

## Original Research Article

# Standardized Karyotype and Idiogram of Native Black Bengal Goats

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## ABSTRACT

### Keywords

Black Bengal goat,  
Cytogenetic,  
Karyotype,  
Chromosome  
number

Standardized Karyotype and idiogram of the native Black Bengal goats from Instructional Farm Small ruminants, Birsa agricultural university Ranchi Jharkhand were studied. Blood samples were taken from 10 male and 10 female goat. After short term lymphocyte culture the mitotic chromosome preparation was accomplished. The diploid chromosome no was found to be 60, XY consisting of 29 pairs of acrocentric autosomes and a pair of allosomes. The X chromosome was the longest acrocentric and Y chromosome was suspected to be sub metacentric. The mean relative length of autosome ranged from  $5.22 \pm 0.03$  to  $1.78 \pm 0.02$  percent and relative length of X and Y chromosomes were  $5.76 \pm 0.05$  and  $1.47 \pm 0.03$ , respectively.

## Introduction

Livestock biodiversity is critically important for achieving food security and alleviating poverty for the rapidly growing human population. Among various animals, goat farming plays an important role in the livelihood of many families in the developing world. Goats are mostly found in the rural areas are variously referred to as native, open grazing system, indigenous. Native goats are generally hardy, survive and reproduce on a low plane of nutrition and require minimal inputs in terms of family labor. Goat rearing is the best choice for the rural people in developing countries like India because of their wider adaptability, low investment, high fertility and fecundity, low feed and management needs, high feed conversion efficiency, quick pay off and low risk involved (P. Uma

Devi *et al.*, 2011). Black Bengal goat is small sized predominantly black coloured breed of goat native of North east India. It is a famous breed known for high prolificacy, superior chevon quality, best quality Skin, early sexual maturity, low kidding interval and very good adaptability. Black Bengal goats have been documented as important assets because they improve livelihoods of rural farmer's. They are well adapted to tropical conditions as they are adapted to local production conditions and environments. They are also less susceptible to common diseases and parasites. In addition, the local breeds have the ability to survive long periods of feed and water deprivation compared to exotic breeds. Cytogenetics can be used to select reproducers free from chromosome

abnormalities, which are responsible for abnormal body conformation (aneuploidy), lower fertility (balanced chromosome abnormalities) or sterility (sex chromosome abnormalities). Cytogenetics plays a significant role in identifying X-trisomy, Sex-reversal syndrome, XX/XY mosaicism and 1/29 Robertsonian translocation, etc. For studying the evolution of species, cytogenetics has been recognized as an important tool, besides conventional classification and numerical taxonomy. Cytogenetic studies have been widely carried out in all domestic animal species along with goats in India. Goat possesses a fundamental chromosome number of 60 (58 autosome and 2 allosome). The Study of chromosomal profile in livestock provide a useful tool to evaluate reproductive health and fertility status of breeding animals even at an early age (Basumantary 2003). Research strategies involving cytogenetics hold the promise of yielding insight into the mechanisms underlying chromosome instability in embryos (King, 2008). Cytogenetic offer a simple and easy method to characterize a breed, which is the first step towards conservation. It enables correct identification of individual chromosomes and establishes standard Karyotype which is essential for breed characterization (Stranzinger and Fechheimer, 1989). Keeping this in view the technique of short term lymphocyte culture for black Bengal breed of goat was standardised and various morphometric measurement were noted with the objective to characterise the breed cytogenetically.

## **Materials and Methods**

### **Selection of animals**

The present study was undertaken on Black Bengal goats maintained in Instructional Farm Small Ruminants, Ranchi Veterinary

College, Birsa agricultural University, Jharkhand. Out of the total animals present in this farm, 20 goats (10 Males and 10 females) were taken randomly from the breeding population for karyological study.

### **Collection of Blood**

2 ml of blood was taken from each goat aseptically from jugular vein puncture in a 5 ml disposable syringe containing 40 IU of sodium heparin. The samples were carried to the laboratory packed in ice. Care was taken to prevent direct contact of the sample and ice. On arrival to the laboratory the blood samples were kept in the refrigerator at 4<sup>o</sup>C till the culture was set up.

The study of somatic metaphase chromosome in goats were carried out by whole blood short-term lymphocyte culture method as given by Moorehead *et al.*, (1960) was followed with slight modifications.

