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Effect of Supplementation of Mineral Mixture and Bypass Fat on Performance of Crossbred Cattle

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ABSTRACT

A total of sixty reproductive disordered animals having 38 cows and 22 heifers were selected for this experiment which were divided among three groups in equal numbers of 20 animals in each, having anoestrus and repeat breeding problems. Animals in control group (C) were maintained as per the traditional practices of the farmer where as treatment groups were fed with mineral mixture @ 50 g per day per animal in T_1 group and bypass fat @ 100 g per day per animal along with mineral mixture @ 50 g per day per animal in T_2 group. The growth performances were measured in tunes of body weight and average daily gain (ADG). Heamoto-biochemical and mineral profile (Ca, P, Zn, Cu and Mn) were assessed for the analysis of the reproductive status of the animals. The average daily gain (g) of all the treatment group differed significantly ($P<0.05$) from the control group. Higher percentage of conception was achieved in group II (55%) followed by group III (40%). The least percentage was in group I (15%). It may be concluded that mineral mixture and bypass fat supplementation increased growth and reproductive performances of crossbred cattle.

Keywords: Bypass fat, Crossbred Cattle, Mineral mixture, Reproduction.

Reproductive physiology of an animal is influenced by many factors out of which nutritional factors are the most crucial in terms of their direct effects on reproduction and the potential to modulate the effects of other factors. Minerals are the essential nutrients bearing a significant role in the animal reproduction, because their excess or deficit produces detrimental effect on the performance of livestock. Deficiency of essential minerals may result in failure of the homeostasis mechanism, affecting the productive and reproductive potential of animals. Similarly Bypass fat technology protects the nutrient from degradation and bio-hydrogenation in rumen with increasing the energy density of diet, thus enabling the animals to meet their energy and essential fatty acid requirements and improving reproductive and lactating performance. When fatty acids are bio-hydrogenated, the resulting Trans fatty acids produced in the rumen might also benefit fertility (de Veth *et al.,* 2009). The role of Bypass fat, which act as a precursor of progesterone via cholesterol and prostaglandins was considered also as an energy supplement during the transition period leading to improvement in reproductive performance (Staples *et al.,* 1998). Keeping this view, an attempt has been made in Jatani block of Khurda district, Odisha to study the effects of Nutritional supplementations like mineral mixture and bypass fat feeding on the performance of Crossbred cattle.

MATERIAL AND METHODS

Selection of animals

An on-farm trial was carried out in the villages of a semi urban and industrialised area of Jatani block in Khurda district of Odisha. The Jatani block is located between 20.1700º N latitude and 85.7000º E longitudes at an altitude of 36 meters. The average rainfall of the zone is about 1443 mm. From the farmers general information viz., 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, post-partum anoestrus, 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 sixty reproductive disordered animals with no physiological and anatomical abnormality were selected from eight villages of Jatani Block. The animals were dewormed with broad spectrum anthelmintic (Fenbendazole @ 10 mg/kg body weight) to rule out the possible effect of worms on reproduction of the animals.

Experimental design

An experiment was designed for a period of 60 days in which animals in control group (C) were maintained as per the traditional practices of the farmer without any nutritional supplementation where as treatment groups were fed with area specific mineral mixture @ 50 g per day per animal in T_1 group and bypass fat @ 100 g per day per animal along with area specific mineral mixture @ 50 g per day per animal in T_2 group along with the traditional practices of the farmer. All the treatment groups along with the control group were maintained as per the standard managemental practices.

Body weight and feed intake

The body weight of the cows was recorded in monthly interval during the experimental period using Johnson's formula (1940). Quantity of feed and fodders offered to the animals and residue left were recorded. The area specific mineral mixture was prepared as per Mohapatra (2012). The ingredient composition of the area specific mineral mixture is presented in Table 1. The bypass fat was prepared according to the procedure of Garg (1997). Representative samples of pasture grasses, paddy straw and concentrate ingredients (viz. maize, wheat bran and mung chunies) were collected from grazing and/ or farmers door, respectively. About 250 grams of these collected materials were dried and were analyzed for proximate principles (Table 2) as per AOAC (1995). Cu, Zn, Mn, Fe and Co of soil, feeds, fodders and serum were done by Atomic Absorption Spectrophotometer (ELICO-SL 243 Double Beam AAS).

