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Original Article

Frequencies of the Transferrin Alleles and Genotypes in Red Sokoto Goats of Nigeria

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Abstract

The aim of this study was to determine the frequencies of Transferrin alleles and genotypes in Red Sokoto goat. The present study was conducted on 96 adult Red Sokoto goat, maintained in the Northern parts of Nigeria and transported to Bodija market in Ibadan. The polymorphism of transferrin was determined using Cellulose Acetate electrophoresis technique. It was found that the transferrin was controlled by three codominant alleles (*Tf*A, *Tf*B, *Tf*C) in Red Sokoto goats. These three alleles, because of the codominant nature of inheritance, control the occurrence of four transferrin genotypes in the analyzed flock. Two (*Tf*AA and *Tf*BB) of these were homozygous while the other two (*Tf*AB and *Tf*AC) were heterozygous. It was found that the *Tf*AB genotype (0.562) was predominant while *Tf*AC genotype (0.021) was least common in the analyzed flock. Frequencies of other genotypes were as: *Tf*AA (0.292) and *Tf*BB (0.125) for each genotype in the population. The heterozygote genotype frequency (0.583) was more than that of homozygote genotype (0.417). Considerable variations were observed in the frequencies of transferrin alleles. The frequencies of transferrin alleles were found to be *Tf*A = 0.583, *Tf*B = 0.406 and *Tf*C = 0.010. Transferrin system has showed genetic equilibrium in the analyzed population (χ^2 value = 4.414). The value of observed heterozygosity was 0.583 with average Fis value of -0.1795.

Keywords: Transferrin alleles, genotypes, Red Sokoto goat, polymorphism, Cellulose Acetate electrophoresis technique.

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Introduction

The importance of genetic diversity in livestock is directly related to the need for genetic improvement of economic traits as well as facilitates rapid adaptation to potential changes in breeding goals (Baker and Manuel, 1980). Studies of genetic diversity are useful to the understanding of evolution of breeds, gene pool development and the level of differentiation among breeds (Baker and Manuel, 1980; Blot *et al.*, 1998; Bennewitz and Meuwissen, 2005).

Several goat breeds have been evaluated for genetic variation based on morphological, physiological, pathological, productive, reproductive and behavioral features (Pourlis and Christodoulous 2008; Salako *et al.*, 2007). However, these are influenced by environmental factors. The gene frequencies of haemoglobin and transferrin types are thought to be related to breeds and geographical distribution (Guney *et al.*, 2003) and are used in studies of genetic variation within and between breeds.

Transferrin is ß-globulin which is characterized by its specific ability to reversibly bind iron and various other metal ions. Generally, it exhibits a high degree of polymorphism and belongs to the well studied systems in man and different animal species (Valenta *et al.*, 1976). Genetic studies on Transferrin polymorphism have been conducted in many countries and in different species, such as goats and sheep in China, Argentine, Japan and Nigeria (Nozawa *et al.*, 1978; Katsumata *et al.*, 1981; Chen *et al.*, 2009; Deza *et al.*, 2000; Akinyemi and Salako, 2012). Red Sokoto (Maradi) goat is a major breed found in Northern part of Nigeria, reputed for its high quality skin that is used in the leather industry locally and internationally (Akpa *et al.*, 1998). Several studies have been carried out on the phenotypic variation in goat breeds (Yakubu *et al.*, 2010); these traits are however under the influence of the environment and not a true reflection of the genetic constitution of these breeds. This paper is therefore aimed at describing the distribution of transferrin alleles and genotypes within the Red Sokoto goat of Nigeria.

Materials and Methods

Material

Ninety six (96) blood samples collected from adult Red Sokoto goats at the Bodija Sheep and Goat market were used as materials for this study. These goats were raised by farmers under traditional systems around the Northern part of Nigeria and brought to Bodija Sheep and Goat market for live sales and slaughter at the abattoir.

Sample Analysis

The blood samples were taken from jugular vein by using syringe. 5 ml of blood was drawn into tube containing Lithium Heparin as anticoagulant. Blood plasma was separated from blood cell by centrifugation at 3500 rpm at room temperature for 10 minutes. Blood plasma was drawn into labeled sample tube after centrifugation and stored in the freezer until tested.

Cellulose Acetate Electrophoresis was performed according to RIKEN (2006) with minor modifications. Band scoring was carried out to visualize the protein bands at the transferrin (*Tf*) locus. The Electrophoresis condition was as shown in table 1.

Table 1: Cellulose Acetate Electrophoresis Conditions for Transferrin.

