C- AND G- BANDING PATTERN OF RATTUS RATTUS WITH 38 CHROMOSOMES FROM AHMEDABAD (1975)

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Many races and subspecies of rats show high incidence of chromosomal polymorphism. Majority of chromosomal variation between different populations have been attributed to Robertsonian translocations and pericentric inversions.[1-4] Within the Indian subcontinent different populations of Rattus rattus have been described from different regions. The North Indian Rattus rattus population has 2n = 42 or more[5,6], Rattus rattus from Ahmedabad in North-Western India has 2n = 38[8] whereas the South India has both the populations of 2n = 38 and 2n = 42[7,9].

In recent years chromosome banding techniques have been used to understand and clarify the taxonomic and karyological relations of many mammalian groups including Rattus rattus[3,4]. Hence we have studied the different chromosome banding patterns in Rattus rattus populations. In this preliminary communication, the C- and G- banding patterns of Rattus rattus from Ahmedabad situated in North-Western India are reported.

MATERIALS AND METHODS

The animals used for the present study were collected from the densely populated domestic areas as well as from the fields around our university campus.

Bonemarrow chromosome preparations were made following the usual air-drying technique; for hypotonic treatment a 0.56% solution of potassium chloride was used. Preparations were made on precleaned wet slides and a jet of warm air was used to dry them.

For C- banding the technique of Arrighi and Hsu[10] with some modifications was used. Two to three days old slides were denatured in 0.07N NaOH for 1 to 1½ minute at room temparature without prior treatments with RNAase and HCl. The slides were then incubated for 24 hours in 2 x SSC or Sorensen's buffer at pH 7.0, rinsed in distilled water, dehydrated through alcohol grades and stained with Giemsa (E. Merck) stain diluted 1 : 10 in Sorensen's buffer (pH 7.0). Staining was done for a period of one hour.

For studying G- bands, either trypsin treatment[11] or 1 or 2 hours incubation in 2 x SSC at 65 °C[12] were employed. A 0.005% solution of 2 x crystalline trypsin (Worthington) in Sorensen's buffer (pH 7.5) was used at room temparature for 10 to 60 seconds. The treated slides for SSC and trypsin techniques were stained with 1 : 50 diluted Giemsa's stain for ten minutes.

RESULTS

It has been reported that Rattus rattus from Ahmedabad has 2n = 38[8] with two pairs of large metacentrics,

one large subtelocentric pair, 8 pairs of graded telocentrics including the X- chromosome, 7 pairs of small metacentrics and a pair of small submetacentrics. The Y-chromosome is the smallest telocentric. The standard karyotype is presented in fig. 1.

C-bands:

Centromeric regions of all the chromosomes stain intensly after C-band staining (Fig. 2). None of the chromosomes show any intercalary C-bands. The centromeric C-band regions vary in different chromosomes with respect to their size and intensity. Metacentrics and large subtelocentrics have medium sized C-bands. The telocentric pairs 4 and 6 show relatively large C-bands but the 2nd pair of telocentrics only a faintly stained small C-band region. The X- chromosome carries a distinctly stained centromeric heterochromatin. Y-chromosome, the smallest of the telocentrics often does not show any specific C-band pattern. It stains uniformly. All the small metacentrics and submetacentrics show more prominent C-bands.

G-bands:

We have obtained nearly similar G-banding pattern following either trypsin treatment or SSC incubation. However, trypsin digestion gave clearer and sharper bands.

