Short Communications / Kort Mededelings

Milk production responses to feeding fatty acids

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Two trials were conducted to determine the milk production response to feeding a highly saturated free fatty acid supplement to grazed dairy cows in early lactation. The trials were conducted during spring and autumn, respectively. Sixty-five Friesian cows were supplemented with fat-prills at rates of 0,00 (control), 0,25 and 0,50 kg/d during the first 60 days of lactation, in addition to the usual concentrates fed at levels equivalent to 2% of body-weight in early lactation. Cows in their first lactation did not respond to the fatty-acid supplements. The response of multiparous cows is described by the equation: peak yield (FCM) = 22,44 + 5,88 (kg fat suppl/d) + 3,52 (body-weight loss/d) (n = 40; R = 0,57; P < 0,01), for the combined trial data. No significant differences were recorded for the butterfat and protein concentrations in the milk. A tendency towards increased weight losses, although non-significant, was recorded for each additional increment of fatty-acid supplement over that of the control cows.

Twee proewe is onderskeidelik in die lente en herfs uitgevoer om die melkproduksierespons te bepaal wanneer 'n hoogs-versadigde vryevetsuuraanvulling aan weidende melkbeeste in vroeë laktasie gevoer word. Vyf-en-sestig Frieskoeie is benewens kragvoer (gevoer teen 2% van liggaamsmassa gedurende vroeë laktasie) vir die eerste 60 dae van laktasie ook aangevul met die volgende peile 'fat-prills' bo-op die kragvoer: 0,00 (kontrole), 0,25 en 0,50 kg/dag. Koeie in hul eerste laktasie het nie 'n respons getoon op die vetsuuraanvulling nie. Die ouer koeie se respons word deur die volgende vergelyking voorgestel: piekproduksie (VGM) = 22,44 + 5,88 (kg vetaanvulling/dag) + 3,52 (liggaamsmassaverlies/dag) (n = 40; R = 0,57; P < 0,01), vir die gekombineerde proefdata. Geen betekenisvolle verskille kon tussen bottervet- en proteïenkonsentrasies in die melk gevind word nie. 'n Neiging tot verhoogde massaverlies, alhoewel nie betekenisvol nie, is vir elke addisionele verhoging van vetsuuraanvulling bo dié van die kontrolekoeie gevind.

Keywords: Dairy cows, free fatty acids, milk production.

The dairy cow is capable of transferring more energy to milk than is taken in from the diet. High-producing dairy cows, therefore, tend to be in a negative energy balance in early lactation, relying on body reserves to meet the deficit between energy consumption and energy excretion in the milk. Supplemental dietary fat may be beneficial to the high-producing cow. Firstly, by increasing the energy density of the diet when feed capacity limits energy intake and production and, secondly, by substituting for starch in high-cereal diets, thereby increasing forage to concentrate ratios, normalizing rumen fermentation and correcting milk-fat percentage (Palmquist, 1984). Palmquist & Jenkins (1980) concluded that the feeding of protected lipids consistently increased milk-fat percentage. However, cows with a low production potential (< 5 000 kg FCM per lactation) did not respond to high-energy rations containing fat by producing more milk, but rather by becoming excessively fat.

The aim of this investigation was to determine the response of cows, which were grazed on local pastures supplemented with concentrate feeding, to a commercially available fat supplement. Sixty-five Friesian cows were fed with commercial fat-prills at rates of 0,00 (control), 0,25 and 0,50 kg/d for the first 60 days of lactation, in addition to the usual concentrates offered in early lactation, equivalent to 2% (*as fed*) of body-weight. These concentrates consisted of maize meal with minerals (1% salt, 2% dicalcium phosphate and 0,5% feedlime) added, top-dressed with groundnut oilcake as the protein source (amount determined by the CEDARA feeding program; Jones & Stewart, 1987). Two trials were conducted, one in the spring where the roughage source consisted of maize silage and Italian ryegrass (*Lolium multiflorum*) grazing, changing to kikuyu (*Pennisetum clandestinum*) as the season progressed, and the second in the autumn where the cows grazed kikuyu as the only source of roughage. Milk yields were recorded daily, whereas protein and butterfat (BF) levels in the milk, determined by infra-red milk analysis, as well as body-weight changes were recorded fortnightly for 25 primiparous and 40 multiparous cows in the two trials.

