Original Research

Combined Effect of Area Specific Mineral Mixture and Bypass Protein Supplementation on the Performance of Crossbred Cattle

J. Agrawalla, K. Sethy*, R. K. Swain, S. K. Mishra, K. Behera[1], N. R. Debata and B. K. Mishra

Department of Animal Nutrition, C.V.Sc. & A.H., OUAT, Bhubaneswar, INDIA

[1]Department of LPM

***Corresponding author:** babuivri@gmail.com

Rec. Date:	Sep 07, 2017 05:26
Accept Date:	Mar 25, 2018 17:06
DOI	10.5455/ijlr.20170907052615

Abstract

A total of forty five reproductive disordered animals (anestrus and repeat breeder) i.e. 30 cows and 15 heifers were selected for this experiment, which were divided among three groups in equal numbers of 15 animals in each. Animals in control group (T0) were maintained as per the traditional practices of the farmer, whereas treatment groups were fed with area specific mineral mixture @ 50 g per day per animal in T1 group and bypass protein @ 100 g per day per animal along with area specific mineral mixture @ 50 g per day per animal in T2 group. The growth performance was measured in tunes of body weight and average daily gain (ADG). Biochemical and mineral profiles were assessed for the analysis of the reproductive status of the animals. The average daily gain (g) of all the treatment groups differed significantly (P<0.05) from the control (T0) group. The serum glucose, total protein and albumin concentration was significantly (P<0.05) higher in supplemented than control animals. Similarly higher mineral concentrations were observed in treated group than control. Higher percentage of conception was achieved in group T2 (53.33%) followed by T1 (40.00%) and T0 (15.00%). It may be concluded that area specific mineral mixture and bypass protein supplementation increased growth and reproductive performances of crossbred cattle.

Key words: Bypass Protein, Crossbred Cattle, Minerals, Reproduction

How to cite: Agrawalla, J., Sethy, K., Swain, R., Mishra, S., Behera, K., Debata, N., & Mishra, B. (2018). Combined Effect of Area Specific Mineral Mixture and Bypass Protein Supplementation on the Performance of Crossbred Cattle. International Journal of Livestock Research, 8(8), 92-98. doi: 10.5455/ijlr.20170907052615

Introduction

Nutrition exerts a significant influence on reproductive function through changes in body weight affecting processes of follicular development and finally, ovulation rate (Scaramuzzi *et al.,* 2006). Protein supplementation also acts as a potent stimulator of glucose and insulin secretion (Muturi *et al.,* 2002).

Development of more antral follicles has been linked to supplementation of energy and protein in order to maintain adequate levels of both FSH and LH in sows (Quesnel *et al.*, 1998). On the contrary, any deficiency of dietary protein in rats and goats has been found to cause a reduced number of antral follicles and a decreased ovulation rate (Cognie *et al.*, 2003). Minerals are considered to be essential nutrients having vital role in the animal production and reproduction. Any deficiency or excess may lead to poor performance of livestock. Reproductive problems like anestrous, prolonged estrous, conception failure, retained foetal membranes have been associated with deficiency of some essential minerals (Gupta *et al.*, 2005). Moreover, other problems like abortion in cattle and weak calf syndrome have been reported with deficiency of essential minerals (Mee, 2004; Logan *et al.*, 1990). In Odisha, the cows are deficient in calcium and phosphorous which hampers their reproductive performance (Mohapatra *et al.*, 2012). Keeping this view, an attempt has been made in Kakatapur block of Puri district, Odisha to study the effects of bypass protein and area specific mineral mixture (ASMM) supplementation on the performance of crossbred cattle.

Material and Methods

Selection of Animals

An on-farm trial was carried out in Othaka, Anantapur and Jagannathpur villages of Kakatpur block in Puri district of Odisha. The Kakatpur block is located between 20.100º N latitude and 86.120º E longitudes at an altitude of 19.30 meters. The average rainfall of the zone is about 1488.43 mm. From the farmers general information *viz*. age of animals, details of estrus, treatment after estrus, age at first calving, calving number, services per conception, date of last calving and other breeding history including anestrus, post-partum anestrus, repeat breeding, feeding practices of dairy cows were collected. Individual animal was examined per-rectally to know the status of reproductive organs like cervix, ovary and uterus etc. On the basis of survey findings, forty five reproductive disordered animals (anestrus and repeat breeder) with no anatomical abnormality were selected from Kakatpur Block. The cows were 4 to 6 years age with 2nd to 4th lactation and in late stage of lactation, whereas all the heifers were more than 03 years old. The animals were dewormed with broad spectrum anthelmintic (Fenbendazole @ 10 mg/kg body weight) to rule out any possible effect of worms on reproduction of the animals.

