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Effect of Dietary Supplementation Area Specific Mineral Mixture along with Hormonal Interventions on the Performances of the Anoestrous and Repeat Breeding Crossbred Cattle

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ABSTRACT

A study was conducted to assess the effect of dietary supplementation of area specific mineral mixture and hormonal therapy on the reproductive performances of anoestrous and repeat breeder crossbred cattle at Nimapara block of Puri district, Odisha, India. A total of 60 animals (40 cows, 20 heifers) were selected and were randomly distributed into four groups of 15 animals each (containing both anoestrus and repeat breeder), experiment was continued for 60 days. Animals of the Group I (control) were fed straw based diet along with concentrates as practiced by the farmers and received no dietary or hormonal intervention. However, animals of group II received dietary supplementation of an area specific mineral mixture at 50 g/animal/d, Hormonal protocols like double synch and estra double synch along with area specific mineral mixture at 50 g/d/animal were tested on animals in group III and IV, respectively. Results revealed significant ($P<0.05$) improvement in growth and reproductive performance in treatment groups as compared to control group. Thus, supplementation of area specific mineral mixture along with hormones gave better results in augmenting reproductive disorder in crossbred animals.

Key words: Cattle, Hormones, Minerals, Reproduction

INTRODUCTION

Minerals play important role in vital metabolic and physiological fucntions including reproduction. Deficiency of essential minerals may result in failure of the homeostasis mechanism, affecting the productive and reproductive potential of animals. Hormonal imbalance affects follicular growth and ovulation which are dependent on the pulsatile secretion of luteinizing hormone (Canfiel and Butler, 1990). Reproductive problems like anestrous, prolonged estrous, conception failure and 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 (Logan *et al.,* 1990). Deficiency of calcium and phosphorous in cattle of Odisha had been reported (Mohapatra *et al.,* 2012). Treatment with GnRH and $PGF_{2\alpha}$ synchronises estrus, enhances ovulation and maximizes the conception rates and timed estrus behaviour in many dairy herds. A follicular wave can be hormonally programmed for synchronous development (Diskin *et al.,* 2002). Keeping in view the magnitude and complexity of the problem affecting the livelihood security and profitability of the venture, concept of stimulating corpus luteum and follicular development through minerals and hormones were evaluated.

MATERIALS AND METHODS

An on-farm trial was carried out at Nimapara block (20.07° N latitude and 86.02° E longitudes at an altitude of 19.3 m above msl) of Puri district, Odisha, India which lies in the east and south eastern coastal plain agro-climatic zone. The average rainfall of the zone is about 1449.68 mm. General information like breed and age of animals, details of oestrus, treatment after oestrus, age at first calving, calving number, services per conception, date of last calving and other breeding history including anoestrus, postpartum anoestrus, repeat breeding, and feeding practices of dairy cows were collected from the farmers. Status of reproductive organs like the cervix, ovary, and uteri of individual animals was examined par rectum. On the

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basis of survey, 60 animals with reproductive disorders with no physiological and anatomical abnormality were selected and dewormed with broad spectrum anthelmintic (Fenbendazole at10 mg/kg body weight) to rule out the possible effect of worms on reproduction of the animals. These animals were randomly distributed into four different groups of 15 animals (05 anestrous and 10 repeat breeders) each on the basis of their body weights following completely randomized design. Animals in control group (I) were maintained as per the traditional practices of the farmer (straw based diet with locally available concentrate) without any nutritional and hormonal intervention, whereas, the animals in treatment II were fed with area specific mineral mixture @ 50 g/d/animal. The hormonal protocols like double synch and estra double synch along with area specific mineral mixture @ 50 g/d/animal were tested in group III and IV, respectively.

The area specific mineral mixture (ASSM) was prepared as per the reported formulation of Mohapatra *et al.* (2012). The ASSM contains dicalcium phosphate (800 g); wheat flour (200 g); cupric sulphate (200 mg); potassium iodide (1.63 mg); manganous sulphate (400 mg) and zinc sulphate (500 mg). In double synch protocol, prostaglandin $F_{2\alpha}$ (dinoprost tromethamine) and gonadotropin releasing hormone (GnRH) analogue (buserelin acetate) were used twice each on any day of cycle in the following manner (0 day: PGF2α, 2nd day: GnRH, 9th day: PGF2α, 11th day: GnRH). Fixed time artificial insemination was conducted twice on 16 and 24 h of the last GnRH injection. The same protocol was used for both anoestrus and repeat breeding animals (Savalia *et al.,* 2014). In *Estra* double synch protocol, the steps were similar to double synch protocol with replacement of the last GnRH injection with estradiol benzoate in the following manner (0 day: PGF2α, second day: GnRH, ninth day: PGF2α, tenth day: estradiolbenzoate). Fixed time artificial insemination was conducted twice on 48 and 72 h of the last estradiol injection (Biradar *et al.,* 2014).

