Indian J Physiol Pharmacol 2002; 46 (2) : 245–248

SERUM PROFILE OF CALCIUM, PHOSPHORUS AND MAGNESIUM IN CROSSBRED HEIFERS AS INFLUENCED BY GESTATION AND EARLY LACTATION+

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(Received on April 4, 2001)

Abstract : The serum profile of certain macroelements such as calcium, inorganic phosphorus and magnesium of healthy crossbred heifers in Kerala were estimated before and after conception, at different stages of pregnancy and early lactation. The serum concentration of calcium showed a decreasing trend during second trimester of pregnancy which attained significantly lower ($P<0.01$) value (5.57 mg/dl) when compared to controls. By the ninth month of pregnancy calcium level was elevated. The serum phosphorus level was significantly higher ($P<0.01$) during the fifth month of pregnancy (8.29 mg/dl) when compared to controls and then it was decreased by the 9th month of pregnancy. The serum magnesium level showed an increasing tendency to attain a peak value (2.55 mg/dl) by the 9th month of pregnancy which was significantly higher ($P<0.01$) when compared to the control. During the period of study no production diseases were encountered in the animals screened which indicated that the serum calcium, phosphorus and magnesium profile of these animals were at the optimum level.

Key words : crossbred heifers, gestation and lactation, serum macroelements, conception

INTRODUCTION

Minerals play an important role in the maintenance of various metabolic processes. According to the nutritional requirements of the minerals in the body, they are classified as macro and microelements. Accordingly, calcium, phosphorus, magnesium, sodium, potassium, sulphur and chlorine are considered as the macroelements. The requirement of minerals depends upon the age, level of production, interrelationship with other nutrients, breed, chemical form of elements and animal's adaptations. Meagre studies had been carried out in the crossbred cattle to evaluate the fluctuations in the mineral content of blood during pregnancy and lactation, which is a period of physiological stress for the animal (1, 2). No scientific information is available regarding the status of major

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+Part of M.V.Sc. Thesis submitted to Kerala Agricultural University by the first Author

elements like calcium (Ca), phosphorus (P) and magnesium (Mg) in the crossbred cattle of Kerala especially during pregnancy and early postpartum periods. Hence this study was assigned to elucidate the variations in the macroelement profile in the blood of crossbred heifers during different periods of pregnancy and early lactation.

METHODS

Twenty, healthy crossbred heifers in a single herd in Kerala Agricultural University – Cattle Breeding Farm, Thumburmuzhi were selected and maintained under standard managemental conditions. Ten ml of blood was collected in separate labelled clean vials from each of the twenty animals by jugular vein puncture in order to estimate the basal value (control group) of serum calcium, phosphorus and magnesium. The animals were inseminated during estrus and pregnancy was confirmed in 11 animals. Blood was then collected from the 11 animals at monthly intervals from third month to term (ninth month) and at first month of lactation. Serum was separated by centrifuging at 500 g for 10 minutes at various stages of experiment and stored at –20°C until the analysis was carried out.

The concentration of elements such as calcium and magnesium were estimated using Atomic Absorption Spectrophotometer – Perkin Elmer 2380. The serum inorganic phosphorus was analysed spectrophotometrically at 340 nm (3). Statistical analysis of the data were conducted using Paired 't' test (4).

RESULTS

The mean values of calcium, inorganic phosphorus and magnesium in the blood of non-pregnant (control), pregnant (3, 4, 5, 6, 7, 8 and 9 months) and early lactating crossbred heifers are shown in Table I.

TABLE I: The serum concentration of calcium, inorganic phosphorus and magnesium before and after conception and in early lactation in crossbred heifers.

Period / month of pregnancy	*Calcium (mg / dl)*	*Inorganic phosphorus (mg / dl)*	*Magnesium (mg / dl)*
Non pregnant (control)	7.33 ± 0.28^{a}	6.69 ± 0.45^{a}	1.32 ± 0.10^{a}
3	6.67 ± 0.30^{b}	7.66 ± 0.43^{ab}	1.55 ± 0.14^{ab}
4	5.76 ± 0.23^{c}	7.15 ± 0.49^{abc}	1.34 ± 0.16^{ab}
5	5.59 ± 0.16^{cd}	8.29 ± 0.51^{bc}	1.86 ± 0.27^{abc}
6	5.70 ± 0.37^{bcd}	6.31 ± 0.45^{acd}	2.18 ± 0.18^{cd}
7	6.26 ± 0.37^{abcd}	6.74 ± 0.31^{acde}	2.23 ± 0.12^{cde}
8	7.30 ± 0.12^{abe}	6.02 ± 0.26^{acdef}	2.45 ± 0.22^{def}
9	8.11 ± 0.35^{a}	6.66 ± 0.30^{abcdefg}	2.55 ± 0.24^{cdefg}
First month of lactation	7.47 ± 0.17^{abe}	6.20 ± 0.27^{acdefg}	2.41 ± 0.15^{cdefg}

Values bearing similar superscripts in the column did not differ significantly ($P<0.01$).

(i) Serum calcium

There was a great deal of fluctuation in the serum calcium level of crossbred heifers during various stages of pregnancy. Significant reduction ($P<0.01$) in the serum calcium level of heifers was noticed from the third to sixth month of pregnancy in comparision to control animals. Thereafter, the calcium level showed an increasing tendency and the maximum value was attained by the ninth month of pregnancy (8.11 ± 0.35 mg/dl). Then the value declined during the first month of lactation and attained a value of 7.47 ± 0.17 mg/dl.

