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Effect of Supplementation of Mineral Mixture on Serum Mineral, Biochemical Profile of Punganur Calves

K.Vasudha, P. Kavitha*,J.V. Ramana, K.Jayasri and R. Venu
NTR College of Veterinary Science, Gannavaram-521102
Sri Venkateswara Veterinary University, Tirupati, India.
*Correspondence:kavitha.pathakamuri@yahoo.com

ABSTRACT

The aim of the present study was to know the effect of supplementation of mineral mixture on mineral and biochemical profile of Punganur calves at Livestock Research Station, Palamaner. Twelve calves of 3- 4 months age (39.2±1.41 kg) were selected, and initial serum analysis was done to know the deficit minerals. Macro minerals viz., Ca, P, Mg, Na, K and Cl and micro minerals viz., Fe, Cu and Zn were assessed. The animals were found to be deficit in Zn. A mineral mixture was prepared accordingly and fed to them for 90 days@ 10gm/animal/day. Serum mineral analysis showed a significant ($P<0.01$) increase in serum calcium and zinc levels whereas Mg, Na, K, Cl, Fe and Cu levels remained unaffected ($P>0.05$) upon supplementation of mineral mixture. Biochemical analysis showed a significant ($P<0.01$) decrease in serum glucose, creatinine,SGPT and LDL-C levels and significant ($P<0.01$)increase in BUN, HDL-C, SOD and catalase ($p<0.05$). No significant effect was seen in the levels of total protein, albumin, globulin, A/G ratio, SGOT, triglycerides, cholesterol, VLDL-C and MDA upon supplementation of mineral mixture. Based on the overall results of the study, it was concluded that supplementation of deficit minerals in the form of mineral mixture has positive effect on mineral, biochemical and health status of Punganur calves.

KEYWORDS: Mineral status, Biochemical profile, Mineral mixture supplementation, Punganur calves.

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INTRODUCTION

Punganur cattle is a dwarf breed of Indian cattle and are strong, hardy, drought resistant and are well known for their quality milk production with relatively high fat content compared to all other native cattle breeds and are rich in medicinal properties. Despite all these special characteristics, they were grossly neglected over the past decades due to their low milk production resulting in the erosion of its valuable germplasm (Bharathi et al., 2015). As Punganur breed is present only in Andhra Pradesh (AP) and is at the verge of extinction, measures need to be taken to conserve the breed and to increase the productivity and reproductive ability of the animal.

It is well known that the normal productive and reproductive functions in livestock are closely associated with nutritional status of animals. Apart from energy and protein, minerals are the other limiting factor for livestock production (Judson and McFarlane, 1998; Prasad and Gowda, 2005). Both excess and deficiency of minerals produce detrimental effect on the performance of livestock (Akhtar et al., 2009). Hence the present study was undertaken to know the serum mineral content and formulate mineral mixture for deficient minerals and to study the effect of mineral mixture supplementation on mineral biochemical and health status of Punganur calves.

MATERIALS AND METHODS

Selection, housing and feeding regimen of animals

The study was conducted by selecting twelve Punganur calves of 3- 4 months age (39.2±1.41kg) of LRS, Palamaner were selected to know the deficit minerals in serum and to prepare mineral mixture

accordingly for supplementation.The selected animals were housed in well-ventilated conventional sheds maintained in good hygienic conditions and were provided with good quality water, chopped green fodder and concentrate feed throughout the trial period. Feed and fodder were provided according to ICAR 2013 recommendations.

Serum Analysis

At the start and at the end of the experiment, serum and hemolysate were prepared for mineral, biochemical and antioxidant estimation. The serum samples were analysed for concentrations of minerals viz., Ca, P, Mg, Na, K, Cl, Fe, Cu, Zn and biochemical parameters like glucose, total protein, albumin, cholesterol, HDL-C, LDL-C, VLDL-C, triglycerides, BUN, SGOT, SGPT, creatinine by using diagnostic kits as per standard methods (Coral clinical systems and ERBA Diagnostics Mannheim GmbH).

The hemolysate prepared was used for estimation of antioxidants enzymes.Protein content of hemolysate was estimated by Lowry et al., (1951) using bovine serum albumin (BSA) as a standard. Superoxide dismutase activity (Misra and Fridovich,1972), Catalase activity (Beers and Sizer,1952) and MDA concentration (Niehaus and Samuelsson,1968) were estimated by traditional methods.

Identification of deficit minerals and mineral mixture preparation

Critical values of serum minerals were taken as 8.0 mg/dl for calcium, 4.5 mg/dl for phosphorus, 1.0 mg/dl for magnesium, 100 µg/dl for iron, 65 µg/dl for copper and 80µg/dl for zinc (McDowell, 1985). The normal range values of sodium, potassium and chloride levels in cattle are 132-152 mmol/l, 3.9-5.8 mmol/l and 97-111 mmol/l (Kaneko et al., 1997). Based on the comparison of preliminary serum mineral analysis at start of experiment (Table 1) with critical values, it was confirmed that, the selected animals were showing deficiency of zinc.

