Effect of Feeding Rumen Protected Nutrients on Milk Production in Cows and Buffaloes

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Feeding trials using bypass fat / protein supplement were conducted on 18 lactating crossbred cows (HF X Jersey) and 10 buffaloes. Cows yielding 12-14 kg milk per animal per day were divided into three groups of six each, based on milk yield, fat% and stage of lactation. In addition to basal ration, animals in three groups were fed 250, 500 or 1000 g bypass fat/protein supplement. Milk yield (kg), fat and protein per cent were recorded for a period of four weeks. On feeding 250, 500 or 1000 g bypass fat/ protein in cows, the average increase in milk yield (kg) in three groups were 0.4, 0.8 and 1.1 respectively, compared to base level milk yield recorded at the time of starting experimental feeding. The average increase in fat % in three groups was 0.3, 0.5 and 0.6 respectively. Average protein% increased by 0.2, 0.2 and 0.3 in three groups respectively. On feeding 500 and 1000 g by pass supplement, increase in milk yield was significantly ($p<0.05$) higher. Increase in fat per cent was significantly ($p<0.05$; $p<0.01$) higher at all the three levels of feeding. However, no significant effect was observed on level of protein per cent in milk at all the three levels of feeding bypass fat supplement. The highest net daily income of Rs. 10.18 per cow was obtained on feeding 1000 g bypass fat/protein. In another trial ten buffaloes were divided into two groups of 5 each, based on milk yield and stage of lactation. Animal in both groups were fed similar basal ration. However, in experimental group, buffaloes were fed 500, 1000 or 1500g bypass fat/protein supplement, each for a period of four weeks. Increase in milk yield and protein per cent was significantly ($p<0.05$; $p<0.01$) higher on feeding 1.0 and 1.5 kg bypass fat/ protein supplement. However, increase in fat per cent was significantly ($p<0.05$; $p<0.01$) higher at all the three levels of feeding. Net daily income per animal per day was the highest at Rs.26.89, on feeding 1000g supplement.

Keywords: Rumen, protected nutrients, bypass fat/protein, cattle, buffaloes

INTRODUCTION

In developing countries, energy density of rations is low and high yielding dairy animals lose body weight heavily in the first quarter of lactation. This not only affects the lactational yield, but also the reproductive efficiency in animals (Wilkins *et al.* 1996; Staples *et al.* 1998). Incorporation of fat or grains as a source of energy in the diet of ruminants at high levels adversely affects rumen fermentation (Palmquist, 1984; Mustafa *et al.* 2000); thereby, affecting fibre digestibility. It is reported that protecting fat components from digestion in the rumen, but allowing them to be digested in the lower part of the gastro-intestinal tract i.e. by optimally protecting them, can enhance a better balance of nutrients to be absorbed and utilized, resulting in a substantial improvement in productivity (Ashes *et al.* 1995). In the production of bypass fat, the fats are encapsulated in a matrix of aldehyde treated protein, this protected fat/protein bypasses the rumen and provide the essential fatty acids and amino acids to be available for absorption at the small intestine (Palmquist, 1984; Ashes *et al.* 1992, 1995, 1997; Scott and Ashes, 1993; Gulati *et al.* 1995,1996,1997; Garg and Mehta, 1998). The present investigation was planned to study the effect of different levels of bypass fat/protein on milk yield, (kg), fat and protein % in lactating cows and buffaloes.

MATERIALS AND METHODS

Trials using bypass fat/protein supplement was conducted on 18 lactating crossbred cows (HF x Jersey) yielding 12-14 kg milk per animal per day, divided into three groups of six each. All animals were fed similar basal ration, comprising 20 kg green maize fodder, 5 kg paddy straw and 15 kg oat silage. Concentrate mixture was given according to level of milk production (NRC, 1989): The chemical composition of feeds and fodder

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was carried out as per AOAC (1984). Feeds and fodder were also tested for NDF, NDIN, ADF, ADIN, cellulose, hemi-cellulose and acid detergent lignin as per Goering and Van Soest (1970). In addition to the basal ration, animals in the experimental group were fed 250, 500 or 1000 g bypass fat/protein (Fat 32-33%, CP 25-26%, NDIN 0.46%, ADIN 0.21%). Each treatment was given for a period of two weeks. Basal milk yield was taken to compare the effect of feeding supplement at various levels. The degree of fat protection was 80 per cent and protein protection was 74 per cent in the bypass fat/protein supplement.

Another trial was conducted on 10 lactating buffaloes, yielding 10-12 kg milk per animal per day. Animals were divided into two groups of 5 each, based on milk yield, fat % and stage of lactation. Each animal in both the groups was fed similar standard ration, comprising 10 kg green jowar fodder, 7 kg jowar straw and concentrate mixture according to level of milk production (Kearl, 1982). However, animals in experimental group were fed 500, 1000 or 1500 g bypass fat/protein supplement, each for a period of four weeks.

