



# Genetic diversity and population structure analysis of native and crossbred goat genetic groups of Kerala, India



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## ABSTRACT

Goats are rightfully recognized as an important livestock species, mainly due to their high prolificacy, ecological adaptation and acceptance of goat products by all communities. Kerala has two native breeds of goats namely Attappady Black and Malabari. These autochthonous breeds, along with Malabari crossbreds, revealed great phenotypic diversity. Six goat populations namely, Attappady Black (AB), Malabari crossbreds (CB), Malabari populations of Kannur, Calicut, Thrissur and Malappuram districts (MK, MC, MT and MM) were analysed for genetic diversity using microsatellites. Ten microsatellite markers were chosen from FAO-ISAG panel and amplified from genomic DNA by multiplex PCR using fluorescent labeled primers. Observed number of alleles, Polymorphic Information Content and expected heterozygosity were high revealing high genetic diversity. Low  $F_{ST}$  values ( $0.02 \pm 0.004$ ) indicated that only two per cent of total genetic variability was attributed to between population variations, whereas 98 per cent was due to within population differences. Structure analysis revealed the presence of three underlying clusters, with AB and CB showing fewer admixture whereas Malabari goats showed greater admixture with less differentiation between subpopulations. Bottleneck analysis revealed typical L-shaped mode shift curve, which confirmed the absence of bottleneck in all populations under study. Attappady Black goats differentiated into a distinct population with fewer admixtures and no bottleneck. Malabari populations, except MM could be clubbed into a single population based on this study. Malabari crossbreds differentiated into a separate group with fewer admixtures, ascertaining their genetic identity.

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## 1. Introduction

Goats play a substantial role in food production systems and are often recognized as a multipurpose animal capable of enhancing rural economy. Low input, high prolificacy, easy marketing and consumer acceptance of goat products, gain much popularity to goat breeding. In India, more than 70 per cent of marginal farmers prefer to rear small ruminants, rather than cows or buffaloes. There are 23 breeds of goats in India and these breeds are very diverse in nature. Kerala, the southernmost state of India, has two native goat breeds namely, Attappady Black and Malabari goats. Attappady Black goats, originating from the hilly terrains of Attappady region in Palakkad district of Kerala state Fig. 1, are noted for their hardy nature and disease resistant capacity. Mathew et al.

2005 reported that Attappady Black AB goats were black in colour, had bronze coloured eyes, with moderately long ears and horned appearance. They were reported as meat type breed with a milk yield of less than 200 ml per day. Though milk production potential is poor, they are recognized as a distinct meat breed of Kerala. In a survey conducted in its native tract, the total population of Attappady Black goats was estimated to be 9351 Mathew et al., 2005 and hence they were placed under insecure category in terms of germplasm conservation. These goats are mainly reared by the tribes of the Attappady region and are reported to be comparatively more disease resistant than other goats of Kerala. Thomas et al., 2011 and Radhika et al., 2012 They must have evolved differently, gaining adaptability to the specific agro ecological peculiarities of the hilly terrains of Attappady region. But now there is a tendency of intermixing among Attappady Black goats, especially with Malabari goats, thus posing a serious threat towards decreasing the purity of the breed.

Malabari goats of Northern Kerala are reputable for high prolificacy, milk yield, excellent growth rate and adaptability to hot

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humid conditions in the state (Acharya, 1982). Malabari goats were described as medium sized, dual purpose goats with small, slightly twisted horns and medium sized ears by Raghavan et al. (2004) and they were utilized for milk and meat purposes. Kaura (1952) reported that Malabari breed of goats belonged to a mixed population of Arab Indian goats including Cutch cross and Tellichery. Since home tract of Malabari goats extended along the coastal and mid-land areas in Northern Kerala, comprising of Kannur, Calicut and Malappuram districts (Fig. 1), different subpopulations of Malabari goats are seen in these areas. Jimcy (2007) reported that goat populations of Kerala were highly variable. She further reported that, though populations were not very distinct based on physical traits, biometrical traits observed in Kerala goats, helped to differentiate the population into distinct groups.