### **Parameters taken for study**

#### **Length**

The chromosomes in the karyotypes was measured in millimetre with an accuracy of 0.01 mm, using the Software IKRYOS Karyotyping system V5.15.

#### **Relative length**

Relative length was represented as the ratio of the length of a chromosome to the total length of haploid set of chromosome containing the X- chromosome and the ratio was expressed in percentage.

$$\text{Relative length (\%)} = \frac{\text{Length of a chromosome}}{\text{Total length of haploid genome including X-chromosome}} \times 100$$

The idiogram was drawn by taking the chromosome number on X-axis and the relative length (%) on the Y- axis.

## Results and Discussion

The diploid chromosome number of Black Bengal goat was 60 which consisted of 58 autosome and 2 sex chromosomes. The findings are in agreement with the observation of Nicodemo *et al.*, (2008) and Kasabe *et al.*, (2009). The length of autosomes of male Black Bengal goat varied from  $0.96\pm 0.01$  to  $2.78\pm 0.04\mu\text{m}$  in autosome while among allosomes, the X chromosome was largest ( $3.19\pm 0.05\mu\text{m}$ ) and Y chromosome was smallest ( $0.79\pm 0.02$ ) similar to the findings of Devi *et al.*, (2011). All the 29 pairs of autosome of Black Bengal goat were found to be acrocentric which was in agreement with the findings of Bhatia and Shankar (1993, 1994), and Devi *et al.*, (2011). The X chromosome was found to be acrocentric and longest which is in agreement with the observations of Hancock and Jacobs (1966). The Y-chromosome was found to be smallest, dot like structure and suspected to be sub-metacentric in the present investigation which is similar to the findings of Bhatia and Shankar (1992) in Marwari goat and Ford *et al.*, (1980) and Berardino *et al.*, (1987), while Bunch *et al.*, (1977) reported that the Y chromosome may be metacentric or submetacentric but not acrocentric. Estimation of relative lengths of corresponding chromosomes of each sex of Black Bengal goats revealed that the longest autosome contributed 5.19%, 5.25% and 5.22% of haploid genome in female, male and pooled over sex, respectively. The relative length of autosome were almost similar to those of Gaddi, White Bengal, Ganjam and Ganjam X Black Bengal goats reported earlier by Pattanayak and Patro (1986), Bhatia and Shankar (1991) and Bhatia and Shankar (1992) respectively. The relative lengths of longest autosomes in

Black Bengal goat was found to be longer than that of observed by Bhatia and Shankar (1993) as 4.87% in male and 5.04% in female Marwari goats and by Bhatia and Shankar (1992) as overall 4.99% in White Bengal goat. Das (1990) reported that the contribution of largest autosome in male and female of Assam local goat were 5.50% and 5.53% respectively, which were higher than that of observed in our condition. Nicodemo *et al.*, (2008) found higher contribution i.e. 6.18% of longest autosomes to total haploid genome in Angora goat.

The relative length of smallest autosome contributed 1.79%, 1.78% and 1.78% of haploid genome in female, male and data pooled over sex in Black Bengal goat respectively. This finding was slightly higher than that of observed by Hansen (1973) in domestic goat as 1.7% and Das (1990) as 1.57% and 1.61% in male and female respectively in Assam local goat. Bhatia and Shankar (1993) also reported the contribution of smallest autosome to be 1.95% and 1.83% of haploid genome in female and male Marwari goats. The longest acrocentric chromosome was found to be X chromosome in this study. This finding was in agreement with the findings of Bunch *et al.*, (1977), Berardino *et al.*, (1987) and Bhatia and Shankar (1992). The relative length of X chromosome was found to be  $5.95\pm 0.05$  in male,  $5.57\pm 0.05$  in female and  $5.76\pm 0.05$  % in data pooled over sex in the present study. These findings were higher than that of the findings of Bhatia and Shankar, 1992 (5% in White Bengal goat), Bhatia and Shankar, 1993 (5.21% in Marwari goats), Bhatia and Shankar, 1994 (5.33% in Beetal goat) and Nicodemo *et al.*, 2008 (5.30% in Angora goat) but in agreement with the findings of Pattanayak and Patre (1986) who observed that the relative length of X chromosome varied from 5.1 to 5.8 percent in Ganjam and Ganjam X Black Bengal goat.

