

Genetic Characterization of Indigenous Goats of Sub-saharan Africa Using Microsatellite DNA Markers*

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ABSTRACT : Genetic diversity of sub-Saharan African goats was assessed using 19 microsatellite markers. Breeds were sampled from eastern Africa (Maasai, Kigezi, Mubende, North West Highland, Arsi-Bale), southern Africa (Ndebele, Pafuri) and West Africa (West African Dwarf, Maure, Djallonke). European breeds (Grisons Striped, Toggenburg), Asian breeds (Mongolian Cashmere, Bandipur) and a Middle East breed (Arab) were also included. The mean number of alleles per locus and average gene diversity ranged from 5.26±0.464 (Djallonke) to 7.05±0.516 (Mubende) and from 0.542±0.036 (Pafuri) to 0.672±0.031 (Ndebele), respectively. The between breeds variation evaluated using G_{ST} and θ were found to account for 14.6% (θ) and 15.7% (G_{ST}) of the total genetic variation. The D_{ST} measure of genetic distance between pairs of breeds indicated that the largest genetic distance was between Pafuri and Djallonke while the lowest genetic distance was between Arsi-Bale and North West Highland. A neighbour-joining tree of breed relationships revealed that the breeds were grouped according to their geographic origins. Principal component analysis supported the grouping of the breeds according to their geographic origins. It was concluded that the relationships of sub-Saharan African goat breeds were according to their geographical locations implying that the goats of eastern Africa, West Africa and southern Africa are genetically distinct. Within each sub-region, goat populations could be differentiated according to morphological characteristics. (*Asian-Aust. J. Anim. Sci.* 2004, Vol 17, No. 4: 445-452)

Key Words : African Goats, Within- and Between-breed Genetic Variation, Relationships Among Breeds

INTRODUCTION

The goats of sub-Saharan Africa can be divided into five major types (Mason and Maule, 1960; Rege et al., 1996): (i) The Long lop-eared goats of North-east Africa which includes the Sudanese Nubian and Sudanese Desert found mainly in northern Sudan, the Shukria of Eritrea and Ethiopia and the Benadir of Somalia; (ii) the Small short-eared goats which extend from Ethiopia and Somalia through East Africa up to Zimbabwe and some parts of South Africa; (iii) the Dwarf short-eared goats which are found along the coast of West and Central Africa; (iv) the

Sahelian and Intermediate goats found in the Savannah belt and (v) the Southern lop-eared goats found in southern Africa. In between these major types there are many intermediate and less distinguishable subtypes. The genetic relationships among the major types as well as the subtypes is unclear because their history (how they were established and if later on intercrossing occurred between the types) is not well documented. The considerable variation observed among the goat populations, in terms of size and coat colours has led to some inconsistencies in the classification of the various local populations into breeds/strains. Often the subtypes are named after locations or communities keeping them (Rege et al., 1996), for instances, goats kept by Somali and Maasai people of East Africa are called Somali and Maasai goats, respectively. This naming system may not reflect the genetic differentiation of the breeds. However, given the wide geographic area and the diversified climate and topography of the region, local populations in different places might have been isolated over a long period while also being subjected to varying selection pressures and genetic drift, thus have become genetically divergent. However, the extent to which various populations are different from each other is not clear.

In recent years, a range of innovations in molecular genetics have been developed for the study of genetic variation and evolution of populations using DNA marker genotype information. One of the recent DNA markers are microsatellites. The analysis of microsatellites is currently

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Buys, Jutta Roosen, Michèle Tixier-
Boichard, Paolo Ajmone Marsan**

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Sustainable Goat Production in Adverse Environments: Volume II João Simões, Carlos Gutiérrez, 2018-01-09 This book covers more than 40 indigenous goat breeds and several ecotypes around the globe and describes genotypic and phenotype traits related to species adaptation to harsh environments and climate change It also addresses sustainable global farming of local goat breeds in different production systems and agro ecosystems Discussing three main global regions Asia Africa and Europe it particularly focuses on adverse environments such as mountain semiarid and arid regions The topic of this highly readable book includes the disciplines of animal physiology breeding sustainable agriculture biodiversity and veterinary science and as such it provides valuable information for academics practitioners and general readers with an interest in those fields

Goat Science Sándor Kukovics, 2023-01-18 This volume provides a comprehensive overview of goat keeping and farming It includes twenty two chapters that address such topics as breeding and selection goat reproduction production systems the effects of goat farming on the environment the use of goat byproducts the economics of goat farming and much more