Native breeds of livestock should be conserved for the present and for the posterity. The prospects of complementing endangered breed or population with one or more established breeds, into a multi-breed composite population was proposed by Shrestha (2005). They argued that, even though development of a composite population does not directly lead to preservation of endangered breed, it promoted 'conservation by utilisation', and conserved inherent potential of foundation breeds. Malabari crossbreds (CB) were produced in University Goat and Sheep Farm, Mannuthy, Kerala, by crossing Malabari with exotic milch breeds, Saanen and Alpine, which were subsequently crossed with meat breed, Boer. Crossbreds were maintained by *interse* mating and subsequent backcrossing with Malabari bucks to maintain a minimum of 50 per cent Malabari inheritance. They have resulted from four decades of breeding and selection, and have turned out to be a productive group with moderate milk production, good prolificacy and higher body size. Mathew and Rai (1995) compared economic traits of Malabari goats and its crosses with Alpine and Saanen breeds. Multivariate analysis of variance conducted by analysing first

lactation milk yield and length, age at first kidding and body weight at 12 months revealed that these genetic groups were significantly different from native Malabari goats.

Six populations mentioned above (Attappady Black goats, Malabari crossbreds, Malabari goats of Kannur, Calicut, Thrissur and Malappuram districts) exhibited different characteristics when visualized on the basis of external qualitative (morphologically) and quantitative (biometric) attributes. This variation forms the basis for all breed improvement programs including conservation strategies for sustainable management of autochthonous breeds and/or commercial utilization and development of specific crosses for practical purposes. Unique characteristics of each and every population contributed to the abundant genetic diversity under each species and these unique characteristics could be diluted due to intermixing, sub structuring and/or consequent genetic drift in the population over time (Gour et al., 2006). Since such consequences could be expected among the goat genetic groups existing in Kerala, a thorough knowledge about the genetic makeup of these populations was the need of the hour. Among the molecular markers which identify variations at DNA level, microsatellites are commonly used for genetic diversity analysis. Boyce et al. (1996) opined that microsatellites showed high variability, high mutation rate, large number, distribution throughout the genome, co dominant inheritance and neutrality with respect to selection. For defining breeds and describing them, microsatellite loci were considered to be best suited (Goldstein and Pollock, 1997). In 2011, food and agricultural organization (FAO) issued guidelines regarding the use of the panel of microsatellites for diversity analysis in domestic animals, which was followed by researchers worldwide, to maintain global uniformity in such diversity studies. Thus, in order to analyse the variability of goat genetic groups of Kerala and to test the hypothesis of breed subdivision into separate groups, an effort was made to systematically study each population, and

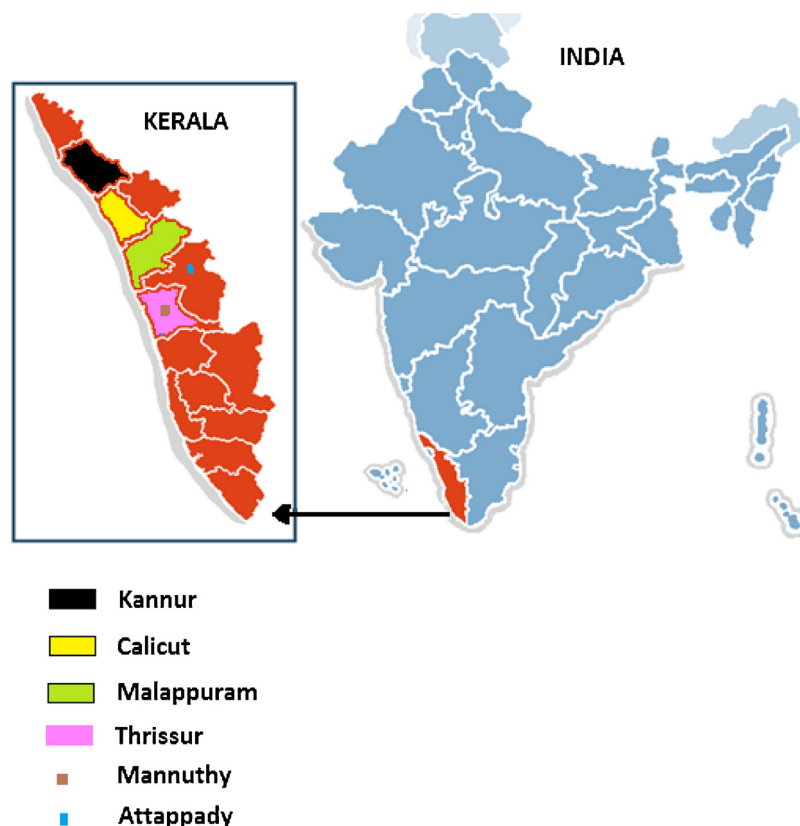


Fig. 1. Map of Kerala showing locations for animal sampling.

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