G-, C-, and NOR-stained karyotype of the Eversmann’s hamster Allocricetulus eversmanni and comparison with the karyotype of Cricetulus species (Rodentia: Cricetinae)

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Differential chromosomal stainings for various species belonging to genera in the tribe Cricetini of the Eurasian Cricetinae including Cricetus, Cricetulus, Tscherkia, Phodopus, and Mesocricetus are available (Gamperl et al. 1978; Kartavtseva et al. 1979; Popescu and DiPaolo 1980; Kral et al. 1984). Hitherto, however, no differential chromosomes stainings for species in the genus Allocricetulus have been described and the phylogenetic position of this genus in the Cricetini, based on chromosomal data, has not been determined.

The Eversmann’s hamster Allocricetus eversmanni Brandt, 1859 occurs in dry steppes and semi-deserts between the Volga and Ural rivers in Russia and in Kazakhstan, and includes three subspecies. The karyotype of A. eversmanni (2n = 26) was first described by Matthey (1960) from Kazakhstan, then subsequently those for subspecies, A. e. eversmanni and A. e. beljaevi (2n = 26, NF = 40: 8M + 10T + 6ST, X – SM, Y – SM) and A. e. pseudocurtatus (2n = 26; NF = 38: 8M + 12T + 4ST, X – M/SM, Y – SM/ST) were described. Kartavtseva and Vorontsov (1992) found distinctions in the morphology of one pair of large autosomes, pair no. 5, and in the size and morphology of the Y-chromosome and have suggested that the difference in the chromosome pair no. 5 appeared in A. e. pseudocurtatus.

One female A. e. eversmanni was captured in the vicinity of Djakovka Village, Saratov Region, near the Lower Volga River, Russia. Chromosome preparations were obtained from bone marrow cells. After colcemid-treatment and hypotonic treatment with KCl-solution, the cells were fixed with acetic-methanol (1 : 3) and air or flame-dried. We arranged the chromosomes as described previously by Kartavtseva and Vorontsov (1992). The procedure of tripisin treatment was used for G-banding (Seabright 1971). The distribution of heterochromatin in chromosomes was shown using Sumner’s (1972) modified C-banding technique. The locations of nucleolar organizer regions (NORs) of metaphase chromosomes were determined after 50% aqueous AgNO3 treatment for 12 hours at 50–60°C (Bloom and Goodpasture 1976).

The karyotype consisted of 24 autosomes (2n = 26, NF = 40): four pairs of metacentrics (M) and submetacentrics (SM): one pair large, one pair medium and two pairs small, two pairs of large subtelocentrics (ST) and six pairs of acrocentrics (A), ranging from medium-sized to small. The X chromosome was a medium sized submetacentric (Fig. 1).

Differential G-staining made it possible to define the homologues in the karyotype (Fig. 1a). The short arm of the large subtelocentric no. 5 had no clear bands, while the short arm of the large subtelocentric no. 6 had a clear band in the pericentromeric region. The least acrocentrics nos. 11 and 12 had no clear bands.

The C-staining of chromosomes obtained a low amount of heterochromatin in A. e. eversmanni in biarmed chromosomes nos. 1, 2, 5, 6, and acrocentric no. 7 had no positive band. The two pairs of small metacentrics nos. 3, 4 and small acrocentrics nos. 8–12 had heterochromatin in pericentromeric areas. The X chromosome carried one dark C-block in the pericentromeric region of the short arm (Fig. 1b).

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NORs were ascertained in five pairs of chromosomes. In pairs 2, 4, and 5 of biarmed chromosomes, the NORs were found at the telomeric ends (pair 5 had NORs in short arms). In the acrocentric pairs 8 and 10, very small NORs were observed at the centromeric positions (Fig. 1c).

Earlier we assumed that distinction among A. e. eversmanni, A. e. beljaevi and A. e. pseudocurtatus based on the occurrence of deletion in the short arm of

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the subtelocentric chromosome no. 6, required a quantita-
tive change in heterochromatin. Our present research has
shown clearly that the short arm of chromosome no. 6
consisted of euchromatin. Therefore we admit that the
euchromatin material of this chromosome is not deleted
and is displaced to another chromosome region.

We compared the differentially stained chromosomes
of *A. eversmanni* with the published data of G- and
NOR-stained chromosomes of *Cricetulus pseudogriseus*
(*2n = 24: 12M + 10T/ST + X – M, Y – SM*), *C. griseus*
(*2n = 22: 14M + 6T/ST + X – M, Y – SM*) and *C. bara-
bensis* (*2n = 20: 16M/SM + 2T/ST + X – ST, Y – SM*)

![Fig. 1. Differentially stained karyotypes of *A. e. eversmanni*: G-band (a), C-band (b), and NOR-band (c).](image)

![Fig. 2. Comparison of G-banded chromosomes in two species of *Allocricetulus eversmanni* (A) and *Cricetulus pseudogriseus* (ps) (from Kral et al. 1984).](image)
The G-banded chromosomes of *A. e. eversmanni* had the greatest similarity with *C. pseudogriseus* (Fig. 2, Table 1). The long arms of the two large subtelocentrics (nos. 5q and 6q) of *A. e. eversmanni* were similar to the long and short arms of metacentric no. 1 of *C. pseudogriseus*. We also found a similarity between the autosome pairs of *A. e. eversmanni*, nos. 1, 2, 3, 4, 7, 8, 9, 10, 12 and the X chromosome with corresponding chromosomes or chromosomal arms of *C. pseudogriseus* (Table 1). The comparison of NOR-stained chromosomes of *A. eversmanni* and *Cricetulus* species has not revealed a similarity of localization of blocks on all NOR-carrying chromosomes.

The two genera, *Allocricetulus* and *Cricetulus*, show considerable similarity in the G-banding patterns of the majority of their chromosome arms, but exhibit different combinations of telocentric chromosomes for biarmed chromosomes. This implies that these karyotypes have emerged independently from a common ancestral karyotype (2n = 34: 2M + 14T/ST + X – M) through chromosomal fusion (Table 1). A similar form of chromosomal reorganization has previously been described for the genera *Cricetus* and *Cricetulus* (Gamperl et al. 1976, 1978).

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References


