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EFFECT OF FISH MEAL OR SOYABEAN MEAL AND DIFFERENT AMOUNTS OF CONCENTRATE SUPPLEMENTING GOOD QUALITY SILAGE FED TO HIGH YIELDING DAIRY COWS IN A COMMERCIAL HERD

SUMMARY

In a trial with a commercial dairy herd (72 cows/heifers) at Ashcott Farm, Somerset, cows fed a high quality grass silage ad lib received either fish meal or soyabean meal as their main course of supplementary protein. In addition the concentrate was fed at three levels, 4.8 kg, 6.2 kg or 7.6 kg dry-matter per day to the higher yielding cows and 3.5 kg, 4.9 kg and 6.3 kg dry-matter to the moderate yielding cows and heifers.

Neither source of supplementary protein nor amount of concentrate fed affected milk yield. There was a small reduction in yield of milk fat when fish meal replaced soyabean meal. It is suggested that high intakes of good quality silage, probably resulting in cows being in positive energy balance in early lactation, may be the explanation for the lack of a response to either protein source or amount of concentrate fed.

It is recommended that if possible the trial should be repeated using two silages of different quality.

Introduction

The introduction of milk quotas in the EEC has forced many farmers to reduce milk yield and reduce feed costs by reducing the supplementary feed offered with forage. In the Association's previous dairy cow trial (Mark III) it was shown that reducing large quantities of supplementary concentrate (from approximately 12 kg to 10 kg per day) fed with moderate quality grass silage, and including fish meal, there was no reduction in milk yield. Farmers now need to know how much further supplementary concen-

trates can be reduced, especially where silage quality is good, if milk production is allowed to fall by around 9%, i.e. the reduction necessitated by quotas. To test if greater reductions in concentrate could be achieved feeding fish meal, a trial was undertaken comparing fish meal and soyabean meal and different amounts of supplementary concentrate.

In view of problems of metabolic disease encountered at the AGRI, Shinfield in a similar trial with poor quality silage and low amounts of concentrate, emphasis was placed on finding a commercial farm with good silage, which is believed to be a prerequisite if drastic cuts in concentrate feeding are to be made.

The farm selected, Ashcott in Somerset, has a high yielding herd of Holstein-Friesian cows, and has won awards for the quality of silage produced. A sophisticated electronic feeding system in the yard, computer controlled, enabled cows to be individually fed one of two concentrates, with fish meal or soyabean meal. In the parlour automatic feeders dispensed quantities of concentrate which was varied for individual cows.

Methods

Trial design - feeding

Forty two high yielding cows (peak milk yield over 27 kg per day) and 30 heifers and second calving moderate yielding cows were allocated to blocks of six according to calving date and milk yield. Within each block of six, two animals were allocated to receive a high, a medium or a low level of concentrate feed. For high yielders these were 8.5, 7.0 and 5.5 kg/day respectively; for heifers and moderate yielding cows the corresponding amounts were 7.0, 5.5 and 4.0 kg/day.

For the high yielding cows the concentrate was supplied as 2 kg of a protein concentrate dispensed from one out-of-parlour electronic feeder with 2.1 kg rolled barley dispensed from a second electronic feeder. The variable total concentrate supply was achieved by feeding 3.4 kg, 1.9 kg or 0.4 kg of a barley/maize gluten feed mix in the parlour (see table 1). There were two protein concentrate mixtures, A and B. Within each level of concentrate feeding half the cows received the protein concentrates in the sequence ABAB over four successive periods each of four weeks while the remaining cows followed the sequence BABA. Protein concentrate A contained 37.5% fish meal and 38.6% sugar beet pulp; concentrate B contained 50% soyabean meal and 20.1% sugar beet pulp (see table 2). The remainder of the diet of all cows consisted of ad libitum high quality grass silage with small amounts of hay (approx. 1 kg per head) and molasses (1 kg per head) offered on a group basis (see table 3a). The heifers and moderate yielding cows received 1.3 kg of protein mix A or B and 1.3 kg of rolled barley dispensed from the out-of-parlour feeders. All other feeds were as for the high yielding group.

The amounts of energy, minerals and vitamins supplied by the ration feed to the high and moderate yielding cows were designed to meet requirements for a 600 kg cows losing 0.5 kg liveweight per day and producing 30 and 25 litres of milk respectively (ARC, 1980) (table 3b). However the protein supply in terms of that leaving the rumen was calculated to be adequate for the fish meal diet but not for the soyabean diet [ARC, 1980 (1)] in both cases.

Recording

Milk yields were measured on the last day (two milkings) of each week. Milk was sampled for analysis on the milk yield recording day at the end of each period. It was analysed for fat, protein and lactose content. Milk yield was measured and milk sampled prior to the start of the trial.

