Difference in trace mineral status among genetic groups of goats

Radhika G., Raghavan K.C., Ajithkumar S., Reghunandanan K.V., Alex R., Thomas N.

in

Ranilla M.J. (ed.), Carro M.D. (ed.), Ben Salem H. (ed.), Morand-Fehr P. (ed.).
Challenging strategies to promote the sheep and goat sector in the current global context

Zaragoza : CIHEAM / CSIC / Universidad de León / FAO
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 99

2011
pages 195-199

Difference in trace mineral status among genetic groups of goats

G. Radhika, K.C. Raghavan, S. Ajithkumar, K.V. Reghunandanan, R. Alex and N. Thomas

Department of Animal Breeding and Genetics, College of Veterinary and Animal Sciences, Mannuthy, Thrissur -680651, Kerala (India)

Abstract. University Goat & Sheep Farm, Mannuthy, Kerala, India, formed the venue for study. It houses pure-bred native breeds like Malabari & Attappady Black, along with Malabari crossbreds (Malabari with Saanen, Alpine and Boer). Major problems which the farm faced were increased kid mortality rate and ill thrift among adult animals, with lusterless hair coat and low productivity. Trace elements play an important role in many essential metabolic functions and trace mineral deficiency affects many vital systems in the body. At the beginning of the study, Malabari, Attappady Black and crossbred goats were tested for serum copper levels and their means with standard error were 53.80 ± 4.84, 44.00 ± 2.12 and 51.14 ± 3.67 µg/dl, respectively indicating marginal copper deficiency. Differences exist between individuals and between breeds regarding trace mineral status and their threshold levels in the serum. So the study was conducted with the objective of finding out the effect of genetic groups on the levels of trace minerals in the serum of goats of Kerala. After a ten month period of mineral supplementation with calcium, manganese, iodine, iron, zinc, copper and cobalt, at the rate of 0.6%, there was definite improvement in the productive and reproductive status of adult animals. Mineral estimation was done systematically among three different genetic groups, and it revealed that overall mean values of copper, iron, selenium and cobalt were 88.72 ± 6.83 µg/dl, 1.53 ± 0.18ppm, 25.02 ± 0.83 µg/dl and 1.33 ± 0.01ppm, respectively. Serum copper levels showed improvement with a mean value of 81.00 ± 4.75, 63.13 ± 7.75 and 117.70 ± 14.01 µg/dl in Malabari, Attappady Black and crossbreds, respectively. Statistically significant difference existed between genetic groups in the case of serum copper and selenium levels ($P<0.05$) indicating that tolerant breeds can be utilized for crossing with more susceptible ones to decrease the incidence of deficiencies and lessen the dependence on supplementation where problems are endemic.

Keywords. Goat – Malabari – Attappady Black – Trace mineral – Copper.

Différence concernant les niveaux d'oligo-éléments entre groupes génétiques de caprins

