**ABSTRACT**

Karyological investigation pertaining to 30 crossbred pigs (both sexes) maintained at AICRP, Tirupati was undertaken in order to study the chromosomal profile of the crossbred pigs and their morphometric measurements. The cells had the usual diploid complement of 38 chromosomes ($2n = 38$) and a fundamental number of 64 as in the exotic pigs with XY complement in males and XX complement in females. The karyotype of crossbred pig was characterized by 5 pairs of submetacentric chromosomes (1-5), next two pairs were sub telocentric (6-7), subsequent 5 pairs were metacentric (8-12) and remaining six pairs were telocentric (13-18). A detailed idiogram was constructed from the results obtained. First chromosome was the longest pair and thirteenth pair was the second largest, while Y-chromosome was the smallest in the karyotype of the pig. The X chromosome was metacentric, but not readily distinguishable from the autosome pair number 9, while Y chromosome was metacentric.

**Key words:** Chromosomal profile, Crossbred pig, Fundamental number, Idiogram, Morphometric measurements.

**INTRODUCTION**

India, with an estimated population of 11 millions (BAHS 2012) accounts for 1.14 per cent of world’s pig population (BAHS 2012) and Andhra Pradesh ranks 8th in the country with the population of 0.44 millions. In India, pig production has an important role to serve as an instrument of social change in weaker sections of rural community. Further, per capita availability of meat in India is estimated to be 5.5kg/annum against the recommended level of 10.8kg/annum. Pigs, with their high prolificacy, short generation interval, faster growth rate and higher dressing percentage could play an important role in augmenting animal protein supplement to the growing needs of emerging population. Efforts were being made to improve the genetic potentiality of native germ plasm by introducing exotic breeds under AICRP projects. Systematic breeding programme was under implementation at All India Coordinated Research Project on pigs, College of Veterinary Science, Tirupati and Crossbred pigs (75% Large White Yorkshire and 25% desi blood levels) were being maintained. Cytogenetic studies on these crossbred pigs are important to screen the animals for chromosomal abnormalities besides it helps in providing the techniques for identification, analysis and understanding of the chromosomes for individuals having scientific interest. Therefore, the present study was undertaken to characterize the crossbred pigs through various morphometric measurements viz. relative length, arm ratio, centromeric index and morphological index.

**MATERIALS AND METHODS**

The present karyological study was undertaken on 30 crossbred pigs (75% Large White Yorkshire and 25% desi blood levels) maintained at All India Coordinated Research Project on Pigs (AICRP), College of Veterinary Science, Tirupati. Blood (2 ml per animal) was collected aseptically from external jugular vein into a sterile 5 ml heparinized vacutainer tube containing sodium heparin as an anticoagulant. Cultures were set up as per the short term lymphocyte culture method given by Moorehead et al. (1960) with slight modifications. Blood samples (0.5ml) were cultured for 72 hrs. in 8 ml of RPMI-1640 tissue culture media supplemented with Phytohaemagglutinin-M (0.1ml), Fetal Bovine Serum (1.5ml) and finally 40 µl
Colchicine (0.4 µg) was added one and half hours prior to harvesting to arrest cells at the metaphase stage. After 72 hrs. of incubation, culture was centrifuged at 1000 rpm for 10 min 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 min 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 chromosome complement under microscope. Karyotypes were prepared from the photographs taken out of best metaphase spreads.

The length of short arm (p), long arm (q) and total length of chromosomes in the karyotypes was measured in millimeters with an accuracy of 0.05 mm, using the digital vernier calipers and the morphometric measurements computed were relative length, arm ratio, centromeric index and morphologic index. 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. 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 long 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 analysed as per the standard statistical procedure recommended by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

A total of 450 metaphases were examined for the chromosome count and the modal diploid chromosome number (2n) in crossbred pigs was found to be 38 with XY complement in males and XX complement in females (Fig. 1 and 3). Out of 19 pairs of chromosomes found in the crossbred pigs, there were 18 pairs of autosomes and one pair of allosomes. First 5 pairs of autosomes were submetacentric, next two pairs were sub telocentric (6-7), subsequent 5 pairs were metacentric (8-12) and remaining six pairs were telocentric (13-18) and allosomes were metacentric in nature. First chromosome was the longest pair and thirteenth pair was the second largest, while Y-chromosome was the smallest in the karyotype of the pig (Fig. 2 and 4), which coincided with the findings of Kanadkhedkar et al. (2006) in Desi pigs, Tanomtong et al. (2007) in Thai wild boar, Ziolkowska and Bogdzinska (2008) in Polish Landrace and Polish Large White breeds and Oluwole and Omitogun (2009) in Nigerian Indigenous Pigs.