During each period (four weeks) all feeds were sampled and analysed. It was not possible to weigh cows.

Results

In the first half of the trial (periods I and II) intake of silage dry-matter, averaged over all cows and heifers and all treatments, was estimated to be approximately 13 kg per day, giving total dry-matter intake of approximately 19 kg.
Analysis of the forages offered are given in appendix table 1. The quality of silages fed in the first three periods was very good according to 'D' values (over 70) and ammonia N as percent total N (under 10). However, in the last period silage quality was poor but some limited grazing and nutritionally improved straw were fed to supplement silage.

Milk yield and yields of milk components during the trial were not affected significantly by the amount of concentrate fed or the protein concentrate, fish meal or soyabean meal (see tables 4 and 5).

Although replacing soyabean meal by fish meal reduced milk fat by 0.17% units and reduced milk fat yield by 47 g per day in the high yielding cows, neither decreased in the heifers and medium yielding cows (table 4).

According to farm staff, cows were generally below the condition they normally expect at the beginning of the trial, but improved during the course of the trial.

Discussion

The failure to get a response to either amount of concentrate or type of protein supplement (fish meal or soyabean meal) is surprising. The explanation may lie in the very high quality silage fed, and generally lower than expected milk yields. If, when concentrates fed were increased, there was a corresponding substitution of silage i.e. a 1:1 substitution, and the silage and concentrate dry matter had similar energy contents, there would have been no overall increase in energy intake. High substitution rates of concentrate for silage have been noted when silage quality is good (2). If there was no change in energy intake, the lack of response in milk production with increasing concentrate allowance is understandable.

Both the quality of the silage and intake were higher than expected. Energy intake from silage was believed to be 30 MJ to 40 MJ higher than predicted originally. On the other hand, milk yields were lower than expected (for 'high' yielders yields averaged 24kg per day - expected yield 28kg per day). In consequence, it is likely that all cows, even those on the low concentrate intake, would have consumed energy surplus to their requirements in periods 1 and 2 (see appendix table 2). As milk production fell in subsequent periods, the energy surplus may have increased. Cows may have maintained or gained weight - this was indicated from the farm staffs' observations.

The good quality silage plus concentrate may have supplied most cows with adequate microbial

protein, because the latter is known to be related to intake of fermentable energy. The additional undegraded protein from fish meal, compared with soyabean meal may not have been required (see appendix table 2) - hence the lack of an effect on milk production.

It has been shown that milk yield increased when intake of undegraded dietary protein was increased (substituting fish meal for groundnut meal) when cows were in negative energy balance, but not when they were in positive energy balance (3).

The importance of silage quality to the comparison of fish meal with soyabean meal has been shown also in a recent trial with beef cattle. With very good silage, growth rate was similar for fish meal and soyabean meal (4). With a medium quality silage (which was better than the national average) growth rate increased with fish meal feeding (5).(160 g per day feeding 250 g fish meal).

The silage fed in the present trial was far superior to the national average ('D' value 62, NH_3 N as % total N 15%) and probably better than that fed on most farms. Consequently result obtained may not be typical.

During the past winter, fish meal has been fed again at Ashcott Farm. Milk yields were higher. The farmer is convinced there was a beneficial effect on milk production though a feeding trial was not carried out.

It is recommended that the trial is repeated (perhaps at Ashcott) with two silages, one above and one below the national average quality, with cows averaging 28kg/day milk yield or more. Until the trial is repeated it is recommended that the results of the trial are not issued outside Association Membership, as they could be misinterpreted.

References

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4. Steen, R.W.J. 1985. Protein supplementation of silage-based diets for calves. Anim. Prod. 41 293-300.

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TABLE 1

MK IV DAIRY COW TRIAL - ASHCOTT FARM

DAILY FEEDING SCHEDULE

(kg/cow/day)

HIGH YIELDING GROUP (Peaking over 27 litres)

Grass silage		ad lib	
Hay		1	
Molasses		1	
Protein concentrate (F or S)		2	
Rolled barley		2.1	
Parlour feed (Maize gluten/ barley)	0.4	1.9	3.4
Total dm	17.7	18.1	18.5
Total concentrate dm	4.8	6.2	7.6

MEDIUM YIELDING GROUP (Peaking under 27 litres)

Grass silage		ad lib	
Hay		1	
Molasses		1	
Protein concentrate (F or S)		1.3	
Rolled barley		1.3	
Parlour feed (Maize gluten/ barley)	0.4	1.9	3.4
Total dm	14.4	14.8	15.2
Total concentrate dm	3.5	4.9	6.3

