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Genetic distance between two popular Nigerian goat breeds used for milk production

A O Adebambo, Olufunmilayo Adebambo, J L Williams*, Sara Blott* and Barbara Urquart*

Dept of Animal Breeding and Genetics, University of Agriculture, Abeokuta, PMB 2240, Abeokuta Nigeria
tumininuadebambo@yahoo.com
** Roslin Institute, Midlothian EH25 9ps, Roslin, Scotland*

Abstract

A panel of 21 microsatellites markers selected from bovine and caprine was used to study diversity between the Maradi and West Africa Dwarf goat DNA as a preliminary study for sustainable milk production in South West Nigeria. All the 21 markers were successfully amplified by Polymerase Chain Reaction (PCR) and they were tested for polymorphism. The study showed that genetic distance between Western African Dwarf goat and Maradi was 0.39.

Key words: diversity, microsatellite, Maradi, West African Dwarf

Introduction

Livestock production is vital to subsistence and economic development (Winrock International 1992). The ever increasing demand for livestock production to cater for the nutritional needs of rapidly growing human population has led to indiscriminate crossbreeding in an effort to improve productivity. Nigeria has 53.8 million goat population (FAOSTAT 2009) which constitute an important source of milk and meat for local consumption and hide for export market.

The Maradi goat is especially noted for its good skin which serves as good economic return apart from being a good milk animal among the Nigerian Fulani cattle herdsmen. The economic importance of livestock in African farming systems increases with decreasing rainfall (Winrock International 1992). The Fulani herdsmen suffer an annual loss in production during the dry season, to sustain themselves and their animals there is an annual exodus to the southern part of Nigeria in search for pasture during the dry season. While some go back up north during the wet season; some have remained sedentary at the south. The need to stay down south has led to indiscriminate crossbreeding in order to keep and sustain the Maradi in the Southern Nigeria environment; a rain forest region prevailing in diseases like trypanosomiasis. To achieve sustenance the Maradi goat is crossed with the well adapted West African Dwarf goat which is indigenous to the southern Nigeria. This creates a new line of goats both good in milk production at same time trypanotolerant. Both goats are endowed with unique qualities such as water economy, heat tolerance, disease resistance, mothering and walking abilities, and the ability to efficiently metabolize low quality feeds (Muema *et al*. 2009). The present research studies genetic diversity of the Maradi and West African Dwarf goats and their crosses being used in sustainable milk production program in South Western Nigeria.

Material and methods

One hundred and thirty eight unrelated individual goats from two different breeds: Maradi (Mar) a Northern breed, West African Dwarf (WAD) a Southern (Forest zone) breed and crossbreeds of both were used to estimate the allelic frequencies of each microsatellite.

Plate 1. Maradi goats

Plate 2. West African Dwarf goats

The selection was random with at least 100km distance between selection points to maintain sampling of unrelated animals. DNA was prepared from 7ml blood collected into vacuteiner tubes, from the jugular vein of the animals.

Twenty one microsatellite markers used in this study were selected from bovine and caprine markers recommended by the International Society for Animal Genetics and Food and Agriculture Organisation (ISAG/FAO) advisory group on animal genetic diversity for use in chicken biodiversity studies (Hoffman *et al*. 2004).

PCR conditions

The PCR conditions were as described by ISAG/FAO recommendations (Hoffman *et al* 2004). Allelic frequencies were estimated from a panel of 61 Maradi, 43 West Africa Dwarf and 34 WAD x Mar cross animals. DNA was prepared from 7ml blood, transported to buffy coat in equal volume of Urea/Tris/EDTA to Roslin Institute for amplification and analyses.

PCR typing was carried out on 50ng of the genomic DNA in a 10µl reaction, comprising 10pM each of fluorescently labeled PCR primers, 1µl of PCR buffer (Amersham) 20µM each of dCTP, dGTP, dTTP and dATP, 0.5 units of Taq polymerase per reaction and 1.5-3.0 µl of $MgCl_2$ depending on the primer. The mixture was cycled on the Hybaid Omnigene thermal cycler with cycling conditions of 3 mins of initial denaturation at 93.5°C followed by 30 cycles at 94°C, 30 secs at annealing temperature of 50-65°C and 30 secs and final elongation at 72°C for 9 mind.

