



ISSN: 2456-2912

VET 2024; 9(1): 1360-1363

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Received: 13-11-2023

Accepted: 14-12-2023

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## Status of calcium and phosphorous levels in pregnant and lactating crossbred cattle of Chittoor district, AP

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### Abstract

A study was conducted in 17 mandals of Chittoor district in Andhra Pradesh, to assess the level of calcium (Ca) and phosphorous (P) in randomly selected crossbred cattle which are at different stages of gestation and lactation. The average blood serum levels of cattle in Chittoor district is Ca (9.11mg/dl), phosphorus (5.41 mg/dl). Animals in majority of mandals in the present study are higher than the critical limits. Few mandals showed values below the normal range. The reasons could be attributed to lack of awareness among farmers in supplementation of Calcium and Phosphorus and mineral deficient soils. Systematic investigation of soils in the mineral deficient mandals would help in taking appropriate measures to provide area specific mineral mixtures as feed supplements.

**Keywords:** Calcium, phosphorous, crossbred cattle, blood serum

### Introduction

The economics and health of the animals are two major factors influenced by the field of mineral nutrition in livestock. It's notable that livestock in India typically receives minimal mineral and vitamin supplements, mainly common salt and calcite/dolomite powder (Garg *et al.* 2008) [1]. This is despite the well-established role of major minerals like calcium and phosphorus in regulating biological processes, growth, production and reproduction (Underwood and Suttle, 1999) [2]. Complicating matters, intensive farming practices have led to the depletion of essential mineral elements in soils across the country, causing imbalances in soil, plant and animal mineral content (Garg *et al.*, 2003) [3]. Consequently, the quantity of minerals available in forages may fall short of supporting optimal growth, milk production and reproductive health in animals (McDowell, 1992) [4]. The current study was initiated to assess the levels of macro minerals, such as calcium and phosphorus in crossbred animals from different mandals in Chittoor district, Andhra Pradesh, with the aim of identifying critical areas requiring special attention.

### Materials and Methods

#### Sampling Procedure

The present study was conducted in 17 mandals of Chittoor district. A total of 615 blood samples were collected from jugular vein of pregnant (305) and lactating (310) cross bred cattle in a sterile serum collection vacutainer by random sampling method and the serum was separated and stored at  $-4^{\circ}\text{C}$  in refrigerator till the analysis. The levels of serum calcium and phosphorous were estimated with the help of ERBA calcium OCPC kit and Gen X phosphorus kit, respectively, using Semi-automatic serum biochemical analyzer with spectrophotometer. In the current study, the calcium was analyzed in 615 samples whereas the phosphorus was analyzed in 513 samples.

#### Statistical analysis

The sample size from Puttur mandal was very less ( $n=2$ ) and hence this mandal was excluded for statistical analysis. Data pertaining to 16mandals was analyzed through one way ANOVA and correlation coefficients of the tested traits were also examined using bivariate correlations and expressed as Pearson's correlation coefficient by using SPSS version 26.

## Results

The descriptive statistics of the calcium & phosphorous levels in serum are presented in Table 1. Coefficient of variation percentage results illustrated that serum phosphorus level showed the more discrepancy from their mean when compared to Calcium.

The Mean  $\pm$  Standard error values of calcium of different mandals were shown in table-2. In the present study, the overall Mean  $\pm$  Standard error value of serum calcium was  $9.11 \pm 0.60$ . Bangarupalyam and Naglapuram mandals showed significantly ( $p < 0.05$ ) lower values of serum calcium whereas, GD Nellore, Kuppam, Vijayapuram, Tirupati and Srikalahasti mandals showed significantly higher values. The percentage of animals that showed lower calcium levels in Bangarupalyam and Naglapuram mandals were 60.6% and 48.1% respectively.

The Mean  $\pm$  Standard error values of phosphorus of different mandals were shown in table-3. In the present study, the overall Mean  $\pm$  Standard error value of serum phosphorus was  $5.41 \pm 0.06$ . Animals from Punganur mandal showed higher serum Phosphorous levels whereas, Bangarupalyam mandal showed lower levels. The percentage of animals that showed lower phosphorus levels in Bangarupalyam and Palamaner mandals were 41.6% and 41.2% respectively.

