PRELIMINARY INVESTIGATION OF HEMOGLOBIN AND TRANSFERRIN POLYMORPHISMS IN INDIGENOUS GOAT BREED (SALEM BLACK) OF TAMIL NADU

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Received: August 8, 2016; Accepted: August 25, 2016

Abstract: The present investigation has been undertaken to study the Hemoglobin and Transferrin polymorphisms in indigenous goat breed Salem Black of Tamil Nadu. A total of fifty blood samples from the adult male and female local breed of Salem Black goats were collected, among which 40 samples from Mecheri Sheep Research Station, Pottaneri, Salem and 10 samples from Institutional Livestock Farming Complex, VC&RI, Namakkal were collected. Polyacrylamide gel electrophoresis (PAGE) was used for visualizing hemoglobin and transferrin bands. Gene frequency was calculated using general formula of population genetics. Two variants of haemoglobin namely HbA and HbB and two allele of transferrin, namely TfA and TfB were observed.

Key words: Salem Black, Hemoglobin, Transferrin, Gene frequency

INTRODUCTION

Goat plays an important role in food production in developing countries. Their great popularity can be explained by their good adaptation to many different climates (Ecological adaptations). Tamil Nadu has two recognized goat breeds, the Kanni adu [1-3] and the Kodi adu [4]. Apart from these breeds of goat, Tamil Nadu has another goat breed, the Salem Black goat. The first two breeds have been well-known because of their dissemination, but the last one has lack of information. The Salem Black is an important meat goat breed in the north-western part of Tamil Nadu, India. The native tract of this breed is the Salem, Dharmapuri, Krishnagiri, Erode, Karur and Namakkal districts located in north-western agro-climatic zone of Tamil Nadu where the climate is generally hot, semi-arid and tropical in nature.

Study on goat breeding is very important to detect the genetic quality of the animals. The importance of goat quality is needed in order to select good performance of goat from a population [5]. Selection on a certain trait can be applied when base information on genetic variation of a population is available. Genetic variation has become the objective tool used for improving animal species [6]. One way to study this genetic diversity is by determination of genetic variability through polymorphism studies. Polymorphism in a population assures a pool of genetic variability, for if none exists, there would be no progress made through selection and breeding.

A number of blood protein systems have been found to exhibit heterogeneity in different species. Hemoglobin and Transferrin are the two important blood proteins. The gene frequencies of hemoglobin and transferrin types are thought to be related to
breeds and geographical distribution. According to Menrad et al. [7], hemoglobin and transferrin genotypes may have an influence on the performance of sheep and goat.

Hemoglobin molecule variants exist in the goats and they have been associated with the environment adaptability and productivity [8]. For example, it is reported that carriers of hemoglobin A have been responsible for significant resistance against helminth infections [8]. Di Stasio [9] suggests that this could be due to the better functional properties such as greater affinity for oxygen and higher hemoglobin concentration and packed cell volume. Similarly, transferrin polymorphism would give an idea for selecting breeding stock associated with the traits of economic importance once the polymorphism is elucidated in the local breeds. The Salem black is a well known breed of goat in the northern district of Tamilnadu region and adapted to hot humid climate. Electrophoretic study of blood hemoglobin will elucidate the variation in the breed. Unfortunately, there is limitation of study on genetic variation in indigenous goat breed. On the basis of that reason, study on genetic variation on indigenous breed of goat was conducted; hence identification of Hb types at different age group is essential for accessing the adaptability of the breed in the region.

MATERIALS AND METHODS

A total of fifty blood samples from the adult male and female local breed of Salem Black goats were collected, among which 40 samples from Mecheri Sheep Research Station, Pottaneri, Salem and 10 samples from Institutional Livestock Farming Complex, VC&RI, Namakkal were collected. The samples were further typed for hemoglobin and transferrin variants using vertical polyacrylamide gel electrophoresis (PAGE).

Five milliliters of whole blood was collected aseptically from jugular vein of each animal in centrifuge tubes containing heparin (5000 IU/ml) as anticoagulant. Immediately after collection, samples were labeled and transported in an ice-packed container to the laboratory. The whole blood was centrifuged; cell pellets were collected and washed with normal saline thrice. The cell pellet was diluted with distilled water (1:10). Fifteen microliters of the diluted cell pellet was loaded in the wells. Blood plasma was separated from blood cell by centrifugation on 3500 rpm at room temperature for 10 minutes. For analysis process, blood plasma and hemolysate was stored in -20˚C till processing.

Polyacrylamide gel electrophoresis (PAGE) was used for visualizing hemoglobin and transferrin bands. Eight per cent of the separating gel and five per cent of the stacking gel were used for the preparation of the polyacrylamide gel. Tris-glycine electrophoresis buffer was used. Fifteen microlitres each of the serum and hemolysate samples were loaded in the wells and electrophoresed at 85 V for two hours. The gel was stained with coomassie brilliant blue for 1 hour and was destained overnight in destaining solution.