(ii) Serum phosphorus

The serum inorganic phosphorus (Pi) concentration showed a gradual increase from the basal value of controls (6.69 ± 0.45 mg/dl) and reached a significantly higher ($P<0.01$) level by 5th month of pregnancy (8.29 ± 0.51 mg/dl). Thereafter a declining trend was noticed in the Pi levels as the concentration was lowered to 6.66 ± 0.30 mg/dl during 9th month of pregnancy which was lower than the basal value and the level further declined to 6.20 ± 0.27 mg/dl by first month of lactation.

(iii) Serum magnesium

Serum magnesium concentration showed a gradual leap from the basal value of controls (1.32 ± 0.10 mg/dl) and the value significantly ($P<0.01$) elevated by the second and third trimester of pregnancy. The peak level of magnesium was attained during the ninth month (2.55 ± 0.24 mg/dl) of pregnancy which was later reduced to 2.41 ± 0.15 mg/dl by first month of lactation.

DISCUSSION

In the present investigation, it was recorded that during the early stages of pregnancy there was a decline in serum calcium level, with a negative calcium balance. During this period the serum calcium concentration was negatively correlated with serum Pi, which showed higher values. This observation closely agreed with the findings of (5) who reported that levels of serum Ca and Pi were inversely correlated. The increasing trend of serum calcium recorded from 6th to 9th month of pregnancy agree with the report of (6) which could be attributed to an increased physiological demand when the fetation and organogenesis take place. The highest serum calcium level was recorded during ninth month of pregnancy as peak estrogen activity is encountered during this period.

In the present investigation, serum phosphorus showed a higher value during fifth month of pregnancy, which may be due to its requirement for fetal growth as explained by (7). The increase in serum phosphorus during ninth month of pregnancy may be due to the effect of higher levels of estrogen in the advanced stage of gestation, since estrogen is found to raise the blood level of phosphorus as reported by (8).

The increasing trend in serum magnesium level during early pregnancy which reached a maximum value by ninth month was in concurrence with an earlier observation made by (2) and this may be due to an increased gastrointestinal absorption of magnesium which was

required to meet the increased metabolic demands during pregnancy as reported by (9). Glycolytic enzymes like glucokinase, phospho-fructokinase, enolase and TCA cycle enzyme namely succinate thiokinase require magnesium as co-factor and thus magnesium being greatly related with carbohydrate metabolism.

In the present study all the three macroelements screened declined during early lactation due to an increased lactational demand of these minerals.

As far as production diseases of farm animals are concerned the major elements such as calcium, phosphorus and magnesium play a decisive role. It was reported (10) that during peripartum period, in exotic cattle with a serum calcium level of 2 to 5 mg/dl, magnesium level of 0.5 to 1.2 mg/dl, and phosphorus level of 1.5 to 3.0 mg/dl resulted in production diseases namely milk fever, grass tetany and downer syndrome. During the period of this study none of the above cited conditions were encountered in the experimental animals as the serum concentration of these minerals were higher than the values reported by (10). This indicated that the serum calcium, phosphorus and magnesium levels of these animals were at optimum in the body system and no subclinical deficiency was occurred reflecting a better managemental conditions in the farm.

ACKNOWLEDGEMENTS

Thanks are due to the Dean, College of Veterinary and Animal Sciences, Mannuthy and Kerala Agricultural University for the facilities provided for the work.

REFERENCES

1. Sahukar CS, Pandit RK, Chauhan RAS, Porwal ML. Electrolytes during various reproductive phases in crossbred cows. *Indian J Anim Sci* 1984; 54(10): 993–995.
2. Deshpande SM, Mantri AM, Talvelkar BA, Deshmukh BT. Studies on macroelements during gestation and early postpartum period in Gir and crossbred cows. *Indian J Dairy Sci* 1998; 51(5): 275–279.
3. Daly JA, Ertingshausen G. Direct method for determining inorganic phosphate in serum with the "centrifichem". *Clin Chem* 1972; 15: 263.
4. Snedecor GW, Cochran WG. Statistical Methods. 1994; 8th edition, Iowa State University Press, Ames, Iowa.
5. Harper HA. Review of Physiological Chemistry. 1969; 12th edn, Lange Medical Publications, Los Altos, California, 194–217.
6. Pathak MM, Janakiraman K. Blood serum calcium, inorganic phosphorus and magnesium at different stages of pregnancy in Surti buffaloes. *Indian J Anim Sci* 1987; 57(5): 398–402.
7. Patel BM, Memon GN, Mistry VV. Inorganic phosphorus, calcium and magnesium in the serum of Gir cattle. *Indian Vet J* 1966; 43: 795–800.
8. Hackett PL, Gazalar DW, Busted IK. Blood constituents in Suffolk ewe and lambs. *Am J Vet Res* 1957; 18: 338–343.
9. Sarmah BC, Kalita DJ, Bhattacharyya BN. Certain mineral profile and haemoglobin concentration in local non-descript and crossbred (NxJ) cattle. *Indian Vet J* 1999; 76: 291–293.
10. Blood DC, Henderson JA. Veterinary medicine. 1974; 4th edn. The English Language Book Society and Bailliere Tindall: 683–717.