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Frequencies of the Transferrin Alleles and Genotypes in West African Dwarf Goats of Southwestern Nigeria

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Abstract

The aim of this study was to determine the frequencies of Transferrin alleles and genotypes in West African Dwarf (WAD) goat. 140 adult WAD goats, maintained in four Southwestern States of Nigeria were used in the study. The polymorphism of transferrin was determined using Cellulose Acetate electrophoresis technique. It was found that the transferrin was controlled by two codominant alleles (TfA and TfB) in WAD goats. These two alleles, because of the codominant nature of inheritance, control the occurrence of three transferrin genotypes in the analyzed populations. The first two (TfAA and TfBB) were homozygous while the third one (TfAB) was heterozygous. The TfAB genotype was predominant with frequency of 0.90, 1.00, 0.87 and 0.55 in Ogun, Ondo, Osun and Oyo States respectively with a mean frequency of 0.83±0.20 while TfBB genotype was least common except for population from Osun State with a frequency of 0.05, 0.00, 0.22 and 0.15 in Ogun, Ondo, Osun and Oyo States respectively with a mean frequency of 0.08±0.07. The frequencies of transferrin alleles were 0.50, 0.50, 0.45 and 0.58 for TfA and 0.50, 0.50, 0.55and 0.43 for TfB in Ogun, Ondo, Osun and Oyo States respectively with a mean frequency of 0.49±0.05. Transferrin system showed genetic equilibrium in the analyzed population ($\chi 2$ value = 1.780). The observed heterozygosity was 0.91, 1.00, 0.87 and 0.55 43 in Ogun, Ondo, Osun and Oyo States respectively with a mean frequency of 0.84 and average Fis value of -0.67.

Keywords: Cellulose Acetate electrophoresis technique, Genotypes, Polymorphism, Transferrin alleles, West African Dwarf goat.

Description of Problem

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 (3). Studies of genetic diversity are useful to the understanding of evolution of breeds, gene pool development and the level of differentiation among breeds (3, 4, 6). Several goat breeds have been evaluated for genetic variation based on morphological, physiological, pathological, productive, reproductive and behavioral features (15, 17). 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 (9) 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

(19). 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 (1, 7, 8, 10, 13). 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 (2). Several studies have been carried out on the phenotypic variation in goat breeds (23); 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 West African Dwarf goat of Southwestern states of Nigeria.

Materials and Methods

One hundred and forty (140) animals, twenty from each sampling area comprising Ijebu- Ode and Ado – Odo, (Ogun state), Ondo, (Ondo state), Ile –Ife, Osogbo and Iwo, (Osun state), and Ibadan, (Oyo state), were randomly selected. Blood was collected from each animal by jugular venipuncture and placed in heparinized tubes to prevent coagulation. Farmers raised these goats under traditional systems.

Sample Analysis

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 (16) 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 stain	5% acetic acid

Statistical Analysis

Allelic variants or allozyme bands were marked in the order of increasing mobility, allele A being the allele with the 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 square test ($\chi 2$ goodness– of – fit test). The observed and expected heterozygosity (*Ho* and *He*) were calculated according to (12). All computations were performed using Popgene Programe (24) and Tools for Population Genetic Analyses (11).

Results and Discussion

The results of allele frequencies of transferrin are presented in Table 2. Observation of the transferrin band in WAD goat showed that two codominant alleles were present at the transferrin locus; these are Tf^{A} and Tf^{B}. These two alleles controlled three genotype of transferrin (Tf^{AA}, Tf^{AB} and Tf^{BB}) as autosomal codominant (Table 3). This result was parallel to the findings of (20) that reported the results of study in five breeds of goat in USA and found the Tf^{A} and Tf^{B}. (9) 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 Tf^{AB} was most frequently occurring in the

studied population, whereas the allele Tf^{BB} was the rare β-globulin. The higher frequency of Tf^{AB} genotype observed in this study is similar to the frequency of Tf^{AB} genotype in the Italian Alpine goat, Sannen (22), Bambari from India (5), Sannen from USA (14). Wright' *F-statistics* (Table 2) result with average Fis of -0.6804 indicated excess of heterozygosity at the *Tf* locus in WAD goat 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 (18).

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

Alleles	Frequency	F_{IS}
TfA	0.51	-0.6804
TfB	0.49	-0.6804
Total		-0.6804

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

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

Genotype	Frequency	Obs. (O)	Exp. (E)	$(O-E)^2/E$
AA	0.09	09	30.1325	14.8207
AB	0.83	105	62.7349	28.4743
BB	0.08	11	32.1325	13.8982

Chi-square test for Hardy-Weinberg equilibrium:
Chi-square: 1.7799
Degree of freedom: 3
Probability: 0.619329

Table 4: Expected homozygosity and heterozygosity at Transferrin locus.

Obs_Hom	Obs_Het	Exp_Hom*	Exp_Het*	Nei**	Ave_Het
0.1600	0.8400	0.4981	0.5019	0.4999	0.4961

Observed heterozygosity (*Ho* =0.8400) and expected heterozygosity (*He* =0.5019) values are presented in Table 4. The value of expected heterozygosity obtained in this study (0.8400) indicated genetic variation in transferrin locus in WAD goats. By implication, selection programme if carefully planned and executed will result in genetic gain towards improved performance in the select populations. Chi-square test (1.7799) did not show significant differences between the observed and expected genotype values in the transferrin locus of WAD goat, this means that the WAD goat population is a random mating population.