TABLE 2

MK 1V DAIRY COW TRIAL - ASHCOTT FARM

DIET FORMULATION

	FISH MEAL DIET A	SOYABEAN MEAL DIET B
	%	%
Fish meal	37.5	-
Soyabean meal	-	50.0
Sugar beet pulp	38.6	20.1
Molasses	7.5	7.5
Fat	1.9	1.9
Dical	5.0	10.0
Calcined magnesite	1.5	1.5
Salt	0.5	1.5
Copper-sulphate ($Cu.SO_4 : 5H_2O$)	0.06	0.06
Min./vit.supplement	7.5	7.5
	100.0	100.0

FEED FOR PARLOUR (14% PROTEIN)	%
Barley	44
Maize gluten feed	45.5
Molasses	7.5
$NaHCO_3$	3.0
	100.0

TABLE 3

MK 1V DAIRY COW TRIAL - ASHCOTT FARM

Daily rations fed - dm.kg or %

	FISH MEAL (A)						SOYABEAN MEAL (B)					
	L		M		H		L		M		H	
	kg.dm	% dm	kg.dm	% dm	kg.dm	% dm	kg.dm	% dm	kg.dm	% dm	kg.dm	% dm
Grass silage	12	67.4	11	61.2	10	54.3	12	67.0	11	60.8	10	54.1
Hay	0.9	5.1	0.9	5.0	0.9	4.9	0.9	5.0	0.9	5.0	0.9	4.9
Barley	2.1	11.8	2.6	14.4	3.2	17.4	2.1	11.7	2.6	14.4	3.2	17.3
Molasses[1] (mineralised)	0.8	5.1	1.0	5.6	1.1	6.0	0.9	5.0	1.0	5.5	1.1	6.0
Sugarbeet pulp	0.7	3.9	0.7	3.9	0.7	3.8	0.4	2.2	0.4	2.2	0.4	2.2
Maize gluten feed	0.2	1.1	0.8	4.4	1.4	7.6	0.2	1.1	0.8	4.4	1.4	7.6
Soyabean meal	-	-	-	-	-	-	0.90	5.0	0.90	5.0	0.90	4.9
Fish meal	0.68	3.8	0.68	3.8	0.68	3.7	-	-	-	-	-	-
Fat (BP prill)	0.038	0.21	0.038	0.21	0.038	0.21	0.038	0.21	0.038	0.21	0.038	0.21
Dical	0.10	0.56	0.10	0.56	0.10	0.54	0.20	1.11	0.20	0.110	0.20	1.1
Salt	0.01	0.056	0.01	0.056	0.01	0.054	0.03	0.168	0.03	0.166	0.03	0.162
Calcined magnesite	0.03	0.168	0.03	0.167	0.03	0.163	0.03	0.168	0.03	0.166	0.03	0.162
Sodium bicarbonate	0.012	0.0674	0.057	0.317	0.102	0.554	0.012	0.0670	0.057	0.315	0.102	0.551
Copper sulphate $CuSO_4 5H_2O$	0.0012	0.0067	0.0012	0.0067	0.0012	0.0065	0.0012	0.0067	0.0012	0.0066	0.0012	0.0065
Min.vit supplement[2]	0.150	0.843	0.150	0.833	0.150	0.815	0.150	0.838	0.150	0.829	0.150	0.812
TOTAL	17.7		18.0		18.4		17.9		18.1		18.5	

[2] Contains 10.8% Ca, 7% P, 8% Mg, 40% Salt, trace elements 267 i.u. vit. A per g. and 67 i.u. vit. D per g. and 0.6 i.u. vit. E per g.

[1] provides the following per cow per day 1.6g Ca, 1.2g P, 2g NaCl, 0.3g Mg, 10g $NathCo_3$, Fe 70mg, Mn 60mg, Cu 100mg, Co 1mg, I 6mg, Zn 15mg, Se 2mg, K 1.8mg, S 8mg, vit.A 3,000 i.u. vit.D 600 i.u. vit.E 2.5 i.u.