Résumé. *Cette étude a eu lieu dans le cadre de la ferme ovine et caprine de l'Université, à Mannuthy, Kerala, en Inde. Elle abrite des races pures autochtones telles que Malabari et Attappady Black, de même que des croisements avec Malabari (Malabari avec Saanen, Alpine et Boer). Les problèmes majeurs que la ferme rencontre sont un taux de mortalité accru des chevreaux et une mauvaise santé des animaux adultes, qui ont une robe terne et une faible productivité. Les oligo-éléments jouent un rôle important pour de nombreuses fonctions métaboliques essentielles, et leur carence affecte plusieurs systèmes biologiques vitaux. Au début de l'étude, les animaux Malabari, Attappady Black et croisés furent testés pour les niveaux de cuivre sérique et leurs moyennes, avec erreur-type, furent de 53,80 ± 4,84, 44,00 ± 2,12 et 51,14 ± 3,67 µg/dl, indiquant respectivement une carence marginale en cuivre. Des différences furent trouvées entre individus et entre races concernant les concentrations en oligo-éléments et leur niveau de seuil sérique. Ainsi l'étude fut menée dans l'objectif de découvrir l'effet des groupes génétiques sur les niveaux d'oligo-éléments sériques de caprins de Kerala. Après une période de dix mois de supplémentation minérale avec calcium, manganèse, iode, fer, zinc, cuivre et cobalt, selon un taux de 0,6%, il y eut une nette amélioration de la situation productive et reproductive des animaux adultes. Une estimation minérale fut systématiquement effectuée parmi trois groupes génétiques différents, qui révéla que les valeurs moyennes d'ensemble pour le cuivre, fer, sélénium et cobalt étaient de 88,72 ± 6,83 µg/dl, 1,53 ± 0,18 ppm, 25,02 ± 0,83 µg/dl et 1,33 ± 0,01 ppm, respectivement. Les niveaux de cuivre sérique montraient une amélioration, avec une valeur moyenne de 81,00 ± 4,75, 63,13 ± 7,75 et 117,70 ± 14,01 µg/dl chez les animaux Malabari, Attappady Black et croisés, respectivement. Il existait une différence statistiquement significative entre les groupes génétiques dans le cas des niveaux sériques de cuivre et de sélénium ($P<0.05$) indiquant que les races tolérantes peuvent être utilisées en croisement avec d'autres plus sensibles pour diminuer l'incidence des carences et réduire la dépendance de la supplémentation là où des problèmes endémiques existent.*

Mots-clés. *Caprins – Malabari – Attappady Black – Oligo-élément – Cuivre.*

I – Introduction

Goats commonly referred as "poor man's cow" form an important species of livestock in India. Their contribution to Indian rural economy, mainly in the form of meat and rarely milk is commendable. Out of 23 native breeds of goats in India, two main breeds namely Malabari and Attappady Black originated from Kerala – a small, but thickly populated South Indian State. Animal husbandry activities in Kerala are at present facing a setback due to competition in space and feed between humans and animals. At this juncture, goat rearing is gaining momentum among small scale farmers of Kerala. Present goat population in Kerala is 1,213,000 (Livestock Census, 2003) which contribute 1% of total goat population in India.

Malabari goats are medium sized, dual-purpose animals and their coat colour varies from white to black (Fig. 1). Both sexes have small, slightly twisted horns and medium sized ears directed outward and downward (Raghavan *et al*., 2004). Mixing of Jamunapari, Surti and Arab goats with the local goats of northern Kerala coast, centuries ago, led to the evolution of prolific and highly adapted Malabari breed (Kaura, 1952). Attappady Black, a meat type breed originated from the hilly terrains of Palakkad district of Kerala, is famous for its disease resistance and sturdy nature (Fig. 2). They are black in colour with bronze coloured eyes, and they are reared mainly for meat purpose (Stephen *et al*. 2005).

University Goat and Sheep Farm, Mannuthy, Thrissur acts as a nodal institution, for goat research and it supplies quality germplasm to farmers throughout the state. Foremost objective of the farm is genetic enhancement of purebred native breeds namely Malabari and Attappady Black. Malabari crossbreds (with Saanen, Alpine and Boer) are also maintained (Fig. 3) and their performances compared with purebreds. Objective of the present study was to find out the effect of genetic group on the levels of trace minerals in the serum of goats before and after mineral supplementation.

Fig. 1. Malabari doe with kid. Source: University Goat and Sheep Farm, Mannuthy.

Fig. 2. Attappady Black doe. Source: University Goat and Sheep Farm, Mannuthy.

Fig. 3. Crossbred doe. Source: University Goat and Sheep Farm, Mannuthy.