Experimental Design

The experimental animals were divided into three groups basing on body weight randomly. Animals in control group (T0) were maintained as per the traditional practices of the farmer without any nutritional supplementation, whereas the treatment groups were fed with ASMM @ 50 g per day per animal in T1 group and bypass protein @ 100 g per day per animal along with ASMM @ 50 g per day per animal in

 DOI 10.5455/ijlr.20170907052615

T2 group along with the traditional practices of the farmer. Both the treatment groups along with the control group were maintained as per the standard managemental practices. The experiment was continued for 60 days.

Preparation of ASMM and Bypass Protein

The ASMM was prepared as per the reported formulation of Mohapatra *et al.* (2012). The ingredient composition of the ASMM is presented in Table 1. The bypass protein was prepared according to the procedure of Garg *et al.* (2002).

Table 1: Composition of area specific mineral mixture

S. No.	Ingredients	Amount/1000 g
1.	Dicalcium phosphate	800 g
2.	Wheat flour	200 g
3.	Cupric sulphate	200 mg
4.	Potassium iodide	1.63 mg
5.	Manganous sulphate	400 mg
6.	Zinc sulphate	500 mg

Body Weight Gain

The body weight of the cows was recorded in monthly interval during the experimental period using Johnson's formula (1940). The average daily gain was measured by dividing the body weight gain with the days of the experiment.

Serum Biochemical Profile

About 10 ml blood was collected from the jugular vein of each animal in the morning (before watering and feeding) at 0 and 60th day of the experiment. The serum was collected in cryovials and stored at -40°C until further analysis. Serum samples were analysed for the concentration of glucose, total protein, albumin and urea using the kits of CREST BIOSYSTEMS (India). Globulin concentration was determined by subtracting the albumin from the total protein concentration in the serum samples. The serum calcium and phosphorus concentrations were estimated by using the kit manufactured by CREST BIOSYSTEMS (India). The serum micro minerals like copper, zinc and manganese were estimated by Atomic Absorption Spectrophotometer (ELICO-SL 243, Hyderabad, India).

Reproductive Performances

The animals were regularly monitored for the onset of heat. The heat was detected by behavioural symptoms as reported by Layek *et al.* (2011) and by maintaining heat expectancy chart. Animals exhibiting the signs of heat were artificially inseminated by the local Veterinary Assistant Surgeons.

DOI 10.5455/ijlr.20170907052615

Pregnancy diagnosis for each inseminated animal was conducted per-rectum on 45th day post insemination.

Statistical Analysis

Statistical analysis was done by using Software Package for Social Sciences (SPSS) Version 17.0 (2008) and one-way analysis of variance (Generalized Linear Model, ANOVA) with comparison among means was made by Duncan's multiple range and post-hoc test (Duncan, 1955) with significance level of $P \leq 0.05$. The statistical analysis for conception rate was done by using Chi square test with 3×2 contingency table.

Results and Discussion

Body Weight

Average daily gain in the treatment groups were significantly (P<0.05) higher than control group (Table 2), whereas there was no significant (P<0.05) difference between the treatment groups.

Table 2: Growth performance of the crossbred animals during the experiment

Attributes	Group			P value
	T0	T_1	T_2	
Initial BW, kg (0 day)	255.02±22.97	256.30±32.51	254.26±24.38	0.525
Final BW, kg (60th day)	264.94±21.41	269.10±23.21	267.90±24.18	0.610
ADG (g)	165.33^{a}±15.05	213.33^{b}±10. 40	227.33^{b}±13.92	0.021

^{ab} *Values bearing different superscripts in a row differ significantly (P<0.05)*

Similar to our findings, Sawant *et al.* (2013) reported significant (P<0.05) increase in average daily gain in indigenous heifers supplemented with 30 g mineral mixture daily. Upadhyaya and Gupta (1988) also reported that supplementation of HCHO treated groundnut oilcake resulted in higher daily growth rate in crossbred calves. The increased body weight might be due to better nutrient availability and metabolisms in treated animals than control.

Serum Biochemical Profile

The data regarding blood glucose, total protein, albumin, globulin and urea at 0 and 60th day of experiment were presented in Table 3. Among the different serum biochemical parameters glucose and total protein concentration varied significantly (P<0.05) between control and treatment groups at 60th day of the experiment. The higher blood glucose concentration in treatment groups might be due to altered molar proportion of VFA in the rumen with an increase in propionate concentration resulting in higher glucose level in the plasma due to mineral supplementation (Aliarabi and Chhabra, 2006). Similar to our results, Khan *et al*. (2015) reported that feeding 50 g of commercial mineral mixture (Agrimin) along with

DOI 10.5455/ijlr.20170907052615

1500 IU Vitamin E resulted in significantly (P<0.05) higher glucose level as compared to control. Abdel-Ghani *et al*. (2011) reported an increase of glucose concentrations in bypass protein supplemented animals, may be due to the higher carbohydrate metabolism as a result of higher thyroid hormones secretion.

