Effect of Feeding Rumen Protected Protein on Milk Production in Lactating Cows

M.R.Garg*, P.L.Sherasia, B.M.Bhanderi, S.K.Gulati** and T.W.Scott

*Feeding trial using bypass protein supplement was conducted with 20 lactating crossbred cows (HF x Jersey). Cows yielding 8.0-10.0 kg milk per animal per day were divided into two groups of ten each, based on milk yield, fat % and stage of lactation. Each animal in both the groups were fed standard ration, comprising 12.0 kg green maize fodder and 5.0 kg paddy straw. Concentrate mixture was given according to their level of milk production. In addition to the basal ration, animals in control group were fed 1.0 kg untreated rapeseed meal (*Brassica campestris; *CP 39.76%, UDP 37.72% of CP) and in experimental group 1.0 kg protected rapeseed meal (CP 39.76%, UDP 76.00% of CP). Average increase in milk yield (kg), fat, FCM and protein per cent in experimental groups were 1.10, 0.20, 1.46 and 0.20, respectively. Increase in milk yield, fat and FCM per cent were significantly ($P<0.05$) higher. However, no significant effect was observed on the level of protein per cent in milk. Average net daily income increased by Rs. 9.44 on feeding 1.0 kg protected rapeseed meal in lactating cows. In the present study, supplementation of 1.0 kg protected protein in the ration of milch cows was found to be economical, compared to feeding similar quantity of untreated meal.*

Keywords: Bypass protein, undegradable protein, rumen degradable protein, rapeseed meal, crossbred cows, milk yield, milk composition

INTRODUCTION

The discovery by McDonald (1948) that soluble dietary proteins are extensively degraded to ammonia in the rumen and the subsequent observations that proteins or amino acids administered postruminally resulted in greater N retention compared to when these were administered directly in the rumen, led to attempts to find ways of protecting soluble, high quality dietary proteins from microbial degradation within the rumen. There are several alternatives for reducing or preventing the degradation of proteins in the rumen, so that they would pass to the lower gut for subsequent digestion viz., closure of reticulo-rumen groove (Orskov and Benzie, 1969) by feeding liquid diets or by feeding dietary proteins subjected to heat treatment (Senger and Mudgal, 1982), tannic acid treatment (Delord-Laval and Zelter, 1968) or formaldehyde treatment (Ferguson *et al.* 1967; Walli *et al.*1980). In parallel with this research, it was also recognized that the dietary proteins needed to be classified in terms of their digestibility in the rumen, and the RDP, RUP and metabolisable protein to be determined for evaluating protein quality of feeds, with the aim of improving the efficiency of protein utilization and productivity of ruminants.

In the developing countries, the inclusion of RUP or by-pass protein supplements has the potential to increase milk production provided they have consistent natural protection and are cheap to produce (Walli *et al.* 1995; Garg *et al.* 1998; Walli, 2002). In view of the high energy cost in developing countries and the potential to significantly increase the NDIN and ADIN contents of heat treated protein meals, it is considered that formaldehyde (HCHO) treatment, of meals provides the most economically viable approach to optimize the RDP/UDP without changing the NDIN/ADIN. These by-pass protein meals will enhance the post ruminal supply of essential amino acids (Clarke, 1975; Ashes *et al.* 1984). Thus, an attempt has been made to study the effect of feeding formaldehyde treated protein meal, on quantity and quality of milk in lactating crossbred cows.

MATERIALS AND METHODS

A feeding trial during June to August, was conducted on 20 crossbred cows (HF x Jersey),

* *Productivity Enhancement Group, Animal Nutrition and Feed Technology Laboratory, National Dairy Development Board, Anand 388001, Gujarat.*

** *Faculty of Veterinary Science, B19, Sydney University, NSW2006, Australia*

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yielding 8.0-10.0 kg milk per animal per day. The feeding trial was conducted at Bhaikaka dairy farm, Ravipura, near Anand. Animals were divided into two groups of 10 each, based on milk yield, fat % and stage of lactation. Each animal in both the groups was fed standard ration daily, comprising 12.0 kg green maize fodder and 5.0 kg paddy straw. Concentrate mixture was given according to level of milk production, to meet the maintenance and production requirements (NRC, 1989). Roughage:concentrate was about 2.6:1 during the trial period. The chemical composition of feeds and fodder was carried out as per AOAC (1984). Feeds and fodder were also tested for NDF, NDIN, ADF, ADIN, cellulose, hemi-cellulose, acid detergent lignin as per Goering and Van Soest (1970). Animals in the control group were fed 1.0 kg untreated rapeseed meal (Brassica campestris) and in experimental group 1.0 kg protected rapeseed meal, over and above NRC requirements.

Rapeseed meal was treated with formaldehyde (0.5% of CP) in sealed chambers where it underwent formation of complexes, resisting degradation in the rumen (Ashes *et al.* 1995). This is attributed to HCHO – binding to the proteins by the formation of methylene bridges (Fraenkel-Conrat and Olcott, 1948), which makes them resistant to microbial attack (Walker, 1964). The protein 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.

Unprotected or protected rapeseed meal was fed to milch cows for a period of ten weeks. The milk yield of individual cows was recorded in the morning and evening. The milk samples were analysed for fat (IS:1224, 1977) and proteins (IS:1479, 1961) contents. Milk yield (kg) fat and protein % were recorded in both the groups, for ten weeks period. The data were analyzed statistically (Snedecor and Cochran, 1968).

