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Studies on Gerbillinae (Rodentia)

I. Banding patterns of mitotic and meiotic chromosomes of the Mongolian gerbil, *Meriones unguiculatus*

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Abstract

Presented G- and C-bands of the karyotype of *Meriones unguiculatus* and C-bands of meiotic chromosomes during metaphase I. The study was carried out on several male and female individuals derived from a laboratory stock. Mitotic chromosome preparations were obtained from fibroblast cultures, meiotic preparations from testes.

The mitotic chromosomes reveal characteristic G-banding patterns and can easily be identified. After application of C-banding technique, a remarkable distribution of heterochromatin becomes obvious. Though centromeric C-bands can be found in each pair of autosomes, differences in amount and staining intensity are present. Several autosomes show interstitial C-bands and one pair is heterochromatic throughout its length. The X chromosome is characterized by several bands of different staining intensity, whereas the Y chromosome shows uniformly dark staining.

In C-banded preparations of male meiosis, the pairing behaviour of the partly and totally heterochromatic autosomes and of the gonosomes could be analysed.

Several data suggest the presence of different categories of heterochromatin.

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Introduction

Previous karyological investigations have revealed a chromosome number of 2n = 44 in the Mongolian gerbil, but do not completely agree in their description of chromosome morphology and identification of sex chromosomes (Nadler and Lay 1967; Pakes 1969; Cohen 1970; Vorontsov and Korobitsina 1970; Weiss et al. 1970). Now, the advanced staining techniques have provided us with the means for more precise analyses. The study of banding patterns leads to unequivocal identification of each pair of chromosomes and allows to trace chromosomal rearrangements, not only within one species but also between different species.

In this paper, we present the G- and C-banding patterns of the mitotic chromosomes of *Meriones unguiculatus* and, in addition, report upon C-stained meiotic chromosomes.

Material and methods

Our investigations were carried out on several male and female individuals of *Meriones unguiculatus* derived from a laboratory stock. Fibroblast cultures were initiated from ear biopsies and maintained in TC Medium Eagle, Earle BSS supplemented with 20% fetal bovine serum. Air dried mitotic chromosome preparations were submitted to G-banding procedure (Sumner et al. 1971) or to C-banding technique (Sumner 1972, slightly modified). Meiotic preparations from testes were done following the air-drying method of Evans et al. (1964).

Results

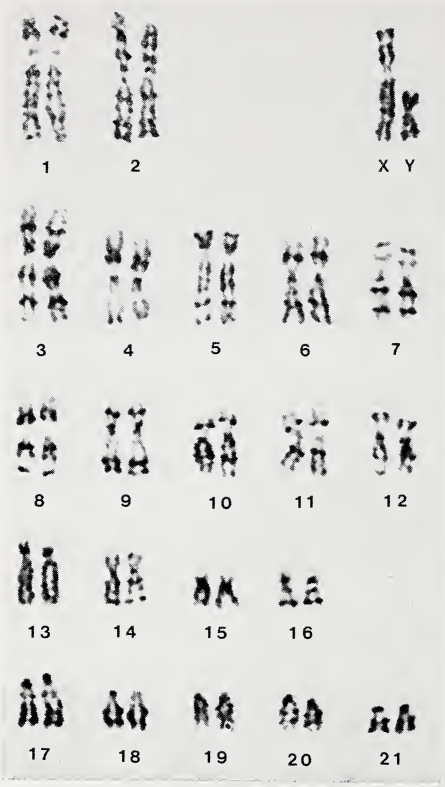
Mitotic chromosomes

G-bands: After application of ASG banding technique, each chromosome can be identified by its characteristic banding pattern (Fig. 1). Most of the autosomes reveal distinctly stained G-bands, while the G-banding patterns of the sex chromosomes appear less conspicuous.

