Differential karyotype profiling of three popular breeds of dogs in India

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The description of the domestic dog (Canis lupus familiaris) as man’s best friend is a conception that is derivative from ages of co-existence and friendship. Dog breeds are companion animals primarily employed for guarding the farm and farmhouses, shepherding the livestock species. The 2.4 GB of DNA comprising the haploid nuclear genome of the (female) domestic dog are apportioned into 38 pairs of acrocentric autosomes and two metacentric sex chromosomes (Breen 2008). Cytogenetic studies may help categorize the chromosomal abnormalities which may prime to generative failures or infertility-related difficulties mainly in males.

The studies of the meiotic cells of the dog has determined the presence of 78 chromosomes (Minouchi et al. 1928) and later confirmed by using cultured peripheral lymphocytes (Gustavsson et al. 1964). The karyotype comprises 38 pairs of acrocentric autosomes, a large sub-metacentric X chromosome, and a small metacentric Y chromosome. Based on genome sequence data, dog chromosome 1 (CFA 1), is the largest autosome, with ~125 Mb in size (Lindblad-Toh et al. 2005) and is, therefore, smaller than human chromosome 12, with all but the five largest dog chromosomes (CFA 1–5) being smaller in Mb size than human chromosome 18.

Divergence among the canidae with respect to the common ancestor is reported to have commenced ~7–10 million years ago (Wayne et al. 1993). Earlier studies indicated the two major groupings, the ‘dog-like’ and ‘fox-like’ canids (Bininda-Emonds et al. 1999) (Graphodatsky et al. 2001). More latest genetic data, including data created as part of the project, dog genome sequence (Lindblad-Toh et al. 2005), have directed that the family may be refined into four major phylogenetic groups represented by the fox-like canids (including the raccoon dog), the gray and island fox species, the South American canids and the wolf-like canids (including the domestic dog) (Ostrander 2007). The karyotype design of the Canidae ranges from 2n = 34 in the red fox (Vulpes vulpes) to 2n = 78 in the wolflike canids (Wayne 1993).

More than 1000 dog data were recorded while visiting Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab hospital from the Out Patient Department Cards.

Labrador, Pug, and German shepherd are the most prevalent breeds of the region (Table 1). The blood samples were collected aseptically from the above mentioned three breeds for cytogenetic profiling. The blood was subjected to the separation of lymphocyte cells.

The collected data were analyzed to find out the top three most common breeds of dogs prevailing in the region. The peripheral blood samples were collected aseptically from the cephalic vein or saphenous vein of those three popular breeds of dog and local indigenous dogs in a heparinized tube. Short term peripheral blood lymphocyte culture technique (Moorhead et al. 1960) was followed with few modifications. The cultures were set up in a sterile culture tube by placing 0.3 to 0.5 ml of white blood cells (buffy coat) in 6 ml of Ham’s F-Medium supplemented with L-glutamine, 1.0 ml fetal bovine serum, and Pokeweed mitogen. The cells were cultured by incubation at 37°C for 70–72 h. The cells were harvested by the addition of colchicine. The cell suspension was incubated in pre-warmed at 37°C in hypotonic solution (0.075 M potassium chloride) for 8–10 min and fixed in Carnoy’s fixative methanol and acetic acid (3:1). Further, cells were treated to make their cell wall brittle to get burst against the slide, while dropping from a specific height. Slides were air-dried and stained by Giemsa for the visualization of chromosomes under a microscope prepared in a clean pre-chilled glass slide and air-dried.

The chromosomes G-banding was carried out using trypsin digestion protocol (Barch et al. 1991). The slides were observed under a microscope (Mag-cam DC 5) and decent metaphase spreads were photographed for developing banded karyotypes.

Labrador (29.64%), Pug (17.20%) and German shepherd (11.89%) were the most common breeds in this region. Chromosome analysis of four breeds of dogs revealed the diploid number (2n) as 78, with 38 pairs of acrocentric autosomes, one large sub-metacentric X-chromosome, and a small sub-metacentric Y-chromosome.
breeds of the Punjab region which are maintained as companion animals, or for guarding. Metaphase plates were prepared after culturing of lymphocytes isolated from heparinized blood collected from the identified three most popular canine breeds. The isolated lymphocyte cells were cultured for 70–72 h following the cell cycle arrest at metaphase. The G-banding of the chromosomes was done by Giemsa staining through a standard protocol. The most popular three breeds of dog in the sub-tropical region were Labrador, the German Shepherd, and Pug. There were no significant distinguishable differences between the karyotypes of the dog breeds studied. This study gives insight into karyology information, which can be beneficial to the researchers, dog breeders, and kennel clubs. Moreover, it provides information about chromosomal abnormalities which may lead to the study of various fertility, growth, and phenotypic abnormalities problems in dog breeds.

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