RESULTS AND DISCUSSION

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. Chemical analysis of feeds and fodder reveals that the NDIN and ADIN contents were very low. Thus, cell wall bound nitrogen level was

Table 1: Chemical Composition of Feeds and Fodder and Account of Daily DMI During the Trial Period

Particular	Maize Green	Paddy Straw	Cattle Feed	Untreated Rapeseed Meal	Treated Rapeseed Meal	Total DM Intake (kg/day)	Roughage Conc. Ratio (kg/day)
Chemical Composition (% on DM Basis)							
Crude Protein (CP)	6.52±0.02	3.11±0.01	21.11±0.12	39.76±0.11	39.76±0.10		
Ether Extract (EE)	1.30±0.00	0.34±0.00	2.78±0.01	0.40±0.00	0.39±0.00		
Acid Detergent Fibre (ADF)	41.25±0.11	49.52±0.13	13.67±0.12	15.65±0.04	16.18±0.03		
Acid Detergent Insoluble Nitrogen (ADIN)	0.81±0.00	1.24±0.00	0.70±0.00	0.98±0.00	1.08±0.00		
Neutral Detergent Fibre (NDF)	62.18±0.14	68.22±0.12	22.16±0.16	23.61±0.05	24.06±0.05		
Neutral detergent insoluble nitrogen (NDIN)	1.31±0.00	1.26±0.00	1.21±0.00	1.64±0.00	1.61±0.00		
Acid Detergent Lignin (ADL)	4.28±0.02	2.82±0.01	1.02±0.01	4.56±0.02	4.49±0.02		
Cellulose (C)	32.18±0.10	42.21±0.06	10.26±0.10	5.58±0.01	5.85±0.01		
Hemi-cellulose (HC)	20.93±0.12	18.70±0.12	8.49±0.14	7.96±0.02	7.88±0.02		
Total ash (TA)	8.00±0.02	15.52±0.09	11.62±0.08	7.37±0.01	7.40±0.01		
Silica (S)	3.41±0.01	6.88±0.01	3.12±0.00	0.91±0.00	0.90±0.00		
Daily DM Intake (kg)							
Control	2.68±0.00	4.35±0.01	6.45±0.00	0.93±0.00	-	14.41±0.01	2.60:1.00
Experiment	2.65±0.01	4.32±0.00	6.47±0.01	-	0.93±0.00	14.37±0.01	2.60:1.00

non-significant in all the feeds and fodder offered to animals during trial period. It also reveals 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 the daily DM intake. The nitrogen fraction associated with fibre i.e. neutral detergent insoluble nitrogen (NDIN) and acid detergent insoluble nitrogen (ADIN) is a measure of the quality of protein in treated feeds (Nakamura *et al.* 1994), their higher content depicts over protection of proteins, which has not been observed in the present study.

Account of 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 in kg was 8.45 ± 0.162, 9.55±0.214, fat % 4.40 ± 0.061, 4.60 ± 0.070 and protein % 3.30 ± 0.008, 3.50 ± 0.010 respectively. On feeding 1.0 kg treated rapeseed meal in experimental group compared to similar level of untreated rapeseed meal fed in control group, increase in milk yield (kg), fat and fat corrected milk (FCM) % were significantly ($p<0.05$) higher (Garg *et al.* 2002 a,b). Increase in protein percent was not significantly different on feeding 1.0 kg treated rapeseed meal. Significant effect of feeding treated protein meals on growth and milk production has been demonstrated by other workers as well (Gupta and Walli, 1987; Yao Ming *et al.* 1996; Kunju *et al.* 1992; Manget Ram and Gupta, 1994; Tomlinson *et al.* 1994; Ashes *et al.* 1995; Sampath *et al.* 1997; Chatterjee & Walli, 2003).

Similar trend of results was found by other workers on feeding formaldehyde treated bypass protein meal in dairy cows (Hamilton *et al.* 1992; Christensen, 1993; Atwal *et al.* 1995; Santos *et al.* 1998 and Mustafa *et al.* 2000; Garg *et al.* 2002 a,b). Economics of milk production on feeding protected rapeseed meal was also calculated. It was observed that on feeding 1.0 kg protected rapeseed meal, compared to unprotected, net daily gain was Rs. 9.44 per animal per day.

Economics Analysis of Feeding 1.0 kg Bypass Protein Supplement

Average value of 8.45 kg milk in control group with 4.4 % fat (@ Rs. 8.00 per kg = 67.60

Average value of 9.55 kg milk in experimental group with 4.6% fat (@ Rs. 8.14 per kg) = 77.74

Increase in gross income per animal per day = Rs. 10.14

Additional feeding cost = Rs. 0.70

Increase in net daily income = Rs. 9.44

Table 2: Daily Average Milk Parameters on Feeding 1.0kg Untreated or Treated Protein Supplement

Particular	Control (1.0 kg untreated rapeseed meal)			Experimental (1.0 kg Treated Rapeseed Meal)			Level of Significance
	Range	Mean	SE	Range	Mean	SE	
Milk Yield (kg)	8.00-9.10	8.45	0.162	8.00-10.50	9.55	0.214	*
Fat (%)	4.31-4.48	4.40	0.061	4.31-4.70	4.60	0.070	*
FCM (%)	8.37-9.75	8.95	0.091	8.37-11.60	10.41	0.087	*
Protein (%)	3.25-3.35	3.30	0.008	3.25-3.55	3.50	0.010	ns

* $p<0.05$, ns=Not significant ($p>0.05$)

The above study suggests that it was most economical to supplement 1.0 kg treated rapeseed meal in the ration of dairy cows yielding 8.0-10.0 kg of milk, compared to feeding untreated meal.

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