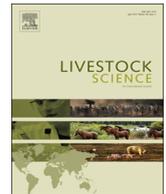




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Comparative genetic diversity analysis among six Indian breeds and English Thoroughbred horses



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ABSTRACT

Genetic diversity analysis, population structure and relationship among six Indian horse (Kathiawari, Marwari) and pony breeds (Manipuri, Spiti, Zanskari and Bhutia), along with English Thoroughbred horses as an out group was carried out using 284 DNA samples with 48 polymorphic microsatellite markers. Allele number, observed and expected heterozygosity, polymorphism information content were estimated. These values were higher for all Indian breeds except Spiti ponies in comparison to Thoroughbred horses which indicated high genetic diversity in them. Mean number of alleles was maximum in Marwari horse breeds (10.06 ± 0.36) followed by Bhutia, Zanskari, Manipuri, Kathiawari and Thoroughbred. The allelic count was the lowest in Spiti (5.52 ± 0.42). Similar pattern was observed in terms of allelic richness also. An overall significant deficit of heterozygote (F_{is}) equal to 0.066 was observed in Indian horse and pony breeds. The mean values of F_{is} ranged from 0.003 in Spiti to 0.132 in Marwari with mean of 0.065 ± 0.040 . The F_{st} values ranged from 0.0512 (TKY394) to 0.2724 (COR018) with an overall genetic differentiation of 9.8% among breeds. The overall global deficit of heterozygote across populations (F_{it}) amounted to 15.98%. The estimates of F_{st} between each pair of breeds revealed that genetic differentiation between Spiti and Thoroughbred (0.1729) was the maximum followed by Spiti and Kathiawari (0.1725) while Zanskari and Manipuri were the least differentiated (0.0379). Individual assignment indicated admixture in all the breeds except Thoroughbred horses. The neighbor-joining dendrogram using the allele sharing distance clearly defined clusters for most of the breeds, Indian horse and pony breeds clustered separately while Thoroughbred formed a separate out-group. The Bayesian analysis using STRUCTURE revealed three distinctive clusters of Indian horse and pony breeds, Kathiawari the most prominent cluster as horse breed, second of Zanskari, Spiti and Manipuri ponies and third one having Bhutia and a sub-population of Marwari horses. Clustering of one sub-population of Marwari with Bhutia indicated their common ancestries which need further investigations as both these are distinct at phenotypic level and geographically isolated. Kathiawari represents the oldest stock and has contributed in other Indian breeds. Similarity of Kathiawari and Marwari horses is attributed to contiguity of their breeding tracts.

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1. Introduction

India has two horse (Kathiawari and Marwari) and four pony (Manipuri, Spiti, Zanskari and Bhutia) breeds inhabiting in different agro-climatic regions (Gupta et al., 2012). Over the time, these breeds have adapted with certain unique traits like endurance, relative disease tolerance, sturdiness, sure-footedness to sustain and work in harsh environmental conditions. Among horse breeds, Marwari is the best adopted breed in hot, dry and desert conditions of Marwar area of Rajasthan. The animals of this breed are selected for their conformation, speed and stamina, endurance capacity with good export potential, while Kathiawari, the native breed of Kathiawar area, Gujarat, is also known for its speed, stamina, endurance capability of fast moving, etc. (Zala, 2010). The Arabian horses, the first to be introduced in India by invaders/traders, are believed to have contributed substantially in the evolution of Kathiawari breed (Gupta, 2010; Kaura, 1961a,b). Marwari breed seems to have developed from Arabian or exotic blood. “Chetak” famous Marwari war horse of Maharana Pratap is also believed to have some Arabian blood. These animals were reared for warfare purpose by princely states of Marwar of medieval times in Marwar area of Rajasthan. Marwari and Kathiawari breeds appear to be very similar and share adjoining breeding tracts, therefore, it will be quite interesting to assess the genetic diversity among these breeds. English Thoroughbred horses (reared in India), being used in race industry have been bred and maintained by private equine breeders in different parts of India. Comparison of indigenous breeds with Thoroughbred shall provide an insight of their genetic structure. Among pony breeds, Zanskari, Manipuri, Spiti and Bhutia are stout, strong, sure-footed on difficult terrains, have unique stamina, capable of surviving in cold and harsh climatic conditions (-35°C) even on low plane of nutrition. All the four pony breeds are endangered breeds because of their shrinking number in their respective breeding tracts (Gupta et al., 2012). Zanskari breed is localized in Zanskar valley (Cold desert in Jammu and Kashmir State, India) which is not easily approachable due to its mountainous surroundings (Gupta et al., 2012) while Spiti, another pony breed of cold desert, is localized in Pin Valley (Himachal Pradesh State, India). Spiti breed has been developed systematically by the local inhabitants by adopting selective breeding (Pal et al., 2011). Manipuri pony breed (Manipur – a North-Eastern Indian State) is considered to be the oldest among indigenous pony breeds, used for “Polo” in one of the oldest Polo grounds in the world. In its proximity is the Bhutia breed reared in Sikkim and Arunachal Pradesh states of India. These ponies can survive on low planes of nutrition than other ponies of its size. They are well known for their surefootedness as while moving on narrow mountainous path, their one leg dangles over several hundred feet of nothingness (Gupta et al., 2012).

