Economic Evaluation of Feeding Bypass Protein Feed on Milch Animals in Vadodara District of Gujarat

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A study was carried out to assess the economic benefit of feeding bypass protein feed (UDP 72.75 % of CP, NDIN 1.98 %, ADIN 1.08 %) produced at cattle feed plant, Itola, Vadodara district of Gujarat State. A survey was carried out among 360 sample households having 122-bypass protein feed users and 238 non-users – spread over 6 villages in three regions, (based on bypass protein feed adoption levels), – two villages from non-adoption category (NAV), two villages from low adoption category (LAV) and two villages from high adoption category (HAV). Animals in all the three groups were fed dry and green fodder, concentrate and compound cattle feed. Farmers in user groups were advised to replace the concentrate and cattle feed with bypass protein feed. On feeding bypass protein feed, average increase in milk yield was 24.0 ($p<0.05$), 5.0 and 12.0 ($p<0.05$) percent for local cows, crossbred cows and buffaloes, respectively. For local cows the average daily increase in expenditure was Rs. 4.60 and the average increase in income was Rs. 13.80 leaving a net income of Rs. 9.20 per cow per day. The crossbred cow holdings reported an average increase in expenditure was Rs. 6.42 and average increase in income was Rs. 14.00 leaving a margin of Rs. 7.58 per cow per day. For buffaloes, the reported average increase in income was Rs. 18.38 against the increase in expenditure Rs. 5.97 indicating a net return of Rs. 12.41 per buffalo per day. The survey also included socio-economic characteristics like sample households, cattle population, land holding, feeding practices, milk production and utilization. In the present study, supplementation of formaldehyde treated bypass protein feed was found to be economical for milch animals producing on an average 5 to 8 litres of milk per animal per day in Vadodara district of Gujarat.

Keywords: Bypass protein feed, economic evaluation, sample households, adoption category

INTRODUCTION

India emerged as world leader in milk production in 2001 achieving 84 million tones. The country has achieved the distinction of producing largest amount of milk per annum, which crossed the 91 million tones in 2003-04. However, when we see yield per animal, it is one of the lowest in the world. The lower genetic potential of our bovine stock, which is largest in the world i.e. 205 million cattle and 85 million buffaloes (2004), is coupled with lack of sufficient amount of good quality nutrients available to animals. As a result, genetical potential of milch animals is not fully exploited.

Dairy enterprise plays a very important role in the rural economy in India. It provides income and employment not only to the weaker section of the society but also to the farming community of the country in general. The returns from small holdings can be maximized by feeding bypass protein feed supplement, in place of conventional cattle feeds and concentrates. In developing countries, inclusion of bypass protein supplement has the potential to increase milk production (Chaturvedi and Walli, 2001), provided they have consistent natural protection and are cheaper to produce (Garg, 1998). There are many ways to minimize excess rumen ammonia in ruminant diets and improve N utilization. In view of the high energy cost in developing countries and potential to increase 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 protein meals provides the most economically viable approach to optimize the rumen degradable protein (RDP)/ rumen undegradable protein (UDP) without changing the NDIN/ADIN levels. Therefore, it may be

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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 milch animals. (Garg *et al.* 2002a, b; Gulati *et al.* 2002; Hamilton *et al.* 1992; Walli *et al.* 2004). Encouraged with the feeding trials, a semi-commercial bypass protein plant was set up in Vadodara district of Gujarat and the present study was undertaken to assess the economic benefits of feeding bypass protein feed in the ration of milch animals.

MATERIALS AND METHODS

Sampling Design

The survey was carried out during January 2004, after feeding bypass protein feed for minimum 12 months, among 360 sample households having 122-bypass protein feed users and 238 non-users – spread over 6 villages in three regions, based on bypass protein feed adoption levels. Two villages (Natavar nagar and Vemar) from non-adoption category (NAV), two villages (Dabhasa and Manpur) from low adoption category (LAV) and two villages (Ranajit nagar and Choranda) from high adoption category (HAV). Within the village, help was sought from village milk producers and Vadodara district cooperative milk producers' Union.

