IAFMM

international association of fish meal manufacturers

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MILK PRODUCTION RESPONSE OF DAIRY COWS FED A SUPPLEMENT OF FISH MEAL ON COMMERCIAL FARMS[1]

BY

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SUMMARY

Addition of a low degradability fishmeal to normal commercial diets increased milk yield in early lactation. Use of the double reversal design enabled this to be detected with a high degree of statistical confidence, but the mean response averaged over 16 weeks of intermittent feeding of fishmeal is necessarily less than the response obtained in early lactation. Assuming that the effect is fully established by the third and fourth week of feeding fishmeal, the best estimate of the immediate response to a fishmeal supplement in early lactation, averaged over 13 herds, is an increase of 2.71 *l.* per day or 9.1%. Under U.K. price conditions this response was economically advantageous.

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1 Paper presented to the British Society of Animal Production Meeting in Harrogate, March 1981. See Animal Production (1981) Vol. 32 (3) pp 368, 369.

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INTRODUCTION

The digestible crude protein system of expressing protein requirements of dairy cows is now known to be inadequate. The U.K. Agricultural Research Council (ARC), on the basis of new research findings, has proposed a new scheme to express protein requirements[1]. This Scheme is in two parts based on:

(i) Protein required to maintain micro-organisms, in the rumen which are necessary to digest feed, particularly structural carbohydrates, and

(ii) Protein which is not degraded by rumen micro-organisms, but which supplements microbial protein passing out of the rumen. This protein is subsequently digested and contributes towards the animal's requirements for amino acids to meet the needs of milk synthesis and body maintenance.

Fish meal, particularly when processed from fresh raw materials and containing a low level of soluble protein is recognised to provide protein which is largely undegraded in the rumen[2], and which has a good amino acid balance.

The new ARC Scheme indicates that high yielding dairy cows, particularly in early lactation, would benefit from additional undegraded proteins of high quality. This appears to be especially true where the roughage component of the diet is supplied by grass silage.

Although trials have been reported in which fish meal was assessed when fed to dairy cows, they have generally used lower yielding cows than those in the better commercial herds. Furthermore, in these trials the fish meal used was not processed from selected raw materials and in most cases the roughage component of the diet was not silage. The objective of the trial now reported was to determine whether high yielding cows in early lactation would respond to a supplement of fishmeal (A), specially selected to be of high undegraded dietary protein content, substituting for sugar beet pulp or barley (B) in normal farm diets.

EXPERIMENTAL DESIGN

From 13 herds on 12 farms, recently calved multiparous cows each yielding over 25 *l.* milk per day were selected, with a minimum of 15 cows per herd. A double reversal design with four periods each of four weeks was adopted. After a preliminary period on the normal farm diet, five herds were allocated at random to sequence ABAB and eight herds to sequence BABA. Unsupplemental diets (B) were those normally used by each farm (Table 1). The main roughage was grass silage (8 farms) maize silage (3 farms) or mixed grass-lucerne hay (1 farm). Silage was either self-fed (5 farms), fed separately (2 farms) or mixed with part or all the compound feed (4 farms). Compound feeds without fishmeal contained 160–206 g CP/kg DM and all control diets were considered adequate in DCP by current standards. The specially selected fishmeal analysed (g/kg) DM 919, CP 682; proportion of CP soluble in 0.15M NaCl 0.19; degradability, estimated from polyester bags suspend in the rumen and assuming a 0.05 rate constant for the fractional outflow rate from the rumen, 0.41.

1 "The Nutrient Requirements of Ruminant Livestock", Commonwealth Agricultural Bureaux, Farnham Royal, Slough, England (1980), Chapter 4.