A mineral mixture was prepared by using horizontal ribbon type feed mixer using 50 parts of dicalcium phosphate, 25 parts of calcite, 2 parts of zinc sulphate and 23 parts of salt. The prepared mineral mixture was offered in concentrate feed to the 12 selected animals daily for 90 days @ 10 gm / animal /day.

Statistical analysis

Statistical analysis of the preliminary and final data was carried out according to the procedures suggested by Snedecor and Cochran (1994) through software version 23.0; SPSS 2015 by subjecting the data to paired t-test with a significance at $p<0.05$.

RESULTS AND DISCUSSION

Serum mineral profile

Serum macro and micro mineral content of selected Punganur calves before and after supplementation of mineral mixture is presented in Table 1. A significant increase ($p<0.01$) in serum calcium and zinc levels was noticed upon supplementation of mineral mixture. However, supplementation of mineral mixture showed no significant effect on serum phosphorous, magnesium, sodium, potassium, chlorine, iron and copper levels of calves.

Table 1. Effect of supplementation of mineral mixture on serum mineral status of Punganur calves

Parameter	Before supplementation	After supplementation
Calcium (mg/dl) **	10.5^{a} ± 0.25	11.6^{b} ± 0.33
Phosphorous (mg/dl)	6.19 ± 0.17	6.68 ± 0.28
Magnesium (mg/dl)	3.67 ± 0.16	3.72 ± 0.16
Sodium (mmol/l)	133 ± 2.74	137 ± 2.50
Potassium (mmol/l)	5.25 ± 0.21	4.76 ± 0.21
Chlorine (mmol/l)	109 ± 2.50	108 ± 1.33
Iron (µg/dl)	121 ± 3.91	122 ± 4.42
Zinc (µg/dl) **	71.5^{a} ± 2.54	104^{b} ± 3.94
Copper (µg/dl)	88.1 ± 2.05	101.6 ± 6.08

[ab]Values within a row bearing different superscripts differ significantly, *(P<0.05); **(P<0.01)

In agreement with the results of the present study, significant increase in serum calcium and zinc levels of cattle were reported by Tiwari et al., 2012 (P<0.05), Mohapatra et al., 2012 (P<0.01), Agrawalla et al., 2017 (P<0.05), Satapathy et al., 2016 (P<0.05), Meher et al., 2017 (P<0.05), Sahoo et al., 2017a (P<0.05), Sahoo et al., 2017b (P<0.05), Chaudhary and Patel 2019 (P<0.05), Joshi et al., 2020 (Ca: P<0.01; Zn: P<0.05) and Dutta et al., 2022 (Ca: P<0.05; Zn: P<0.01) with the supplementation of mineral mixture.

Serum biochemical profile

The effect of supplementation of mineral mixture on serum biochemical profile of Punganur calves is presented in the Table 2. A significant decrease (p<0.01) was observed in the serum levels of glucose, creatinine and SGPT and a significant increase (p<0.01) was observed in the serum levels of BUN upon supplementation of mineral mixture.

Table 2. Effect of supplementation of mineral mixture on serum biochemical profile of Punganur calves

Parameter	Before supplementation	After supplementation
Glucose (mg/dl) **	80.6^{b} ± 2.05	68.4^{a} ± 2.08
Total Protein (g/dl)	6.18 ± 0.19	6.27 ± 0.13
Albumin (g/dl)	2.30 ± 0.08	2.47 ± 0.06
Globulin (g/dl)	3.88 ± 0.21	3.76 ± 0.13
A /G ratio	0.62 ± 0.04	0.66 ± 0.03
BUN (mg/dl) **	16.5^{a} ± 0.72	21.4^{b} ± 0.75
Creatinine (mg/dl) **	1.03^{b} ± 0.05	0.83^{a} ± 0.02
SGPT (IU/L) **	31.5^{b} ± 1.62	26.3^{a} ± 1.11
SGOT (IU/L)	31.6 ± 1.00	32.7 ± 1.86

[ab] Values within a row bearing different superscripts differ significantly**(P<0.01)

Decrease in serum glucose levels in calves might be attributed to the fact that, as the development of rumen advances with the age of the calf, serum glucose levels are decreased and serum volatile fatty acids are increased (Mc Carthy and Kesler, 1956). The serum creatinine levels are good indicators of renal function. In agreement to the present findings, Das et al. (2016) and Satapathy et al. (2016) reported no significant effect on serum total protein content upon mineral mixture supplementation. On the other hand, a significant increase in serum total protein levels was reported Mohapatra et al. (2012), Ray et al. (2016), Sahoo et al. (2017a), Pandey et al. (2018) and Joshi et al. (2020) with the supplementation of mineral mixture. In conferment to the present findings, Sahoo et al. (2017a) and Chaudhary and Patel (2019) also reported no significant effect in serum albumin and globulin content upon mineral mixture supplementation. In contrary, Mohapatra et al. (2012) reported a significant (P<0.01) increase in serum albumin and globulin levels with the supplementation of mineral mixture.

