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Studies on Gerbillinae (Rodentia)

II. The karyotype of *Gerbillus campestris*, analysed by G- and C-banding techniques

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Abstract

Studied banding patterns of the chromosomes of *Gerbillus campestris* from South Morocco. Air-dried chromosome preparations were submitted to G- and C-banding techniques. The karyotype consists of 56 chromosomes that can be distinguished on basis of their characteristic G-bands. After application of C-staining method, blocks of centromeric heterochromatin can be observed in each pair of autosomes. Chromosome no. 3 is entirely heterochromatic, but the darker stained centromeric area remains still visible. The X chromosome which seems to be totally heterochromatic can be subdivided into regions with different degrees of staining intensity. The Y chromosome stains heavily throughout its length. — In two pairs of autosomes, structural polymorphism is present.

Comparison of the karyotypes of the two gerbil species *Gerbillus campestris* and *Meriones unguiculatus* revealed a considerable number of chromosome arms with apparently homologous G-banding patterns. With regard to the distribution of heterochromatin, similarities as well as differences can be found.

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Introduction

Chromosomal investigations of several members of the genus *Gerbillus* have demonstrated great differences in chromosome number and morphology (MATTHEY 1953; WAHRMAN and ZAHAVI 1955; ZAHAVI and WAHRMAN 1957; WAHRMAN and GOUREVITZ 1972; LAY 1975; LAY and NADLER 1975; LAY et al. 1975). In most of the studies, conventional staining techniques have been applied that did not allow detailed comparisons, but nevertheless, the importance of cytogenetic analyses has already been emphasized. The improved staining techniques may now contribute to the solution of numerous questions concerning systematics and evolution of gerbils. For this purpose, it is necessary to accumulate cytogenetic data on as many species as possible. The present paper deals with G- and C-banding patterns of the karyotype of *Gerbillus campestris* and gives a brief comparison with those of *Meriones unguiculatus*, another member of Gerbillinae that has been analysed by us (GAMPERL and VISTORIN 1978).

Material and methods

For this study, we used several males and females of *Gerbillus campestris* that were descended from individuals of South Morocco, kindly provided to us by Prof. Dr. J. NIETHAMMER, Bonn. Chromosome preparations were obtained as described earlier (GAMPERL and VISTORIN 1978).

Results

The chromosome number of our individuals of *Gerbillus campestris* was found to be $2n = 56$. Application of G-banding technique allowed to identify each pair of chromosomes, though the complement contains many elements of similar size and morphology (Fig. 1). The autosomes can be distinguished based on a considerably well differentiated G-banding pattern. The gonosomes, however, do not show distinct G-bands.

C-banding revealed some remarkable details (Fig. 2). The autosomes are characterized by heavily stained blocks of centromeric heterochromatin. While additional C-bands of different staining intensities become obvious in several autosomes, chromosome no. 3 is totally heterochromatic. Its dark centromeric area, however, can still be distinguished. The same is true for the X chromosome which seems to be entirely heterochromatic, too. This gonosome additionally shows a characteristic region of darker staining intensity at the end of the short arm. The heterochromatic Y chromosome stains heavily throughout its length.

In two pairs of autosomes, distinct polymorphism was observed (Fig. 3). The heterochromatic chromosome no. 3 revealed variations in arm length so that it appeared metacentric as well as submetacentric. The second case of polymorphism concerned pair no. 7. These small, submetacentric chromosomes possess interstitial C-bands which occurred either on the long arm or on the short arm or even on both arms.



Fig. 1 (left). Karyotype of a male individual of *Gerbillus campestris* after application of G-banding technique. — Fig. 2 (right). C-banded male karyotype

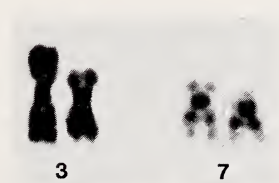


Fig. 3. Pairs of polymorphic chromosomes after application of C-banding technique

Discussion

The genus *Gerbillus* comprises 40 to 50 species, about half of them being analysed cytogenetically. Diploid chromosome numbers between 38 and 72 have been found up to now. Within an Israeli population of *Gerbillus pyramidum*, extreme numerical variations have been reported that range from 50 to 66 (WAHRMAN and ZAHAVI 1955; WAHRMAN and GOUREVITZ 1972). A second case of numerical polymorphism is known from *G. campestris*. LAY et al. (1975) have presented karyotypes