Dairy fat-prills, as marketed in the UK, are a mixture of free fatty acids containing *ca* 450 g/kg palmitic acid, 450 g/kg stearic acid and 100 g/kg oleic acid (Clapperton & Steele, 1982), while the South African product differs slightly (Table 1). The product is a rumen-inert fat, as opposed to a rumen-protected fat, containing long-chain saturated fats (Table 1) with a high rate of passage, which generally remain solid in the rumen because of their relatively high melting points (> 45°C), with an ME concentration of 37,5 MJ/kg (Meggison, 1981). Research has determined that highly saturated, long-chain fatty acids boost both milk yields and fat content as opposed to unsaturated fatty acids, e.g. groundnut, sunflower, maize and linseed oils, which tend to enhance yields but depress the fat content (Meggison, 1981; Jimenez, 1986).

Table 1 Typical analysis of Priplus 10 fat-prills (Silicate and Chemical Industries, Jacobs, Natal)

Iodine value		20 — 25
Melting point		> 45°C
Approx. carbon chain distribution and associated fatty acid:		
C14	(Myristic)	5%
C16	(Palmitic)	40%
C18	(Stearic)	30%
C18:1	(Oleic)	20%
C18:2	(Linoleic)	4%
Feed grade antioxidant		0,1%

Rumen fermentation parameters for diets including fat-prills and the Ca salts of fatty acids suggest that they both are inert in the rumen and have minimal effects on rumen fermentation and ration digestibility (Schauff & Clark, 1989). Metabolic trials have revealed that less than 10% of fat-prills were lost from Dacron bags suspended in the rumen of sheep for 24 h (Meggison, 1981). Losses of 9,35% ± 4,04 were recorded from nylon bags suspended in the rumen of sheep for 24 h for the local fat-prills. The basal diet of sheep in this trial consisted of *Eragrostis* hay, lucerne meal and maize grain.

Responses recorded for mature cows are presented in Tables 2 and 3. The large responses to the fat supplement (Table 3), together with the associated weight losses that were recorded, although non-significant, suggest that the fat supplementation may somehow induce increased withdrawal of fatty acids from body reserves. A multiple regression analysis (Table 3) quantified the responses due to the fat-prills and thát due to the additional weight losses. A response of 5,88 kg FCM per kg fat was attributed to the fat-prills and 3,52 kg FCM per additional kilogram weight loss. Similar responses to protected-fat supplementation of 3,3 and 3,8 kg 3,5% FCM have been recorded by Robb & Chalupa (1987) and by Ferguson, Torralba, Schneider, Vecchiarelli, Sklan, Fronfeld & Chalupa (1988), respectively. No significant responses to fat supplementation were recorded for cows in their first lactation (primiparous) (Table 2). However, this is consistent with the findings of Robb & Chalupa (1987) and Ferguson *et al.* (1988).

Table 2 Peak milk yields, milk composition and weight losses of cows fed various levels of fat supplement