Geography

Total area of the district is 108.22 sq. km., distributed into 12 talukas. The district is having annual rainfall of 931.9 mm, having latitude of 17° 59' and longitude of 15° 18'. Atmospheric temperature ranges from 11 to 45°C during different seasons.

Data Collection

The data was collected on the socio-economic characteristics included, number of sample households, cattle population, land holding, feeding practices, milk production, utilization and economic aspects. Primary data were collected from sample households by personal interview of the head of family, with the help of village DCS and the district milk co-operative union. Data on number of animals, total quantity of feeds and fodder offered to each animal, cost of feeding, average milk production per animal were recorded. In calculating costs and returns per animal per day, the lactating animals were considered consisting of local cow, crossbred cows and buffaloes.

Tabular analysis was carried out to work out cost and returns from milk. The cost component included expenditure on green and dry fodders, concentrates, ordinary compound cattle feed and bypass protein feed. Bypass protein feed (UDP 72.75 % of CP, NDIN 1.98 %, ADIN 1.08 %) was produced at cattle feed plant, Itola, Vadodara. Chemical composition of feeds offered to animals is shown in Table 1. Chemical analysis of feeds was carried out as per AOAC (1984). Feeds were also tested for NDF, NDIN, ADF, ADIN, cellulose, hemi-cellulose and acid detergent lignin as per Goering and Van Soest (1970).

Production of 'Bypass Protein Feed'

Rapeseed and sunflower protein meals were 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 attributrd 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 period (Gulati *et al.* 1999). Treated meals were incorporated, rapeseed meal @ 15 % and sunflower meal @ 10 %, for production of bypass protein feed. The extent of crude protein rumen degradation was 27.25 per cent of CP in bypass protein feed. Bypass protein feed thus produced, was supplied to the villages under study in the Vadodara district.

RESULTS AND DISCUSSION

Socio-Economic Characteristics

The religious background revealed that majority of the households were Hindus (97 %) and the rest were Muslims (Table 2). The majority of the households' head belonged to the age group of 41–55 years. Only 2.5 and 5.0 % family head had taken degree education among users and

Table 1: Chemical Composition (% on DM basis)

Particulars	Cattle feed	Bypass protein feed
Crude Protein (CP)	20.91 ± 0.08	25.65 ± 0.10
Acid Detergent Fibre (ADF)	12.27 ± 0.12	12.58 ± 0.10
Acid Detergent Insoluble Nitrogen (ADIN)	1.00 ± 0.00	1.08 ± 0.00
Neutral Detergent Fibre (NDF)	20.25 ± 0.16	21.62 ± 0.12
Neutral Detergent Insoluble Nitrogen (NDIN)	2.10 ± 0.00	1.98 ± 0.00
Acid Detergent Lignin (ADL)	1.44 ± 0.01	1.72 ± 0.01
Cellulose (C)	9.06 ± 0.10	9.22 ± 0.11
Hemi-cellulose (HC)	7.98 ± 0.12	8.04 ± 0.11
Total ash (TA)	12.98 ± 0.22	11.56 ± 0.20
Rumen Degradable Protein (RDP)	—	6.99 ± 0.11
Rumen Undegradable Protein (UDP)	—	18.66 ± 0.10

Table 2: Household Characteristics

Particulars	User	Non-user
Religion		
Hindu	116	232
Muslim	6	6
Age of family head (years)		
Below 25	4	10
26 - 40	26	77
41 - 55	67	103
56 - 70	22	42
Above 70	3	6
Education of family head		
No schooling	12	24
Below 5 standard	16	53
Below 8 standard	37	43
High school	52	96
Primary Teachers Course (PTC)	2	5
Degree course	3	12
Post Graduate (PG)	0	2
Technical	0	3
Main occupation of family head		
Agriculture	91	186
Animal Husbandary	7	5
Technical/Professional	5	5
Government Service	2	4
Non-Agriculture Labour	9	19
Agriculture Labour	8	19

non-users, respectively. About the main occupation of the family head, majority of them were involved in agricultural activity (75-78 %), while only 2 % had got government services in both the groups. Among the users, about 66 % of the households had annual income more than Rs. 20,000 while among the non-users, about 42 % belonged to this category.

