Original Research

Influence of Slow Release Non-Protein Nitrogen Compound on Utilization of Poor Quality Roughages and Lactation Performance in Lactating Cows

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Abstract

Twelve early lactating crossbred cows were divided into two equal groups viz., Groups T0 (Control) and T1 (Treatment). The groupT0 received farm made concentrate mixture whereas groups T1 received concentrate mixture containing 1% slow release non-protein nitrogen compound (SRNPN). Concentrate mixtures in both the experimental groups were made iso-nitrogenous. The experimental groups received paragrass and paddy straw as a source of roughage and experiment lasted for 180 days. The average dry matter, TDN and DCP intake, milk yield and 4% FCM yield of cows from group T1 was significantly (P≤0.01) higher than that of the group T0. The average DM, TDN and DCP required per kg FCM was comparable between both the experimental groups. The average specific gravity, solid not fat, total solids and total ash percentage of milk revealed non-significant effect of feed treatments, however, the average milk fat and protein percentage of cows from groups T1 was significantly (P≤0.01) higher than the control group. The digestibility coefficients for all the nutrients were significantly higher for SR-NPN supplemented feeds. The economics of the milk production revealed that the profit realized per day over feed cost per cow from in groups T0 and T1 was Rs. 91.51 and 105.61, respectively. Thus, it can be inferred that efficient utilization of poor quality roughages, better productivity and profit margin in lactating cows can be achieved by inclusion of SR-NPN at 1 percent level in the concentrate mixture of lactating cows.

Key words: Composition, Lactating Cows, Milk Yield, Slow Release Non Protein Nitrogen Compound, Straw Utilization

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Introduction

Based on potential nutritive value of crop residues as well as agro-industrial by-products and their importance, they form an essential component of the ruminants ration. However, among roughages some roughages are refereed as low quality roughages because of their physical and chemical complications which limit their efficient utilization. The physical complications are because of high lignin and silica which are very intimately connected in microfibriller network with other cell wall carbohydrates, viz. cellulose and hemicellulose. These complications are further aggravated due to limitations in their chemical composition like low protein, minerals and fermentable energy (Devendra, 1988). These lacunae in the straws, there by impair the microbial digestion in the rumen and as well as hamper the voluntary intake of the animals on such poor quality roughages.

Despite recent research, no methods for improved utilization of straw are practically applied by farmers in the country, probably because none has proved to be relevant and sustainable under the local physical and socio-economic conditions (Stiles *et al.*, 1970). Supplementation of slow release urea could improve utilization of poor quality roughages by improving fibre digestion. The fibre digesting microbes need nitrogen for their growth and multiplication. By making nitrogen available continuously in rumen, slow release NPN helps in better growth and multiplication of fibre digesting microorganisms. This ensures better fibre digestion from roughages and release of extra energy from roughages. Slow release urea product could improve utilization of poor quality roughages like paddy straw and could even replace the conventional roughages like hay and costlier protein supplements (Kononoff *et al.*, 2006). Therefore, the study was undertaken to investigate the effect of supplementation of slow release NPN (SR-NPN) compound to paddy straw based feeding on the performance of early lactating crossbred cows.

Materials and Methods

The trial involved twelve early lactating cows of Gir breed and its crosses with Holstein Friesian and Jersey. The cows were divided into two equal groups viz. Groups T_0 and T_1, having six cows in each group allotted randomly on the basis of their parity, lactation number and milk yield. The groups T_0 received farm made concentrate mixture whereas group T_1 received concentrate mixture containing 1% SRNPN. The concentrate mixtures of both the groups were made iso-nitrogenous. The cows from both experimental groups received paddy straw and para grass as a source of dry and green roughage, respectively. The experiment lasted for 180 days.

Slow Release NPN

Slow release NPN used in this experiment was procured from Alltech Biotechnology Pvt. Ltd., Bangalore, India. It was a blended non protein nitrogen source which provided controlled release nitrogen in the rumen.

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It also acts as nutrient dense nitrogen source. It is a coated product but blended one with specific structure which ensures slow release of nitrogen in rumen and maintains optimum level of ammonia in the rumen for 24 hrs. Slow release ammonia was insured by embedding small urea particles in a lipid matrix. This is achieved through a carefully designed, multi staged, patented process. The main steps involved were-

Composition of Slow Release NPN

Crude Protein (N X 6.25)	: 240%
Ether Extract	: 14%

Conventional practice of feeding concentrate mixture and roughages separately was followed throughout the experiment. The farm procured the feed ingredients from local market in bulk quantities. The concentrate mixture (Table 1) was prepared fresh every day by hand mixing on the farm and kept for soaking in water for 4 to 5 hours and was fed in two installments. Normal standards of hygiene, management, feeding practices, vaccination and deworming programs were followed for all the experimental cows throughout the experimental period. All the cows were weighed before the start of the experiment and thereafter at monthly interval throughout the experimental period. At the end of experiment digestibility trial of seven days duration was conducted by total collection method.