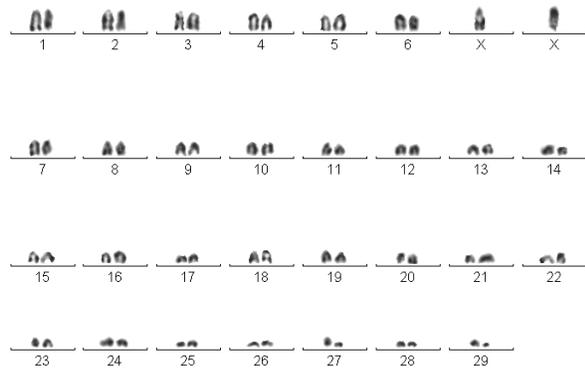
**Table.1** Mean ± SE of the relative length (%) of the chromosomes in male and female Black Bengal goat

Chr. Pair number	Mean ± SE	Mean ± SE
1	5.19±0.03 <sup>z''</sup>	5.25±0.04 <sup>z</sup>
2	5.00±0.02 <sup>z'</sup>	4.96±0.03 <sup>y</sup>
3	4.78±0.03 <sup>z</sup>	4.70±0.03 <sup>w</sup>
4	4.52±0.02 <sup>y</sup>	4.55±0.03 <sup>x</sup>
5	4.28±0.02 <sup>x</sup>	4.44±0.03 <sup>v</sup>
6	4.13±0.01 <sup>w</sup>	4.26±0.03 <sup>u</sup>
7	4.02±0.01 <sup>v</sup>	4.05±0.03 <sup>t</sup>
8	3.87±0.01 <sup>u</sup>	3.95±0.01 <sup>s</sup>
9	3.74±0.01 <sup>t</sup>	3.79±0.01 <sup>r</sup>
10	3.62±0.01 <sup>s</sup>	3.74±0.02 <sup>r</sup>
11	3.52±0.01 <sup>r</sup>	3.60±0.01 <sup>q</sup>
12	3.37±0.01 <sup>q</sup>	3.44±0.01 <sup>p</sup>
13	3.31±0.01 <sup>p</sup>	3.35±0.01 <sup>o</sup>
14	3.24±0.01 <sup>o</sup>	3.23±0.01 <sup>n</sup>
15	3.09±0.01 <sup>n</sup>	3.16±0.01 <sup>m</sup>
16	2.99±0.01 <sup>m</sup>	3.06±0.01 <sup>l</sup>
17	2.93±0.01 <sup>l</sup>	2.94±0.02 <sup>k</sup>
18	2.87±0.01 <sup>k</sup>	2.87±0.01 <sup>j</sup>
19	2.81±0.01 <sup>j</sup>	2.75±0.01 <sup>i</sup>
20	2.65±0.02 <sup>i</sup>	2.63±0.01 <sup>h</sup>
21	2.57±0.01 <sup>h</sup>	2.59±0.01 <sup>h</sup>
22	2.51±0.01 <sup>h</sup>	2.47±0.02 <sup>g</sup>
23	2.42±0.02 <sup>g</sup>	2.36±0.02 <sup>f</sup>
24	2.32±0.02 <sup>f</sup>	2.32±0.02 <sup>f</sup>
25	2.26±0.02 <sup>f</sup>	2.26±0.02 <sup>e</sup>
26	2.15±0.02 <sup>e</sup>	2.14±0.03 <sup>d</sup>
27	2.09±0.02 <sup>d</sup>	1.94±0.03 <sup>c</sup>
28	1.98±0.02 <sup>c</sup>	1.86±0.03 <sup>b</sup>
29	1.79±0.02 <sup>b</sup>	1.78±0.03 <sup>a</sup>
X	5.95±0.05 <sup>z'''</sup>	5.57±0.05 <sup>z'</sup>
Y	1.47±0.03 <sup>a</sup>	

\*\*P<0.01, Value having same superscript in column did not differ significantly; N=100