Table 1: Composition of area specific mineral mixture

Sl. 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

Haemato Biochemical profile

Blood samples were analysed for biochemical and mineral estimation as per the protocol of Oser (1971).The haemoglobin content of the blood samples were estimated by Hellige and Sahli's haemoglobin meter. The PCV (%) determinations of all the blood samples were carried out by the procedure given by Jain (1986). The concentration of glucose, total protein, albumin and urea was estimated using the kit of CREST BIOSYSTEMS (India). Globulin concentration was determined by subtracting the Albumin from the total protein concentration in the serum samples. The Alanine transaminase (ALT) and Aspartate aminotransferase (AST) activity in serum was determined as per Reitman and Frankel (1957). Serum alkaline phosphatase (ALP) activity was estimated by the method of Kind and King (1954) using diagnostic kit manufactured by Span Diagnostic Limited, Surat, India**.** The serum calcium and phosphorus concentration was estimated by using the kit prepared by CREST BIOSYSTEMS (India). The serum micro minerals like copper, zinc and manganese were estimated by Atomic Absorption Spectrophotometer (ELICO-SL 243 Double Beam AAS) as per the method described by Piper (1996).

Reproductive performances

Reproduction related hormones like progesterone and estradiol (E_2) levels in serum were estimated before the start of experiment by using the kit prepared by Calbiotech, Inc. as per the method of Engvall and Perlmann (1971). The animals were regularly monitored for the onset of heat by behavioural symptoms (Layek *et al.*, 2011). Animals

Table 2: Composition and nutritive value of feeds and fodders offered to the animals on dry matter basis

Ingredients	DM (%)	CP (%)	CF (%)	NFE** (%)	EE (%)	Ash (%)	DCP* (%)	TDN* (%)
Paddy straw	90.00	3.01	35.80	50.59	2.8	7.8	0	41.12
Maize	26.50	6.50	34.80	47.82	1.98	8.90	14.95	81.9
Wheat bran	85.15	14.9	10.75	65.72	3.38	5.25	11.85	74.75
Mung chuni	88.45	7.91	27.8	48.73	2.65	12.91	—	-
Doob grass	15.5	8.20	16.8	36.95	26.3	11.75	3.89	47.88

*Reported values, **Calculated values

Table 3: Growth performance and feed intake of cross bred animals under different dietary treatments

Attributes	Groups			P value
	Control	T_1	T_2	
Initial Body Weight (kg)	292.00 ± 10.32	300.62 ± 10.83	292.50 ± 3.59	0.944
60 Days Body Weight (kg)	299.50 ± 10.17	311.04 ± 10.40	303.55 ± 3.29	0.910
Avg. Daily Gain (gm)	125.00^{a} ± 8.23	173.66^{b} ± 7.10	184.16^{b} ± 9.96	0.03
DM Intake (kg)	3.39 ± 0.41	4.66 ± 0.38	3.48 ± 0.43	0.146
Straw intake (kg)	2.80^{ab} ± 0.34	4.19^{c} ± 0.48	2.67^{a} ± 0.21	0.023
Green fodder intake (kg)	0.60 ± 0.40	0.19 ± 0.10	0.83 ± 0.40	0.136
Concentrate (kg)	0.70 ± 0.30	0.91 ± 0.14	0.83 ± 0.31	0.637
DCP Supply (kg)	0.12 ± 0.04	0.14 ± 0.02	0.15 ± 0.05	0.367
TDN Supply (kg)	2.00^{a} ± 0.32	2.43^{ab} ± 0.15	1.99^{a} ± 0.32	0.045
Avg. DCP requirement (kg)	0.24 ± 0.03	0.32 ± 0.02	0.30 ± 0.00	0.135
Avg. TDN requirement (kg)	2.63 ± 0.24	3.20 ± 0.18	2.67 ± 0.02	0.163
DCP Balance (kg)	0.12 ± 0.05	0.18 ± 0.03	0.15 ± 0.05	0.148
TDN Balance (kg)	0.63 ± 0.06	0.77 ± 0.08	0.68 ± 0.03	0.385
Percentage(%) deficit of DCP	50.00	56.25	50.00	
Percentage(%) deficit of TDN	23.95	24.06	25.46	

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

exhibiting the sign of heat were inseminated artificially by the local Veterinary Asst. Surgeons. Pregnancy diagnosis was conducted per-rectally to confirm the conception after 45 days of 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 test (Duncan, 1955) with significance level of $P \leq 0.05$.

RESULTS AND DISCUSSION

Body weight and feed intake

Average daily gain in the treatment groups are significantly (P<0.05) higher than control group where as there was no significant (P<0.05) difference observed among both the treatment groups (Table 3). This finding was in agreement with the observations of Sawant *et al.* (2013). No significant (P<0.05) difference was noticed in the body weight and feed intake among the groups throughout the experimental period, however the straw intake was significantly (P<0.05) higher in T_1 group than control and T_2 group.