Sample	Buffer	Time	pH	Voltage	Stain	Destain
0.6μl Plasma undiluted	Tris glycine	20 mins	8.5	150	Ponceau S	5% acetic acid

Statistical Analysis

Allelic variants or allozyme bands were marked in the order of increasing mobility, A being the allele with slowest mobility. Allele frequencies and genotypic frequencies were computed by direct gene counting method and tested for fit to Hardy-Weinberg (HW) ratios using $\chi 2$ goodness– of – fit test. The observed and expected heterozygosity (H_o and H_e) were calculated according to Nei (1973). All computations were performed using Popgene Programe (Yeh *et al.*, 1997) and Tools for

Population Genetic Analyses (TFPGA; Miller, 1997).

Results and Discussion

The results of allele frequencies of transferrin are presented in Table 2. Observation of the transferrin band in Red Sokoto goat showed that three codominant alleles were present at the transferrin locus; these are TfA, TfB and TfC. These three alleles controlled four genotype of transferrin (TfAA, TfAB, TfBB and TfAC) as autosomal codominant (Table 3). This result was parallel to the findings of Wang *et al.,* (1991) that reported the results of study in five breeds of goat in USA and found the TfA and TfB. In another study by Watanabe and Suzuki (1973) they found allele TfC which was the slow running allele. Güney *et al.,* (2003) in an experiment to detect haemoglobin and transferrin polymorphism in Damascus goats using starch gel electrophoresis reported that nine transferrin genotypes, namely Tf AA, AC, AD, BB, BC, BD, CC, CD and DD exists, in which C and D are the two common occurring allele at the β locus and A is the rare β-globulin variant. In this current study allele TfA was most frequently occurring in the studied population, whereas the allele TfC was the rare β-globulin.

The higher frequency of TfAB genotype observed in this study is similar to the frequency of TfAB genotype in the Italian Alpine goat, Sannen (Watanabe *et al.*, 1971), Bambari from India (Bhat *et al.*, 1982), Sannen from USA (Osterhoff, 1995).

Table 2: Allele Frequency and Fis of Red Sokoto goats at Transferrin Locus.

Allele	TF	*Fis
Allele A	0.5833	-0.2000
Allele B	0.4062	-0.1660
Allele C	0.0104	-0.0105
Total		-0.1795

*Wright's (1978) fixation index (Fis) as a measure of heterozygote deficiency or excess.

Wright' *F-statistics* (Table 2) result with average Fis of -0.1795 indicated excess of heterozygosity at the *Tf* locus in Red Sokoto population. The observed heterozygosity in this breed could be explained by overlapping generations, mixing of populations from different geographical locations, natural selection in favour of heterozygosity or subdivision accompanied by genetic drift (Toro and Mäki-Tanila, 2007).

Table 3: Genotype Frequencies and test of Hardy-Weinberg equilibrium at Transferrin locus in Red Sokoto Goats.

Genotypes	Frequencies	Obs. (O)	Exp. (E)	$(O-E)^2/E$
AA	0.292	28	32.5445	0.6346
AB	0.563	54	45.7382	1.4923
BB	0.125	12	15.7225	0.8814
AC	0.021	2	1.1728	0.5835
BC	0	0	0.8168	0.8168
CC	0	0	0.0052	0.0052
Chi-square test for Hardy-Weinberg equilibrium:				
Chi-square: 4.413766				
Degree of freedom: 3				
Probability: 0.220112				

Observed heterozygosity (*Ho = 0.5833*) and expected heterozygosity (*He = 0.4972*) values are presented in Table 4. The value of expected heterozygosity obtained in this study (0.495) indicated genetic variation in transferrin locus in Red Sokoto goats. By implication, selection

program if carefully planned and executed will result in genetic gain towards improved performance in the select populations. Chi-square test did not show significant differences between the observed and expected genotype values in the transferrin locus of Red Sokoto goat, this means that the Red Sokoto goat population is a random mating population.

Table 4: Expected homozygosity and heterozygosity at Transferrin locus.

Obs_Hom	Obs_Het	Exp_Hom*	Exp_Het*	Nei**	Ave_Het
0.4167	0.5833	0.5028	0.4972	0.4946	0.4946

* Expected homozygosity and heterozygosity were computed using Levene (1949).
** Nei's (1973) expected heterozygosity.

Conclusion

In this work we have demonstrated that Red Sokoto goat genetic diversity is still conserved. Three codominant alleles were identified (TfA, TfB and TfC) in the Red Sokoto goat. The Gene frequency of TfA was higher than that of TfB. Gene frequency and genotype frequency of transferrin were in Hardy Weinberg equilibrium. However, Fis values supported breed heterogeneity.

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