The body measurements of the animals was recorded at monthly intervaland body weight was calculated using Johnson's formula (1940). About 10 ml of blood was collected from each animal through jugular venipuncture in the morning (before watering and feeding) at 0 and 60 d of the experiment and serum was separated. The serum was kept at -40°C until used. The haemoglobin (Hb) content of the blood samples were estimated by using a Hellige and Sahli's haemoglobin-meter. The packed cell volume (%) determinations of all the blood samples were carried out (Jain, 1986). The concentration of glucose, total protein, albumin, and urea in serum were measured using the Crest Biosystems kit (Mumbai, India). Globulin concentration was determined by subtracting the albumin from the total protein concentration in the serum samples. Serum concentrations of calcium and phosphorus were estimated by using commercial kit (Crest Biosystems, India). Serum concentrations of micro minerals like copper, zinc and manganese were estimated by Atomic Absorption Spectrophotometer (ELICO-SL243, Hyderabad, India).

All the animals were regularly monitored for the onset of heat. The heat was detected by behavioural symptoms (Layek *et al.,* 2011). Animals exhibiting the sign of heat were par-rectally inseminated artificially by the local Veterinary Assistant Surgeon. Pregnancy diagnosis was conducted routinely par rectum at 45 days

Table 1. Body weight changes in experimental animals

Attribute	Groups				P value
	I	II	III	IV	
Initial BW, kg(0 day)	263.60±6.56	258.45±5.21	246.67±5.44	253.33±6.21	0.613
Final BW, kg(60 days)	271.41±7.06	273.17±5.21	261.64±5.42	267.93±6.18	0.740
ADG (g)	130.16^{a}±3.51	245.33^{b}±9.51	249.50^{b}±9.70	243.33^{b}±11.30	0.01

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

Table 2. Haematological profile of cross bred cattle under different dietary treatments

Attribute	Group					P value
	Days	I	II	III	IV	
Hemoglobin (g/dl)	0	11.46±0.44	11.78±0.48	11.61±0.23	11.54±0.49	0.220
	60	11.04[a]±0.59	12.77[b]±0.37	11.99[b]±0.07	11.67[b]±0.50	0.04
Packed cell volume (%)	0	26.73±3.00	28.87±2.45	30.20±2.97	29.40±1.57	0.392
	60	26.65±2.73	28.93±337	29.60±3.40	27.90±2.72	0.116

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

post-insemination. 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 test (Duncan 1955) with significance level of P≤0.05.

RESULTS AND DISCUSSION

Average daily gain in the treatment groups was higher (P<0.05) than control group whereas there was no significant difference among the 3 treatment groups (Table 1). Trenkle (1976) and Sawant *et al.* (2013) also reported similar findings. The increased body weight gain due to ASMM supplementation might be due to increased nutrient metabolism in supplemented animals. Haemoglobin concentration was higher (P<0.05) in treated groups whereas PCV values were similar in all the groups (Table 2). Increased Hb concentration in mineral supplemented groups was probably due to better interaction of trace minerals and utilization of dietary Fe because of supplementary Cu in the diet (Tiwari *et al.,* 2000).

Serum glucose concentration varied (P<0.05) between control and treatment groups at 60 days of the experiment (Table 3). Similarly, Satapathy *et al.* (2019) observed increased blood glucose levels in anestrous cows supplemented with ASMM at 50g/day/animal. The higher blood glucose concentration in treatment groups might be due to altered molar proportion of volatile fatty acid (VFA) in the rumen with an increase in propionate concentration resulting in increased glucose level in the plasma due to mineral supplementation (Aliarabi and Chhabra, 2006).

