IAFMM Fish Meal Flyer

international association of fish meal manufacturers

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FISH MEAL FOR GROWING-FINISHING BULLS AND LACTATING COWS -

TRIALS AT THE RESEARCH INSTITUTE HERCEGHALOM, HUNGARY

SUMMARY

Growing cattle fed isoenergetic diets based on maize silage received in addition supplements providing three levels of protein, 80%, 100% and 116% of the requirement, with proteins of high (over 70%) and low (under 60%) degradability at each protein level. Combinations of fish meal (low protein degradability), and sunflower meal and urea (high protein degradability) were used as the protein supplements. Increasing protein intake, using high and low degradability proteins, resulted in growth rates of 1235, 1311, 1341 and 1353, 1459, 1508g per day respectively. Effects of protein quality and degradability were significantly at $P \leq 0.01$ and $P \leq 0.001$ levels respectively. The increases in growth resulting from feeding the less degradable protein from fish meal were 10%, 11% and 12% at the low, medium and high protein intakes respectively.

These results showed that increasing the amount of protein fed above requirement to bulls fed a maize silage based diet gave a growth response (2% to 3%); increasing the proportion of undegraded dietary protein by including fish meal gave greater responses (10% to 12%).

Lactating Holstein Fresian primiparous cows fed a diet based on maize silage, alfalfa and cereals received a protein supplement of either fish meal plus sunflower meal (low degradability) or sunflower (high degradability). During the trial period in early lactation energy and protein intake of the two groups were equated. Milk production of the group receiving the low degradable protein supplement containing fish meal was 1.9kg higher than that of the other group (29.4 v 27.5 kg/day). Liveweight losses for the two groups averaged 13kg and 4kg respectively.

TRIAL WITH GROWING-FINISHING BULLS*

The object of this study was to investigate the effect of different quantities of protein, using proteins of different rumen degradability, on the performance of growing-finishing bulls. Fish meal (low degradability) and sunflower and urea (high degradability) were used to provide protein supplements of different degradability. Energy intake was equated for the different treatments.

The trial was carried out at the Research Institute for Animal Nutrition, Herceghalom, Hungary using crossbred Hungarian Simmental x Hereford x Charolais growing bulls.

The diets used were based on maize silage, maize grain and protein supplements of fish meal[1], sunflower meal and urea. The rations were designed to provide equal energy and either 80%, 100% or 116% of protein requirement. In Hungary recommended requirements for energy and protein are based on the system from the USA (NRC, 1985 [1]). Each level of protein was provided with high (74%) and low (56%) rumen degradability based on in sacco determinations, incubating in the rumen (see Table 1). The rations fed are detailed in Table 2.

The bulls weighed on average 236kg at the start of the trial and remained on trial until they reached an average weight of 473kg, with different periods on trial. They were pen fed in groups of 16 and weighed every 28 days.

TABLE 1
In sacco protein degradability and amino acid composition of fish meal and extr. sunflower meal

PROTEIN DEGRADABILITY, %		
Time of incubation, hours	**Feed**	
	Extr. sunflower meal	**Fish Meal**
2	63.8	22.6
4	73.0	29.0
8	88.5	25.5
16	94.5	27.2
24	97.5	28.8
48	98.3	40.0
AMINO ACIDS, %		
	Feed	
	Extr. sunflower meal	**Fish meal**
Lysine	1.34	5.00
Histidine	1.20	1.70
Arginine	3.20	3.80
Threonine	1.40	2.50
Valine	2.00	3.20
Methionine	0.96	2.00
Isoleucine	1.50	2.80
Leucine	2.50	5.80
Phenylalanine	1.74	2.80

[1]Danish Type B for ruminants

**Editors note: résumé of translation of original paper: Várhegyi, Józsefné, Varhegi, J. and Lányi Istvanné. Állatenyésztés és Takarmányozás Tom. 37, No. 5, 1989.*