Table 3: Serum biochemical profiles of crossbred animals under different dietary treatments

Parameter	At 0 day			P value	At 60th day			P value
	T0	T_1	T_2		T0	T_1	T_2	
Glucose (mg/dl)	51.39 ±3.79	52.34±2.71	51.60±3.92	0.559	50.56^{a}±1.34	54.55^{b}±1.47	55.73^{b}±1.04	0.030
Total Protein (g/dl)	5.21±0.51	5.52±0.68	5.21±0.51	0.696	5.41±1.45	6.32^{b}±1.62	7.05^{b}±2.74	0.004
Albumin (g/dl)	3.10±0.43	3.19±0.55	3.10±0.43	0.171	3.30^{a}±0.27	3.75^{b}±0.18	4.23^{b}±0.21	0.022
Globulin (g/dl)	2.10±0.23	2.33±0.22	2.10±0.23	0.861	2.11±0.22	2.57±0.21	2.82±0.14	0.745
Urea (mg %)	20.08±1.50	19.86±0.99	23.08±1.37	0.416	21.19^{a}±2.46	19.52^{a}±2.19	16.44^{b}±1.80	0.019

[ab]Values bearing different superscripts in a row differ significantly (P<0.05)

Similar, to our observation, Samanta *et al.* (2005) reported that feeding of mineral mixture to anestrus cows for 90 days resulted in a significant (P<0.05) increase in serum protein and globulin level. Aly (2005) also reported that values of serum total proteins, albumin, and globulin were increased (P<0.01), when goats were fed protected protein in the diet. A decreased serum urea concentration due to supplementation of ASMM and bypass protein is in the similar line of the finding of Khan *et al*. (2015), which may be due to reduced catabolism of body protein source.

Serum Mineral Profile

The serum macro (Ca, P) and micro mineral concentrations were significantly (p<0.05) higher in treated groups than the control animals (Table 4). The serum concentrations of calcium and phosphorus concentration at 0 day were found to be below the critical value; Ca (9-12 mg/ml) and P (4-8 mg/ml) that may be due to the traditional feeding practices (Panda *et al.*, 2014).

Table 4: Mineral profile of crossbred cattle under different dietary treatments

Parameter	At 0 day			P value	At 60th day			P value
	T0	T_1	T_2		T0	T_1	T_2	
Ca (mg/dl)	7.39±0.79	7.40±0.84	7.38±1.15	0.903	7.28^{a}±0.68	8.51^{b}±0.45	8.60^{b}±0.86	0.002
P(mg/dl)	3.91±0.13	4.02±0.26	3.74±0.14	0.607	4.04^{a}±0.26	5.12^{b}±0.17	4.85^{b}±0.28	0.015
Zn(ppm)	0.82±0.01	0.82±0.01	0.84±0.01	0.473	0.82^{a}±0.01	1.19^{b}±0.01	1.12^{b}±0.07	0.040
Cu(ppm)	0.71±0.03	0.71±0.05	0.69±0.04	0.745	0.79^{a}±0.08	1.07^{b}±0.05	0.97^{b}±0.07	0.012
Mn(ppm)	0.32±0.01	0.32±0.01	0.33±0.007	0.267	0.32^{a}±0.03	0.64^{b}±0.02	0.58^{b}±0.06	0.010

[ab] Values bearing different superscripts in a row differ significantly (P<0.05)

At 60th day of the experiment, both macro and micro mineral concentrations varied significantly (p<0.05) between the control and the treatment groups. The increased serum mineral concentration might be due to

 DOI 10.5455/ijlr.20170907052615

extra supplementation of minerals through concentrate and ASMM. Similar results were reported in dairy cattle by other workers (Agrawalla *et al.*, 2017; Samanta *et al.*, 2005).

Reproductive Performances

The conception rates of the animals to the different treatments are presented in Table 5. The overall conception rates in different groups were found to be 15.00, 40.00 and 53.33% respectively (Table 5).

Table 5: Distribution of conceived animals (heifers and cows) in different treatment groups

Attributes	Groups					
	T0		T_1		T_2	
Number of disordered animals	15		15		15	
Type of disorder	An	RB	An	RB	An	RB
	10	05	10	05	10	5
Total conceived	03		06		08	
Percentage of conception	15.00[a]		40.00[b]		53.33[c]	

[abc] *Values bearing different superscripts in a row differ significantly (P<0.05); An – Anestrus and RB – Repeat breeder*

The maximum conception rate was found in ASMM and bypass protein supplemented group (T3). Similarly, increased conception rate was found in ASMM supplemented cows (Mohapatra *et al.*, 2012) and anestrus buffaloes (Kumar *et al.*, 2012). The increased conception rate in ASMM and bypass protein treated group might be due to enhanced LH surge and ovulation rate in animals.

Conclusion

Supplementation of ASMM along with bypass protein enhanced the growth, serum mineral concentration and conception rate in repeat breeding and anoestrus animal.

Acknowledgments

The authors are thankful to the Orissa University of Agriculture and Technology, Bhubaneswar and the AICRP Project on "Nutritional and physiological approach for enhancing reproductive performance in animals" for providing necessary funds and facilities to carry out this research.

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DOI 10.5455/ijlr.20170907052615