TABLE 4

IAFRN TRIAL FARM IV ASHCOTT FARM

Effect of concentrate feeding level on milk production

High Yielders

Nominal concentrate dry matter intake	Milk[1] Yield	Milk composition[2]			Component Yield[2]		
		Fat	Protein	Lactose	Fat	Protein	Lactose
kg/d	kg/d	%	%	%	kg/d	kg/d	kg/d
4.8	23.6	3.89	3.33	4.73	0.91	0.78	1.12
6.2	23.3	4.11	3.41	4.71	0.95	0.79	1.10
7.6	23.9	4.15	3.34	4.77	1.0	0.80	1.15
Mean	23.6	4.05	3.36	4.73	0.95	0.79	1.12
SED	0.90	0.175	0.057	0.052	0.045	0.023	0.045

Heifers and Moderate Yielders

3.3	17.5	4.48	3.41	4.91	0.78	0.60	0.89
4.7	18.3	4.38	3.36	4.94	0.80	0.61	0.91
6.1	17.6	4.45	3.43	4.85	0.78	0.60	0.87
Mean	17.8	4.43	3.40	4.90	0.78	0.60	0.89
SED	1.07	0.173	0.080	0.062	0.003	0.028	0.040

[1] Yields averaged over 3rd and 4th weeks of each period
[2] Milk composition and component yield averaged over the 4th week of each period

TABLE 5

IAFMM TRIAL MARK IV ASHCOTT FARM

Effect of replacing soyabean meal by fish meal on milk yields and composition, averaged over three levels of concentrate feeding

High Yielders

Milk yield	Milk Composition[2]			Milk Component Yield[2]		
	Fat	Protein	Lactose	Fat	Protein	Lactose
kg/d	%	%	%	kg/d	kg/d	kg/d
-0.12	-0.17	+0.02	-0.01	-0.047	+0.002	-0.006
0.201	0.079	0.017	0.022	0.0179	0.0087	0.0101
NS	<0.05	NS	NS	<0.05	NS	NS

Heifers and Moderate Yielders

+0.24	+0.07	+0.03	+0.02	+0.02	+0.01	+0.01
0.191	0.092	0.021	0.017	0.015	0.009	0.011
NS	NS	NS	NS	NS	NS	NS

[1] Effects on yield determined from yields in 3rd and 4th weeks of each period.

[2] Effects on composition and component yield determined from data of the 4th week of each period

APPENDIX TABLE 1

ASHCOTT TRIAL - FORAGE ANALYSIS

Analysis of Silage

Sample No.	1 (7765)	2 (70)	3 (1188)	4 (257)
DM % (Toluene)	26.5	28.7	NA '	25.5
CP %	18.2	15.2	15.6	13.1
MAD %	24.1	23.4	36.1	35.6
NH_3 N %	7	6	7	21
pH	3.8	3.7	4.4	5.1
'D' value	72	73	62	59
ME MJ/kg dm	11.5	11.6	9.9	9.9
Ash %	9.9	9.6	9.1	12.1
Magnesium %	0.17	0.11	0.17	0.18
Phosphorus %	0.40	0.34	0.33	0.40
Sulphur %	0.34	0.31	0.36	0.36
Copper mg/kg	11.4	9.8	1.00	9.5
Molybdemium mg/kg	3.1	5.1	5.8	17.2
Iron mg/kg	400	315	140	120

Analysis of Hay

Sample No.	1 (7766)	2 (71)	3 (1189)	4 (258)
DM %	78.2	86.8	85.4	77.1
CP %	13.1	14.2	11.3	14.6
MAD Fibre %	31.5	31.6	37.9	32.7
'D' value	65	64	57	63
ME MJ/kg dm	9.9	9.9	8.5	9.6

Silage No 1 fed in period 1

Silage No 2 fed in period 2 and 3

Silage Nos 3 and 4 fed in period 4

Hay No 1 fed in period 1

Hay No 2 fed in period 2

Hay No 3 fed in period 3

Hay No 4 fed in period 4

' Not Available

APPENDIX TABLE 2 ASHCOTT FARM TRIAL RATIONS - COMPOSITION AND ESTIMATED NUTRIENT INTAKE

	FISH MEAL						SOYABEAN MEAL						REQUIREMENT FOR	
	L		M		H		L		M		H		30l/day'	20l/day'
	% of dm	g intake	% of dm	g intake	% of dm	g intake	% of dm	g intake	% of dm	g intake	% of dm	g intake	g intake	
Crude protein	16.8	2974	16.8	3024	16.6	3054	16.3	2918	16.2	2932	16.0	2960	2165	1515
UDP	3.71	657	3.96	713	4.13	760	2.95	528	3.17	574	3.37	623	630	370
ME - R(MJ/kg)	10.7	189	10.9	196	11.0	202	10.6	190	10.8	195	10.9	202	197	147
Oil	3.5	620	3.5	630	3.4	626	3.4	609	3.3	597	3.1	574	-	-
Fibre	23.5	4159	22.1	3978	20.5		23.5	4207	22.1	4000	20.5	3793	-	-
Ca	0.97	190	0.95	192	0.94	191	0.85	170	0.83	150	0.81	167	64	48
P	0.59	116	0.60	117	0.61	124	0.53	107	0.56	101	0.58	119	59	44

'MJ assuming no weight loss