CYTOGENETIC CHARACTERIZATION OF VIZIANAGARAM SHEEP

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Received: 02-03-2013
Accepted: 19-08-2013

ABSTRACT

Cytogenetic studies were conducted on a total of 60 Vizianagaram sheep maintained at the Livestock Research Station, Garividi and sheep managed by farmers in and around Srikakulam District of Andhra Pradesh. Short term lymphocyte culture technique was adopted. The diploid chromosome number was found to be 54 (2n = 54, XY). The first three pairs of the autosomes were submetacentric and the remaining 23 pairs of autosomes were acrocentric. The X chromosome was the longest acrocentric, while the Y- chromosome was the smallest biarmed. The mean relative length for the autosomes ranged from 1.54 ± 0.04 to 9.59 ± 0.12 per cent, while the mean relative length of X and Y chromosomes were 5.06 ± 0.02 and 1.81 ± 0.17, percent respectively. The mean arm ratios, centromeric indices and morphological indices varied from 1.31 ± 0.07 to 1.24 ± 0.07, 0.545 ± 0.04 to 0.565 ± 0.07 and 7.59 ± 0.01 to 5.36 ± 0.01, respectively.

Key words: Chromosomal profile, Idiogram, Morphometric measurements, Vizianagaram sheep

INTRODUCTION

India is bestowed with rich livestock biodiversity hosting about 42 recognized breeds of sheep constituting about 6.18 percent of total sheep population in the world (FAO, 2009). Vizianagaram sheep, which is not yet recognized as a breed is well known for its sturdiness and is found in north coastal districts (Srikakulam, Vizianagaram and Visakhapatnam) and constitute 4.5 per cent of total sheep population in Andhra Pradesh. These are predominantly white in color with tan/brown/black color patches on nose line, lateral face, neck/mane, perineum, back and lower extremities. Ears are either pendulous or tubular or even rudimentary. Rams are horned and ewes are polled. Prominent occipital bone is the important feature of the breed. Convex nose line is the characteristic feature of the sheep of above seven months of age. Hair growth is observed on thigh, dewlap and neck/mane region. Although, some work has been done on the phenotypic characterization of Vizianagaram sheep, information on the chromosomal architecture is lacking. Moreover, cytogenetic information is an essential prerequisite in characterizing a breed and is essential for breed development and conservation attempts and further provides the basis for molecular characterization. Therefore, the present study was undertaken to characterize Vizianagaram sheep cytogenetically.

MATERIALS AND METHODS

A total of 60 Vizianagaram sheep maintained at Livestock Research station, Garividi and farmers flocks present in Srikakulam district and adjoining areas, aged between 1 and 4 years were utilized for cytogenetic characterization. Blood samples were collected aseptically from external jugular vein into heparinized vacutainers. Short term lymphocyte culture (Moorehead et al., 1960) was adopted with slight modifications. Each blood sample (0.5 ml) was cultured for 72 hr in 8 ml of RPMI-1640 tissue culture media supplemented with Phytohaemagglutinin–M (0.1ml), Fetal Bovine Serum (1.5ml) and Colchicine (40 µl) was added one and half hours prior to harvesting cells at the metaphase stage. After 72 hours of incubation, culture was centrifuged at 1000 rpm for 10 mts and
then blood lymphocyte layer was collected and transferred into clean dry centrifuge tubes. The culture was treated with 0.075M hypotonic (KCl) solution for 30 minutes at 37°C and fixed in freshly prepared chilled Carnoy's fluid (methanol and glacial acetic acid in 3:1). Chromosome suspensions were prepared and dropped on pre cleaned and air dried microscopic slides. Slides were screened for non-overlapping metaphase spreads with complete chromosomal complement under microscope and photographed for preparing karyotypes and for assessing morphometric measurements.

The length of chromosomes was measured in millimeters with an accuracy of 0.05 mm, using digital vernier calipers. The relative length of a chromosome was computed as the ratio of the length of a chromosome to the total length of haploid set of chromosomes including the X-chromosome and expressed in percentage (Bhatia and Shanker, 1991). The arm ratio of the biarmed chromosomes was calculated as the ratio between length of long arm to short arm, While Centromeric index was the ratio between the length of short arm to total length of chromosome expressed in percentage. The morphological index was calculated as ratio between total chromosomal length to arm ratio.

Data on Morphometric measurements like relative length, arm ratio, centromeric index and morphological index were analyzed as per the standard statistical procedure recommended by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

The mitotic metaphase spreads of both sexes of Vizianagaram sheep were shown in the Figures 1 and 3. The modal chromosome number was found to be (2n) 54 with 52 autosomes and two sex chromosomes. The modal chromosome number of 54 recorded in the present study was in agreement with the findings of earlier research workers in various indigenous breeds viz. Patanwadi (Bhatia and Shanker, 1999), Mecheri (Karunanithi et al., 2005), Coimbatore (Devendran et al., 2009) sheep and exotic breeds of Merino, Southdown, Ryeland, Dorset Horn, Border Leicester, Romney Marsh and Cheviot (Borland, 1964). Out of 26 pairs of autosomes, first three pairs of autosomes were found to be submetacentric and remaining 23 pairs were acrocentric in nature (Fig 2 and 4). Submetacentric
nature of first three pairs of autosomes noticed in the present study further confirmed the findings of Amareswari et al., (2005) in Jodipi, Palla and Brown varieties of Nellore sheep and Prakash et al., (2008) in Deccani sheep, but, in contrast to the findings of Karunanithi et al., (2005) in Mecheri, Devendran et al., (2009) in Coimbatore, Shaik et al. (2009) in Deccani and Kirikci (2003) in Konya wild sheep, who noticed the metacentric nature of first three pairs of autosomes. While, Rcheulishvili and Dzhokhadze (1985) found that the first two pairs of autosomes were submetacentric and the third chromosome was metacentric in nature in Imeritian sheep.

