Animal Nutrition and Feed Technology (2005) 5 : 1-8

Effect of Feeding Rumen Protected Protein on Milk Production in Low Yielding Crossbred Cows

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(Received August 12, 2003)

ABSTRACT

Feeding trial using bypass protein supplement was conducted on 16 low yielding crossbred (Holstein-Friesian X Jersey) cows for 8 weeks. Cows yielding 4-5 kg milk per animal per day were divided into two groups of eight each, based on milk yield, fat percentage and stage of lactation. The animals in both the groups were fed basal diet, comprising of 9.0 kg green maize fodder and 5.0 kg paddy straw. In addition to the basal ration, animals in the two groups were fed 1.0 kg each of either untreated (Control) or formaldehyde treated (Experimented) rapeseed meal (*Brassica campestris*). The degree of protein protection in treated rapeseed meal was 76.5 per cent of CP compared to an equivalent value of 36.3 per cent in the untreated meal. Average increase in milk yield; fat, FCM and protein content in experimental group, over control, was 0.70 kg; 0.20, 1.0 and 0.20 per cent, respectively. Increase in milk yield in experimental group compared to control group was significantly ($P < 0.05$) higher. However, no significant effect was observed on the level of fat, FCM and protein percent in milk. Average net daily income increased by Rs.6.49 on feeding protected rapeseed meal. It is concluded that supplementation of 1.0 kg protected protein in the form of formaldehyde treated rapeseed meal in the ration of low yielding cows was found to be economical, compared to feeding similar quantity of untreated protein meal.

Key words: Bypass protein, Rapeseed meal, Milk yield, Cows.

INTRODUCTION

The use of protein supplements in ruminant diets depends upon the requirement of undegradable and rumen degradable protein to both the host animal and its

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rumen microbes. Although excess ruminal ammonia nitrogen can be partly recycled to the rumen via saliva and blood, nitrogen losses in the urine can be substantial due to extensive degradation of feed protein and/or inefficient use of non-protein nitrogen. There are many ways to minimize excess rumen ammonia in ruminant diets and improve N utilization, for instance, by using formaldehyde treatment. In view of the high energy cost in developing countries and possibility of increase in the neutral detergent insoluble nitrogen (NDIN) and acid detergent insoluble nitrogen (ADIN) contents of heat treated protein meals, it is considered that formaldehyde treatment of meals provides the most economically viable approach to optimize the rumen degradable protein (RDP)/rumen un-degradable protein (UDP) without changing the NDIN/ADIN. Rapeseed meal is one of the cheaper protein supplements for livestock, but at the same time highly degradable in rumen. Therefore, it may be worthwhile to feed this protein meal in protected form to improve the utilization of its nutrients for the enhanced productive performances of the animals. Studies carried out earlier in other parts indicate positive effect of feeding formaldehyde treated protected proteins on the milk production performance of the high producing animals (Hamilton *et al.*, 1992; Gulati *et al.*, 2002).

Usually it is felt that the bypass protein feed is meant for high yielding animals and some policy makers feel that bypass protein feed is not relevant for low producing animals in India with more than 70 per cent of milch animals being low yielders (< 5 litres per day). Thus, an attempt was made to enhance the rumen bypass protein value of one of the most commonly used protein supplement and to find out how far the feeding of bypass protein could be beneficial to low yielding cows.

MATERIALS AND METHODS

Animals, feeds and feeding

A feeding trial was conducted on 16 crossbred (HF X Jersey) cows, yielding 4-5 kg milk per animal per day. Feeding trial was conducted at R.M. Patel dairy farm, Sarsa (Anand). Animals were divided into two groups of 8 each (Control and Experimental), based on milk yield, fat per cent and stage of lactation (50-60 days post calving). Each animal in both the groups was fed on a basal diet, comprising of 9.0 kg green maize fodder and 5.0 kg paddy straw per day. The feeding was done twice daily in the morning and evening. Additionally, the animals in control group were supplemented with 1.0 kg untreated rapeseed meal per animal per day, whereas animals in experimental group were fed 1.0 kg (formaldehyde) treated rapeseed meal daily.

