POLYMORPHISM OF C-HETEROCHROMATIN REGIONS IN CHROMOSOMES OF DIFFERENT LINES OF MICE

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The C-heterochromatin regions were studied in the chromosomes of mice of lines C3HA and CBA and of mice homozygous for chromosomal translocations T6T6 and T1IEM. Preparations of metaphase chromosomes were obtained from bone marrow cells by Ford's method. The pericentromeric heterochromatin was revealed by the method of Arrighi and Hsu. Different chromosomes in the karyotypes of mice of different lines were found to contain different quantities of pericentromeric heterochromatin. Polymorphism of the C-heterochromatin regions is observed not only in mice of different lines, but also in different individuals belonging to the same line.

KEY WORDS: chromosomes; polymorphism of heterochromatin.

The use of new techniques has been largely resposible for the determination of the localization and some properties of the heterochromatin in mammalian and human chromosomes [4, 6, 7, 13, 16, 18, 22], and for the creation of a standard international classification [17], according to which Arrighi Q-, G-, and R-heterochromatins, localized in the chromosomal arms in the form of bands, and the C-heterochromatin, located in most species (including in mice) in the pericentromeric regions [3, 15, 19, 21], are distinguished; there are, however, some animals (Syrian hamsters, guinea pigs, California mice) in which whole arms of autosomes evidently consist of this type of constitutive heterochromatin [12].

In some lines of laboratory mice and also in domestic mice caught in certain regions of Czechoslovakia, polymorphism of the C-heterochromatin region has been shown to take place in homologous chromosomes [11]. However, it is not yet clear how widespread this phenomenon is among other lines and colonies of laboratory mice.

For this reason the C-heterochromatin was investigated in chromosomes of different lines of mice from the Rappolovo Nursery, Academy of Medical Sciences of the USSR.

EXPERIMENTAL METHOD

Mice of lines C3HA and CBA and mice homozygous for chromosomal translocations T6T6 and T1IEM were used [1]. Preparations of metaphase chromosomes were obtained from bone marrow cells [10] and stained by the method of Arrighi and Hsu [4]. Altogether the karyotypes of 15 males and 7 females were analyzed. In each mouse about 50 metaphase plates were studied by the NU microscope (objective 100, oil immersion, ocular 1.30).

EXPERIMENTAL RESULTS

C-heterochromatin was seen in the pericentromeric regions of each chromosome as darkly stained regions, in the lighter region between which was the centromere. If there was considerable coiling of the chromosomes the unstained region was invisible and the impression was obtained that the whole tip of the chromosome consisted of C-heterochromatin.

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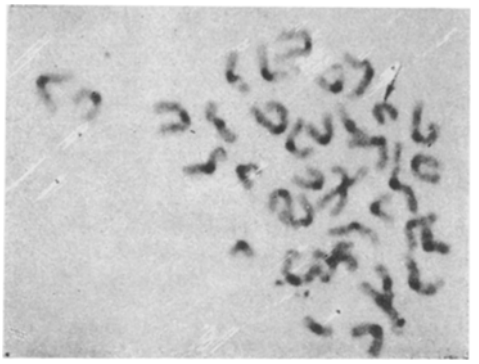

Fig. 1. Chromosome set of a mouse of line T1IEM (♂). Arrow indicates Y chromosome.

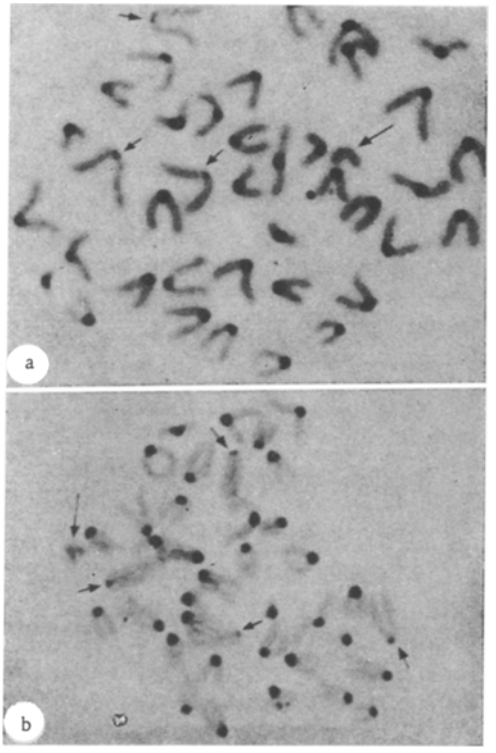

Fig. 2. Chromosome sets of mice of line T6T6 (♂♂): a) 3 chromosomes, b) 4 chromosomes with a low content of pericentromeric heterochromatin are identified by a short arrow. A long arrow points to the Y chromosome.

Large blocks of C-heterochromatin were seen in all autosomes and in the X chromosome. In the pericentromeric region of the Y chromosome two dark spots could be seen, about equal in size to the resolving power of the immersion objective. The arms of the Y chromosome were more darkly stained throughout their length than in other chromosomes, thus enabling the Y chromosome to be easily distinguished.

Certain distinctive features of the C-heterochromatin were found in the karyotype of mice belonging to different lines. In line T1IEM the C-heterochromatin regions were larger than in the chromosomes of the mice of the other lines. All the autosomes and the X chromosomes could not be distinguished visually by the size of their C-heterochromatin regions (Fig. 1). In the mice of other lines the dimensions of the C-heterochromatin regions varied in the different chromosomes; some autosomes had smaller C-heterochromatin regions. In the karyotype of some mice there were 4 such chromosomes, 3 in others. For instance, in the karyotype of C3HA and CBA males there were 4 chromosomes with C-heterochromatin regions of reduced size, whereas among the T6T6 males there were some individuals with 3 and some with 4 autosomes with reduced C-heterochromatin regions (Fig. 2). In CBA females there were 2, 3, or 4 of these chromosomes.

In all metaphase plates obtained from the same animals the same picture was observed. Consequently, polymorphism of the C-heterchromatin is characteristic of different individuals, but not of different cells of the same animal and it is a clear sign characterizing the karyotype of each individual animal.

Polymorphism of the C-heterochromatin regions in homologues evidently arises in meiosis as a result of unequal crossing over and translocation [22]. This phenomenon takes place frequently, and that is why polymorphism of the C-heterochromatin in homologous chromosomes has been described for man and animals [5, 8, 9, 14, 20], including for mice of different lines [11]. The present observations show that polymorphism of the C-heterochromatin in homologues takes place not only in mice of different lines, but also in different individuals belonging to the same line.

Phenotypically, individuals with polymorphism of the C-heterochromatin were indistinguishable in every respect from mice without such changes, although preliminary observations show that in animals with polymorphism of the C-heterochromatin aneuploid gametes were found more often. Polymorphism of the C-heterochromatin thus may affect the separation of the chromosomes in meiosis somehow. The problem of the role of the C-heterochromatin in the co-orientation and separation of homologues in meiosis has already been considered [2, 18]. Mice with polymorphism of the C-heterochromatin regions could be a convenient object for the experimental analysis of this hypothesis.

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