The overall incidence of subclinical form of hypocalcaemia and hypophosphatemia in periparturient crossbred cows was 20.55% and 9.98% respectively. The percentage of animals that showed subclinical hypocalcaemia were higher in Bangarupalyam (59.62%), Naglapuram (33.33%) and Satyavedu (33.33%) mandals and no animals showed lesser than normal reference Calcium values in mandals such as Nagari, Vijayapuram, Peddapanjani and Srikalahasti and were shown in table-4. Among all the mandals, Bangarupalyam had highest percentage of animals with subclinical hypophosphatemia (28.71%) followed by Chowdepalli mandal (18.52%). In the present study, weak but significant correlation was observed between Calcium and Phosphorous ( $r = 0.29^{**}$ )

## Discussion

In the present study, the values of serum calcium were within normal reference ranges in all the selected mandals of Chittoor district except in Bangarupalyam and Naglapuram mandals which showed higher percentage of animals with subclinical hypocalcaemia. The lower calcium and phosphorus levels in these mandals may be attributed to mineral-deficient soils and fodder, as well as a potential lack

of awareness about proper feeding practices among farmers in the region, as suggested by Garg *et al.*, (2009) [5]. Alternatively, the lower calcium levels in these areas could also be due to a higher number of selected animals being in the late gestation and early lactation period, aligning with findings of Patel *et al.*, (2017) [6]. On the other hand, the normal serum calcium levels in the remaining mandals may be attributed to the adoption of good feeding practices by farmers in those areas.

The average serum phosphorus levels in the present study were within normal reference ranges in all the selected mandals. But in mandals like Bangarupalyam, Palamaner and Peddapanjani had relatively higher percentage of selected animals are with below normal serum phosphorus levels. This variation may be due to differences in the ages and stages of pregnancy and lactation among the selected animals and these findings were in line with Hadzimusic and Krnic (2011) [7].

Calcium (Ca) and Phosphorus (P) play crucial roles in maintaining the health, production and reproduction of animals. Calcium is the most abundant macro mineral and is essential for various cellular functions in the animal's body. Phosphorus is necessary for the growth and cellular metabolism of microorganisms in the rumen. Together, these minerals contribute to bone formation. When there is a deficiency of calcium and phosphorus, it can lead to harmful effects on the health and production of animals, causing significant economic losses for farmers. Therefore, it's essential to maintain appropriate levels of these minerals in the animal's body. The results of the current study showed that all of the selected mandals in the Chittoor district, with the exception of two (Bangarupalyam and Nagari) had normal average serum calcium levels, while with regards to average serum phosphorous levels, though all mandals exhibited the normal values, the mandals like Bangarupalyam and Chowdepalli, contains relatively higher percentage of animals with subclinical hypo phosphatemia.

To address this issue, special attention is needed for these three mandals. This could involve providing area-specific mineral mixtures and raising awareness among farmers about proper feeding practices. Additionally, supplying calcium and phosphorus supplements to animals in these areas is recommended, especially since a higher number of animals in these mandals show signs of subclinical hypocalcaemia and subclinical hypophosphatemia. This approach aims to support the overall health and well-being of the animals and prevent economic losses for the farmers.

**Table 1:** Descriptive Statistics of Ca & Pin the blood serum of crossbred cattle, Chittoor

	Valid N	Mean	Standard deviation	Coefficient of variation (%)	Standard error
Calcium(mg/dl)	505	9.12	1.49	16.3	0.06
Phosphorous (mg/dl)	505	5.41	1.26	23.3	0.05

Normal physiological range of serum calcium is 8.0 - 11.0 mg/dL (Radostits *et al.*, 2007) [9] and serum phosphorus is 4-

6 mg/dl in young cattle and 6-8mg/dl in adult cattle (Noller *et al.*, 1977) [8].

**Table 2:** Average serum Ca concentrations in animals of different Mandals of Chittoor district

Name of the Mandal	Sample Size	Mean $\pm$ Standard Error	Range		% of individuals less than Normal range
			Minimum	Maximum	
Bangarupalyam	104	<sup>a</sup> 7.93 $\pm$ 0.09	5.31	11.40	*60.6
G D Nellore	25	<sup>b</sup> 9.65 $\pm$ 0.39	7.00	17.40	8.0
Palamaner	22	<sup>ab</sup> 8.90 $\pm$ 0.23	6.26	10.07	18.2
Kuppam	72	<sup>b</sup> 9.87 $\pm$ 0.20	5.85	15.10	11.1
Chowdepalli	29	<sup>ab</sup> 8.91 $\pm$ 0.26	5.10	11.00	27.6
Punganur	47	<sup>b</sup> 9.44 $\pm$ 0.16	6.80	12.50	12.8

Nagiri	28	<sup>ab</sup> 9.16±0.14	8.20	10.80	0.0
Vijayapuram	12	<sup>b</sup> 9.45±0.30	8.20	11.41	0.0
Peddapanjani	12	<sup>ab</sup> 9.19±0.26	8.06	10.80	0.0
Ramachandrapuram	17	<sup>ab</sup> 9.09±0.36	6.90	11.98	29.4
Chandragiri	40	<sup>ab</sup> 9.07±0.21	6.57	12.20	20.0
Tirupati	98	<sup>b</sup> 9.78±0.16	1.36	14.29	6.1
Srikalahasti	39	<sup>b</sup> 9.57±0.15	6.80	11.00	2.6
Yerpedu	20	<sup>ab</sup> 9.12±0.25	7.40	11.00	20.0
Satyavedu	21	<sup>ab</sup> 8.71±0.30	7.00	12.60	33.3
Nagalapuram	27	<sup>a</sup> 7.93±0.32	4.40	10.50	*48.1