Decreased (P<0.01) creatinine levels reflect effective and healthy kidney function. Chaudhary and Patel (2019) in contradiction to the present findings a significant (P<0.05) increase in serum creatinine levels and inline with the present findings reported significant (P<0.05) increase in serum BUN levels upon mineral mixture supplementation that might be due increased nutrient availability by supplementation of mineral mixture.

Decreased SGPT levels with the supplementation of mineral mixture indicates better liver health. In contrary, Gunjan et al. (2011) and Pandey et al. (2018) reported a significant (P<0.05) increase in serum SGPT levels. Gunjan et al. (2011) reported increased (P<0.05) and Ray et al. (2016) reported decreased (P<0.05) serum SGOT levels upon mineral mixture supplementation. However, Ray et al. (2016), Satapathy et al. (2016), Sahoo et al. (2017a) and Chaudhary and Patel (2019) found no significant difference in serum SGPT and SGOT levels with supplementation of mineral mixture.

Serum lipid profile

The effect of supplementation of mineral mixture on serum lipid profile of Punganur calves is presented in the Table 3. Supplementation of mineral mixture had no significant effect on serum concentrations of triglycerides, cholesterol and VLDL-C. A significant increase in the levels of HDL-C (P<0.05) and decrease in LDL-C (P<0.01) upon supplementation of mineral mixture was noticed.

In contradiction with the present findings, a significant (Pd"0.05) increase in serum triglyceride levels was reported by Sahoo et al. (2017a), and non-significant increase was reported by Chaudhary and Patel (2019). Similar findings with respect to cholesterol levels were reported by Gunjan et al. (2011), Ray et al. (2016), Satapathy et al. (2016), Sahoo et al. (2017a) and Pandey et al. (2018) and Chaudhary and Patel (2019). However, Mohapatra et al. (2012) and Joshi et al. (2020) reported a significant increase in the serum cholesterol levels with the supplementation of mineral mixture

Table 3. Effect of supplementation of mineral mixture on serum lipid profile of Punganur calves

Parameter	Before supplementation	After supplementation
Triglycerides (mg/dl)	75.4 ± 4.06	74.8 ± 2.86
Cholesterol (mg/dl)	116 ± 2.99	109 ± 2.45
HDL-C (mg/dl) *	45.4^{a} ± 1.49	51.6^{b} ±2.12
LDL-C (mg/dl) **	56.2^{b} ± 3.00	43.2^{a} ± 1.61
VLDL-C (mg/dl)	15.1 ± 0.81	14.9 ± 0.58

[ab] Values within a row bearing different superscripts differ significantly, *(p<0.05); **(p<0.01).

Significant increase in HDL-C and significant decrease in LDL-C with the supplementation of mineral mixture in the present study was supported by Sein and Latt (2014) who reported similar results with supplementation of calcium in humans. However, in contrary to the present findings, Sobhanirad and Naserian (2012) reported that supplementation of zinc had no significant effect on HDL-C and LDL-C levels of Holstein dairy cows. Increased HDL-C and lowered LDL-C in the present study might be due to improved antioxidant status as explained by Ayoub et al., 2022; Pal et al., 2010).

Anti-oxidant status

Antioxidant status of Punganur calves before and after supplementation of mineral mixture is presented in Table 4. Supplementation of mineral mixture has no significant (P>0.05) effect on MDA value. However, a significant increase (P<0.01) was noticed in SOD and catalase values upon supplementation of mineral mixture.

Table 4. Effect of supplementation of mineral mixture on antioxidant status of Punganur calves

Parameter	Before supplementation	After supplementation
SOD (U/mg protein) **	$22.7^{a} \pm 1.45$	$67.1^{b} \pm 4.18$
Catalase (U/mg protein) **	$1.77^{a} \pm 0.19$	$2.79^{b} \pm 0.36$
MDA (nmol/ml)	0.43 ± 0.02	0.42 ± 0.01

[ab]values within a row bearing different superscripts differ significantly, **(p<0.01).

Zn is an intracellular signalling molecule and plays an important role in antioxidant mechanism through number of proposed mechanisms (Powell, 2000). In corroboration to the present findings, Sobhanirad and Naserian (2012) and Kumar et al. (2021) also reported increased (P<0.05) SOD activity in zinc supplemented Holstein dairy cows and Hariana cattle compared to unsupplemented control group, respectively. Further, Parashuramulu et al. (2015) reported increased catalase (mmol/mg Hb) activity in buffalo calves supplemented with zinc compared to control. Therefore, in the present study, the increased activities of SOD and catalase with supplementation of mineral mixture may confirm the influence of Zn supplementation on the metabolic functions. In contrary to the present findings, Parashuramulu et al. (2015) and Ulutas et al. (2020) reported decreased MDA concentrations (µmol/mg Hb) upon zinc supplementation in buffalo calves and goats, respectively.

CONCLUSION

Based on the results of present study, it was concluded that supplementation of mineral mixture @ 10 gm / animal /day to Punganur calves not only improved mineral profile but also had positive effect on lipid and antioxidant profile. Thus, it may be concluded that supplementation of mineral mixture resulted in better health condition of the Punganur calves.

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