Acrocentric nature of the remaining 23 pairs of autosomes recorded in the present study (Fig. 2 and 4) coincided with the findings recorded in Nali and Magra and Patanwadi (Bhatia and Shanker 1989, 1999), Lohi (Intizar et al., 1999), Mecheri (Karunanithi et al., 2005), Deccani (Prakash et al., 2008) and Coimbatore (Devendran et al., 2009) sheep. While Benjamin and Bhat (1978) reported that last 23 pairs of autosomes were telocentric in Muzaffarnagari sheep. Gupta and Gupta (1995) noticed that these set of autosomes were either acrocentric or telocentric in nature in Malpura sheep.

The X - chromosome was found to be the largest and acrocentric, while Y-chromosome was biarmed (Fig: 2 and 4) and the smallest of all chromosomes in Vizianagaram sheep which further confirmed the findings of Bunch and Foote (1976),

![FIG 4: Giemsa stained karyotype of Vizianagaram sheep ewe (2n = 54, XX)](image)

![FIG 5: Ideogram of Vizianagaram sheep](image)

**Relative length**: The Ideogram showing the mean relative lengths of chromosomes is depicted in Fig. 5. The mean relative length of autosomes based on raw data ranged from 1.54 ± 0.04 (26th chromosome) to 9.59 ± 0.12 percent (1st)
Biarmed autosomes together contributed 25.08 percent of the genome length in males and 24.44 percent in females. The overall mean relative lengths for the X and Y- chromosomes were 5.06 ± 0.02 and 1.81 ± 0.17 percent, respectively. The mean relative lengths reported in the present study were within the range of means reported by Bhatia and Shanker (1994), in Munjal, Magra and Patanwadi sheep. Gupta and Gupta (1995) in Malpura sheep, Amareswari et al. (2005) in Nellore sheep, Prakash et al. (2008) in Deccani sheep and Devendran et al. (2009) in Coimbatore sheep.

Non significant differences between sexes for the relative length of all the autosomes, noticed in the present study was in agreement with the findings of Bhatia and Shanker (1999), Amareswari et al. (2005) and Prakash et al., (2008).

**Arm ratio:** The mean arm ratios (Table 1) for the first three autosomes in Vizianagaram sheep varied between 1.31 ± 0.07 (chromosomes 1) and 1.24 ± 0.07, (chromosome 3). The mean arm ratios recorded in Vizianagaram sheep were slightly higher than the means reported by Bhatia and Shanker (1994) in Patanwadi and Munjal sheep, Gupta and Gupta (1995) in Malpura sheep, Karunanithi et al. (2005) in Mecheri sheep and Devendran et al. (2009) in Coimbatore sheep, but almost similar to the findings of Sheik et al. (2009) in Deccani sheep.

The arm ratio decreased from first to third chromosome and the magnitude of the arm ratio denotes the nature of the chromosomes. The arm ratios of the first three autosomes in the present study were greater than one which indicated that the chromosomes were submetacentric in nature.

Non significant effect of sex on arm ratios of submetacentric chromosomes in the present study was in concurrence with the findings of Bhatia and Shanker (1999), Amareswari et al. (2005) and Prakash et al. (2008) in Magra, Nellore and Deccani sheep breeds, respectively.

**Centromeric index:** The mean centromeric index values for the first three autosomes of Vizianagaram sheep ranged from 0.545 ± 0.04 to 0.565 ± 0.07 (Table 1). The first three biarmed autosomes of the Vizianagaram sheep chromosomes were confirmed as submetacentric as the centromeric index values of all the first three autosomes deviated from the value of 0.5.

<table>
<thead>
<tr>
<th>Arm ratio</th>
<th>Centromeric indices</th>
<th>Morphological indices</th>
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<tbody>
<tr>
<td></td>
<td>Rams</td>
<td>S.E</td>
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<tr>
<td>Mean</td>
<td>1.31</td>
<td>0.07</td>
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<td>S.E</td>
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Means bearing different superscripts in a column differ significantly.
The mean centromeric indices observed in the present study were almost similar to those reported in Munjal, Magra and Patanwadi sheep (Bhatia and Shanker, 1994; 1999), Nellore sheep (Amareswari et al., 2005) and in Coimbatore sheep (Devendran et al., 2009). While Langhe et al. (1993) and Gupta and Gupta (1995) reported slightly lower indices in Bannur and Malpura sheep than the means reported in the present study in Vizianagaram sheep.

Non-significant effect of sex on the centromeric indices of Vizianagaram sheep chromosomes in the present study was in conformity with the findings of Bhatia and Shanker (1996) and Prakash et al. (2008).

**Morphological index:** The mean morphological indices of the first three biarmed autosomes of Vizianagaram rams were $7.59 \pm 0.01$, $5.99 \pm 0.01$ and $5.36 \pm 0.01$, respectively. The mean morphological indices decreased from first to third chromosomes as the morphological index was directly proportional to the length of the chromosomes. Similar trend was noticed in Bannur, Nellore, Mecheri, Decani and Coimbatore sheep (Langhe et al., 1993; Amareswari et al., 2005; Karunanithi et al., 2005; Prakash et al., 2008 and Devendran et al., 2009).

The effect of sex of the animal was not evident on the morphological indices of the first three chromosomes of Vizianagaram sheep and was in accordance with the findings of Amareswari et al., (2005) in Nellore and Prakash et al. (2008) in Deccani sheep.

**REFERENCES**