TABLE 2
Feed and nutrient intake of growing-finishing bulls fed isocaloric diets

Degradability	High (74%)			Low (56%)		
Protein level (%)	80	100	116	80	100	116
Feed intake kg/day						
Maize silage	16.1	16.1	16.2	15.9	15.9	15.9
Maize grain	1.5	1.5	1.3	1.7	1.5	1.3
Fish meal	-	-	-	0.3	-	-
Fish meal with urea	-	-	-	-	0.48	0.69
Sunflower meal with urea	-	0.65	0.96	-	-	-
Maize with urea	0.49	-	-	-	-	-
Mineral and vitamin supplement	0.15	0.15	0.15	0.15	0.15	0.15
Feed refusals	0.11	0.04	0.04	0.22	0.13	-
Daily nutrient intake						
Dry matter, kg	8.3	8.4	8.5	8.1	8.1	8.2
Crude protein, g	802	995	1157	810	1010	1177
NEm MJ/kg dry matter	7.39	7.22	7.13	7.46	7.39	7.36
NEg MJ/kg dry matter	4.82	4.67	4.59	4.87	4.82	4.79
NEm requirement, MJ	29.33	29.54	29.55	29.50	29.55	29.59
NEg available for deposition in gain	20.68	20.17	20.10	20.16	19.81	19.78

TABLE 3
Performance of growing finishing bulls fed isocaloric diets

Degradability	High (74%)			Low (56%)		
Protein level (%)	80	100	116	80	100	116
Number of bulls	14	14	14	14	14	14
Initial weight, kg	235	235	235	237	235	236
Final weight, kg	468	475	475	471	475	475
Days on feed	189	183	179	173	165	159
Liveweight gain g/day	1235	1311	1341	1353	1459	1508
Effect of protein quantity, %	94	100	102	93	100	103
Effect of protein degradability, %	100	100	100	110	111	112

The effect of quantity and degradability is significant at $P < 0.01$ and $P < 0.001$ level, respectively.

The performance data are shown in Table 3. On the high degradability protein weight gains with increasing protein intake were 1235, 1311 and 1341g per day; on the low degradability protein they were 1353, 1459 and 1508g per day respectively. The increased weight gain resulting from increased protein intake and from decreasing protein degradability were significant $P \leq 0.01$ and $P \leq 0.001$ respectively. Bulls consumed 802,995 and 1157g crude protein with the high degradability diets and 810, 1010 and 1177g with the low degradability diets at the three dietary protein levels respectively. Protein intakes at the medium protein level exceeded protein requirement based on actual weight gain by 63g and 43g for the high and low degradability diets respectively.

These results showed that increasing the amount of protein fed above requirement to bulls on a maize silage diet gave a small growth response (2% to 3%); increasing the proportion of undegraded dietary protein by including fish meal gave greater responses (10% to 12%).

TRIAL WITH LACTATING COWS**

The trial was undertaken at the Hódmezővásárhely State Farm supervised by staff from the Institute of Animal Nutrition at Herceghalom, Hungary. The objective was to investigate the effect of reducing protein degradability on the performance of high yielding cows compared with feeding typical Hungarian diets the protein of which is about 70% degradable. Fish meal was used as a source of low degradability protein being highly digestible and having a high biological value.

Twenty-four first calf Holstein heifers were assigned to two groups according to calving date and milk yield. At the beginning of the trial the average days from calving were 68 and 67 and milk yields 28.3 and 28.5 kg per day for the control and experimental (low degradability) diets respectively.

The diets were based on maize silage, lucerne, lucerne hay, lucerne haylage and dried beet pulp (see Table 4). The concentrates fed contained maize grain and wheat grain with either sunflower meal (control) or sunflower meal plus fish meal (experimental) (see Table 5). They contained 225g and 218g crude protein with degradabilities of 48% and 72% respectively. The fish meal used, a Danish herring type fish meal for ruminants (type B), was fed at 1kg per day. The two rations, except hay, were fed as complete feed and provided similar amounts of crude protein, energy and fibre. Hay was offered separately.