The representative samples of concentrate mixture, paddy straw and green fodder used for feeding animals were collected, oven dried and pooled feed and fecal samples collected during digestibility trial were analyzed. The analysis of feed samples for proximate principles and phosphorus was undertaken as per A.O.A.C. (1990) and calcium estimation as per Talapatra *et al.* (1940). NDF and ADF was estimated as per Van Soest *et al.* (1991) in the Laboratory of Department of Animal Nutrition, Bombay Veterinary College, Parel, Mumbai – 400012. The composition of milk in relation to Fat, Protein, Total solids and Specific gravity was estimated at fortnightly interval by using Milkoscan Complete Milk Analyzer. Total ash was estimated by gravimetric method and SNF was calculated by difference. The fat corrected (4%) milk yield was calculated by using Gain's formula as per Manual in Dairy Chemistry (1972). Data of all the parameter was statistically analysed as per Snedecor and Cochran (1998) by using paired t test.

Results and Discussion

The ingredient composition of concentrate mixtures with and without slow release NPN is presented in Table 1. The percent chemical composition (% DMB) of concentrate mixture, paddy straw and para grass is presented in Table 2. The overall performance of the cows from various experimental groups is given in Table 3. The average dry matter intake of cows from group T_1 was significantly ($P \leq 0.01$) higher than control group. The average dry matter intake per unit metabolic body size of cows from both the experimental groups revealed non-significant effect of feed treatments.

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Table 1: Ingredient composition of concentrate mixtures of different experimental groups

Ingredients	Concentrates	
	T_0	T_1
Maize	8	5.9
Cotton seed cake	10	3.8
Wheat bran	16.85	54
Pulse by-products	62.8	32.95
Slow release NPN	-	1
Di-calcium phosphate	1	1
Salt	1.3	1.3
Trace mineral mixture	0.05	0.05
Total	100	100

Table 2: Average chemical composition (% DMB) of concentrate mixture, paddy straw and paragrass

Nutrients	Concentrate Mixture (Control)	Concentrate Mixture with 1% Optigen	Paddy Straw	Para grass
Dry matter	92.15	92.17	90.18	18.68
Organic matter	91.55	92.76	85.75	89.95
Crude protein (Nx6.25)	16.35	16.37	3.86	10.85
Ether extract	3.42	3.68	1.43	1.62
Crude fibre	19.76	17.93	38.55	34.52
Nitrogen free extract	52.02	54.78	41.91	42.96
Neutral detergent fibre	28.87	28.64	70.26	64.4
Acid detergent fibre	13.01	7.71	41.96	30.6
Total ash	8.45	7.24	14.25	10.05
Acid insoluble ash	1.7	1.62	7.22	2.53
Calcium	1.45	1.36	0.25	0.38
Phosphorus	0.48	0.42	0.1	0.2

Thus, dry matter intake when considered in terms of absolute DM intake or DM intake per unit metabolic size revealed that palatability of diet was not affected by supplementation of SR NPN compound; instead the absolute DM intake of group T_1 supplemented with SR NPN compound was significantly higher than control. Findings of the present study corroborated with Inostroza (2010) who reported higher DM intake in animals receiving one or other form of controlled slow release NPN in their feed. The average TDN and DCP intake of cows from group II was significantly ($P \leq 0.01$) higher than the control group. The average daily milk yield and 4% FCM yield of cows from groups T_1 supplemented with SR-NPN compound was significantly ($P \leq 0.01$) higher than groups T_0. The performance of cows from group T_1 receiving SR-NPN compound supplementation might have enhanced due to increased utilization of poor quality roughage source like paddy straw. The supplementation of SR-NPN compound might have resulted in multiplication of fibre digesting microorganisms due to continuous supply of nitrogen in the rumen which in turn improved

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ruminal microbial balance and utilization of poor quality roughages like paddy straw especially through improving fibre digestibility of paddy straw.

The SR-NPN has lower rates of ruminal degradation (Taylor-Edwards *et al.*, 2009) which tends to improve the efficiency of microbial protein synthesis, probably because of the better capture of released N by rumen microbes. The results of the present experiment are in accordance with, Inostroza (2010) who reported significantly (P≤0.01) higher milk production in cows supplemented with Optigen (SR-NPN) than that of control. Stewart *et al.* (2008) also reported that inclusion of Optigen in the diet tended to increase milk production. Findings of the present study are not matching with Abdel-Raouf (2017) who reported that slow release urea supplementation for lactating Holstein cows did not showed any significant effects on feed intake and milk yield. The average DM, TDN and DCP required per kg FCM yield was comparable between both the experimental groups. Findings of the present study are matching with Abdel-Raouf (2017) who reported no effect of supplementation of slow release urea on feed conversion ratio of lactating Holstein cows. Contrary to the findings of present study Akay *et al.* (2004) observed improvement of 4.2% in efficiency of milk production for the Optigen 1200 supplemented cows. Varga and Ishler (2008) also reported greater milk nitrogen efficiency in the Optigen supplemented diet.

