

Influence of age and pregnancy on serum calcium, inorganic phosphorus and alkaline phosphatase activity in red Sokoto goats

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RÉSUMÉ

KUMARESAN (A.), NDZINGU AWA (D.). — Influence de l'âge et de la gestation sur l'activité de la phosphatase alcaline, le phosphore inorganique et le calcium du sérum chez la chèvre rousse Sokoto. *Rev. Elev. Méd. vét. Pays trop.*, 1984, 37 (4) : 477-481.

Cinquante-sept chèvres rousses Sokoto apparemment en bonne santé ont été divisées en 3 groupes suivant leur âge : groupe I moins de 1 an, groupe II de 1 à 2 ans, groupe III plus de 2 ans. L'estimation de l'activité de la phosphatase alcaline, du phosphore inorganique et du calcium a été faite à partir de prélèvements de sérums.

Les chèvres des groupes I, II et III avaient respectivement des teneurs en calcium de $11,43 \pm 0,58$; $11,38 \pm 0,47$ et $10,13 \pm 0,58$ mg/ml et des concentrations en phosphore inorganique de $6,93 \pm 0,40$; $7,40 \pm 0,39$ et $5,68 \pm 0,29$ mg/100 ml. Il n'y avait pas de différences significatives entre les 3 groupes pour les taux de phosphore et de calcium du sérum. L'activité moyenne de la phosphatase alcaline était respectivement de $25,42 \pm 3,86$; $54,64 \pm 14,77$ et $25,85 \pm 4,46$ unités de King et Armstrong.

L'activité enzymatique était significativement plus élevée chez le groupe II comparée à celle des deux autres groupes.

Le niveau enzymatique élevé peut être dû au plus grand nombre d'animaux en gestation présents dans le groupe II. La raison de ce taux élevé chez les chèvres gestantes n'est pas bien établi.

Mots-clés : Phosphatase alcaline - Phosphore inorganique - Calcium - Sérum - Age - Gestation - Chèvre rousse Sokoto - Nigeria.

SUMMARY

KUMARESAN (A.) and NDZINGU AWA (D.). — Influence of age and pregnancy on serum calcium, inorganic phosphorus and alkaline phosphatase activity in red Sokoto goats. *Rev. Elev. Méd. vét. Pays trop.*, 1984, 37 (4) : 477-481.

Apparently healthy red Sokoto goats with a total of 57 were divided into three groups as below one year, one to two years and above two years according to their age (groups I, II and III). Estimation of calcium, inorganic phosphorus and alkaline phosphatase activity were carried out on serum samples.

Goats in groups I, II and III showed calcium values as $11,43 \pm 0,58$, $11,38 \pm 0,47$ and $10,13 \pm 0,58$ mg per 100 ml respectively. Inorganic phosphorus concentrations were $6,93 \pm 0,40$, $7,40 \pm 0,39$ and $5,68 \pm 0,29$ mg per 100 ml in groups I, II and III respectively. There were no significant differences between three age groups on serum calcium and phosphorus levels. Mean alkaline phosphatase activity in groups I, II and III were $25,42 \pm 3,86$, $54,64 \pm 14,77$ and $25,85 \pm 4,46$ King-Armstrong units respectively. The enzyme activity was higher in group II which was significant when compared with other two age groups. High enzyme level may be due to more number of pregnant animals in group II. The reason for this enzyme rise in pregnant animals is not well established.

Key words : Alkaline phosphatase - Inorganic phosphorus - Calcium - Serum - Age - Pregnancy - Red Sokoto - Nigeria.

INTRODUCTION

Calcium and phosphorus are the two most important macroelements necessary for bone growth and its maintenance. Apart from bone

growth, calcium also functions in osmoregulation, muscle contraction, blood clotting and other vital processes in the animal body. Phosphorus occupies essential role in various aspects of absorption and energy metabolism

in addition to its contribution to the skeletal tissues (2, 6).

Alkaline phosphatase is present in nearly all tissues of mammalian body. Reasonably high enzyme concentrations are found in bone, especially in ossifying cartilage (4). This might have been derived from bone; therefore it is believed that the enzyme is associated with bone formation.

It is clear that calcium, phosphorus and alkaline phosphatase are interrelated, owing their function in bone formation. Young animals normally show higher osteoblastic activity because of their growth. Under normal circumstances one would expect higher concentrations of these substances in young animals than adults. Though there are basic reports on blood calcium, phosphorus and alkaline phosphatase levels of red Sokoto goats, they were not related to age and pregnancy. Therefore the present study was undertaken to correlate these three parameters according to their age and physiological status like pregnancy in red Sokoto goats.