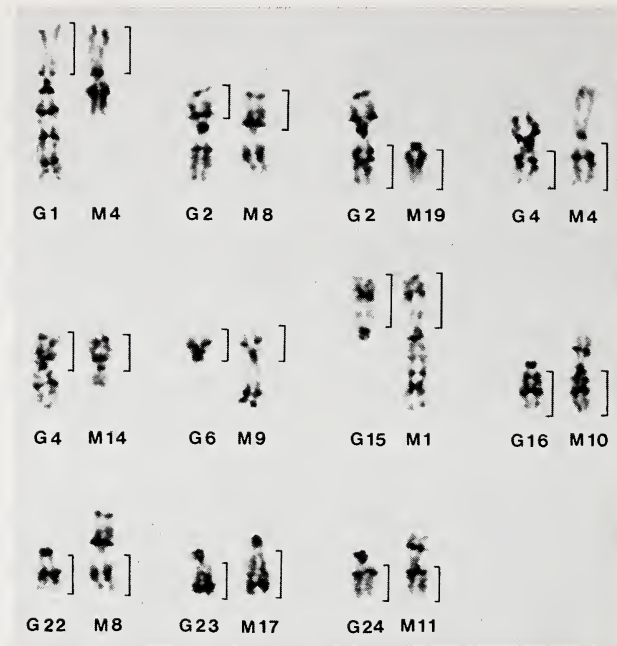


Fig. 4. Chromosomes of *Gerbillus campestris* (G1, G2 etc.) and *Meriones unguiculatus* (M1, M4 etc.) which reveal segments of apparently homologous G-banding patterns. Similar regions are indicated by bars

with diploid numbers of 56, 57 and 58. In our individuals of *G. campestris*, however, the chromosome number was found to be constant. Yet, we were able to observe structural polymorphism. — As banding techniques have not been used by LAY et al. (1975), it is difficult to compare their results with those of our study. On the other hand, WAHRMAN and GOUREVITZ (1972) published G-bands of *G. pyramidum*, but we did not discover considerable similarities to our species. On account of these findings, the degree of G-band homology with *Meriones unguiculatus* is surprisingly great (for description of the karyotype of this species see GAMPERL and VISTORIN 1978). Though these two members of different genera show considerable discrepancy in chromosome number and morphology, several chromosome arms were found that reveal apparently identical G-banding patterns (Fig. 4). With regard to the distribution of heterochromatin, similarities as well as differences can be pointed out between *G. campestris* and *M. unguiculatus*. The gonosomes of both species, already similar in morphologic characters, correspond in C-staining reaction. The Y chromosomes reveal uniformly dark staining whereas both X chromosomes can be subdivided into regions with different degrees of staining intensity. The arrangements of these regions, however, do not agree. Another remarkable similarity may be seen in the presence of a totally heterochromatic pair of autosomes in both karyotypes. As to the other autosomes, it is noteworthy that all of them possess centromeric heterochromatin, but here, differences become obvious. While the *Gerbillus* chromosomes reveal blocks of darkly stained heterochromatin, *Meriones* shows varying amounts of more or less intensively stained centromeric heterochromatin. — When the two gerbil species are regarded from the evolutionary point of view, the karyotype of *G. campestris* with its great number of acrocentrics appears more

"primitive" than that of *M. unguiculatus*. The lower diploid number of the latter, its few acrocentrics and many metacentrics may be considered as more derived (NADLER and LAY 1967). The available data on centromeric C-bands can perhaps suggest similar conclusions, as a parallel may be seen to findings in the genus *Rattus*, where evolutionary changes seem to tend to a diminution of centromeric heterochromatin (YOSIDA and SAGAI 1975; VISTORIN et al. 1978). It should be interesting to know whether such a tendency could be confirmed by the C-banding patterns of other species of Gerbillinae. Furthermore, C-banding as well as G-banding would certainly help to elucidate taxonomic and phylogenetic relationships within this group of rodents.

Zusammenfassung

Untersuchungen an Gerbillinae (Rodentia). II. Analyse des Karyotyps von Gerbillus campestris mit Hilfe der G- und C-Bändermethode

Der Karyotyp von *Gerbillus campestris* enthält $2n = 56$ Chromosomen mit sehr charakteristischen G-Bändern. Mit Hilfe der C-Bändermethode lassen sich in jedem Autosomenpaar Blöcke von Zentromerenheterochromatin nachweisen. Chromosom Nr. 3 ist vollständig heterochromatisch, läßt aber eine etwas dunkler gefärbte Zentromerenregion erkennen. Das X-Chromosom scheint heterochromatisch zu sein. Es ist in Regionen mit unterschiedlicher Färbungsintensität gegliedert. Das heterochromatische Y-Chromosom färbt sich einheitlich dunkel an. — Zwei Autosomenpaare weisen strukturellen Polymorphismus auf. — Beim Vergleich der Karyotypen von *Gerbillus campestris* und *Meriones unguiculatus* wurde eine Reihe von Übereinstimmungen gefunden.

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