Daily feed intake and nutrient intakes are shown in Table 6. Dry-matter intake, 3.5% of liveweight, providing about three times maintenance energy requirement was considered satisfactory. Intake of degraded and undegraded protein were 2085g and 920g for the controls and 1711g and 2349g for the experimental group receiving fish meal.

During the trial the cows receiving the experimental diet with fish meal produced 29.4kg milk per day, 1.9kg per day more than the controls (Table 7). This difference was significant ($P \leq 0.001$). The experimental group lost more liveweight (13kg v 4kg) over the trial period (41 days). Information about composition of the milk is not available.

TABLE 4
Daily rations fed - (kg per cow per day)

	Experimental group kg	Control group kg
Maize silage	10.2	10.2
Green lucerne	9.4	9.4
Lucerne hay	2	2
Lucerne haylage	3	3
Dried beet pulp	2	2
Mineral and vitamin supplement	0.5	0.5
Maize grain	2.5	2
Experimental dairy concentrate	7.1	
Control dairy concentrate	-	8
Refusals	2	2.7

***Editors note: résumé of translation of original paper: Várhegyi, J., Várhegyi, Jozsefné and Huszár, I. Allattenyésztes és Takarmányozás Tom. 38, No. 1, 1989.*

TABLE 5
Composition of experimental and control dairy concentrates

	Experimental concentrates %	Control concentrates %
Maize grain	30.7	29.8
Wheat grain	45.0	33.3
Extr. sunflower meal	9.0	36.5
Fish meal	15.3	-
Limestone	-	0.4
Nutrient content in dry matter:		
Crude protein	225	218
degradable protein g	108	157
%	48	72
Soluble protein, g	51	80
Net energy for lactation, MJ	8.34	7.70

TABLE 6
Average daily nutrient intake and nutrient concentration of the rations

	Experimental group	Control group
Daily intake:		
Dry matter intake, kg	18.16	18.11
Crude protein, g	2960	3005
degradable protein, g	1711	2085
undegradable protein, g	1349	920
Protein degradable (%)	58	69
Net energy for lactation NE_ℓ, MJ	125.8	126.8
Crude fibre	2890	2839
in dry matter		
Nutrient concentration		
Crude protein, %	16.3	16.6
NE_ℓ, MJ	6.9	7.0
Crude fibre, %	15.9	15.7
Proportion of protein:		
degradable, %	58	69
undegradable, %	42	31

TABLE 7
Performance data

	Experimental group	Control group
Number of cows, n	12	12
Days on feed	41	41
Liveweight, kg		
at the beginning	522	502
at the end of trial	509	498
Milk yield, kg		
before the trial	28.5	28.3
during the trial	29.4***	27.5
after the trial	25.0	24.9
peak yield	31.9*	30.2

* P < 5%, *** P< 0.1%

The authors conclude that protein degradability can have an important effect on milk production. The results were similar to those obtained by other workers (Miller et al. [2]), Chalupa and Ferguson [3], Vandersall and Erdman [4]), a response of 5% to 10% milk production being expected when protein degradability of typical diets of 68% to 70% is reduced to 50% to 60% in early lactation. Positive response can only be obtained, they indicated, if the production level is high and microbial protein synthesized in the rumen plus degraded protein of common diets do not provide sufficient to meet requirements.

References

1. *NRC 1985:* Ruminant Nitrogen Usage, National Academy of Sciences, Washington DC.

2. *Miller, W.R., Galway, N.W., Pike, I.H., Newman, G.* (1981): Techn. Bull. IAFMM. 1-7.

3. *Chalupa, W., Ferguson, J.D.* (1985): Proc. 46th. Minnesota Nutrition Conference, St. Paul 1-29.

4. *Vandersall, J.H., Erdman, R.A.* (1985): 18th Annual Meeting of the ADSA. J. Dairy Sci. Champaign. 113.