Land Holding

The average size of land holdings among the users was 4.49 hectares against 2.89 hectares for the non-users. The size of land holdings in the non-adoption villages was only 2.25 hectares. The LAV and HAV households had higher size of land holdings, but the average size between LAV and HAV indicated contrasting pattern between the users and non-users. About 60 % of the households had land holdings of less than 2.5 hectares (Table 3).

Cattle Population

The 122 user households had 14 local cows in milk, 12 dry local cows, 27 crossbred cows in milk, 6 dry crossbreds, 200 buffaloes in milk and 48 dry buffaloes. The 238 non-users had 30 local cows in milk, 21 dry local cows, 81 crossbred cows in milk, 36 dry crossbred cows, 293 buffaloes in milk and 130 dry buffaloes. There has been a clear distinction between users and non-users in terms of the average number and proportion of animals in milk and the difference was more predominant for buffaloes. In addition to this, the sample households had about 15 % bullocks for agriculture purposes (Fig. 1).

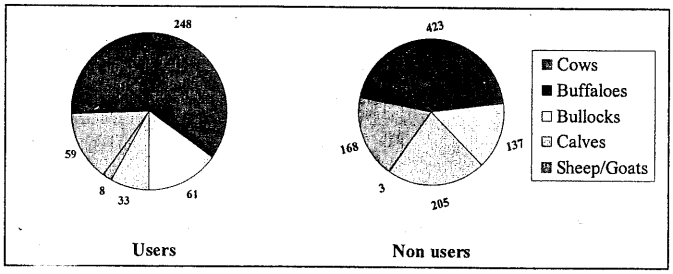
Feeding Practices

The survey work revealed that amongst dry roughages, straws of paddy, wheat and jowar were commonly fed by the farmers of Vadodara district in the ration of cows and buffaloes. On an average quantity of dry fodder offered to animals was 5-6 kg per animal per day. Cultivated green fodders,

Table 3: Size of Land Holdings and Cattle Population

Particulars	Total operated area									
	Below 1.0 ha		1.0 - 2.5 ha		2.5-5.0 ha		5-10.0 ha		Above 10.0 ha	
	User	Non user	User	Non user	User	Non user	User	Non user	User	Non user
No. of household	46	86	25	60	16	45	14	33	21	14
No. of local cows in Milk	2	5	3	7		14	2	3	7	1
Dry	1	2	5	9		5	5	2	1	3
No. of crossbred cows in Milk		3	3	28	8	23	6	23	10	4
Dry			2	14	1	10		12	3	
No. of buffaloes in Milk	86	102	49	75	24	62	15	32	26	22
Dry	14	48	18	31	2	19	6	22	8	10
No. of bullocks	3	16	11	21		32	13	39	34	29
No. of calves	5	58	3	60	3	44	5	31	17	12
No. of sheep/goat	8			3						

Figure 1: Livestock Population for Users and Non Users



mainly jowar green, lucerne and locally available grasses were fed about 10-12 kg per animal per day. Most of the farmers fed compound cattle feed produced by the Vadodara Milk Union, for body maintenance and milk production. Along with this, some offered concentrates in the form of grains and cakes, depending upon the level of milk production. With the introduction of bypass protein feed, farmers in user group were being advised to replace conventional cattle feeds and concentrates with the bypass protein feed. Bypass protein feed used by the farmers was tested in NDDB's laboratory at Anand. The nitrogen fraction associated with fibre i.e. NDIN and ADIN is a measure of the quality of the protein in treated protein meals (Nakamura *et al.* 1994). The protection (UDP) of bypass protein feed was 72.75 % of crude protein. The analysis revealed that there was no significant difference between bypass protein feed and ordinary cattle feed in NDF, NDIN, ADF and ADIN contents (Table 1), indicating that the bypass protein fraction of crude protein bound to cell wall was negligible.