Serum concentrations of macro (Ca, P) and micro mineral were more (P<0.05) in treated group than control one (Table 4). Serum concentration of Ca and P at 0 d was below the critical value (Ca:9-12 mg/dl) and

Table 3. Serum biochemical profile of experimental animals under different dietary treatments

Attribute	Group					P value
	Days	I	II	III	IV	
Glucose(mg/dL)	0	49.70±1.61	52.12±3.55	48.69±3.24	49.49±15.02	0.992
	60	42.09[a]±1.85	53.33[b]±2.29	58.69[b]±3.35	59.61[b]±12.65	0.040
Total Protein(g/dl)	0	6.30±0.32	6.49±1.19	5.98±0.66	6.01±0.81	0.963
	60	6.48±0.35	6.65±1.21	6.06±0.66	6.04±0.75	0.927
Albumin(g/dl)	0	3.08±0.06	3.14±0.25	3.23±0.23	3.14±0.20	0.120
	60	3.04±0.05	3.26±0.18	3.20±0.21	3.15±0.21	0.170
Globulin(g/dl)	0	3.86±0.21	3.35±0.96	2.76±0.62	2.87±0.62	0.540
	60	3.79±0.27	3.40±1.02	2.86±0.68	2.88±0.62	0.634
Urea(mg/dl)	0	21.74±3.73	22.87±5.96	21.09±1.06	21.42±3.94	0.785
	60	21.40±4.20	21.52±3.52	22.47±0.87	20.72±3.89	0.037

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

Table 4. Serum mineral profile of crossbred animals under different dietary treatments

Attribute	Group					P value
	Day	I	II	III	IV	
Ca(mg/dl)	0	6.87 ± 0.43	6.85 ± 0.12	6.96 ± 0.23	6.90 ± 0.32	0.922
	60	$6.78^{a}\pm0.36$	$8.04^{b}\pm0.30$	$8.15^{b}\pm0.14$	$7.92^{b}\pm0.37$	0.04
P(mg/dl)	0	3.69 ± 0.12	3.90 ± 0.29	4.18 ± 0.33	3.91 ± 0.21	0.277
	60	$3.70^{a}\pm0.13$	$5.96^{b}\pm0.34$	$5.44^{b}\pm0.29$	$5.67^{b}\pm0.25$	<0.01
Zn(ppm)	0	0.80 ± 0.02	0.87 ± 0.02	0.88 ± 0.04	0.79 ± 0.02	0.130
	60	$0.80^{a}\pm0.01$	$1.52^{b}\pm0.18$	$1.36^{a}\pm0.03$	$1.51^{b}\pm0.01$	<0.01
Cu(ppm)	0	0.73 ± 0.03	0.76 ± 0.02	0.74 ± 0.02	0.75 ± 0.02	0.329
	60	$0.72^{a}\pm0.02$	$1.24^{b}0.04$	$1.29^{b}\pm0.02$	$1.17^{b}\pm0.01$	<0.01
Mn(ppm)	0	0.32 ± 0.02	0.31 ± 0.02	0.36 ± 0.02	0.34 ± 0.01	0.429
	60	$0.33^{a}\pm0.01$	$0.64^{b}\pm0.03$	$0.58^{b}\pm0.04$	$0.57^{b}\pm0.01$	<0.01

^{a,b}Values bearing different superscripts in a row differ significantly ($P<0.05$)

P 4-8 mg/dl) which might be due to the traditional feeding practices. At 60 days of the experiment, both macro and micro minerals concentration improved ($P<0.05$) in treated animals than control group. The increased serum mineral concentration might be due to extra supplementation of minerals through concentrate and ASMM. Similar results were reported in dairy cattle (Samanta *et al.,* 2005; Agrawalla *et al.,* 2017).

The overall conception rates in different groups were found to be 20, 40, 66.70 and 80% respectively (Table 5). The maximum conception rate was found in ASMM and estra-double synch group (IV). Similarly, increased conception rate was found in ASMM supplemented (Mohapatra *et al.,* 2012) and hormone treated animals (Shah *et al.,* 2003; Lopes *et al.,* 2011). Naikoo *et al.* (2015) also recorded 71.42% estrous induction by combined treatment of mineral and ovosync protocol. The increased conception rate in ASMM and hormone treated group might be due to enhanced LH surge and ovulation rate in animals (Naikoo *et al.,* 2015). Kumar *et al.* (2012) and Agarwalla *et al.* (2017) also reported 45.65 and 40% conception rate, respectively in crossbred cattle supplemented with ASMM at 50 g/ day/animal.

CONCLUSION

Supplementation of area specific mineral mixture along with hormonal intervention (double synch and estra double synch) enhanced the growth, serum mineral concentrations and conception rate in repeat breeder and anoestrus animals.

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Table 5. Distribution of conceived animals in different treatments at the end of experiment

Attribute	Group							
	I		II		III		IV	
	An	RB	An	RB	An	RB	An	RB
Total animals	5	10	5	10	5	10	5	10
Animals conceived	1	2	2	4	3	7	4	8
Total animals conceived	03	06	10	12				
Percent of animals conceived	20	40	66.7	80				

AN, Anestrus; RB, Repeat breeders

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