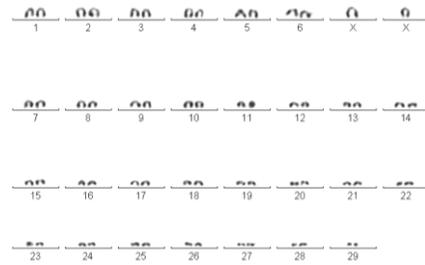
a. Mitotic-metaphase spread



b. Karyotype of Black Bengal buck

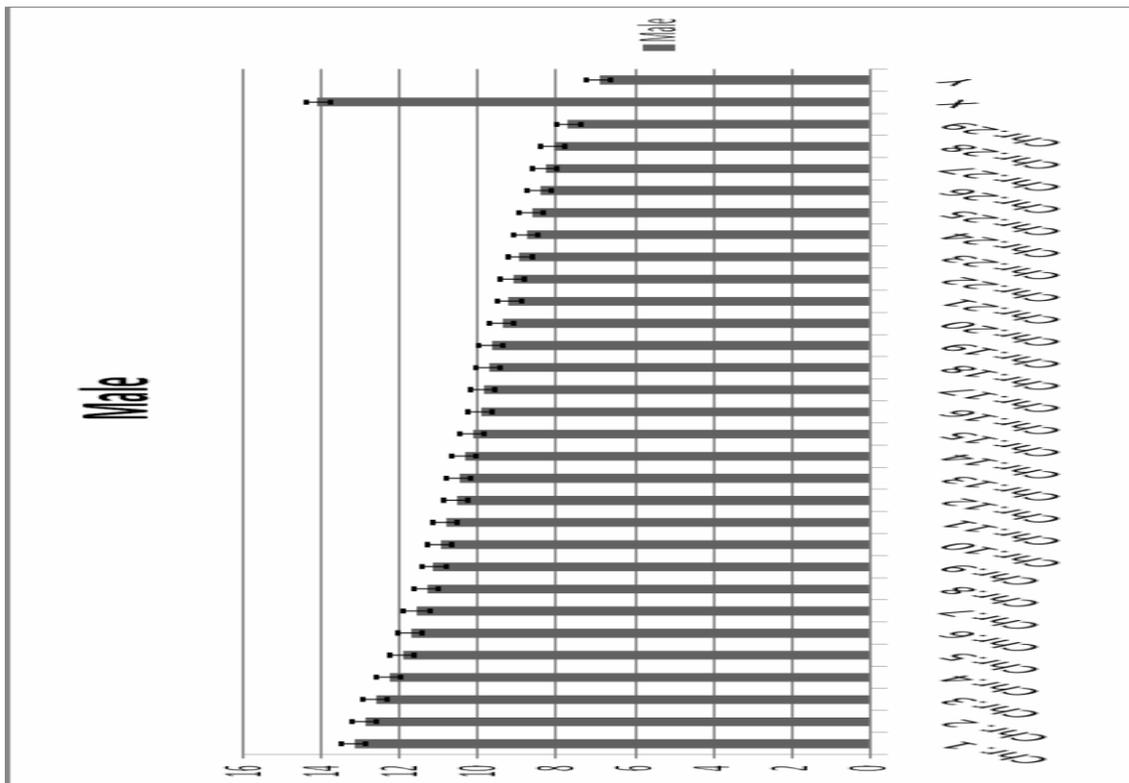


c. Mitotic-metaphase spread

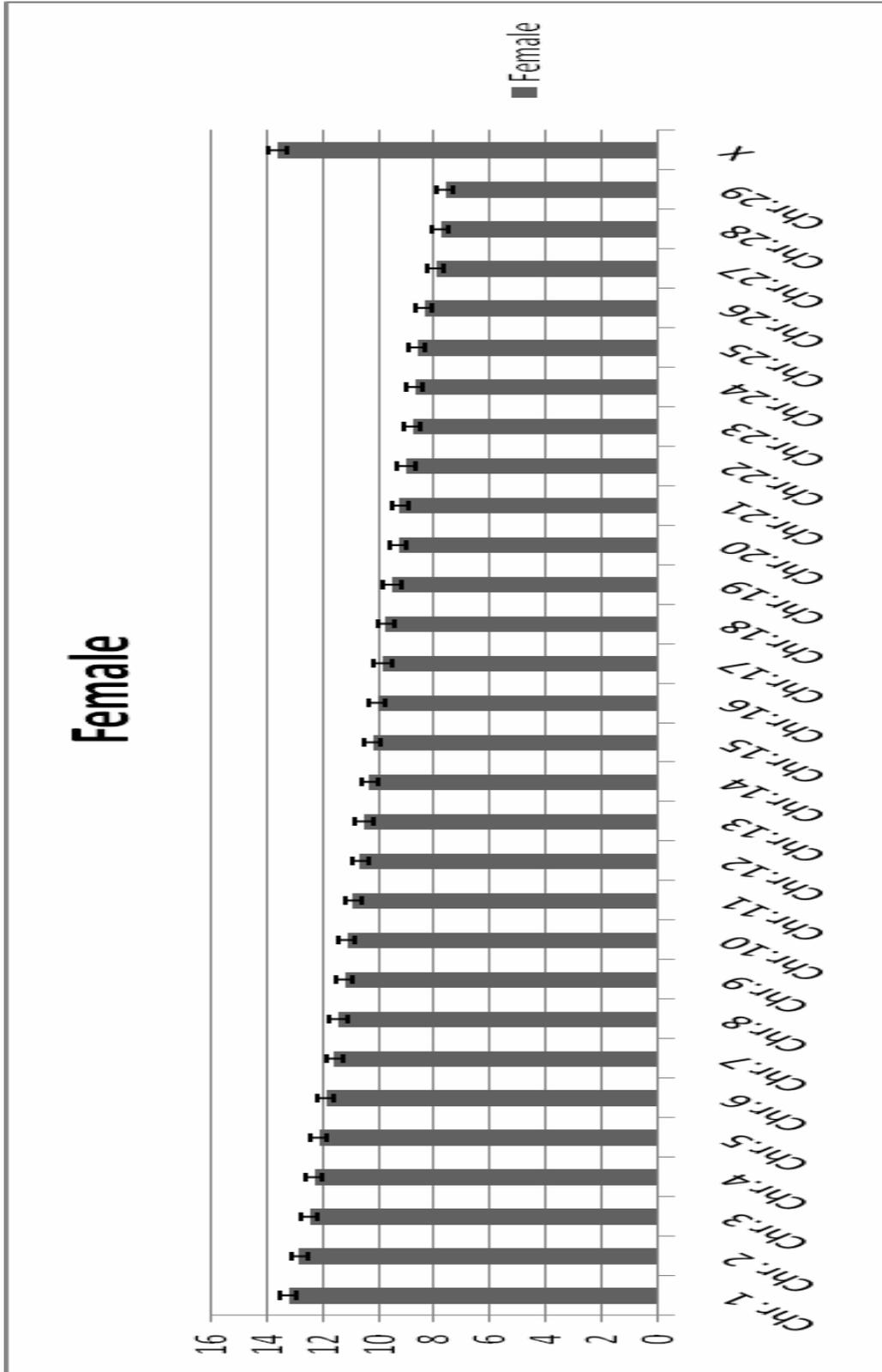


d. Karyotype of Black Bengal doe

**Idiogram based on relative length of chromosome of black Bengal buck**



Idiogram based on relative length of chromosome of black bengal doe



The relative length of Y chromosome was found to be  $1.47 \pm 0.03\%$  in Black Bengal goat. This finding is almost similar to the findings of Pattnanyak and Patre (1986) in Ganjam and Ganjam X Black Bengal, Bhatia and Shankar (1993 and 1994) in Marwari and Beetal goat respectively. Hansen (1973), Das (1990) and Nicodemo *et al.*, (2008) reported the relative length of Y chromosome were 1%, 0.80%, 0.73% and 1.08%, respectively which are lower than that of our findings. However Bhatia and Shankar (1992) reported Y chromosome contributed 1.62% in total genome of White Bengal goat which is higher than that of our findings.

The modal chromosome number (2n) in black Bengal type goat was found to be 60. As regard of morphology all the 58 autosomes and X chromosome were found to be acrocentric in nature. The X chromosome was found to be largest acrocentric chromosome in the complement. The Y chromosome was very minute dot like structure. In the present study it seemed to be sub-metacentric in appearance. The present study concluded that the animals screened were free from chromosomal abnormalities. This information will be of tremendous benefit in goat breeding program aiming at enhancing meat production, disease resistance and adaptation to environmental stress (climate change). The published literature for the effect of chromosome pair on relative length of chromosome on black Bengal type goat is scanty to draw accurate conclusions. Hence, further studies with large sample size are required to draw valid conclusions.

### **Acknowledgements**

The author is highly thankful to the BAU, Ranchi for supporting the work financially and morally. She feels the work had not

been completed without the warm and priceless technical support of the honourable guide and helpful colleagues.

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