MATERIALS AND METHODS

Apparently healthy red Sokoto goats with a total of 57 were divided according to their age as below one year, one to two years and above two years. Here after this will be referred as group I, II and III respectively. They were allowed to go out and graze on their own from 8 a.m. to 5 p.m. every day and housed at night. No feed supplements were given to these animals to imitate the natural condition. Blood samples were collected from jugular vein.

Sampling was done in February which is a dry season in Northern Nigeria. Serum was obtained from these samples after clotting and centrifugation at 3 500 rpm for 5 minutes. The supernatant (serum) was aspirated into plastic stoppered sample bottles and stored at -20°C until analysis.

Analytical procedure

Calcium was estimated in a flame photometer (GALLENKAMP) using the appropriate filter. Inorganic phosphorus was determined by the method of TAUSKY and SHORR (12). Measurement of alkaline phosphatase was carried out by a modified King-Armstrong method. The principle involved is the liberation of phenol from disodium phenyl phosphate through the catalysis of alkaline phosphatase. Thus the phenol evolved acts with a phenol substrate, 4-aminophenazone to give a coloured compound. The intensity of colour is proportional to the enzyme activity and measured photometrically using spectronic-20 (BAUSCH and LOMB). Statistical analysis was carried out by t-test according to the method shown in SNEDECOR and COCHRAN (11).

RESULTS

Mean values of serum calcium, inorganic phosphorus and alkaline phosphatase are presented in Table I. Goats in groups I, II and III showed mean calcium concentrations as 11.43 ± 0.58 , 11.38 ± 0.47 and 10.13 ± 0.58 mg per 100 ml respectively.

TABLE N°I-Serum calcium, inorganic phosphorus and alkaline phosphatase levels in different age groups of Red Sokoto goats
Mean \pm SE

Parameters	Age groups		
	Below one year (Group I)	One to two years (Group II)	Above two years (Group III)
Calcium mg/100 ml	11.43 ± 0.58 (n = 16)	11.38 ± 0.47 (n = 14)	10.13 ± 0.58 (n = 27)
Inorganic Phosphorus (mg/100 ml)	6.93 ± 0.40 (n = 16)	7.40 ± 0.39 (n = 14)	5.68 ± 0.29 (n = 27)
Alkaline Phosphatase (King-Armstrong Units)	25.42 ± 3.86 (n = 16)	54.64 ± 14.77 (n = 12)	25.85 ± 4.46 (n = 26)

n = Number of animals used.

TABLE N°II-Levels of significance of serum calcium, inorganic phosphorus and alkaline phosphatase concentrations among different age groups of Red Sokoto goats

Parameters	Below one year vs One to two years	Below one year vs Above two years	One to two years vs Above two years
Calcium	NS	NS	NS
Inorganic Phosphorus	NS	S*	S**
Alkaline Phosphatase	S*	NS	S*

NS = Not Significant ; S* = Significant (P < 0,05) ; S** = Highly significant (P < 0,01).

There was no significant differences between the three age groups. Inorganic phosphorus levels were 6.93 ± 0.40 , 7.40 ± 0.39 and 5.68 ± 0.29 mg per 100 ml in groups I, II and III respectively. Higher amounts of phosphorus were observed in group II than other two age groups. Therefore the values of group II was significantly different from other two age groups (Table II).

Regarding serum alkaline phosphatase activity, there was wide range in their levels in all the age groups. Mean values were recorded as 25.42 ± 3.86 , 54.64 ± 14.77 and 25.85 ± 4.46 King-Armstrong units in groups I, II and III respectively. Significant differences in the mean values occurred between groups I and II and also groups II and III (Table II). When the levels of calcium, inorganic phosphorus and alkaline phosphatase were compared between pregnant and non-pregnant goats, there was no significant difference (Table III).