C-bands: In Fig. 2, the C-stained karyotype of a male is presented. Each pair of autosomes reveals centromeric heterochromatin, but conspicuous differences in amount and staining intensity of this material become obvious. Outside of the centromeric regions, additional amounts of heterochromatin can be observed. Apart from several autosomes that show small interstitial C-bands, the chromosomes nos. 5 and 13 demand particular interest. No. 5 reveals a large heterochromatic block which comprises the proximal half of the long arm and, additionally, shows an intensively stained C-band in the middle of the short arm. Chromosome no. 13 is heterochromatic throughout its length, but still allows to distinguish the darker stained centromeric area. The submetacentric X chromosome is characterized by several bands of different staining intensity. Its centromeric C-band and the telomeric region of the long arm appear darkest stained. The totally heterochromatic Y chromosome shows uniformly dark staining. — The specimens used in this study did not reveal any polymorphism.

Meiotic chromosomes

Our analysis of meiosis was restricted to metaphases I and II. At metaphase I, the 21 autosomal bivalents show various configurations (Fig. 3). Most of the chromosomes form rod or cross like bivalents with one chiasma, while others form rings with two chiasmata. More than two chiasmata scarcely occurred within one bivalent.



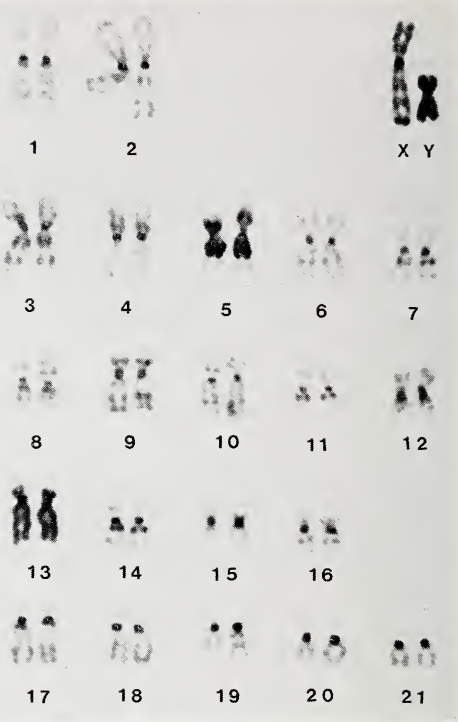


Fig. 1 (left). Karyotype of a male individual of *Meriones unguiculatus* after applications of G-banding technique. — *Fig. 2 (right).* C-banded male karyotype

C-stained preparations did not only reveal the centromeric C-bands, but also allowed the identification of the autosomes nos. 5 and 13 and of the sex bivalent. The partly heterochromatic pair no. 5 nearly always formed a cross like bivalent with one chiasma, visible only in the euchromatic part of the long arm. This appearance is of interest, because other chromosomes of equal length or even smaller ones often show more than one chiasma. The heterochromatic material in chromosome no. 5 does not appear to undergo chiasma formation. A remarkable contrast to this observation can be found in chromosome no. 13. Though totally heterochromatic, these chromosomes build up chiasmata. — As the sex chromosomes are isopycnotic during metaphases I and II, their identification in orcein stained preparations is difficult. After C-staining, however, they can easily be distinguished. In most metaphases I, they were coiled,

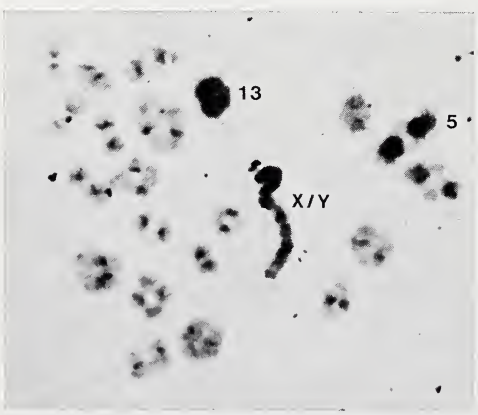


Fig. 3. Male meiosis, C-banded metaphase I

forming ring like structures which were difficult to analyse. The real pairing behaviour became obvious in very few metaphases, when the chromosomes had straightened out. Here, the Y chromosome was found in end-to-end association with the long arm of the X chromosome. A visible chiasma formation within the sex bivalent could never be proved.