Values bearing different superscripts in the column differ significantly ( $p < 0.05$ )

**Table 3:** Average serum P concentrations in animals of different Mandals of Chittoor district

Name of the Mandal	Sample Size	Mean ± Standard Error	Range		% of individuals less than Normal range
			Minimum	Maximum	
Bangarupalyam	101	<sup>a</sup> 4.47±0.11	2.17	9.42	28.7
G D Nellore	25	<sup>abc</sup> 5.34±0.3	2.30	9.00	12.0
Palamaner	17	<sup>ab</sup> 4.66±0.15	3.64	6.08	11.8
Kuppam	37	<sup>bc</sup> 5.66±0.18	3.68	8.00	8.1
Chowdepalli	27	<sup>abc</sup> 5.56±0.26	2.90	7.90	18.5
Punganur	41	<sup>c</sup> 6.14±0.2	2.70	7.70	7.3
Nagiri	28	<sup>abc</sup> 5.09±0.11	3.30	6.50	3.6
Vijayapuram	11	<sup>c</sup> 6.11±0.35	4.60	7.65	0.0
Peddapanjani	10	<sup>abc</sup> 5.13±0.49	3.84	9.19	0.0
Ramachandrapuram	17	<sup>abc</sup> 5.49±0.28	4.07	8.49	0.0
Chandragiri	32	<sup>abc</sup> 5.57±0.25	2.70	9.80	9.4
Tirupati	66	<sup>c</sup> 5.87±0.16	4.14	12.84	0.0
Srikalahasti	31	<sup>bc</sup> 5.73±0.12	4.33	7.10	0.0
Yerpedu	20	<sup>abc</sup> 5.59±0.19	3.80	7.80	5.0
Satyavedu	21	<sup>bc</sup> 5.72±0.29	3.20	8.40	4.7
Nagalapuram	27	<sup>c</sup> 5.91±0.18	4.40	7.60	0.0

Values bearing different superscripts in the column differ significantly ( $p < 0.05$ )

**Table 4:** Percentage of Cattle with subclinical hypocalcemia and Subclinical hypophosphatemia

S. No	Mandal	Calcium				Phosphorous			
		Total Samples	Samples with subclinical hypocalcemia	% of animals with subclinical hypocalcemia	Samples with clinical hypocalcemia	Total Samples	Samples with subclinical hypophosphatemia	% of animals with subclinical hypophosphatemia	Samples with clinical hypophosphatemia
1	Bangarupalyam	104	62	59.62	1	101	29	28.71	0
2	G D Nellore	25	2	8.00	0	25	3	12.00	0
3	Palamaner	22	4	18.18	0	17	2	11.76	0
4	Kuppam	72	7	9.72	1	37	3	8.11	0
5	Chowdepalli	29	7	24.14	1	27	5	18.52	0
6	Punganur	47	6	12.77	0	41	3	7.32	0
7	Nagiri	28	0	0.00	0	28	1	3.57	0
8	Vijayapuram	12	0	0.00	0	11	0	0.00	0
9	Peddapanjani	12	0	0.00	0	10	0	0.00	0
10	Ramachandrapuram	17	5	29.41	0	17	0	0.00	0
11	Chandragiri	40	8	20.00	0	32	3	9.38	0
12	Tirupati	98	5	5.10	1	66	0	0.00	0
13	Srikalahasti	39	0	0.00	0	31	0	0.00	0
14	Yerpedu	20	4	20.00	0	20	1	5.00	0
15	Satyavedu	21	7	33.33	0	21	1	4.76	0
16	Nagalapuram	27	9	33.33	4	27	0	0.00	0
	Total	613	126	20.55	8	511	51	9.98	0

Cows with serum concentration of calcium  $< 8-6$  mg/dL (sub-clinical hypocalcaemia),  $< 6$  mg/dL (Clinical hypocalcaemia), Phosphorous  $< 4-2$  mg/dL (Subclinical hypophosphatemia) and  $< 2$  mg/dL (clinical hypophosphatemia) (Radostits *et al.*, 2007, Reinhardt *et al.*, 2011) <sup>[9, 10]</sup>.

## Conclusion

Deficiency of major minerals like calcium and phosphorus may cause significant economic loss to the farmers by means of production, Reproduction and overall Health. The possible reasons for deficiency could be lack of awareness among farmers in supplementation of Calcium and Phosphorus and mineral deficient soils. Systematic investigation of soils in the mineral deficient mandals would help in taking appropriate measures to provide area specific mineral mixtures as feed

supplements, this study also conclude that there is high percentage of subclinical hypocalcaemia and subclinical hypophosphatemia, this will aim to prevent deficiency diseases in animals and economic losses for the farmers.

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