DISCUSSION

Normally the concentrations of serum minerals would be higher in young than mature animals. This is mainly due to better absorption of minerals present in the diet. The absorption capacity decreases with age increase (1). In addition young animals need more minerals per unit of body weight than adults because of their growing stage. Higher levels of serum calcium and phosphorus were noticed in groups I and II than III (Tables I and II). MOLOKWU (9) showed the mean serum calcium and inorganic phosphorus values as 9.41 ± 2.20 and 6.39 ± 1.82 mg per 100 ml respectively in red Sokoto goats. Using the same breed, KUMARESAN *et al.* (8) observed normal amounts of calcium and phosphorus as 11.22 ± 0.74 and 7.48 ± 0.48 mg per 100 ml respectively. Our calcium values coincided with COLES (3) and KUMARESAN *et al.* (8)

TABLE N°III-Serum calcium, inorganic phosphorus and alkaline phosphatase levels of pregnant and non-pregnant Red Sokoto goats

Mean \pm SE

Parameters	Pregnant	Non-pregnant
Calcium mg/100 ml	$10,67 \pm 0,41$ (n = 30)	$10,13 \pm 0,87$ (n = 10)
Inorganic Phosphorus mg/100 ml	$6,28 \pm 0,30$ (n = 30)	$6,44 \pm 0,66$ (n = 10)
Alkaline Phosphatase (King-Armstrong Unit)	$35,93 \pm 6,62$ (n = 30)	$21,59 \pm 9,18$ (n = 9)

n = Number of animals used.

and was slightly higher than the values of MOLOKWU (9). Serum inorganic phosphorus levels were lower than those of COLES (3) and coincided with the values of KUMARESAN *et al.* (8) and fell in the range given by MOLOKWU (9). However, these values were higher than the values given by MOLOKWU *et al.* (10) for the same breed of goats.

GALATOV (5) indicated that the serum calcium and inorganic phosphorus levels dropped with increasing age in Merino ewes. Similar trend was seen in the present study too, but the differences were not significant. It should be emphasized that serum calcium and inorganic phosphorus levels vary with the type of feeding, stress connected with growth and complex biochemical processes taking place in the body (7).

Proper interaction is achieved between calcium and phosphorus in the body through the maintenance of an approximately constant ratio. When calcium/phosphorus ratio was calculated, the mean value was 1.66, which coincided with the ratio given by KUMARE-

SAN *et al.* (8), but higher than the values of MOLOKWU (9).

According to KUMARESAN *et al.* (8) alkaline phosphatase activity range was 0.78-14.04 with the mean of 3.91 Bessy Lowry Units [One Bessy Lowry Unit is approximately equal to 7 King-Armstrong units (3)]. When these values were converted to King-Armstrong units, they were lower than the ones obtained in the present study. Serum calcium, inorganic phosphorus and alkaline phosphatase activity were higher in group II, where more than 80 p. 100 of the animals were pregnant. This rise may be associated with foetal osteoblastic activity. Therefore it is necessary to study the changes in detail at different stages of pregnancy. Although there is some indication that serum alkaline phosphatase level increase with advancing pregnancy, this is not well established. There has been a lot of variation in methods, techniques, substrates and units in determination of enzyme activity. This has given rise to a wide variation of results and the comparison becomes difficult.

RESUMEN

KUMARESAN (A.), NDZINGU AWA (D.). — Influencia de la edad y de la gestación sobre la actividad de la fosfatasa alcalina, el fósforo inorgánico y el calcio del suero en la cabra roja Sokoto. *Rev. Elev. Méd. vét. Pays trop.*, 1984, 37 (4) : 477-481.

Se dividieron 57 cabras rojas Sokoto aparentemente en buena salud entre 3 grupos según la edad : grupo I menos de 1 año, grupo II de 1 a 2 años, grupo III más de 2 años. Se hizo la estimación de la actividad de la fosfatasa alcalina, del fósforo inorgánico y del calcio a partir de muestras de sueros.

Las cabras de los grupos I, II y III tenían respectivamente contenidos en calcio de $11,43 \pm 0,58$; $11,38 \pm 0,47$ y $10,13 \pm 0,58$ mg/ml y concentraciones de fósforo inorgánico de $6,93 \pm 0,40$; $7,40 \pm 0,39$ y $5,68 \pm 0,29$ mg/100 ml.

No había diferencias significativas entre los 3 grupos para los contenidos de fósforo y de calcio del suero. Era respectivamente de $25,42 \pm 3,86$; $54,64 \pm 14,77$; $25,85 \pm 4,46$ unidades de King et Armstrong.

La actividad enzimática era significativamente más elevada en el grupo II en comparación con la de otros grupos.

El nivel enzimático puede ser causado por el mayor número de animales en gestación presentes en el grupo II.

No se establece bien la causa de este nivel elevado en las cabras en gestación.

Palabras claves : Fosfatasa alcalina - Fósforo inorgánico - Calcio - Suero - Edad - Gestación - Cabra roja Sokoto - Nigeria.

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