Multiplexing was carried out following the recommendations of the ISAG/FAO panel. Genotyping was carried out using the ABI 3730XL automated capillary sequencer using the Liz 500-350 internal lane size standard to size fractionate all amplified products. Allele size calling and binning was done with the aid of GeneMapper 3.5 (Applied Biosystems).

Results and Discussion

Table 1 show that the markers are all polymorphic and can be used to determine diversity in the goat breeds. Examples of disparate diversities are given by the microsatellites which were shown to be highly polymorphic with allele sizes ranging from 5 to 24 in the goats (Table 1). Haberfeld *et al* (1991) recorded an average number of alleles as 21.4 for sheep and Selvam *et al* (2009) recorded a range between 7 and 19 for Madras red sheep all indicating high polymorphism and heterozygosity. The microsatellite markers Hel 1, CSSM 66 and TGLA 53 showed high allelic numbers in the goats 24, 23 and 22 respectively.

Table 1. Range of alleles detected and allele numbers

S/N	Marker	Range	Allele No
1	ETH 225	148-158	10
2	INRA 35	114-120	6
3	ILST 5	129-194	11
4	ETH 152	191-203	5
5	ETH 10-2	203-213	8
6	INRA 63	164-185	10
7	INRA 5-2	137-145	7
8	HEL 9	96-104	5
9	HEL 1	103-165	24
10	CSSM 66	184-237	23
11	MM 12	91-119	22
12	ETH 3	98-126	16
13	BM 2113	124-148	15
14	BM 1824	171-180	10
15	CSRM 60	78-95	14

16	TGLA 122	132-146	12
17	SPS 115	237-252	6
18	BM 1818	252-272	17
19	INRA 37	109-149	18
20	TGLA 53	135-161	22
21	HAUT 27	137-151	15

Percentage heterozygosity among the goats range from 0.46-0.55. This is similar to the 0.51 recorded by Muniyandi *et al* (2009) for the water buffalo, *Bubalus bubalis.* The number of alleles and homozygosity are shown in Table 2.

Table 2. Number of alleles and heterozygosity for the goat breeds

Goat breeds	Maradi	West African Dwarf	Maradi X West African Dwarf
N	61	43	34
Allele no	10.6	6.52	3.57
Heterozygosity	0.46	0.55	0.49

Plotting the dendogram of these frequencies confirmed the divergence of these goat breeds (Figure 1) although with just 3-breeds under consideration, the bootstrap values could not be calculated. Nevertheless the ecological divergence of the breeds is still confirmed with the Western African Dwarf being genetically distant from the Maradi by the value of 0.39 (Table 3). Among some Spanish sheep breeds the percentage heterozygosity ranged from a minimum of 0.30 to a maximum of 0.89 (Arranz *et al* 2001) and were comparable with those observed in Garole sheep (Sodhi *et al* 2003) and Nilagiri sheep (Haris *et al* 2007).