2 Mehrez, A.Z., Ørskov, E.R. and Opstvedt, J. (1980). J. Anim. Sci. *50*, 737-744.

TABLE 1

Main Features of Feeding Regimes Adopted on Each Farm

Farm	Sequence	Basal Feed	Compound Feed Fixed rate (kg/day)	Compound Feed Graded rate (kg/day)
1	B	Grass silage	6	0.4 kg/*l* over 17*l*
2	A	Grass silage *ad lib* 3.6kg dried sugar beet pulp	2.7	7.3 – 8.2 kg
3	A	Grass silage *ad lib*	12.75	–
4	B	Grass silage *ad lib*	12.75	–
5	B	Grass haylage + hay 2.3kg dried sugar beet pulp	2.7	0.4 kg/*l* over 13.6*l*
6	B	Grass silage *ad lib*	3.6	0.4 kg/*l*
7	B	Grass silage *ad lib* Barley straw *ad lib* 2kg dried sugar beet pulp	2.0	0.4 kg/*l*
8	B	Grass silage *ad lib* Barley straw *ad lib* 2kg dried sugar beet pulp	2.0	0.4 kg/*l*
9	A	Grass silage *ad lib* 6.8kg brewers grains	–	0.4 kg/*l*
10	A	Complete diet based on maize silage	5.0 up to period 3 week 3 0.25 from period 3 week 3	–
11	B	Period I grazing	1.5	
		II grazing + 1.5 kg hay	1.5	0.35 kg/*l*
		III grazing + silage	1.5, 1.0 in week 4	
		IV silage *ad lib*	0.5 in week 1	
12	B	Complete diet based on grass silage/maize silage	–	–
13	A	Grass/lucerne hay 5.9 kg	3.6	0.4 kg/*l* over 4.5*l*

l = litres daily milk production

RESULTS

Data from 219 cows were available but that from cows affected by mastitis or other illness were omitted leaving data from 215 and 198 cows for analysis of period 1 data alone and period 1 to 4 respectively. Restricting the analysis to those cows which were less than 42 days into lactation at the start of the trial reduced the numbers to 170 and 152 respectively. Mean yields for each period in each herd were calculated and statistical analysis was carried out on these values, using each herd as the basic unit.

Herds using fishmeal had numerically greater milk yield in the first two weeks of period 1 (Table 2). The effect of fishmeal increased by the third and fourth week of period 1 and was statistically significant for cows commencing the experiment within 42 days of calving. Adjusting milk yields by covariance analysis for differences in initial milk yield slightly reduced the apparent effect of fishmeal but by accounting for part of the variations between farms, increased the statistical significance of the effect.

Using data from the first two weeks of each period, fishmeal supplementation increased milk yield significantly. The effect was further increased when data from the last two weeks of each period was used (Table 3). Restricting the analysis to cows calving within 42 days of commencing the trial did not alter these conclusions.

Data from the two herds managed together on one farm were also analysed using each cow as the statistical unit. All 30 cows were within 42 days of calving at the start, the means times being 25 and 23 days for sequences A and B respectively. Averaged over the 16 weeks of the trial fishmeal significantly increased milk yield. The effect was greater in data from the second two weeks of each period (Table 3).

Averaged over the four periods and all farms fishmeal tended to increase percentage of fat by 0.15% units without change in protein content. The one farm which used two groups of cows gave a highly significant increase in milk fat of 0.28% units and a non-significant trend to lowered protein content (Table 4).

CONCLUSION

Addition of a low degradability fishmeal to normal commercial diets increased milk yield in early lactation. Use of the double reversal design enabled this to be detected with a high degree of statistical confidence, but the mean response averaged over 16 weeks of intermittent feeding of fishmeal is necessarily less than the response obtained in early lactation. Assuming that the effect is fully established by the third and fourth week of feeding fishmeal, the best estimate of the immediate response to a fishmeal supplement in early lactation, averaged over 13 herds, is an increase of 2.71 *l.* day or 9.1%. Under U.K. price conditions this response was economically advantageous.

