International Journal of Livestock Research, Vol. 10 (6) June' 2020
http://www.ijlr.org
eISSN: 2277-1964
NAAS Rating 2020 – 5.36

Original Research

Effect of Slow Release Nitrogen Product on Performance of Growing Crossbred Calves

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How to cite this paper: Umashankar, B., Singh, K., Krishnamoorthy, U., Madhusudhan, H., Gouri, M., & Madhura, Y. (2020). Effect of Slow Release Nitrogen Product on Performance of Growing Crossbred Calves. *International Journal Of Livestock Research*, 10(6), 73-78. doi: http://dx.doi.org/10.5455/ijlr.20200304103441

Received : Mar 04, 2020
Accepted : Apr 19, 2020
Published : Jun 30, 2020

Abstract

An experiment was conducted to study the effect of slow release nitrogen product (SRNP) on the performance and nutrient utilization of growing crossbred calves. Six growing heifer calves each fed two treatment diets viz. 1.5 per cent urea supplementation (T1) and urea replaced by SRNP on equal nitrogen basis in their diet (T2) in switch over design. Compounded feed mixture was offered at 1 per cent of body weight and finger millet straw was provided ad lib thrice a day to all the calves. A five-day metabolic trial at the end of the experiment indicated no significant (P>0.05) difference in digestibility of nutrients viz. DM, OM, CP, NDF, ADF and nitrogen balance between the treatments. It was concluded that the SRNP supplementation had no beneficial effect on performance and nutrient utilization in growing crossbred calves.

Keywords: Digestibility, Growth Performance, Heifer Calves, Slow Release Nitrogen Product

Introduction

Non-protein nitrogen (NPN) compounds can be used as a source of N in the diet of ruminants. Urea, a cheaper source of NPN is widely used for tropical ruminant production. However, urea is degraded rapidly in the rumen by the action of urease and the resulting ammonia supply may exceed the capacity of rumen bacteria to assimilate it (Huber and Kung, 1981). This results in inefficient N utilization in the rumen, may lead to toxicity. Since the microbial growth is dependent on energy availability, it is important that the rate of ammonia production in the rumen be sustained and coordinated with the rate of carbohydrate digestion (Newbald and Rust, 1992). Therefore, a partial solution could be to modify urea to control its rate of release in the rumen so that ammonia production more closely parallels carbohydrate digestion (Rodriguez *et al*., 2010).

Studies conducted in growing calves by Chicco *et al.* (1971) revealed that the growth rate was higher in growing calves fed slow release nitrogen compound (biuret) compared to urea, Contrary to this report, other researchers observed no improvement in the growth performance of calves fed diets incorporated with slow release nitrogen products as compared to the calves fed diets containing feed grade urea (Tedeschi *et al*., 2002; Rodriguez *et al*., 2010). Hence, the present study was taken up to ascertain the effect of slow release nitrogen product (SRNP) on the growth performance of growing crossbred calves.

Material and Methods

Six crossbred calves (Holstein Friesian x Sahiwal) of about 9-10 months of age and comparable body weight were used in a growth trial of 84 days. The trial was conducted at Livestock farm complex, Veterinary College, Hebbal, Bengaluru in two periods of 6 week each in a switch over design comprising two blocks of 3 animals each. The calves within each block were designated to receive treatment 1 (T1) or treatment 2 (T2) in two periods. The treatment diets *viz.* T1 and T2 contained urea (1.5 per cent) and SRNP (urea replaced with SRNP on nitrogen equivalent basis) respectively. Nitrogen content of SRNP (containing 43 per cent calcium chelated urea in liquid form, M/s. Natural Feeds Private Limited, Bangalore, India) was analyzed before the start of the experiment by using macro Kjeldahl method (AOAC, 1995).

Diets for the experimental calves were formulated individually to meet the energy and protein requirement as per ARC (1984). Finger millet straw was fed *ad libitum*. The allowance of compounded feed mixture (CFM) for individual calves was fixed at 1 per cent of the body weight. Finger millet straw and CFM were offered separately. The daily allowance of finger millet straw was offered at 07:00, 13:00 and 18:00 hours of the day. The CFM was fed in three equal parts at 05:00, 13:30 and 17:00 hours. The calves were provided with sufficient drinking water throughout the day. Daily intake of finger millet straw and CFM were recorded (Table 2). Samples of finger millet straw and CFM offered were collected and analyzed once in a week for the estimation of DM. The calves were weighed using a platform weighing scale once in a week during morning hours, before having access to feed and water. During the last week of each period of growth trial, the metabolism trial involving all the animals was conducted for 5 days by total collection method. The samples of concentrate feed mixture, finger millet straw, residues, dung and urine were collected and analyzed for various proximate principles (AOAC, 1995) and fiber constituents (Van Soest *et al.,* 1991) for determination of nutrient digestibility and nitrogen balance.