The milk samples from both the trials were analyzed for fat (IS:1224, 1977) and protein (IS: 1479 , 1961). Fatty acid composition of bypass fat / protein supplement was determined by Gas - Chromatograph (Perkin Elmer auto system XL; Ashes *et al.* 1992). Protected and unprotected fat/ protein was also analyzed for essential amino acids available for absorption, by ion-exchange chromatography (Connell *et al.* 1987). The degree of fat and protein protection was estimated by *in vitro* procedures using rumen liquor of animals fed standard ration (Gulati *et al.* 1997, 2000). The data were analyzed statistically (Snedecor and Cochran, 1968).

RESULTS AND DISCUSSION

Chemical composition of feeds and fodder is shown in Table 1. Analysis of feeds and fodder reveals 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 the animals during trial period.

Level of essential fatty acids/amino acids available for absorption in protected and unprotected fat/protein is given in Table 2. On feeding protected fat/protein, availability of oleic acid ($C_{18:1}$ cis), linoleic acid ($C_{18:2}$) and linolenic acid ($C_{18:3}$) for absorption was higher, as shown in Table 2 (Gulati *et al.* 2000). Similarly, level of essential amino acids available for absorption was higher in protected supplement.

Daily milk yield, fat and protein per cent in control and experimental groups are shown in Table 3. On feeding 250, 500 or 1000 g bypass fat/protein to dairy cows, average increase in milk yield (kg) was 0.4, 0.8 and 1.1 respectively, which was significantly ($p<0.05$) higher on feeding 500 and 1000g supplement. The average increase in fat % was 0.3, 0.5 and 0.7 respectively. The average protein % increased by 0.2, 0.2 and 0.3, respectively (Fig. 1). Increase in fat per cent was significantly higher ($p<0.05$;

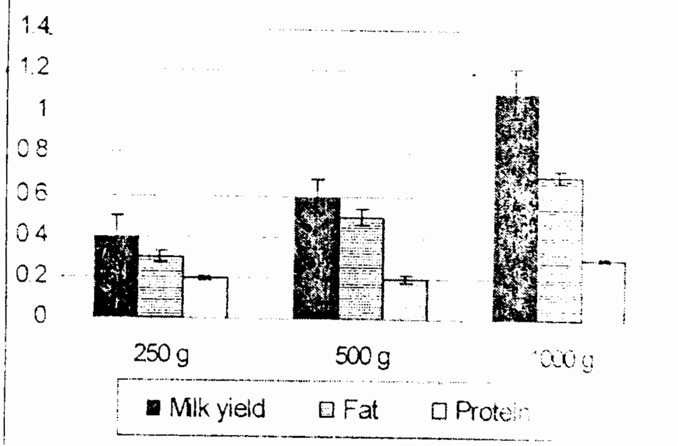
Table 1:Chemical Composition (% on DM basis) of Feeds and Fodder Fed During Trials

Particulars	Maize green	Jowar green	Jowar straw	Paddy straw	Oat silage	Cattle feed
Crude protein (CP)	4.01±0.03	5.15±0.03	5.12±0.01	3.82±0.01	6.54±0.01	22.60±0.13
Ether extract (EE)	0.43±0.00	1.53±0.00	1.40±0.01	1.60±0.00	2.57±0.01	3.09±0.01
Acid detergent fibre (ADF)	40.38±0.11	39.62±0.20	41.68±0.12	50.41±0.12	38.70±0.13	12.27±0.12
Acid Detergent						
Insoluble Nitrogen (ADIN)	0.11±0.00	0.12±0.00	0.10±0.00	0.16±0.00	0.08±0.00	0.10±0.00
Neutral Detergent Fibre (NDF)	61.10±0.15	65.62±0.16	61.78±0.16	67.7±0.11	61.54±0.14	20.25±0.16
Neutral Detergent						
Insoluble nitrogen (NDIN)	0.28±0.00	0.30±0.00	0.24±0.00	0.24±0.00	0.27±0.00	0.21±0.00
Acid Detergent Lignin (ADL)	4.35±0.02	3.67±0.01	4.12±0.01	2.74±0.01	3.81±0.02	1.44±0.01
Cellulose (C)	32.70±0.10	33.63±0.03	32.70±0.12	40.16±0.05	33.42±0.14	9.06±0.10
Hemi-cellulose (HC)	20.72±0.06	26.00±0.14	20.10±0.10	17.29±0.05	22.84±0.16	7.98±0.12
Total Ash (TA)	7.85±0.02	7.79±0.01	5.81±0.03	14.56±0.09	8.87±0.05	10.34±0.08
Silica (S)	3.33±0.01	2.32±0.00	4.86±0.01	7.51±0.01	1.47±0.00	1.77±0.00

Table 2:Level of Essential Fatty Acids and Amino Acids Available for Absorption in Bypass Fat/Protein Feed

Particulars	Unprotected (g/kg)	Protected (g/kg)
Oleic acid ($C_{18:1}$ cis)	8.40	133.20
Linoleic acid ($C_{18:2}$)	4.20	66.30
Linolenic acid ($C_{18:3}$)	1.40	21.90
Cysteine	0.27	1.09
Methionine	0.25	0.98
Isoleucine	0.71	2.85
Leucine	1.21	4.86
Phenylalanine	0.74	2.96
Lysine	0.78	3.12
Histidine	0.46	1.85
Arginine	1.12	4.47