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FARM	ADDRESS	FARMER/MANAGER
Kytton	Holcombe Rogus, Wellington, Somerset.	Messr. John and Tony Gabriel
Blakemoor Farm	Higher Plymouth Road, Totnes, Devon.	Mr. John Anning
Kimland Farm	Barnacott, Brayford, Barnstaple, Devon.	Mr. J. Wadsworth
Pucknowle Manor Farm	Pucknowle, Bridport, Dorset.	Mr. Ivor Bending
Fortescue Estates	Filleigh, South Moulton, Devon.	Mr. M.R. Hancock
Hanford Farms Ltd.	Chile Okeford, Blandford, Dorset.	Mr. Alan Read
Lulworth Castle Farms (two farms)	West Lulworth, Weymouth, Dorset.	Mr. John Dunk
Miserden Park Farms	Miserden, Gloucestershire.	Mr. Hugh Peace
Maitland Farms Ltd. Slepe Farm	Spettisbury, Blandford, Dorset.	Messrs. Ian & Kevin Maitland
Watergate Farm	Bulford, Marlborough, Wiltshire.	Messrs. W.E. & D.T. Cave
M.A.J. Ward	M.A.J. Ward, Whittingham Hall, Fressingfield, Diss, Norfolk.	Mr. John Evans

TABLE 2

Effect of Supplemental Fishmeal on Milk Yield (l/day) in Period I Averaged Over all Farms

	All Cows				Cows < 42 days			
	Fishmeal	Control	Difference	Significance P	Fishmeal	Control	Difference	Significance P
UNADJUSTED DATA								
PRELIMINARY	29.9	29.6	0.3	0.9	30.1	29.6	0.5	0.8
WEEKS 1–2	31.3	29.4	1.9	0.3	31.6	29.6	2.1	0.3
WEEKS 3–4	31.9	29.3	2.6	0.1	32.6	29.6	3.0	0.04
ADJUSTED DATA								
WEEKS 1–2	31.2	29.5	1.8	0.1	31.4	29.7	1.7	0.1
WEEKS 3–4	31.8	29.3	2.5	0.04	32.4	29.7	2.7	0.005

(1) Cows calving within 42 days of commencing trial.

TABLE 3

Effect of Supplemental Fishmeal on Milk Yield (l/day) Averaged Over Four Periods on all Farms

	ALL COWS				COWS < 42 days			
Weeks	1–2		3–4		1–2		3–4	
Sequence	ABAB	BABA	ABAB	BABA	ABAB	BABA	ABAB	BABA
Period 1	31.5	29.4	31.7	29.3	31.7	29.6	32.4	29.7
2	29.2	28.8	28.2	28.6	29.9	29.1	28.9	28.8
3	27.9	25.7	26.0	24.4	28.4	26.0	26.6	24.5
4	24.1	22.8	23.0	22.3	24.7	23.0	23.6	22.3
FISHMEAL EFFECT	0.78		0.95		0.66		0.96	
SIGNIFICANCE	P = 0.01		0.0004		0.03		0.0009	

(1) Cows calving within 42 days of commencing trial.

TABLE 4

Effect of Supplemental Fishmeal on Milk Yield (l/day) Averaged Over Four Periods for Two Groups of Cows on a Single Farm

Weeks	1–2		3–4	
Sequence	**ABAB**	**BABA**	**ABAB**	**BABA**
Period 1	30.6	30.1	31.0	30.0
2	28.2	31.5	26.6	29.9
3	26.4	28.4	25.6	26.1
4	22.8	24.4	21.4	22.9
FISHMEAL EFFECT	0.81		1.34	
SIGNIFICANCE	P = 0.0015		0.000001	

TABLE 5

Effect of Supplemental Fishmeal on Milk Composition

	ALL FARMS				SINGLE FARM			
	FAT (%)		PROTEIN (%)		FAT (%)		PROTEIN (%)	
Sequence	**ABAB**	**BABA**	**ABAB**	**BABA**	**ABAB**	**BABA**	**ABAB**	**BABA**
Period 1	3.92	3.92	3.30	3.39	3.83	3.73	3.24	3.27
2	3.64	3.99	3.20	3.30	3.78	4.36	3.26	3.13
3	3.91	3.84	3.21	3.31	3.91	3.65	3.02	3.21
4	3.95	3.87	3.31	3.34	4.19	3.65	3.36	3.40
FISHMEAL EFFECT	0.15		−0.01		0.28		−0.12	
SIGNIFICANCE	P = 0.08		0.80		0.003		0.09	

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