II – Materials and methods

Goats of three genetic groups of Kerala, namely, Malabari, Attapadi Black and crossbreds maintained in University Goat and sheep Farm, Kerala agricultural University, India were used for the investigation. The animals were reared under semi-intensive system of management with a minimum of four grazing hours per day. They were also provided with a concentrate feed at the rate of 250-500 g/head per day according to their physiological state. In spite of grazing, fodder grass was offered at the rate of 1 kg/head per day. Period of study extended from January 2008 to May 2009 and mineral supplementation with calcium, manganese, iodine, iron, zinc, copper and cobalt was provided at the rate of 0.6% (600 g of mineral mixture per 100 kg feed) from July 2008 to all animals irrespective of the genetic group.

Blood samples were collected at random before and after mineral supplementation, from three genetic groups. A total of 29 samples (11 from Malabari, 8 from Attapadi black and 10 from crossbred goats) were collected. The trace minerals in the serum of goats were estimated by Atomic Absorption Spectrometry and the results obtained were analyzed using analysis of variance method followed by Duncan's multiple range tests for comparison between groups as described by Snedecor and Cochran (1994).

III – Results and discussion

1. Copper deficiency in different genetic groups of goats

At the onset of study, i.e., during January 2008, animals in the farm showed unthriftiness and lusterless hair coat with change in hair colour (Fig. 4). Newborn kids showed weakness at around one week of age, which slowly progressed to ataxia, coma and death – if untreated. General health status of animals, along with infertility and kid mortality problem were suggestive of trace mineral deficiency in the farm. Affection of central nervous system like incordinated movements and change in hair colour suggested copper deficiency. According to Radostits *et al.* (2003) copper deficiency primarily occurs in young ruminants resulting in a range of clinical manifestations. Serum samples were tested at random to analyse copper levels. Blood testing for copper is only a second choice as they are the last to fall after depleting copper reserves in the liver. On practical terms, serum copper determination is important to confirm hypocupremia. Plasma copper levels of 49.90 µg/dl is indicative of low liver copper levels (Radostits *et al.*, 2003).

Fig. 4. Attappady Black goat with discoloured hair.
Source: University Goat and Sheep Farm, Mannuthy.

Five samples each of Malabari and Attappady Black goats and seven samples of crossbred animals were tested for copper levels and their means with standard error were 53.80 ± 4.84, 44.00 ± 2.12 and 51.14 ± 3.67 µg/dl respectively. Plasma copper concentrations less than 57 µg/dl is considered to be a good index of marginal deficiency (Radostits *et al.*, 2003) and less than 19 µg/dl indicates hypocupremia. There are wide variations in how individual animals respond clinically to lower trace elements in the body. The susceptibility to clinical cases may be a function of genetic difference with in a species, interrelationships with other trace elements and physiological stage at which they occur.

2. Comparison of genetic groups after mineral supplementation

During the month of July 2008, mineral supplements containing 0.08% of copper was started at the rate of 400 g mineral mixture mixed in 65 kilograms of feed (0.6%) and fed to goats according to its physiological need. After one year period of mineral supplementation, there was definite improvement in the productive and reproductive status of adult animals. Favourable therapeutic response after copper supplementation in affected goats, support the fact that copper deficiency is playing a central role in the development of disease (Smith and Sherman, 1994).After supplementation with mineral mixtures, mineral estimation was done systematically among three different genetic groups and the results are given in Table 1. The overall mean values of copper, iron, selenium and cobalt are presented in table 1 and the values were 88.72±6.83 µg/dl, 1.53 ± 0.18 ppm, 25.02±0.83 µg/dl and 1.33±0.01 ppm, respectively. Serum copper levels showed improvement with a mean value of 81.00 ± 4.75, 63.13 ± 7.75 and 117.70 ± 14.01 µg/dl in Malabari, Attappady Black and crossbreds, respectively (Table 1). There was significant difference between crossbred and the other two genetic groups as far as serum copper levels are concerned which agrees with the reports of Radostits *et al.* (2003) who suggested marked genetic differences in copper metabolism between breeds of sheep. Same management and nutritional factors existed for all three genetic groups in the farm, including same level of mineral supplementation. But serum copper levels could not be elevated beyond the minimum requirement level for Attappady Black goats. The use of ram belonging to a tolerant breed such as Texel, for crossing with Scottish Blackface could decrease the incidence of hypocuprosis on hill pasture (Wooliams *et al.,* 1986*)*. On the contrary, the breed difference did not remain constant throughout the study in case of goats of Oman (Osman *et al.,* 2003). There was no difference in the levels of various trace minerals including copper, cobalt and selenium determined in Eskisehir and Lalahan breeds in case of Angora goats (Yasar *et al.,* 2006).