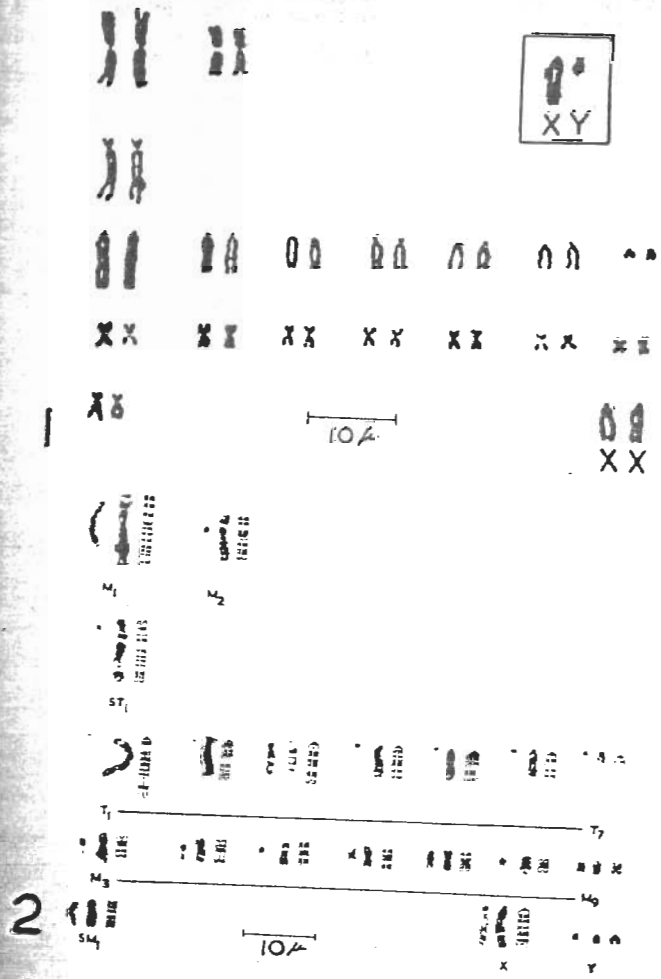

Fig. 1. Karyotype of a female Rattus rattus from Ahmedabad. Inset shows sex chromosomes from a male.

Fig. 2. C- and G- banding (trypsin technique) patterns and a C-band idiogram of Rattus rattus. For each homologous pair, only one chromosome is shown.

The typical G-bands observed after trypsin digestion are shown in fig. 2. Also given in the fig. 2, is a diagramatic representation of the different G-bands seen on the various chromosomes of the complement. The homologous chromosomes usually show identical G-band patterns, though sometimes minor variations may be seen between the homologs. It is seen that in almost every chromosome, the C-band positive regions are also G-band positive though the staining intensity of these regions is some times less in G-banded chromosomes. It seems, however that in the submetacentric chromosome pair(SM_1) the C-band region remains unstained in G-band treated chromosomes. It is also to be noted that the Y- chromosome does not show any G-bands, it remains uniformly stained. Thus, the Y- lacks both C- and G- bands. The three chromosome constrictions noted by Yosida and Sagai[4] on the subtelocentric and the largest telocentric chromosome pair of different populations of Rattus rattus were seen in our material as well.

DISCUSSION

The domestic black rat, Rattus rattus has a world wide distribution and is divided into a large number of subspecies on the basis of various morphological and anatomical features[13]. Chromosomally, however, two main types can be identified on the basis of diploid number. One group is characterised by 2n = 38 and the other with

2n = 42. It is interesting to note that for many of Rattus rattus subspecies both these diploid chromosome numbers have been reported[7,9]. Therefore a comparative study of chromesomes of various Rattus rattus populations is useful particularly using the recently developed chromosome banding techniques since this would permit tracing the homologies of different chromosomes in various populations. It has been suggested that the 2n = 38 and 2n = 42 chromosome types can be derived from each other by Robertsonian translocations and a recent study by Yosida and Sagai [3,4]using G-band techniques has provided evidence for the origin of the two pairs of large metacentrics, characteristic of 2n = 38 population, from 4 pairs of acrocentrics in 2n = 42 types, since the G-bands are clearly comparable in these chromosomes.

We have studied the C- and G- banding in Rattus rattus from Ahmedabad. This population has uniformly showed 2n = 38 chromosomes. So far we have not come across any instance of supernumerary chromosomes in the present population. The C-band pattern of this population presents the usual features characteristic of most mammalian chromosomes[14]. The centromeric region of all autosomes and the X- chromosome show prominent C-bands. There is no evidence for any intercalary C-band positive regions. Also, like most other mammals, the Y- chromosome lacks any C-band at centromere or at other region.

The trypsin technique of Seabright[11] gave sharper and better resolved G-bands than the SSC technique of Sumner et al[12]. We have compared the G-band patterns of the present population with the published G-bands of several subspecies of Rattus rattus[3,4]. The comparison reveals that the G-bands in the Ahmedabad population compares very well with the G-bands of Rattus rattus rattus (2n = 38) from Australia and Rattus rattus rufescens from South India described by Yosida and Sagai[3,4]. The subspecific identification of the present population has not been confirmed but it is noteworthy that in our population we have individuals with black as well as white belly, besides the different individuals studied by us also differ amongst themselves with respect to certain other morpho-anatomical features traditionally used for subspecific identification. However, inspite of these morphological differences, no chromosomal differences have been noted by us so far. All the individuals examined for G-bands show similar G-banding patterns. It is expected that a comprehensive analysis of G-banding pattern of Rattus rattus may elucidate the true taxonomy of this complex group.

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