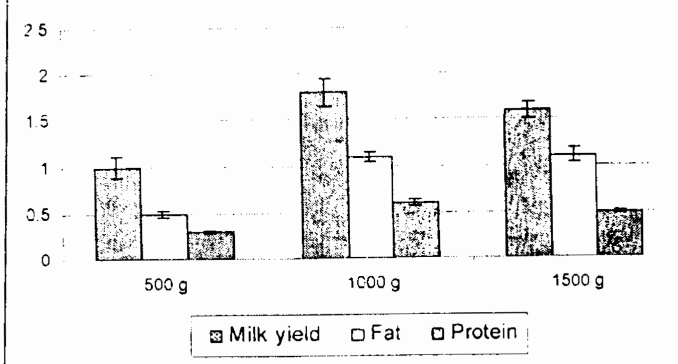
Figure 1: Average Increase in Milk Yield, Fat and Protein Per cent on Feeding Bypass Fat in Lactating Cows



p<0.01) on feeding 500 and 1000g of supplement. Economics of milk production on feeding three levels of protected fat/protein was also calculated. It was observed that the net daily income was Rs.10.18 per cow per day on feeding 1000 g bypass fat/protein, which was the highest, compared to other two group, where net daily income was Rs.5.70 on feeding 250 g and Rs. 8.17 on feeding 500 g bypass fat/ protein. Significant effect of supplementing bypass fat on milk production and daily fat yield in Holstein Friesian cows has been reported earlier (Wost and Hill, 1990; Knapp and Grummer, 1991; Ashes *et al.* 1995; Gulati *et al.* 1997; Garg and Mehta, 1998).

On feeding 500, 1000 or 1500 g of bypass fat/ protein to buffaloes, daily increase in milk yield (kg) per animal was 1.0, 1.8 and 1.6, respectively, which was significantly higher (p<0.05) on feeding 1000 and 1500g supplement (Table 3). The average increase in fat % was 0.5, 1.1 and 1.1 respectively, which was significantly (p<0.05; p<0.01) higher at all the levels of feeding. Average protein % increased by 0.3, 0.6 and 0.5, respectively (Fig. 2), which was significantly (p<0.05) higher on feeding 1000 and 1500 g supplement. Increase in milk yield, fat and

Figure 2: Average Increase in Milk Yield, Fat and Protein Per Cent on Feeding Bypass Fat in Lactating Buffaloes



protein per cent was not significantly different on feeding 1000 or 1500g supplement. Feeding 1000 g bypass fat/protein in the ration of milch buffaloes was most economical, as net daily income in this group was Rs.26.89 per animal per day, compared to other groups, where net daily income 0was Rs.13.20 on feeding 500 g and Rs.14.85 on feeding 1500 g bypass fat/protein supplement. Several other workers have reported similar results on feeding of protected nutrients to lactating cows. (McKinnon *et al.* 1991; Hoffman *et al.* 1991; Tomlinson *et al.* 1994; Maiga and Schingoethe (1997). From this study, it was observed that it was most economical to supplement 1000g protected fat/ protein in the ration of lactating cows and buffaloes yielding daily 12-14 litres and 10-12 litres milk, respectively.

Table 3:Effect of Treatment on Milk Production and Milk Composition in Dairy Animals

COW	Control		250 g		500 g		1000 g					
	Range	Mean±SE	Range	Mean±SE	Range	Mean±SE	Range	Mean±SE				
Milk yield (kg)	13.4-13.7	13.5±0.12	13.6-14.1	13.9±0.24	14.0-14.5	14.3*±0.28	14.3-14.8	14.6*±0.32				
Fat (%)	3.8-4.1	3.9±0.10	4.0-4.4	4.2*±0.08	4.2-4.5	4.4*±0.06	4.5-4.8	4.5**±0.08				
Protein (%)	3.3-3.5	3.4±0.00	3.5-3.8	3.6±0.00	3.5-3.7	3.6±0.00	3.6-3.8	3.7±0.01				
BUFFALO	500 g				1000 g				1500 g			
	Control		Experimental		Control		Experimental		Control		Experimental	
	Range	Mean±SE	Range	Mean±SE	Range	Mean±SE	Range	Mean±SE	Range	Mean±SE	Range	Mean±SE
Milk yield (kg)	10.2-10.9	10.6±0.14	10.8-11.9	11.6±0.16	10.1-11.6	10.5±0.10	11.4-12.6	12.3*±0.18	8.9-9.9	9.4±0.20	10.5-11.6	11.0*±0.18
Fat (%)	6.3-6.6	6.5±0.02	6.8-7.2	7.0*±0.01	6.5-6.8	6.7±0.01	7.5-7.9	7.8**±0.02	5.8-6.0	5.9±0.02	6.9-7.1	7.0*±0.02
Protein (%)	3.7-3.9	3.8±0.00	3.9-4.2	4.1±0.00	3.6-3.8	3.7±0.00	4.2-4.4	4.3*±0.00	3.5-3.8	3.7±0.00	4.0-4.4	4.2*±0.01

* (P<0.05) ** (P<0.01)

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