The data obtained were subjected to statistical analysis using the General Linear Model procedures of statistical analytical system (SAS Institute Inc., 2006, Version, 9.3.1). Individual differences between means were tested using Bonferroni 't' test when treatment effect was significant.

Results and Discussion

The proportion of roughage to concentrate in the experimental diet was approximately 68:32. The CP and ME content of both T1 and T2 diets were similar since the difference was only substitution of urea with SRNP on N equivalent basis. The energy density of the complete diet was 9.12 MJ of ME/kg, the total CP content of the diet was about 141 g per kg DM, desired to meet the requirement of the calves for maintenance and growth according to ARC (1984).

Table 1: Composition of compounded feed mixture and finger millet straw (dry matter basis)

Ingredient/ Kg	Compounded Feed mixture	Finger Millet Straw
Maize	65.50	-
Wheat bran	30.50	-
Urea/SNRP	1.50	-
Salt	1.00	-
Mineral mixture	2.00	-
Chemical composition, %		
Dry matter	89.04	88.00
Organic matter	96.50	92.90
Crude protein	14.12	3.50
Ether extract	2.34	1.29
Total ash	3.50	7.10
Neutral detergent fiber	22.04	67.05
Acid detergent fiber	7.03	44.00
ME (MJ/kg)[2]	10.50	6.20

[2]Determined by rumen in vitro gas production technique (Menke et al., 1979).

The DM intake was 4.39 and 4.19 kg per day for T1 and T2 groups respectively (Table 2). There was no significant difference in the DM intake (total, as per cent body weight or g per kg metabolic body weight) between the treatment groups. This finding corroborated with the results of the previous studies wherein, replacing urea with slow release urea products did not affect DM intake in calves (Tedeschi *et al.*, 2002). Contrary to this, increased DM intake due to feeding of controlled release urea feeding was reported by Puga *et al.* (2001). In the present study, the amount of CFM offered to individual calves was fixed (1 per cent of body weight) completely consumed, whereas, the finger millet straw was offered *ad libitum.* Similar intake of finger millet straw between the treatment's diets indicate that feeding of SRNP did not influence the intake of roughage (ragi straw). Therefore, it was concluded that supplementations of SRNP in the diet had no influence on the intake of roughage or total DM intake of crossbred heifer calves.

The daily intake of ME was 33.3 and 33.1 MJ and that of CP was 300 and 320 g for groups T1 and T2 respectively which were similar to each other. The ME and CP intake of both the treatment groups was as per the stipulations of the ARC (1984) which recommends daily 33.5 MJ ME and 290 g CP requirement for the calves gaining body weight gain of about 400 g per day contrary to the expectations that the SRNP could be more efficiently utilized than urea to support higher growth rates. Similarly, there were no significant differences in both NDF and ADF intake (total and as per cent body weight) between the treatment groups. The NDF and ADF content in the complete diets (calculated as total NDF/ADF intake per total DM intake) of the treatment groups was in the range of 55.0 to 56.3 and 24.9 to 25.9 percent, respectively. The NDF or ADF amounts offered in the experimental diets was above the minimum recommended levels of ARC (1984). The body weight gain of the animals (g per day) for the treatment groups T1 and T2 were 390 and 405, respectively (Table 2). The diet for the experimental calves was formulated to effect a target gain of 500 g per day. However, the observed gain was only about 400 g per day. Lower body weight gain of 100 g per day in the experimental calves is acceptable since, the energy and protein values when calculated using the actual analysed values. The intake and the observed gains corroborated according to the ARC (1984) stipulation. Similar weight gain of calves between the two experimental groups suggested that, when urea replaced by SRNP on equal nitrogen basis had no advantage in terms of weight gain of crossbred growing heifers whereas Omer and Ahmet (2019) indicated that slow-release urea and/or non-structural carbohydrates supplementation on low-quality forage groundnut straw (*Arachis hypogaea*) based diets increase digestibility and body weight gain in in sheep and goats.