Milk Production and Utilization

No significant difference was observed with regard to economics of milk production, increase in milk production, increase in net daily income etc., amongst three different categories of bypass protein feed adopters. In view of this, data from all the three categories was pooled, to study the economic response of feeding bypass protein feed in crossbred cows, local cows and buffaloes. Majorities of animals were yielding 5-8 litres of milk per day. Out of which, approx. 1.0 litre was retained for domestic use and the remaining

Table 4: Economic Analysis of Milk Production

Particulars	Local cow		Crossbred cow		Buffalo	
	User	Non user	User	Non user	User	Non user
Feeding cost (Rs./animal/day)	43.71	39.11	51.44	45.02	47.34	41.37
Ave. daily milk production (Lit./animal)	5.68	4.58	8.19	7.78	5.09	4.49
Ave. daily income from milk (Rs.)	58.00	44.20	73.13	59.13	65.08	46.70
Ave. daily increase in income (Rs.)	13.8	—	14.0	—	18.38	—
Ave. daily increase in expenditure (Rs.)	4.60	—	6.42	—	5.97	—
Ave. daily increase in net income (Rs.)	9.20	—	7.58	—	12.41	—

quantities were sold to the village dairy co-operative society. The average milk yield from local cows was 4.58 litres for non-users and 5.68 ($p<0.05$) litres for users. Crossbred cows had daily milk yield of 7.78 litres for non-users and 8.19 litres for users. From buffaloes non-users obtained 4.49 litres and the users had obtained 5.09 ($p<0.05$) litres. Retention of milk from local cows for home use accounted for about 20 % for users and 16 % for non-users. The retention for home use from crossbred cow milk was 15 % for users and 9 % for non-users. About one-fifth of the buffalo milk was retained for home consumption. Except for very small quantities, the entire milk sale occurred through the co-operative societies. The significant improvement in milk production performance on feeding bypass protein feed in all categories 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 (Antoniewicz et al., 1992; Chalupa and Sniffen, 1996; Garg et al., 2003a, b, 2004, 2005). 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. Significant effect of feeding protected protein on growth and milk production have been demonstrated by other workers as well (Kim *et al.* 1992; Tomlinson *et al.* 1994; Walli, 2002, 2005; Chatterjee and Walli, 2003b) and Yao Ming *et al.* 1996)

Economic Analysis

On feeding bypass protein feed average increase in milk production was 24.0 ($p<0.05$), 5.0 and 12.0 ($p<0.05$) per cent in local cows, crossbred cows and buffaloes, respectively. For local cows the average daily increase in expenditure was Rs. 4.60 and the average increase in income was Rs. 13.8 leaving a net income of Rs. 9.20 per cow per day. The crossbred cow holdings reported an average increase in expenditure was Rs. 6.42 and an average increase in income was Rs. 14.00 leaving a margin of Rs. 7.58 per cow per day. For buffaloes the reported increase in income was Rs. 18.38 against the increase in expenditure was Rs. 5.97 indicating a net return of Rs. 12.41 per buffalo per day (Table 4).

Socio-Economic Benefits

Any technological innovation, which could help increasing dairy milk production by more than 1.0 litre and increases net daily income by Rs. 9.0 – 10.0. per day, is a welcome relief for the farmers. This income could be utilized for meeting day-to-day needs, including education of young children. That is what was anticipated to be achieved through bypass protein feed technology. Village farmers aware of the bypass protein feed and the dairy co-operative societies were the most important source of information. Most of the users had indicated that they had realized the expected level of additional income from switching over to bypass protein feed. A small proportion of farmers discontinued the use of bypass protein feed indicated that the reason for discontinuation was low economic returns. Some farmers were happy with the use of conventional cattle feed and this was the major factor influencing them from not switching over to bypass protein feed. When asked, such farmers had no solid reason of not using bypass protein feed and such farmers need to be convinced through regular follow up and extension efforts.

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