Sustainable Goat Production in Adverse Environments: Volume I João Simões, Carlos Gutiérrez, 2018-01-11 This book explores the current trends and challenges of sustainable goat meat and milk production in different global contexts providing valuable insights into this industry in adverse environments like mountain semiarid and arid regions It also includes contributions from international experts discussing goat reproduction genetic diversity and improvement as well topics such as animal health welfare socioeconomic aspects and many other issues regarding the environmentally friendly and economically viable exploitation of goats This is a highly informative book providing scientific insight for readers with an interest in sustainable agriculture and socio economic aspects as well as goat breed conservation genetic diversity and veterinary care These subjects are complemented in a second volume providing a detailed description of more than 40 indigenous goat breeds and several ecotypes found in Asia Africa Europe and America

Abstracts of MSc Theses Completed by ILRI Graduate Fellows International Livestock Research Institute, **African Livestock Genetic Resources and Sustainable Breeding Strategies** Eveline M. Ibeagha-Awemu, Sunday O. Peters, Appolinaire Djikeng, John E. O. Rege, 2025-12-02 This open access book is a rich resource that chronicles the abundant livestock genetic resources in Africa Organized in five sections the chapters trace special productive and adaptive attributes of African livestock breeds past breed improvement efforts capacity building and strategies to effective utilization of available genetic resources in the era of modern technologies The authors cover major farm animal groups as well as dromedaries rabbits and grasscutters In view of the UN Sustainable Development Goals in particular SDG 2 Zero Hunger and SDG 15 Life on Land the purpose of this volume is to catalogue opportunities that can be leveraged with available technologies and technical knowhow for achieving rapid genetic gain and improved livestock productivity in Africa It fosters the utilization of genetic resources and the protection of indigenous livestock biodiversity Natural selection and humans have generated genetically diverse breeds of

domesticated farm animals which can significantly contribute to the livelihoods of millions of Africans today Africa's indigenous livestock are particularly hardy and well adapted to local production contexts having evolved adaptations to the continent's diverse climatic conditions and environmental pressures In spite of the wealth of desirable genetic traits however some of Africa's iconic and lesser known livestock are disappearing at an alarming rate Moreover despite increasing recognition of what this diversity portends little has been done to understand and optimally harness the full potential of these genetic resources By combining scientific basis and practical instructions this work is a valuable manual for a diverse readership including students researchers livestock farmers livestock and non governmental organizations policy makers and business professionals who want to understand the uniqueness of African livestock genetic resources production systems and strategies for sustainable improvement for the African environment

Review of goat research and development projects in Ethiopia Solomon, A.K., Grum, G., Haile, A., Rischkowsky, B.A., Solomon, G., Dessie, T., 2014-08-15 **Advances**

in Farm Animal Genomic Resources Stéphane Joost, Michael W. Bruford, Ino Curik, Juha Kantanen, Johannes A.

Lenstra, Johann Sölkner, Göran Andersson, Philippe V. Baret, Nadine Buys, Jutta Roosen, Michèle Tixier-Boichard, Paolo Ajmone Marsan, 2016-01-28 The history of livestock started with the domestication of their wild ancestors a restricted number of species allowed to be tamed and entered a symbiotic relationship with humans In exchange for food shelter and protection they provided us with meat eggs hides wool and draught power thus contributing considerably to our economic and cultural development Depending on the species domestication took place in different areas and periods After domestication livestock spread over all inhabited regions of the earth accompanying human migrations and becoming also trade objects This required an adaptation to different climates and varying styles of husbandry and resulted in an enormous phenotypic diversity Approximately 200 years ago the situation started to change with the rise of the concept of breed Animals were selected for the same visible characteristics and crossing with different phenotypes was reduced This resulted in the formation of different breeds mostly genetically isolated from other populations A few decades ago selection pressure was increased again with intensive production focusing on a limited range of types and a subsequent loss of genetic diversity For short term economic reasons farmers have abandoned traditional breeds As a consequence during the 20th century at least 28% of farm animal breeds became extinct rare or endangered The situation is alarming in developing countries where native breeds adapted to local environments and diseases are being replaced by industrial breeds In the most marginal areas farm animals are considered to be essential for viable land use and in the developing world a major pathway out of poverty Historic documentation from the period before the breed formation is scarce Thus reconstruction of the history of livestock populations depends on archaeological archeo zoological and DNA analysis of extant populations Scientific research into genetic diversity takes advantage of the rapid advances in molecular genetics Studies of mitochondrial DNA microsatellite DNA profiling and Y chromosomes have revealed details on the process of domestication on the diversity retained by breeds

and on relationships between breeds However we only see a small part of the genetic information and the advent of new technologies is most timely in order to answer many essential questions High throughput single nucleotide polymorphism genotyping is about to be available for all major farm animal species The recent development of sequencing techniques calls for new methods of data management and analysis and for new ideas for the extraction of information To make sense of this information in practical conditions integration of geo environmental and socio economic data are key elements The study and management of farm animal genomic resources FAnGR is indeed a major multidisciplinary issue The goal of the present Research Topic was to collect contributions of high scientific quality relevant to biodiversity management and applying new methods to either new genomic and bioinformatics approaches for characterization of FAnGR to the development of FAnGR conservation methods applied ex situ and in situ to socio economic aspects of FAnGR conservation to transfer of lessons between wildlife and livestock biodiversity conservation and to the contribution of FAnGR to a transition in agriculture FAnGR and agro ecology