Analytical methods

The feeding trial was conducted for a period of eight weeks. The milk yield of individual cows was recorded in the morning and evening. The milk samples

were drawn weekly and were analyzed for fat (IS: 1224, 1977) and protein (IS: 1479, 1961) contents. The chemical composition of feeds and fodder was carried out as per AOAC (1995). Feeds and fodder were also analyzed for NDF, NDIN, ADF, ADIN, cellulose, hemi-cellulose and acid detergent lignin as per Goering and Van Soest (1970). The data were analyzed statistically (Snedecor and Cochran, 1968).

Formldehyde treatment

Rapeseed meal was treated with formaldehyde (HCHO 40% w/v) in sealed chambers where it underwent formation of complexes, capable of resisting degradation in the rumen (Ashes *et al.*, 1995). This is attributed to HCHO-binding to the proteins by the formation of methylene bridge (Fraenkel-Conrat and Olcott, 1948), which makes them resistant to microbial attack. The protein meal was tested for degree of protection using *in vitro* rumen incubation procedure. Known quantity of feed material was incubated for 24 hours in strained rumen liquor, anaerobically at 38°C. The protein degradation was measured by analyzing ammonia nitrogen level in strained rumen liquor, at the end of incubation (Gulati *et al.*, 1999). The extent of protein degradation was 63.7 per cent of CP in untreated rapeseed meal, while that of treated rapeseed meal was 23.5 per cent of CP.

RESULTS AND DISCUSSION

Chemical composition and dry matter intake

Chemical composition of feeds and fodder offered to animals and the account of daily DM intake during the trial period is shown in Table 1. The nitrogen fraction associated with fibre i.e. NDIN and ADIN is a measure of the quality of protein in treated feeds (Nakamura *et al.*, 1994). The protection (UDP) of untreated rapeseed meal was 36.3 per cent of CP; while that of treated rapeseed meal was 76.5 per cent of CP. Analysis of feeds and fodder revealed that the NDIN and ADIN contents were very low. Thus, cell wall bound nitrogen level was non-significant in all the feeds and fodder offered to animals during trial period. It also revealed that there was no significant difference between treated and untreated rapeseed meal particularly in NDF, NDIN, ADF and ADIN contents. Since animals were fed similar ration, there was no significant difference in daily DM intake in the two groups.

Milk yield and composition

The mean daily milk yield in control and experimental groups is shown in Table 2. On feeding 1.0 kg untreated rapeseed meal in control group and 1.0 kg treated rapeseed meal in experimental group, daily average milk yield was 4.8 ± 0.32, 5.5 ± 0.44 kg, fat 4.6 ± 0.12, 4.8 ± 0.17 %, FCM 5.2 ± 0.14, 6.2 ± 0.19 % and protein 3.3 ± 0.04, 3.5 ± 0.03 %, respectively. Increase in milk yield (kg) was

significantly ($P<0.05$) higher (Garg *et al.*, 2002, 2003, 2004). Increase in fat, FCM and protein percent was not significantly different on feeding treated rapeseed meal. In present study, overall increase in milk yield was 14.58 per cent as a result of feeding formaldehyde treated rapeseed meal, whereas FCM yield increased by 19.23 per cent. Increase in FCM yield was more prominent and higher than the increase in milk yield, as the treated rapeseed meal not only increased the milk yield, but also the milk fat per cent in treatment group.

The significant improvement in milk production performance could be due to the increased supply of amino acids at the tissue level. There are reports by several workers that formaldehyde treatment caused an increased supply of amino acids at the lower tract (Setala and Syrjala-Qvist, 1984; Antoniewicz *et al.*, 1992). Rapeseed meal is a very potent source of methionine and lysine (Chatterjee and Walli, 2002), which are the two most important limiting amino acids for the productive performances of animals. Chalupa and Sniffen (1996) also reported that the increased supply of essential amino acids in protected form causes an increase in milk production. Methionine in particular, plays a significant role as a methyl

Table 1. Chemical composition (% DM basis) of feeds and fodder and account of daily DMI during the trial