RESULTS AND DISCUSSION

Studies on genetic variation through the polymorphism are often conducted to detect genetic differences within or between populations. The identification of the hemoglobin types in the sampled goats was detected with the migration speed of the protein types on the electrophoretic field from the start point towards the cathodal zone. Moving of gene structure in electrophoretic tool relates to molecular weight (MW). Small MW showed slow motion.

Haemoglobin polymorphism: The hemoglobin polymorphism in the Salem Black goats stood out by identification of two migration bands: the fast moving hemoglobin with thick band designated as HbAA type, two migration bands with the intermediate migration designated as HbAB type (Fig. 1) and the separate slow migrating thin band designated as HbBB which was not detected in our goat population.

Among 50 animals typed, 3 animals were of HbAA, 47 were of HbAB with a gene frequency of 0.53 and 0.47 with respect to HbA and HbB and no animals showed HbBB. This demonstrates that both the genes are near evenly distributed. The observation of absence of homologous HbBB types in Salem Black goat agrees with the report of Buvanendran et al. [10] in Red Sokoto breeds of goat. Johnson et al. [11] reported that it is not readily apparent while the BB phenotype is not widely distributed but Buvanendran et al. [10] considered that the
Fig. 1: One of slabs showing illustrating bands observed from electrophoresis

Table 1: Gene frequencies of hemoglobin variants in Salem Black goats

<table>
<thead>
<tr>
<th>Sex</th>
<th>No.</th>
<th>Genotype Frequency</th>
<th>Genotype Frequency</th>
<th>Chi square</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>AA</td>
<td>AB</td>
<td>BB</td>
</tr>
<tr>
<td>Male</td>
<td>10</td>
<td>1 (0.1)</td>
<td>9 (0.9)</td>
<td>0</td>
</tr>
<tr>
<td>Female</td>
<td>40</td>
<td>2 (0.05)</td>
<td>38 (0.95)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>3 (0.06)</td>
<td>47 (0.94)</td>
<td>0</td>
</tr>
</tbody>
</table>
disparity between the observed and expected frequency of certain phenotypes might be strong enough evidence of differential mortality. The study conducted by Canatan and Boztepe [12] in goats of Turkey, which revealed no HbBB phenotype, is also in agreement with the present study. The absence was attributed to the inability of the animals of HbBB phenotype to survive in rural regions of Toros Mountains. Bindu and Raghavan [13] suggested that the absence of homozygous HbBB in indigenous as well as exotic goats may be an indicative of either adaptive preference of HbAB or HbAA phenotype or species characteristic. The gene frequency of heterozygosity (HbAB) increased in the Salem black goat’s is in accordance with the report of Agaviezor et al. [14], who suggested that the trend of predominance decreases from the more humid, high altitude, rain forest breeds of goats to the dryer, low altitude regions of the Sahel zone. There is an indication that vegetation or climatic changes possibly affect Hb types.

The Chi square test (Table 1) revealed that the population as a whole was not in Hardy-Weinberg equilibrium. The deviation from hardy weinberg equilibrium might be connected with management system and mating pattern. HbA is reported to confer genetic resistance to helminth infection. The genotype frequency of HbAB is higher in both males and females. This may be an indicative of good selection to avoid inbreeding and also adaptive nature of breed or animals to the prevalent climate of the rearing area. The effects of HbAB and HbBB alleles on productive performance in sheep have been reported by several workers [15-17]. According to Hrinca [18], the genetic types of hemoglobin can be used to elucidate if a breed is indigenous in its area or it derives from different crossing systems among other domestic breeds. It is possible that sometimes, the profile of hemoglobin system in some goat breeds could be due to the reproduction isolation phenomenon [19].

Transferrin polymorphism: Two bands each were observed for transferrin in all the animals studied, revealing absence of polymorphism at transferrin locus (Fig. 1). The fast moving one was designated as TfA and slow moving band was designated as TfB in accordance with the nomenclature of Trehan et al. [20]. Transferrin is iron-binding blood plasma glycoprotein that controls the level of free iron in biological fluids [21]. Transferrin imbalance can have serious health effects for those with low or high serum transferrin levels. Fesus et al. [22] reported that majority of the goat breeds in the world have gene frequency of TfA more than that of TfB. Baruah and Bhat [23] reported predominance of TfB allele in gene frequency of Jamunapari and Barbari goats. In addition, many authors have reported the presence of more than two variants for transferrin alleles in goat’s viz. in Pashmina goats [24], Jhakrana, Kutchi, Marwari and Sirohi goats [25] and in West African goats [26].

CONCLUSION

The study revealed the slight prevalence of HbA alleles over HbB alleles. There were mostly heterozygotes (AB) than homozygotes. The HbAB predominant in the Salem Black goat could possibly have a direct or indirect relationship with their phenotype characteristics. The two transferrin bands namely TfA and TfB were prevailed on all samples indicating that no existence of polymorphism at Transferrin locus. The result of this study is however, subjected to some limitations being that the sample size for the analysis was rather too small due to time constraints as well as animal resources encountered during the course of this work. However, as this is a preliminary study, further work has to be carried out with an intensive study of large amount of data to correlate the production and reproductive traits with genotypic expression of Salem Black goats by employing more sophisticated methods.

REFERENCES