Relative length: The Idiogram showing the mean relative lengths of chromosomes was depicted in Fig. 5. The mean relative length of autosomes varied

![FIG. 1: Giemsa stained metaphase spread of crossbred Boar (2n= 38, XY).](image1)

![FIG. 2: Giemsa stained Karyotype of crossbred Boar (2n = 38, XY).](image2)
from 2.70± 0.01 to 10.99± 0.21 per cent in crossbred pigs (Fig.5). The relative contribution of X and Y-chromosome were 5.01± 0.07 and 2.03± 0.04 per cent respectively, which were almost similar to the mean relative lengths reported by Apparao et al. (1993) in Indian domestic pigs, Nanthadevi (2004) in Large White Yorkshire, Landrace and Duroc and Oluwole and Omitogun (2009) in Nigerian Indigenous Pig, respectively.

Non significant differences between sexes for the relative length of all the autosomes noticed in present study was corroborated with the findings of Tanomtong et al. (2007) in Thai wild boar.

All the chromosomes were found to have different relative lengths (Fig.5), which indicated differential contribution of chromosomes to the total genome.
**Arm Ratio:** The arm ratio of autosomes in crossbred pigs varied from 1.02±0.06 to 2.90±0.09, while the mean arm ratio of X and Y-chromosome were 1.17±0.05 and 1.20±0.06, respectively (Table 1). Sixth chromosome exhibited the highest arm ratio (2.90±0.09) followed by seventh chromosome (2.87±0.13), which were in accordance with the means reported in Canadian Lacombe breed (Lin et al. 1980), Indian domestic pigs (Vijh et al., 1990; Apparao et al., 1993 and Palegar et al., 1995), Thai wild boar (Tanomtong et al., 2007) and Nigerian Indigenous Pig (Oluwole and Omitogun 2009).

Non significant effect of sex on arm ratios revealed that the biarmed chromosomes of boars and sows were similar in their morphology.

**Centromeric Index:** The mean centromeric indices estimated for the autosomes ranged from 0.52±0.08 to 0.74±0.01 in crossbred pigs. The overall mean centromeric index of X and Y- chromosome were 0.55±0.07 and 0.57±0.05, respectively (Table 1). Sixth chromosome contributed highest centromeric index (0.74±0.01) among all the chromosomes. These findings were comparable with the results of Vijh et al. (1990) and Apparao et al. (1993) in Indian domestic pigs, Tanomtong et al. (2007) in Thai wild boar and Oluwole and Omitogun (2009) in Nigerian Indigenous Pigs.

The influence of sex on centromeric indices of all the chromosomes was found to be non significant. However, males possess higher centromeric index when compared to females.

**Morphological index:** The overall mean morphological index based on raw data for the autosomes varied from 2.60±0.01 to 7.57±0.16 per cent (Table 1). The overall mean morphological index of X and Y- chromosome were 6.10±0.04 and 2.07±0.6, respectively.

The morphological indices of first 12 autosomal pairs differed significantly (P ≤ 0.01) from each other indicating that relative position of centromere on these biarmed autosomes was different. Since morphological index is directly proportional to the total length (p+q) of chromosome, variation in total length results in variation in relative length of chromosomes which results in variation in morphological index.

**TABLE 1:** Mean morphometric measurements (Arm ratio, centromeric index and morphological index) of chromosomes in crossbred pigs

<table>
<thead>
<tr>
<th>Chromosome No</th>
<th>Arm ratio Mean S.E.</th>
<th>Centromeric index Mean S.E.</th>
<th>Morphological index Mean S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.76 ± 0.02</td>
<td>0.55 ± 0.07</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1.77 ± 0.02</td>
<td>0.54 ± 0.07</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.69 ± 0.02</td>
<td>0.74 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1.96 ± 0.08</td>
<td>0.59 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1.99 ± 0.08</td>
<td>0.59 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1.68 ± 0.08</td>
<td>0.59 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1.96 ± 0.08</td>
<td>0.59 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1.66 ± 0.08</td>
<td>0.59 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1.90 ± 0.08</td>
<td>0.59 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1.59 ± 0.08</td>
<td>0.59 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1.64 ± 0.08</td>
<td>0.59 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1.66 ± 0.08</td>
<td>0.59 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1.67 ± 0.08</td>
<td>0.59 ± 0.01</td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES


