period from 63 farmlet trials for high (HS) and low (LS) stocking rate situations.

	Stocking rate[1]		HS-LS	
	HS	LS	HS (%)	Significance
Milk (ℓ cow)	2758	3135	-12.0	**
Fat (kg/cow)	151	170	-11.2	*
Protein (kg/cow)	111	126	-11.9	*
Fat (kg/ha)	644	607	5.8	*
Protein (kg/ha)	473	448	5.6	*
Fat (%)	5.49	5.46	–	
Protein (%)	4.02	4.01	–	
Protein: Fat	0.73	0.74	–	

[1] HS 4.3 cows/ha (average from 22 farmlets); LS 3.6 cows/ha (average from 37 farmlets).

To determine if this occurred the relationships between the major milk constituents and stocking rate was examined in more greater detail by regression analysis. The regression coefficients between stocking rate and milkfat, and stocking rate and protein content did not differ significantly. Also there was no significant difference in the effects of increasing stocking rate on the total per cow production of milkfat and protein. However the production of protein per ha from calving to December did not increase with stocking rate at the same rate as milkfat. over the whole lactation this effect however was not significant.

CONCLUSION

The recent reviews on the effects of nutrition on protein production clearly suggest that lower levels of nutrition in early and mid lactation will depress protein production to a greater extent than milkfat. This effect will be associated with an increase in fat percentage and a decrease in protein percentage. The trials reviewed to obtain this conclusion were all short-term as long-term effects had not been investigated.

This paper reports the production from a large number of experimental farmlets run over a number of years, a variety of stocking rates and management systems. The results presented show that in the short term and only in early lactation, low levels of nutrition effect protein production to a greater extent than milkfat production. However over the total lactation the differential effects were minimal and not significant. From the information presented it is recommended that management of the dairy herd should be no different in a payment system based on milkfat and protein than was recommended when payment was made on milkfat only.

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