	Supplementary fat level (kg/d)		
	0,00	0,25	0,50
Primiparous cows			
Spring			
Peak yield (kg FCM)	23,08 ± 0,74	20,9 ± 1,10	20,3 ± 1,40
BF (%)	3,22 ± 0,28	2,80 ± 0,24	2,82 ± 0,33
Protein (%)	2,86 ± 0,24	2,87 ± 0,13	2,87 ± 0,13
Weight losses (kg/d)	1,32 ± 0,23	1,08 ± 0,30	0,90 ± 0,48
Autumn			
Peak yield (kg FCM)	21,27 ± 3,2	23,31 ± 3,60	20,51 ± 1,80
BF (%)	3,38 ± 0,30	3,21 ± 0,62	3,55 ± 0,66
Protein (%)	2,97 ± 0,10	3,02 ± 0,15	3,10 ± 0,18
Weight losses (kg/d)	0,44 ± 0,44	0,92 ± 0,91	0,65 ± 0,52
Multiparous cows			
Spring			
Peak yield (kg FCM)	23,9 ± 4,10	25,9 ± 2,90	29,3* ± 3,97
BF (%)	3,14 ± 0,50	3,17 ± 0,47	3,47 ± 0,27
Protein (%)	2,77 ± 0,12	2,81 ± 0,33	2,83 ± 0,15
Weight losses (kg/d)	0,59 ± 0,49	0,94 ± 0,71	1,08 ± 0,31
Autumn			
Peak yield (kg FCM)	25,05 ± 3,09	26,37 ± 2,96	29,34* ± 4,02
BF (%)	3,36 ± 0,22	3,72 ± 0,4	3,58 ± 0,26
Protein (%)	2,98 ± 0,13	2,98 ± 0,15	3,2 ± 0,37
Weight losses (kg/d)	0,59 ± 0,44	0,75 ± 0,71	0,89 ± 0,55

* Significantly different from control at $P < 0,05$.

Table 3 Regression equations describing milk production responses to supplementary fatty acids

Spring :	$Y^a = 23,7 + 10,6\ X_1{}^b$;	r = 0,531;	$P<0,05$
Autumn :	$Y = 24,8 + 8,2\ X_1$;	r = 0,480;	$P<0,05$
Overall :	$Y = 24,8 + 8,3\ X_1$;	r = 0,427;	$P<0,05$
Overall :	$Y = 22,44 + 5,88\ X_1 + 3,52\ X_2{}^c$;	r = 0,57 ;	$P<0,01$

[a] Peak yield in FCM.
[b] Kg fat supplement fed.
[c] Kg body-weight loss per day.

There was a tendency to higher, although non-significant, butterfat levels in the milk from cows fed the fat-prills. This increase is consistent with the data of Banks, Clapperton, Girdler & Steele (1984) who found that fat-prills were the only fat supplement tested which improved fat yields. Similar modest, but non-significant, increases in the butterfat concentration of milk from cows supplemented with protected fats have been recorded by Robb & Chalupa (1987) and Ferguson *et al.* (1988).

Dietary fat has been found to decrease the protein content of milk by some workers (Bines, Brumby, Storry, Fulford & Braithwaite, 1978; Banks *et al.*, 1984), but not by others (Palmquist & Conrad, 1978; 1980; Ferguson *et al.*, 1988) and these data (Table 2).

The measured response of 5,88 kg FCM per kg fat fed, was higher than the predicted response of 5,2 kg FCM from nutrient requirement tables for a 500 kg cow (Bredon & Stewart, 1978). Loosli, Maynard & Lucas (1944) found that the increased milk energy value exceeded the calculated energy value for fat supplementation and concluded that supplementary fat improved the energetic efficiency of milk production. Brumby, Storry, Bines & Fulford (1978) similarly concluded that supplying lactating cows with up to 14% of their digestible energy requirements in the form of exogenous fatty acids increased both the output and the efficiency of utilization of nutrients for milk production. The milk production response measured and the body-weight losses encountered when fats are supplemented, indicate that all the energy from the fat was partitioned to milk production rather than to the maintenance of body weight. Ostergaart, Danfaer, Dangaard, Hindhede & Thysen (1981) and Rijpkema & De Visser (1982) similarly found that the energy of supplemental fat was converted to milk with no decrease in body-weight loss.

In conclusion, older animals expressed a response to the fat-prills which is economically encouraging at present prices, whereas no beneficial responses were recorded for cows in their first lactation. Care must be taken not to exceed the daily maximum of 1,4 kg protected fat which can be efficiently absorbed by cows (Bines *et al.*, 1978).

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