Body condition score

Body condition score in the treatment groups i.e. 3.65 in T_1 and 3.53 in T_2 are significantly (P<0.05) higher than control group (3.08) where as non-significant (P<0.05) difference was observed among both the treatment groups. Supplemented groups with area specific mineral mixture showed improvement in feed intake as a result increased in general health, glossy skin and improved body score. Similar observations were observed by Prasad *et al.* (2007). Hess *et al.* (2008) reported that inclusion of protected fat at 3% or less of DM of diet was recommended to obtain the most benefit from the energy contained within the fat and other dietary components in high-forage diets.

Haematological profile

No significant (P<0.05) difference between control and treatment groups was observed which revealed that supplementation of minerals and bypass fat did not exert any effect on the Haematological profile. This observation is in agreement with Savsani *et al.* (2013). However, Tiwari *et al.* (2000) reported that haemoglobin concentration significantly higher in mineral supplemented groups probably due to better interaction of trace minerals and utilization of dietary Fe because of supplementary Cu in the diet.

Serum biochemical profile

Among the different parameters on Serum biochemical profile only serum ALT level varied significantly (P<0.05) between control and treatment groups with a higher value in mineral mixture fed group in the initial period of the experiment (Table 4). Similar findings were also observed by Ashry *et al.* (2012). However, Karcagi *et al.* (2010) reported significant (P<0.05) increase in ALT level after

Table 4: Serum biochemical profile of cross bred animals under different dietary treatments

Parameter	0 day			P value	60 day			P value
	Control	**T_1**	**T_2**		**Control**	**T_1**	**T_2**	
Glucose (mg/dl)	50.30 ±5.74	50.51 ±5.19	52.33 ±5.90	0.679	43.80[a] ±3.23	56.00[b] ±3.50	60.91[b] ±5.69	0.04
Total Protein (g/dl)	6.77 ±0.66	6.55 ±1.15	6.67 ±0.54	0.497	6.47 ±0.62	6.60 ±1.01	6.75 ±0.44	0.087
Albumin (g/dl)	2.41 ±0.22	2.90 ±0.21	2.70 ±0.21	0.060	2.23 ±0.25	2.90 ±0.21	2.76 ±0.16	0.084
Globulin (g/dl)	4.37 ±0.46	3.66 ±1.05	3.97 ±0.34	0.744	4.25 ±0.42	3.70 ±0.89	3.98 ±0.28	0.710
Urea (mg %)	14.33 ±0.47	16.94 ±1.14	15.86 ±1.72	0.528	14.41 ±0.44	17.05 ±0.92	15.94 ±1.87	0.603
Cholesterol (mg/dl)	100.97 ±3.77	100.16 ±3.82	96.60[c] ±4.23	0.032	100.16 ±3.09	99.51 ±3.71	101.56 ±3.51	0.122
Triglyceride (mg/dl)	82.40 ±3.33	78.47 ±4.12	76.40 ±2.94	0.283	78.68[a] ±3.33	79.30[a] ±4.28	92.82[b] ±2.39	0.048
ALT (U/L)	14.12 [a] ±0.49	17.30[b] ±0.65	15.29[ab] ±0.53	0.086	13.99 ±0.45	15.12 ±0.47	15.19 ±0.66	0.110
AST (U/L)	72.60 ±1.07	70.28 ±1.97	71.44 ±2.12	0.117	72.72 ±1.20	73.47 ±2.50	71.81 ±0.99	0.102
ALP (U/L)	126.83 ±0.31	125.57 ±0.80	124.72 ±0.67	0.472	127.03 ±0.51	124.94 ±1.31	125.62 ±0.77	0.689

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

Table 5: Mineral profile of crossbred cattle under different dietary treatments

Parameter	0 day			P value	60 day			P value
	Control	T_1	T_2		Control	T_1	T_2	
Ca (mg/dl)	6.88 ±0.17	6.95 ±0.05	6.81 ±0.26	0.12	6.95^a ±0.17	7.94^b ±0.08	7.40^b ±0.18	0.04
P (mg/dl)	4.14 ±0.26	3.87 ±0.12	3.45 ±0.17	0.24	4.14^a ±0.26	5.37^b ±0.33	4.04^a ±0.28	0.02
Zn (ppm)	0.78 ±0.01	0.82 ±0.04	0.82 ±0.02	0.21	0.77^a ±0.02	1.53^b ±0.14	0.88^a ±0.03	0.01
Cu (ppm)	0.71 ±0.04	0.72 ±0.02	0.66 ±0.02	0.18	0.69^a ±0.02	1.24^b ±0.03	0.68^a ±0.02	0.01
Mn (ppm)	0.32 ±0.02	0.26 ±0.02	0.31 ±0.01	0.27	0.32^a ±0.02	0.58^b ±0.03	0.34^a ±0.04	0.01

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

Table 6: Distribution of conceived animals (heifers and cows) in different treatment groups

Attributes	Groups						Total	
	Control		T_1		T_2			
Number of disordered animals	20		20		20		60	
Type of disorder	An	RB	An	RB	An	RB	An	RB
	11	9	13	7	14	6	38	22
Total conceived	3		11		8		22	
Percentage of conception	15		55		40		36.66	

An – Anoestrus and RB – Repeat breeder

supplementation of bypass fat at 120gm/day starting from 25days pre-partum to 105 days post-partum.