Conclusion and Application

In this work we have demonstrated that:

1. WAD goat genetic diversity is still conserved.
2. Two codominant alleles were identified (TfA and TfB) in the WAD goat.

3. The Gene frequency of TfA was higher than that of TfB.
4. Gene frequency and genotype frequency of transferrin were in Hardy Weinberg equilibrium.
5. However, Fis values supported breed heterogeneity.

References

1. Akinyemi MO and Salako AE (2012). Genetic relationship among Nigerian indigenous sheep populations using blood protein polymorphism. *Agriculture Science Technology*, 4 (2): 107-112.
2. Akpa GN, Duru S and Amos TT (1998). Influence of strain and sex on estimation of within-age group body weight of Nigeria Maradi goats from their linear body measurement. *Tropical Agriculturist* 75: 462-467.
3. Baker CA and Manuel C (1980). Chemical classification of cattle. 1 Blood groups. *Animal Blood Group Bioche. Genetics*, 11: 127-150.
4. Bennewitz J, Meuwissen T.H.E (2005). A novel method for the estimation of the relative importance of breeds in order to conserve total genetic variance. *Genetic Sel. Evolution*, 37: 315-337.
5. Bhat PP, Santiago T and Sinha NK (1982). Blood potassium, sodium haemoglobin and transferrin polymorphism in Jumanapari goats. *Indian Journal of Animal Science*, 53(10): 1151-1152.
6. Blott SC, Williams JL and Haley CS (1998). Genetic relationships among European cattle breeds. *Animal Genetics*, 29: 273-282.
7. Chen CRJ, Yang ZP, Jr DJ, Qu DY, Li YL, Mao YJ and Huang DL (2009). Analysis of genetic polymorphism in six meat sheep breeds and genetic distance between them. *Czech Journal of Animal Science*, 54(10): 461-467.
8. Deza CGT, Pérez CN, Gardenal L, Varela M, Villar S Rubiales and Barioglio C (2000). Protein polymorphism in native goats from Central Argentina. *Small Ruminant Research*, 35: 195-201.
9. Güney O, Özuyanik O, Torun O, Görgülü M and Darcan N (2003). Relationship between some polymorphic parameters and performances in Damascus goats. *Pakistan Journal of Biological Science*, 6(8): 738-740.
10. Katsumata M, Nozawa K, Amano T, Shinjo A and Abe T (1981). Blood protein gene constitution of the Japanese Saanen breed of goat. *Japanese Journal of Zootech. Science*, 52: 553-561.
11. Miller MP (1997). Tools for population genetic analyses (TFPGA) Version 1´3: a Windows program for the analysis of alloenzyme and molecular population genetic data. Computer software distributed by the author.
12. Nei M (1973). Analysis of gene diversity in subdivided populations. *Proceedings of National Academy of Science*, 70: 3321-3323.
13. Nozawa K, Shinjo A and Shotake T (1978). Population genetic of farm animals. III. Blood protein variation in the meat goat in Okinawa Island of Japan. S. Z. Tierz ücht. Züchtgsbiol., 95: 60-67.
14. Osterhoff DR (1995). Studies on blood groups and biochemical polymorphism in goats. Blood Groups Biochemistry Polymorphism. pp. 553-561.
15. Pourlis AF and Christodoulous G (2008). Morphology of the hairs in the goat breed Capra Prisca, *Journal of Animal Veterinary Advances*, 7(9): 1142-1145.
16. RIKEN (2006). Genetic Quality Monitoring by Biochemical Isozymes. RIKEN Bioresource Center.
17. Salako AE, Ijadunola TO and Agbesola YO (2007). Haemoglobin polymorphism in Nigerian indigenous small ruminant

population–preliminary investigation, *African Journal of Biotechnology*, 6(22): 2636-2638.
18. Toro M and Mäki-Tanila A (2007). Genomics reveals domestication history and facilitates breed development. Edited by: Oldenbroek K. Utilization and Conservation of Farm Anim. Genet. Res., Wageningen, The Netherlands: 75-102.
19. Valenta M, Stratil 1A, Slechtovfi 1V, Kfilal 1L and Slechtat V (1976). Polymorphism of Transferrin in Carp (Cyprinus carpio L.): Genetic Determination, Isolation, and Partial Characterization. *Biochemistry Genetics*, Vol. 14. No. 1/2.
20. Wang SQ, Foote WC and Bunch TD (1991). Transferin and haemoglobin polymorphism in domesticated goats in USA. *Animal Genetics*, 22(1): 91-94.
21. Watanabe S and Suzuki S (1973). Studies on the transfer in of goats. III. Evidence for a third transferrin allele. *Animal Blood Group Biochemistry Genetics*, 4: 23-26.
22. Watanabe S, Nozawa K and Suzuki S (1971). Studies on transferrin of goats. I. Typing of transferrin of goat serum by starch gel electrophoresis, *Proceeding Japanese Academy*, 41: 326-331. pp.
23. Yakubu A, Raji AO and Omeje JN (2010). Genetic and phenotypic differentiation of qualitative traits in Nigeria indigenous goat and sheep populations.
24. Yeh F. C. and Yong, R. (1999). POPGENE version 1.31: Microsoft-based Freeware for Population Genetic Analysis. Univ. Alberta, Edmonton, Canada.