Discussion

As conventional staining methods did not lead to unequivocal identification of each chromosome pair in *Meriones unguiculatus,* a detailed comparison of our results with those of previous investigators does not appear to be useful. Here, we only want to mention the discrepancy concerning satellite associations. While Weiss et al. (1970) did not observe any association, Cohen (1970) reports upon associations of acrocentric chromosomes. In our preparations, not only the acrocentric chromosome no. 18, but also the short arms of nos. 5 and 14 have been found to be involved in associations.

Though G-banding has revealed very characteristic banding patterns, the distribution of heterochromatin seems to be more interesting. A remarkable detail may be seen in the presence of a totally heterochromatic chromosome which, however, is not exceptional among Cricetidae. Heterochromatic autosomes have already been observed in *Cricetus cricetus* (Vistorin et al. 1976), *Cricetulus griseus* (Gamperl et al. 1976) and *Cricetulus longicaudatus* (Radjabli, pers. comm.). On the other hand, heterochromatic autosomes have more frequently been discovered as supernumerary chromosomes. Such B-chromosomes are widely known from plants, insects and several mammals, especially rodents (see Yosida 1977). At the present state of our knowledge, it is not possible to decide whether these chromosomes of *Meriones unguiculatus* could be supernumerary chromosomes as well. Further analyses of specimens captured in their natural habitat may elucidate this problem.

With regard to previous autoradiographic studies (Cohen 1970; Weiss et al. 1970), the heterochromatic material of the gonosomes and of chromosome no. 5 corresponds to late labelling segments. Of chromosome no. 13, however, late replicating has not been reported. It can thus be concluded that different categories of heterochromatin are present. A confirmation to this assumption may be seen in meiosis where chiasmata have not been observed in the late replicating type of heterochromatin, but occur within the heterochromatic chromosome no. 13. Further investigations should be carried out in order to analyse the constitution of these categories of heterochromation.

Zusammenfassung

Untersuchungen an Gerbillinae (Rodentia). I. Bändermuster der mitotischen und meiotischen Chromosomen von Meriones unguiculatus

Die mitotischen Chromosomen von *Meriones unguiculatus* (2n = 44) können aufgrund ihres charakteristischen G-Bändermusters leicht identifiziert werden. Bemerkenswert ist die Verteilung des Heterochromatins, das sich mit der C-Bändermethode darstellen läßt. Obwohl jedes Chromosomenpaar Zentromerenheterochromatin aufweist, lassen sich Unterschiede im Gehalt und in der Färbungsintensität nachweisen. Einige Autosomen besitzen interstitielle C-Bänder, ein Autosomenpaar ist zur Gänze heterochromatisch. Das X-Chromosom ist gekennzeichnet durch eine Reihe von C-Bändern unterschiedlicher Färbungsintensität, das Y-Chromosom ist einheitlich dunkel gefärbt. — Metaphasen I und II der männlichen Meiose wurden analysiert. Das Paarungsverhalten der teilweise bzw. total heterochromatischen Autosomen und das der Gonosomen konnte mit Hilfe der C-Färbung untersucht werden.

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Feeding habits of the Stone Marten, *Martes foina* (Erxleben, 1777), in northern Burgos, Spain

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Abstract

This study on the diet of the Stone Marten *(Martes foina)* is based on the analysis of 148 droppings and 14 gut contents collected from 1973 to 1977 in northern Burgos, an area of transition between temperate and mediterranean Spain. The results of the analysis are presented as: a. frequency of occurrence of each type of prey and b. as consumed biomass, estimated using the correction factors of Lockie (1961) for the Pine Marten. Seasonal variations in the diet were found. Small mammals (mainly *Apodemus sylvaticus* and *Crocidura russula)* and birds are the most important prey in Spring — Summer, and berries (mainly of *Juniperus* spp., *Rubus* spp. and *Arctostaphylos uva-ursi)* in Fall-Winter. Reptiles, insects, carrion and honey are complementary foods. The Stone Marten appears in the

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