At the end of the experiment Triglyceride content was significantly (P<0.05) higher in T_2 group (92.82) than that of T_1 group (79.30) and control group (78.68). Similarly trend of succession among the groups in comparison to control group was noticed in Glucose content too. On mineral supplementation group the minerals played active role either in the form of cofactor and/or activator of enzymatic systems associated with the metabolism of nutrients. Zn altered molar proportion of VFA in the rumen with an increase in propionate concentration resulting in increased glucose level in the plasma (Aliarabi and Chhabra, 2006). The blood glucose concentration was affected by energy status and reproductive efficiency of animals (Arosh *et al.*, 1998). The high blood glucose level increased progesterone production directly by increasing LH pulse and mean concentration of LH (Richards *et al.*, 1989) and indirectly by increasing blood insulin level which stimulated progesterone secretion from luteal cells (Mc Ardle and Holtfort, 1989). Lohrenz *et al*. (2010) who reported that plasma concentrations of glucose was not much affected in protected fat supplemented group than in non-supplemented group which might be due to glucose metabolism and hepatic gene expression related to gluconeogenic activity. Ferguson *et al.* (1990) have reported that there was no relationship between cholesterol concentrations in blood and reproductive measures. Lohrenz *et al*. (2010) reported that supplementation of bypass fat able to increase the triglyceride level in serum which favours our findings however the observation of Ramteke *et al.* (2014) reflected that non-significant increase in serum triglyceride level after bypass fat supplementation @ 100g/animal/day for 30 days. Other Haemato- biochemical parameter like total protein, albumin urea and ALP did not varied significantly among the groups.

Serum mineral profile

The serum calcium and phosphorus concentration at start of our experiment was found to be at 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) with paddy straw or wheat straw which are deficient of Ca and P (Table 5). Deficiencies in regards to other mineral profile like Cu, Zn, Mn also marked in the initial stage of the experiment. At sixty days of the experiment both macro and micro minerals studied in the start of the experiment was varied significantly ($p<0.05$) between the control and the treatment groups. The overall mean value of Ca, there were significant difference ($P<0.05$) observed in both the treatment group than control. But in case of P, Zn, Cu and Mn, there was higher significant ($P<0.05$) difference observed only in case of mineral supplemented group than control. The deficiency of minerals in the soil, feed and forage materials are directly reflected in the serum mineral profiles of the animals of that particular area. The results on mineral profiles indicated that only mineral supplemented group showed significantly higher serum mineral values except calcium than the control and other treatment groups. But bypass fat supplementation did not affect any change in the serum mineral profiles. This finding confirms the earlier observations of Samanta *et al.* (2005). Desai *et al.* (1982) reported that Cu has a significant role in maintaining the optimum fertility as it act as an indicator for FSH, LH and estrogens activity. Role of Cu in ovarian steroidogenesis through Cu superoxide dismutase activity was reported by Olson *et al.* (1999).

Reproductive performances

Out of 13 anoestrus animals in mineral supplemented group there were 10 (76.92 %) animals exhibited oestrus and 6 animals got conceived, Similarly, out of 7 repeater 5 animals got pregnant having overall percentage of conception in this group was 55% which also favours the findings of Shah *et al*. (2003). Out of 14 anoestrus animals in both bypass fat and mineral mixture supplemented group, only 10 (71.42 %) animals exhibited oestrus and 5 animals became pregnant and 3 became pregnant out of 6 repeater having 40% conception rate in this group (Table 6). Similar observations were also reported in confirmatory to our findings by Lopes *et al.* (2011). In the control group only 3 animals got conceived having 15% conception rate. The response of animals to various treatments confirmed that supplementation of mineral and by pass fat enhanced the conception rate of the animals (Mohapatra *et al.* 2012; Puvarajan and Vijayarajan, 2013).

CONCLUSION

Supplementation of mineral mixture at the rate of 50 g and bypass fat 100 g per animal per day enhanced the growth and conception rate in repeat breeding animals as well as eliminate the anoestrus problem in cross breed animals without any harmful effect.

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