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SHORT COMMUNICATION

Partial Substitution of Soybean Meal by Slow-Release Nitrogen (Zenitro™) Decreases Feed Cost in Lactating Dairy Cows

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ABSTRACT

An on-farm trial was conducted in a commercial dairy farm to evaluate the effect of inclusion of slow-release nitrogen (SRN) on the performance of milking cows and associated monetary benefits. Twenty early lactating Holstein Friesian cows were used in the trial in such a way that first 18 days served the control (T_1) and the next 21 days were treatment (T_2) phase in which 1% SRN (Zenitro™, Kemin Industries) partially substituted soybean meal (SBM) on an isonitrogenous basis in the concentrates. All the cows were fed a total mixed ration comprising of corn silage, wheat straw and concentrate for a duration of 39 days. Results revealed that milk yield between the 2 groups did not differ (20.0±0.89 *vs.* 20.3±1.03 kg/d; P>0.05). Similarly, milk composition estimated in terms of fat and solid not fat was also not altered. Nevertheless, there was a net economic gain of ₹ 14.5/cow/d on incorporating SRN. Therefore, this study demonstrated that SRN at 1% level in the concentrate could effectively substitute a part of SBM for lactation diets, whilst also improving economic sustainability in dairy farming.

Key words: Economic gain, Feed cost, Milk performance, Protein nutrition, Slow-release nitrogen

Feed cost optimization has been recognized as one of the pressing needs of today's dairy production systems, owing to the volatility in input (feed raw materials) and output (milk) prices in the market. Particularly, protein ingredients are one of the costliest components of dairy ration. As feed alone is factored towards over 60% of recurring expense, the ingredient reformulation and optimizing nutrient supply could offer an immense opportunity to curtail feeding cost to a great extent (Sharma *et al.,* 2021). In this context, use of slow-release nitrogen (SRN) sources that act as concentrated source of nitrogen (N) appears logical to partially replace conventional protein meals (Sinclair *et al.,* 2012; Reddy *et al.,* 2019). It is well known that SRN products release ammonia (NH_3) over a long and sustained period of time (6-8 h) in the rumen and thus enhance microbial protein synthesis. Further, SRN has edge over rapidly degraded N (RDN) like urea in being able to utilize by rumen microbes more efficiently, which avoids chances of NH_3 overload in either rumen or blood stream (Gonçalves *et al.,* 2014; Mahesh *et al.,* 2017). On the other hand, RDN when included without optimum synchrony with fermentable carbohydrates in the rumen may adversely affect fertility in cows/ buffaloes on a long run due to persistent rise in blood urea nitrogen levels.

Basing on the prevailing market prices, SRN appears to deliver unit N in a most economical way (e.g., ₹ 45) than almost all customarily used oilseed cakes/meals such as soybean meal (SBM; ₹ 78) mustard/rapeseed cake (₹ 50), cottonseed cake (₹ 96), de-oiled cottonseed meal (₹ 77), guar meal *korma* (₹ 67), dried distillers grains plus soluble (₹ 55), corn gluten meal (₹ 75), wheat bran (₹ 125) and de-oiled rice bran (₹ 67).Keeping these points in view, the present experiment was planned with an objective of minimizing overall feeding cost by isonitrogenous substitution of a portion of SBM by cellulo-polymer-coated SRN in the diet of Holstein cows.

This on-farm trial was conducted in a progressive commercial dairy located in the northern part of India. A total of 26 apparently healthy early

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lactating Holstein Friesian cows were selected from the herd and used in the trial. The experiment was designed in such a way that first 18 days served the control (T_1) followed by next 21 days of treatment (T_2) phase. In T_1, cows were offered a diet based on existing feeding practices at farm, whereas in T_2, 1% SRN (Zenitro™, a cellulo-polymer-coated urea containing 40% N; Kemin Industries South Asia Pvt. Ltd., Chennai, India) partially substituted SBM on isonitrogenous basis in the concentrate (Table 1). All the cows were fed a total mixed ration (TMR) comprising of 29 kg corn silage (26% dry matter, 8.2% crude protein and 57.1% neutral detergent fibre), 8.5 kg concentrate (22.3% crude protein and 12.2 MJ of metabolizable energy) and 1 kg wheat straw to fulfill or exceed nutrient requirements (NRC, 2001). The forage and concentrate components were mixed through TMR wagon (DeLaval, India) in an approximate proportion of 55:45 prior to feeding and offered twice daily throughout the study spanning 39 days. *Ad libitum* drinking water was made available all the time. On everyday basis, the data recordings on milk yield and composition were done. The net economic gain for the group T_2 was calculated as the summation of additional revenue generated from the sale of milk and feed cost savings due to inclusion of SRN. The data were analyzed by paired t-test using Statgraphics