Table 3: Overall performance of cows from different experimental groups

Parameters	Treatments		Significance
	T_0	T_1	
DMI (kg/day)	10.32±0.10	11.00±0.11	**
DMI (g)/$W^{0.75}$ kg	126.13±2.85	127.20±3.21	NS
Milk yield (g))/$W^{0.75}$ kg	5.70±0.35	6.32±0.32	**
FCM (kg/day)	5.45±0.33	6.10±0.28	**
TDN intake/ cow (kg/day)	6.30±0.06	7.03±0.07	**
DCP intake/cow (kg/day)	0.804±0.007	0.880±0.009	**
DMI (kg)/kg FCM	1.96±0.10	1.84±0.06	NS
TDN intake (kg)/ kg FCM	1.195±.061	1.172±.040	NS
DCP intake (kg)/FCM	0.153±0.008	0.147±.005	NS
Milk Specific gravity	1.032±0.0004	1.032±0.0008	NS
Milk fat (%)	3.72±0.02	3.78±0.03	**
Milk SNF (%)	9.01±0.11	8.94±0.20	NS
Milk total solids (%)	12.73±0.12	12.72±0.22	NS
Milk protein (%)	3.65±0.02	3.70±0.02	**
Milk ash (%)	0.740±0.003	0.746±0.002	NS
% TDN	61	63.87	--
% DCP	7.79	8	--
Profit/d/cow over feed cost (Rs.)	91.51	105.61	--

*NS: non-significant; ** Significant at 1% level*

The average specific gravity and solid not fat, total solids and total ash percentage of milk revealed non-significant effect of feed treatments for cows from different experimental groups. The average milk fat

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percentage of cows from group T_1 supplemented with SR-NPN compound was significantly ($P \leq 0.01$) higher than that for groups T_0. The average milk protein content of cows from group T_1 was significantly higher ($P \leq 0.01$) than that of cows from groups T_0. Findings of the present study are in agreement with Andrieu (2008) who reported higher milk fat and protein content in cows supplemented with Optigen than that of control. High street *et al.* (2006) reported increased ($P<0.01$) milk protein content due to replacement of urea with Nitroshure, a controlled rumen release urea in the TMR, of early lactation Holstein cows. However, Agovino (2007) reported no difference in protein content of milk in lactating buffaloes supplemented with or without Optigen. Findings of the present study are matching with Abdel-Raouf (2017) who observed no effect of supplementation of slow release urea on milk composition of lactating Holstein cows.

At the end of this study, digestibility trial of seven days duration was conducted by total collection method which indicated that the SR-NPN supplementation to concentrate mixture with paddy straw feeding resulted in significantly ($P<0.01$) higher digestibility of DM, OM, CP, EE, NFE, NDF and ADF (Table 4), when compared with that of SR-NPN non-supplemented feeds. Similarly the digestibility for CF was also significantly ($P<0.05$) higher for SR-NPN supplemented group. This, in turn, resulted in higher TDN and DCP contents for SR-NPN supplemented groups. Findings of the present study are contradictory to Santigo *et al.* (2015) and Abdel-Raouf (2017) who observed no difference in the digestibility of nutrients in lactating cows supplemented with slow release urea. The economics of milk production revealed that the profit realized per day over feed cost per cow from groups T_0 and T_1 was Rs. 91.51 and 105.61, respectively. Thus, more profit was recorded with group T_1 than control group.

Table 4: The percent digestibility coefficients of nutrients of different feed treatments

	Treatments		
Nutrients (%)	**T_0**	**T_1**	**Significance**
Dry matter	52.64±0.73	56.00±0.22	**
Organic matter	66.29±0.28	68.73±0.43	**
Crude protein	66.05±0.58	68.86±0.41	**
Ether extract	63.07±0.44	64.01±0.61	**
Crude fibre	58.73±0.56	61.32±0.62	*
Nitrogen free extract	69.52±0.45	72.01±0.61	**
Neutral detergent fibre	50.75±0.64	54.18±0.67	**
Acid detergent fibre	38.24±0.53	42.20±0.60	**

** Significant at 5% level, ** Significant at 1% level*

The overall results of the study indicated that inclusion of slow release NPN compound at 1% level in concentrate mixture of lactating cows had significant positive effect on milk production and its composition. It was also noticed that slow release NPN supplementation resulted in improved utilization of poor quality

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roughage like paddy straw due to better intake, improved digestibility of the nutrients, better plane of nutrition, better feed utilization and efficiency in lactating animals.

Conclusion

Thus, it can be inferred that efficient utilization of poor quality roughages, better productivity and profit margin in lactating cows can be achieved by inclusion of SR-NPN at 1% level in the concentrate mixture of lactating cows.

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