Genetic Analysis of a Crossbreeding Experiment Using Improved Dairy Goat Breeds and Native Goats in a Dry Tropical Environment Omar Jose Garcia Betancourt,1981 The main objectives of the present study are to investigate differences between the native goat in Venezuela and its crosses with Nubian Alpine and Toggeburg breeds and attempt to identify and measure genetic sources of the differences to study the degree of importance of environmental effects on productive and reproductive traits of the local breed and its crosses to make recommendations on the orientation for genetic improvement of the local in Venezuela

Why Livestock Genomics for Developing Countries offers Opportunities for Success Farai Catherine Muchadeyi,Eveline M. Ibeagha-Awemu,Johann Sölkner,Ardeshir Nejati Javaremi,Gustavo Augusto Gutierrez Reynoso,Joram Mwashigadi Mwacharo,Max F. Rothschild,2020-12-14 This eBook is a collection of articles from a Frontiers Research Topic Frontiers Research Topics are very popular trademarks of the Frontiers Journals Series they are collections of at least ten articles all centered on a particular subject With their unique mix of varied contributions from Original Research to Review Articles Frontiers Research Topics unify the most influential researchers the latest key findings and historical advances in a hot research area Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers Editorial Office frontiersin.org about contact

Mason's World Encyclopedia of Livestock Breeds and Breeding, 2 Volume Pack Valerie Porter,Lawrence Alderson,Stephen J.G. Hall,D. Phillip Sponenberg,2016-03-09 Mason s World Encyclopedia of Livestock Breeds and Breeding describes breeds of livestock worldwide as well as a range of breed related subjects such as husbandry health and behaviour This definitive and prestigious reference work presents easily accessible information on domestication including wild ancestors and related species genetics and breeding livestock produce and markets as well as breed conservation and the cultural and social aspects of livestock farming Written by renowned livestock authorities these volumes draw on the authors lifelong interest and involvement in livestock breeds of the world presenting a unique comprehensive and fully cross referenced guide to

cattle buffalo horses pigs sheep asses goats camelids yak and other domesticants Proceedings of the 6th World Congress on Genetics Applied to Livestock Production, January 11-16, 1998, 1998 *Genetic Characterization of Indigenous Goat Populations of Mozambique* Carmen Maria Lucas Pedro Garrine, 2005 Genetic characterization of Mozambican goats was done using microsatellites markers The genomic DNA from 160 unrelated animals from 4 provinces was extracted and PCR amplified with a panel of 17 microsatellite markers PCR amplifications were visualized using 5% polyacrylamide gel electrophoresis on an ABI 377 automated sequencer The data was captured using Genescan 3.1 software and data analysis was carried out using Genotyper 2.0 to determine the fragment sizes in base pairs The microsatellites chosen in this study amplified well in goats Allele frequencies ranged from 0.010 to 0.99 for any specific microsatellite Alleles unique to certain populations were observed with Pafuri goats showing the highest number 13 with allele frequencies ranging from 0.013 to 0.307 The MNA ranged from 5.59 in the Tete population to 6.94 in the Pafuri population within all individuals The observed heterozygosity H_o values ranged from 53% for the Maputo population to 59% for the Pafuri population The average observed heterozygosity estimate for all populations was 56% The genetic distance estimates of Nei 1972 were used and ranged from 0.037 to 0.205 The greatest genetic distance was observed between the Maputo and Pafuri populations The highest gene flow 8.36 was observed between the Tete and Maputo populations 84.38% of populations studied were correctly assigned to their original population The results indicate that the Pafuri and Cabo Delgado populations are the most distinct within all the Mozambican goat populations There is sufficient genetic variation within Mozambican goat populations with distinct genetic differentiation between the Cabo Delgado and Pafuri goats and the Maputo and Pafuri goats which suggests that they are really different breeds *Genetic Characterization of Indigenous Goat Populations of Ethiopia Using Microsatellite DNA Markers* T. A. Tucho, 2004 7 Conférence Internationale Sur Les Caprins, 2000 VI International Conference on Goats, 1996 **Genetic Characterization and Diversity Analysis of Indigenous Goat Populations of North Eastern on India** Pushpraj Shivahre, 2016 DARE/ICAR Annual Report India. Department of Agricultural Research and Education, 2012 Proceedings, 1998 New technologies for the production of Next Generation feeds and additives Food safety in veterinary science Recent advances in animal genome and genetic resources for efficient animal production Role of water buffaloes in producing foods Efficient animal production systems in harsh environments *Tropical Agriculture*, 2011 *Public Investment Plan* Uganda, Uganda. Ministry of Finance and Economic Planning, 2004

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