Table 1. Ingredient composition of experimental diets

Ingredient	T_1	T_2
Composition of diet (kg, as fed)		
Corn silage	29.0	29.0
Wheat straw	1.0	1.0
Concentrate	8.5	8.5
Composition of concentrate (%, as mixed)		
Corn	35.0	35.5
Mustard de-oiled cake	10.5	10.5
Mustard cake	7.0	7.0
Soybean meal	16	9.0
Cottonseed, whole	6.0	7.0
De-oiled rice bran	17.3	21.8
Slow-release nitrogen (Zenitro™)[a]	0	1.0
Calcite ($CaCO_3$)	1.0	1.0
Dicalcium phosphate	2.0	2.0
Salt (NaCl)	1.50	1.50
Sodium bicarbonate	0.90	0.90
Magnesium oxide	0.30	0.30
Rumen-protected methionine (MetiPEARL™)[b]	0.15	0.15
Rumen-protected lysine (LysiGEM™)[c]	0.15	0.15
Trace mineral mixture (Kemtrace®)[d]	0.30	0.30
Toxin binder (Toxfin™)[e]	0.30	0.30
Fat-soluble vitamins (A, D_3 and E)	0.05	0.05
Saccharomyces cerevisiae (YePLUS+™)[f]	0.05	0.05
Bypass fat (EnerFAT™)[g]	1.50	1.50

[a]Cellulo-polymer-coated urea with 40% N; [b]50-60% DL-Methionine; [c]68-72% L-Lysine HCl; [d]A combination of zinc, manganese, copper, cobalt, iodine, iron, chromium and magnesium; [e]Broad-spectrum mycotoxin adsorbents; [f]Active dry yeast + chromium propionate; [g]Calcium salts of vegetable fatty acids with 84% total fat

Centurion XVI software (version 16.2.04) and the statistical significance between means was established when P-value was ≤0.05.

Inclusion of SRN resulted in no change (P>0.05) in milk yield as well as milk fat and SNF content (Table 2). However, dietary incorporation of SRN led to a favourable net savings of ₹ 14.5/animal/d in group T_2. In the present experiment, a lack of effect on milk performance with SRN implies that it can satisfactorily substitute SBM in lactation rations. In line with the present findings, Gonçalves *et al.* (2014) found no changes in milk production (mean: 9.6 kg/d) and composition in crossbred cows when SRN constituted 1.84% of TMR partially substituting SBM. Similarly, Sinclair *et al.* (2011) on including SRN at 0.55% in TMR isonitrogenously replacing SBM observed no differences in milk performance of high yielding (mean milk: 33.8 kg/d) Holstein cows. In another experiment, SRN incorporated at 2% level in the isonitrogenous concentrate replacing cottonseed meal exhibited no change in lactational performance (mean milk: 14.8 kg/d) of Indian dairy buffaloes (Reddy *et al.,* 2019). Overall, on quantitative terms, a daily intake of 85 g SRN in our trial lies within the recommended non-protein nitrogen (urea) inclusion of 135 g/d and/or 20% of total N intake in dairy cattle (Kertz *et al.,* 2010).

Given the fact that feed alone accounts for the single largest input cost in dairy production, it would be interesting to design dietary strategies that decrease feed cost without compromising productivity. Moreover, it is well known that economic feasibility dictates the success or failure of any nutritional program at farm. In other words, farm economics can be improved by either decreasing input (feed) cost or increasing the quantity of saleable farm output (milk), or both. In the current experiment, on absolute basis, 1% SRN replaced 7% SBM in the concentrate with a lowered total feed cost, and as there was a modest additional difference in milk yield, an overall net savings of ₹ 14.5/animal/d was achieved. In this way, the use of SRN justifies as a cost-effective dietary strategy that appears to hold promise in the practical dairy rationing of cows under field conditions. The findings of the present study for group T_2 also broadly corroborate with that of Inostroza *et al.* (2010) demonstrating a better income over feed cost when SRN constituted a part of diet replacing SBM in Wisconsin dairy herds. Furthermore, recently Sharma *et al.* (2021) have also demonstrated a better return on investment when SRN replaced urea under Indian situation.

In totality, it was concluded from the present study that the isonitrogenous substitution of SBM by SRN (Zenitro™) at 1% in the diet of dairy cows helps augmenting farm economy primarily through a

Table 2. Milk yield and economics of inclusion of slow-release nitrogen in the diet of dairy cows (n=26)

Parameter	T_1	T_2
Production		
Milk yield (kg/d)	20.0	20.3
Fat (%)	4.51	4.52
Solid not fat (%)	8.67	8.75
Economics		
Cost of concentrate (₹ /kg)	28.3	27.6
Intake of concentrate (kg/d)	8.50	8.50
Savings from feed cost (₹ /d)[a]	-	5.80
Numerical difference in milk yield (kg/d)	-	0.29
Incremental revenue from milk (₹ /d)[b]	-	8.70
Overall net economic gain (₹ /d)[c]	-	14.5

[a]Difference between the cost of concentrate of T_1 and T_2 (₹) × intake of concentrate (kg/d); [b]Considering farm-gate milk price of ₹ 30/kg; [c]Savings from feed cost + incremental revenue from milk

reduction in feed cost. This strategy would be more practical when the price of SBM is high and/or milk realization price at farm is low.

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