Effective management of equine resources needs comprehensive knowledge of breed characteristics including data on population size and structure, geographical distribution, the production environment, within and between breed genetic diversity. Integration of these different types

of data will result in the most complete representation of biological diversity within and among the breeds. Due to indiscriminate breeding, reduced demand and introduction of exotic horse breeds, the populations of these native breeds of animals have declined rapidly during the last few decades (Gupta and Pal, 2010; Gupta et al., 2012; Chauhan et al., 2004; Singhvi, 2001; Yadav et al., 2001). There is an urgent need to increase their number and to conserve them for future demand of draft power in harsh environment of hilly regions. In order to conserve these breeds, diversity needs to be evaluated phenotypically and genetically, so that suitable breeding strategies can be adopted to improve and conserve the breeds in their native tract. Since the population of true to breed animals is decreasing continuously, therefore, assessment of genetic variability, its distribution among different populations in their home tract and possible detection of rare alleles, as an indicator of populations with unique genetic variants need systematic evaluation with true representatives of each equine breed in India. Beside this, originality of these breeds also needs to be traced. The diversity analysis will enable us to identify the similarity among breeds, dissimilarity with respect to exotic Thoroughbred horses and to adopt appropriate planning strategies for breeding and conservation of equine resources. This study will definitely help the breeders to select the most adaptable traits within the breeds and multiply the resources.

Genetic diversity within individual Indian horse and pony breeds as well as between different breeds has already been reported (Behl et al., 2006a, 2007a,b; Chauhan et al., 2004, 2011; Gupta et al., 2005, 2013; Koringa et al., 2008) using different set of microsatellites. But due to phenotypic similarities between Kathiawari and Marwari and among different pony breeds, evaluation for predicting exact relationship between breeds as well as extent of genetic diversity within each breed along with their originality was carried out. This study deals with the extent of genetic diversity and structure between and within six Indian horse breeds with exotic breed of Thoroughbred horses.

2. Materials and methods

2.1. Animals

Fifty adult, healthy and true-to-breed equines of each breed were selected on the basis of their morphological features, from their breeding tracts in different parts of India. These selected animals either belonged to Govt organizations and / or private small or big equine breeders maintaining these animals for breeding purpose. Fifty Kathiawari horses were sampled from State equine farms at Junagarh and Inaz, Police horses from Junagarh, Rajkot, Surender Nagar as well as some private breeders in other parts of Kathiawar (Gujarat State), Marwari horses (50) from private breeders of Jodhpur, Pali Marwar, Udaipur, Dundlod, Nawalgarh, Jalore, Nagore, Bikaner areas as well as from Pushkar fair (Rajasthan state), Manipuri ponies (50) from Manipur Polo and Riding club as well as of nearby villages in Imphal (Manipur state), Zanskari ponies (50) from Government farms namely Zanskari Equine Breeding Farm, Chuchot (Leh) and Russian Marino Sheep

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