Table 1. Values (mean ± S.E.) of copper, iron, selenium and cobalt in the three genetic groups

Trace minerals	Malabari	Attapadi Black	Crossbred	Overall mean
Copper(µg/dl)	81.00 ± 4.75[a]	63.13 ± 7.75[a]	117.70 ±14.02[b]	88.72 ± 6.83**
Iron (ppm)	1.48 ± 0.40	1.57 ± 0.12	1.55 ± 0.28	1.53 ± 0.18 [ns]
Selenium (µg/dl)	22.31 ± 1.09 [a]	24.33 ± 0.85 [a]	28.56 ± 1.43[b]	25.02 ± 0.83**
Cobalt (ppm)	1.31 ± 0.01	1.35 ± 0.01	1.35 ± 0.02	1.33 ± 0.01 [ns]

[ab] Values within a row with different superscripts differ significantly (P<0.05).
Source: University Goat and Sheep Farm, Mannuthy.

IV – Conclusion

In the present study, statistically significant difference existed between Crossbred with respect to Malabari and Attappady Black goats for serum copper and selenium levels ($P<0.05$). But no such significant effect was noted in the case of iron and cobalt. The existence of genetic variation in copper and selenium levels as indicated in this study could be used to prevent deficiencies and lessen the dependence on supplementation where problems are endemic.

Acknowledgements

The authors are thankful to the Dean, College of Veterinary and Animal Sciences for providing all the facilities. Thanks are due to Department of Nutrition and Radiotracer laboratory for the mineral analysis done.

References

Kaura R.L., 1952. *Indian Breeds of Livestock (including Pakistan Breeds).* Prem Publishers, Lucknow. pp 111-119.

Livestock, poultry, agriculture machinery implements and fishery statistics, 2003. *17th Livestock Census – All India Summary Report.* Government of India, New Delhi, 23 p.

Osman N.I., Johnson E.H., Al-Busaidi R.M. and Suttle N.F., 2003. The effects of breed, neonatal age and pregnancy on plasma copper status of goats in Oman. In: *Vet. Res. Commun.,* 27(3). p. 219-229.

Radostitis O.M., Gay C.C., Blood D.C. and Hinchcliff K.W., 2003. *Veterinary Medicine* (9th ed.) W.B. Saunders Publishers, pp. 1487-1502.

Raghavan K.C., Raja T.V. and Sasikanth V., 2004. Malabari Goats. In: Proceedings of Seminar on Goat genome. April 5-6, 2004. Central Institute for Research on Goats. Makhdoom, p. 101-104.

Smith M.C. and Sherman D.M., 1994. *Goat Medicine*. Lea-Febiger Publishers, USA, p. 538-539.

Snedecor S.W. and Cochran W.G., 1994. *Statistical Methods*. Eighth ed. Iowa State University Press, USA.

Stephen M., Raja T.V. and Sosamma I., 2005. Survey and characterization of Attappady Black goats of Kerala, India. In: *Animal Genetic Resources Information,* 37, p. 43-51.

Wooliams J.A., Wooliams C., Suttle W.F., Jones D.G. and Wiener G., 1986. Studies on lambs from lines genetically selected for low and high copper status. 2. Incidence of hypocuprosis on improved hill pasture. In: *Anim. Prod.* 43, p. 303-317.

Yazar E., Altunok V. and Eroglu T., 2006. Concentrations of some trace minerals in blood serum of Angora goats. In: *Med. Veter.*, 62, p. 1249.