Particular	Maize green	Paddy straw	Untreated RSM	Treated RSM
Chemical composition				
OM	93.22±0.03	80.16±0.16	91.47±0.18	91.84±0.22
CP	5.67±0.02	2.18±0.01	37.83±0.14	37.74±0.12
EE	0.55±0.00	0.32±0.00	—	—
NDF	59.45±0.21	75.48±0.32	24.37±0.11	24.30±0.10
ADF	40.21±0.16	52.97±0.28	14.15±0.13	14.34±0.11
ADL	5.23±0.02	3.88±0.01	5.19±0.03	5.72 ±0.02
Cellulose	31.13±0.02	42.47±0.25	6.83±0.03	6.91±0.02
Hemi-cellulose (HC)	19.24±0.15	22.51±0.30	10.22±0.12	9.96±0.10
Silica (S)	3.12±0.01	7.11±0.02	0.32±0.00	0.33 ±0.00
NDIN	2.14±0.02	1.82±0.01	2.12±0.01	2.10 ±0.00
ADIN	1.62±0.00	1.14±0.01	1.62±0.00	1.63±0.00
Daily DM Intake (kg)				
Control	2.28±0.00	4.71±0.01	0.93±0.02	—
Experimental	2.30±0.01	4.70±0.02	—	0.93±0.02

RSM : rapeseed meal.

donor during milk fat synthesis, and is also the precursor for phospholipid component i.e. choline synthesis. The improved supply of amino acids in the presence of sufficient metabolizable energy, might have also improved the protein-energy balance and created a better balance of precursors for milk synthesis, resulting in increased milk production.

Higher degradability of untreated rapeseed meal causes an excessive production of NH_3 in rumen, rather levels were higher than the quantities needed by rumen microbes for use of microbial protein synthesis. Thus, a significant amount of NH_3 is absorbed through rumen wall and then partly lost through urine in the form of urea. The synthesis of urea itself is an energy consuming process, which costs 4 moles of ATP per mole of urea synthesized. Thus, loss of excess nitrogen in the form of urea not only causes a decreased efficiency of protein utilization but could also cause decreased efficiency of energy utilization. However, when formaldehyde treated rapeseed meal replaced untreated one, this excessive loss of both nitrogen and energy could perhaps be avoided due to the much lower degradability of the protein. It may result in an increased energy and nitrogen balance causing further increase in milk production and the yield of different milk constituents.

Significant effect of feeding treated protein meals on growth and milk production have been demonstrated by other workers as well (Kim *et al.*, 1992;

Table 2. Daily average milk yield, milk composition and economics on feeding untreated or treated protein meal supplement

Particular	Control		Experimental	
	Range	Mean±SE	Range	Mean±SE
Milk yield (kg)	4.2-5.3	4.8±0.32	4.2-6.1	5.5*±0.44
Fat (%)	4.3-4.8	4.6± 0.12	4.3-5.1	4.8± 0.17
Protein (%)	3.0-3.4	3.3±0.04	3.0-3.7	3.5± 0.03
FCM (%)	4.4-5.9	5.2±0.14	4.4-7.1	6.2±0.19
Cost of milk1 (Rs.)	42.91		50.1	
Cost of rsm (Rs./kg)	6.00		6.70	
Increase in gross income per animal per day over control (Rs.)	—		7.19	
Net increase in daily income over control (Rs.)	—		6.49	

*Significant difference between control and experimental groups; $P<0.05$.

Tomlinson *et al.*, 1994; Atwal *et al.*, 1995; Yao Ming *et al.*, 1996; Sampath *et al.*, 1997; Santos *et al.*, 1998; Garg, 1998; Kanjanapruthipong and Buatong, 2002).

Economic analysis

Economics of milk production on feeding protected rapeseed meal was also calculated. It was observed that feeding of 1.0 kg protected rapeseed meal as compared to unprotected resulted in increased average net daily income to the tune of Rs.6.49 per animal per day, as shown in Table 2.

CONCLUSION

Use of formaldehyde treated rapeseed meal in the diet of low yielding crossbred cows (4.0 - 5.0 kg/d) proves to be cost effective. Thus, the popular belief that the feeding of bypass protein can prove beneficial only to high yielding animals, needs to be reconsidered on the basis of the results obtained in the present study.

Acknowledgement

The authors are grateful for the financial support of Australian Centre for International Agricultural Research (ACIAR) and technical support of Commonwealth Scientific and Industrial Research Organization (CSIRO) under the project code AS1/PN97/115. The authors are also grateful to the management of National Dairy Development Board, for providing necessary facilities to carry out this work.

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