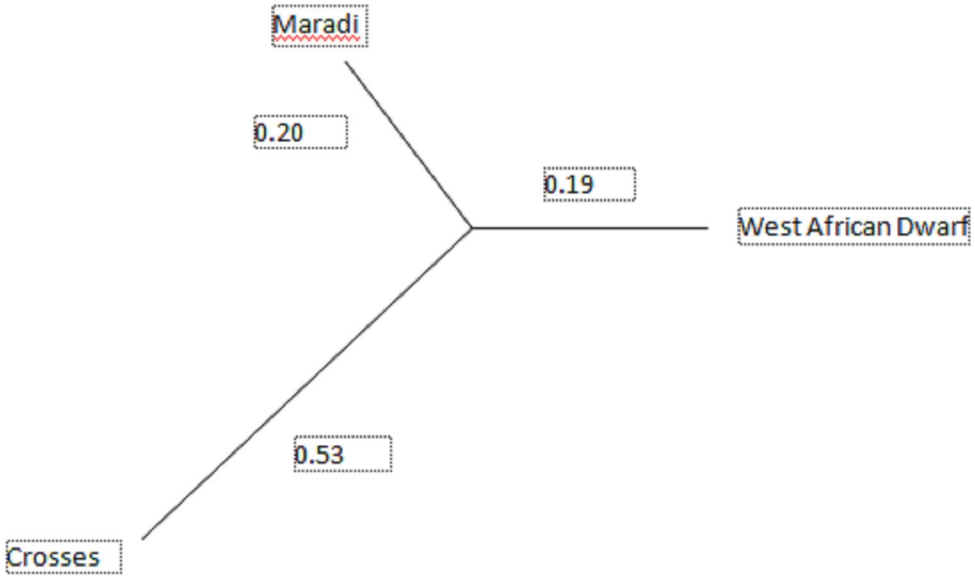

Figure 1. Genetic distance rooted trees (Cavalli-Sforza) among individual goats

Genetic diversity using microsatellite marker shows that crossing of these two goat breeds presents enough diversity to generate good heterotic advantage and combining abilities.

Table 3. Genetic distances between Nigeria's goat breeds

	Maradi	West African Dwarf
Maradi		
West African Dwarf	0.39	

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References

Arranz J J, Bayon Y and San Primitivo F 2001 Genetic variation at microsatellite loci in Spanish sheep. Small Ruminant Research 39: 3-10.

FAOSTAT 2009 Food and Agricultural Organization statistical databases.

Haberfeld A, Cahaner A, Yoffe O, Plotsky Y and Hillel J 1991 DNA fingerprints of farm animals generated by microsatellite and minisatellite DNA probes. Animal Genetics 22:3 pp 299–305.

Haris G, Sivaselvam S N, Karthickeyan S M K and Saravanan R 2007 Molecular characterisation of Nilagiri sheep (*Ovis aries*) of south India based on microsatellites. Asian-Australasian Journal of Animal Sciences 20: 633-637.

Hoffmann I, Marsan P A, Barker J S F, Cothran EG, Hanotte O, Lenstra J A, Milan D, Weigend S and Simianer H 2004 New MoDAD marker sets to be used in diversity studies for the major farm animal species: recommendations of a joint ISAG/FAO working group. In: Proceedings of 29th International Conference on Animal Genetics, Tokyo, Japan

Kemp S J, Brezinky L and Teale A J 1993 A panel of bovine, ovine and caprine polymorphic microsatellites. Animal. Genetics. 24: 363-365.

Muema E K, Wakhungu J W, Hanotte O and Jianlin Han 2009 Genetic diversity and relationship of indigenous goats of Sub-saharan Africa using microsatellite DNA markers. *Livestock Research for Rural Development. Volume 21, Article #28.* http://www.lrrd.org/lrrd21/2/muem21028.htm

Muniyandi Nagarajan, Niraj Kumar, Gopala Nishanth, Ramachandran Haribaskar, Karthikeyani Paranthaman, Jalaj Gupta, Manish Mishra, Vaidhegi R, Shantanu Kumar, Amresh K Ranjan and Satish Kumar 2009 Microsatellite markers of water buffalo, Bubalus bubalis - development, characterisation and linkage disequilibrium studies. BMC Genetics 2009, 10:68doi:10.1186/1471-2156

Selvam R, Rahumathulla P S, Sivaselvam S N, Karthickeyan S M K and Rajendran R 2009 Molecular genetic characterization of Madras Red sheep in Tamil Nadu, India using microsatellite markers. Livestock Research for Rural Development.Volume 21, Article #50. http://www.lrrd.org/lrrd21/4/selv21050.htm

Sodhi M, Mukesh M, Arora R, Tantia M S and Bhatia S 2003 Genetic structure of Garole- a unique Indian micro sheep assessed using microsatellite markers. Indian Journal of Dairy Science 56:167-173

Winrock International 1992 Assessment of animal agriculture in sub-Saharan Africa. Morrilton, Arkansas, USA.

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