These results are consistent with findings of other experiments in which urea was replaced with a slow-release form of urea. Biuret, a condensation product of urea and probably the most common slow-release form of urea was not beneficial to improve the growth rate in heifers (Campbell *et al.*, 1963), lambs (Karr *et al.*, 1965), bulls (Chicco *et al.*, 1971), or steers (Ammerman *et al.*, 1972). Similarly, other slow release urea products like Starea and optigen did not affect body weight gain in growing steers (Tedeschi *et al*., 2002). Considering the results of this study it was concluded that there is no clear advantage in substituting a slow release urea product for urea at the levels usually fed to growing crossbred calves.

Table 2: Performance and nutrient utilization of experimental animals

Parameter	T1	T2
Growth performance (kg)		
Initial body weight	149.17±15.65	150.17±16.39
Final body weight	165.54±15.03	167.19±16.76
Body weight gain	16.42±0.76	17.02±0.66
Average body weight gain (g/day)	390.2±20.5	405.4±14.9
Dry matter intake (Kg/day)		
Finger millet straw	3.01±0.043	2.89±0.056
Compounded feed mixture	1.39±0.13	1.30±0.16
Total DM intake	4.39±0.14	4.19±0.20
Total DM intake (per cent of body wt.)	2.86±0.17	2.84±0.18
Total DM intake (g / kg $BW^{0.75}$)	100.14 ±3.98	99.58±3.77
Nutrient Intake (kg/day)		
Organic matter	4.13±0.11	3.87±0.16
Crude protein	0.30±0.02	0.32±0.02
NDF	2.32±0.04	2.29±0.07
ADF	1.72±0.02	1.67±0.04
ME (MJ/day)*	33.3	33.1
Nutrient Digestibility (%)		
Dry matter	59.45±2.76	62.01±2.39
Organic matter	61.64± 2.64	65.45±2.37
Crude protein	47.79±1.43	53.08±2.16
NDF	50.19± 3.39	52.64±3.18
ADF	43.00± 3.99	44.72±3.38
DOMDM[1]	55.46	56.67
Nitrogen Balance (g/day)		
N intake	48.27±2.90	50.80±3.85
N in dung	26.17±2.12	25.67±1.43
N in urine	7.50±1.69	11.92±1.78
N retained	14.57±1.92	13.21±2.55
N retained (g/kg $W^{0.75}$)	0.12±0.04	0.12±0.05
N retained (% of Intake)	11.55±3.91	11.34±5.02

Mean values between the treatment groups for all parameters are non-significant ($p \geq 0.05$); 1DOMDM = Digestible organic matter in dry matter

The nutrients intake for all the groups (Table 2) was similar when expressed as kg per day or as per cent body weight or g per kg metabolic body weight. Moreover, the intake of OM, CP, NDF, ADF and ME of both the treatment groups in this study was quite adequate and comparable to the recommendations of ARC (1984). The mean energy intake by growing heifer calves between the two groups T1 and T2 were (33.3 MJ/day) similar (Lopez Soto *et al.*, 2014) which matched the expected intake, as stipulated by the ARC (1984) recommendations and reflected the growth performance of animals. Feed intake and digestion balances have a common means of diet evaluation, to the extent that digestibility values are now as much attributes of a feed or diet as compositional values (Van Soest, 1994). There was no significant difference in the digestibility of DM, OM, CP, NDF and ADF between the treatment groups. Therefore, supplementation with SRNP had no effect on apparent DM digestibility in the current study. Previously Loest *et al.* (2001), supplemented urea and biuret to steers and found no differences in total intake and digestibility of DM, OM, and NDF, whereas Puga *et al.* (2001) reported significantly ($P < 0.05$) higher digestibility on nutrients in steers fed slow- release urea supplement (SRUS) and they indicated that higher digestibility of the experiment diets was due to better activity of fiber fermentation in the rumen. The positive N balance in both the treatment groups fed to growing crossbred heifers is suggestive of energy and N supply much more than the maintenance requirement and to effect a gain of about 400g per day. The N balance in the two groups was similar (Table 2) indicating similar N retention, which obviously reflected in similar gains of about 400 g per day. Similar findings were also reported previously by Mizwicki *et al.* (1980), who observed that slow and sustained release of

N from urea had no benefit in increasing the N balance in growing calves.

Conclusion

Considering the overall performance of growing calves, SRNP can substitute urea without any negative effect on growth performance. Further research should be done in order to better describe the beneficial biological effects of SRNP in the rumen and efficiency as a source of nitrogen on the growth performance of calves compared to urea.

Conflict of Interests

There is no conflict of interest.

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