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Nucleolar Organizer Regions (NORs) of the Spiny Mouse, *Acomys cilicicus* (Mammalia: Rodentia) in Turkey

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Abstract: In this study nucleolus organizer regions (NORs) of *Acomys cilicicus* were examined. The karyotype of *A. cilicicus* is composed of 2n = 36, FN = 70, and FNa = 66. Ag-NORs are located on the terminal region of the long arm of chromosome 5 and, as a secondary constriction, on the long arm of chromosome 6 in this species. All the NORs are homomorphic and large-sized.

Key Words: Nucleolar organizer regions (NORs), karyotype, *Acomys cilicicus*

Türkiye'deki Dikenli Fare, *Acomys cilicicus* (Mammalia: Rodentia)'un Nükleolar Organizatör Bölgeleri (NORs)

Özet: İlk defa bu araştırmada, *Acomys cilicicus*'un Nükleolar Organizatör Bölgeleri (NOR) tespit edildi. *A. cilicicus*'un karyotipi 2n = 36, FN = 70 ve FNa = 66'dan oluşmaktadır. Bu türün beşinci çift kromozomun uzun kolunun terminal bölgesinde ve ikincil boğum olarak da altıncı çift kromozomun uzun kolu üzerinde Ag-NOR vardır. Bütün Nükleolar Organizatör Bölgeler aynı görünüm ve büyüklüktedir.

Anahtar Sözcükler: Nükleolar Organizatör Bölgeler (NORs), karyotip, *Acomys cilicicus*

Introduction

The genus *Acomys* (Muridae) includes 14 species, which can be found in Africa, Asia, and Europe (Duff and Lawson, 2004). The systematic and phylogeny of this genus were investigated previously (Setzer, 1975; Musser and Carleton, 1993). Karyotypic investigations appear to be a promising tool for understanding the phylogenetic relationships within the genus because of extensive chromosomal variation between individual species and populations (Wahrman and Zahavi, 1953; Zahavi and Wahrman, 1956; Matthey, 1963, 1965, 1968; Matthey and Baccar, 1967; Baccar, 1969; Tobgy et al., 1972; Wahrman and Goitein, 1972; De Hondt et al., 1977; Al-Saleh, 1988; Volobouev et al., 1991; Macholán et al., 1995; Kıvanç et al., 1997, Zima et al., 1999; Volobouev et al., 2002). A new species of Turkish spiny mouse, *Acomys cilicicus*, was described from the vicinity of Silifke (İçel), in southern Anatolia by Spitzenberger (1978). The first karyotype of this species, which belongs to the *A. cahirinius-dimitiatus* group, was determined by Macholan et al. (1995) and this karyotype study was repeated by Kıvanç et al. (1997) (2n = 36, FN = 70, and FNa = 66). Kunze et al. (1999) compared G-banded karyotypes of *Acomys dimidiatus* from Israel (2n = 38), *Acomys cahirinus* from Egypt (2n=36), *Acomys cineraceus* from Sudan (2n = 48-50), and *Acomys minous* from Crete (2n = 38). Nucleolar organizer regions (NORs) of mammalian chromosomes are known to contain the genes for 18S and 28S rRNA. The localization of the nucleolar organizer regions has been considered a useful taxonomic and phylogenetic marker (Sanchez et al., 1990). There are data related to conventional and C-banded karyotype of *A. cilicicus* in most investigations but not for NORs. Therefore, the objective of this study was to investigate the NORs of *A. cilicicus*.

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Materials and Methods

Five specimens (3 male and 2 female) live-trapped from Silifke in Turkey were karyotyped. Karyotype preparations were performed according to a method described by Ford and Hamerton (1956). Ag-NORs were stained with silver-nitrate staining (Howell and Black, 1980). The chromosome count and karyological analysis were done by studying about 50 mitotic metaphase stages from dividing bone marrow cells. A total of 8 Ag-NOR banded metaphase spreads were analyzed from each specimen. Morphology of chromosomes was established by calculating centromeric indexes according to Zima (1978). The diploid number of chromosomes (2n), morphologies of the chromosome, the fundamental number (FN), and the number of autosomal arms (FNa) were determined. Standard voucher specimens (skins and skulls) are deposited in the Department of Biology, Faculty of Science and Arts, Selçuk University, Konya, Turkey.

Results and Discussion

The Turkish spiny mouse, *A. cilicicus*, had the diploid number (2n) of 36, the fundamental number (FN) of 70 and the number of autosomal arms (FNa) of 66. The autosomal complement comprised 14 pairs of metacentrics (nos. 1-14), 2 pairs of submetacentrics (no. 15 and 16), and 1 pair of acrocentrics (no. 17). The X chromosome was a large subtelocentric, and the Y chromosome was a very small acrocentric (Figure 1). Our results are similar to the data reported by Macholán et al. (1995) and Kıvanç et al. (1997). According to Zima et al. (1999), *Acomys nesiotes* in Cyprus had the diploid number of 38 (FN = 68, FNa = 66) and the chromosomal difference between the 2 species is attributed to Robertsonian translocation between 2 acrocentric chromosomes in the set of *A. nesiotes*. Furthermore, Zima et al. (1999) determined that constitutive heterochromatin (C-banding) of the Y chromosome of *A. nesiotes* is negative stained.

Using silver-nitrate staining, NORs were determined on the telomeric region of the long arm of no. 5 pair metacentric chromosome and as a secondary constriction on the long arm of no. 6 pair metacentric chromosome. All the NORs were homomorphic and large-sized (Figure 2). There are 3 types of NOR sites in the satellite (Sat), secondary constriction (SC), and telomeric (T) regions (Oshida and Yoshida, 1999). Macholán et al. (1995) were

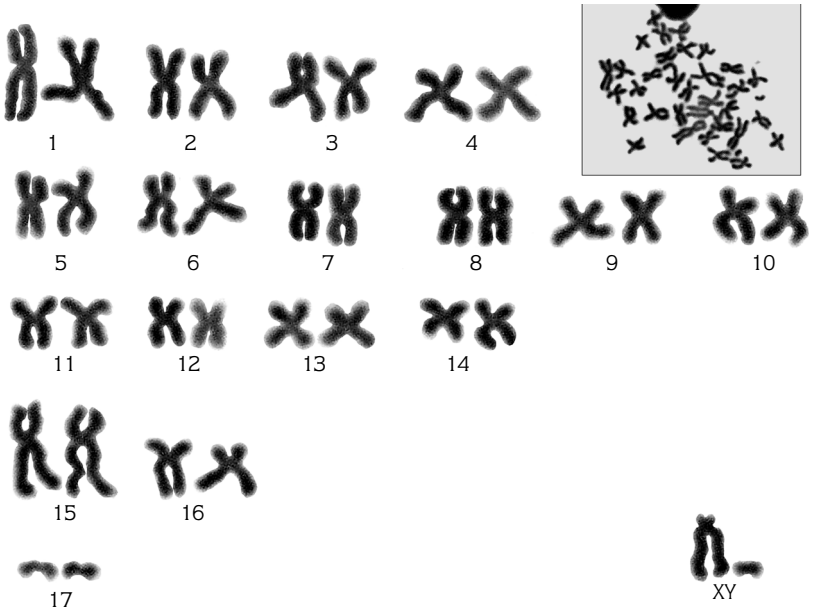

Figure 1. Metaphase spread and karyotype of *Acomys cilicicus* from Silifke, Turkey.

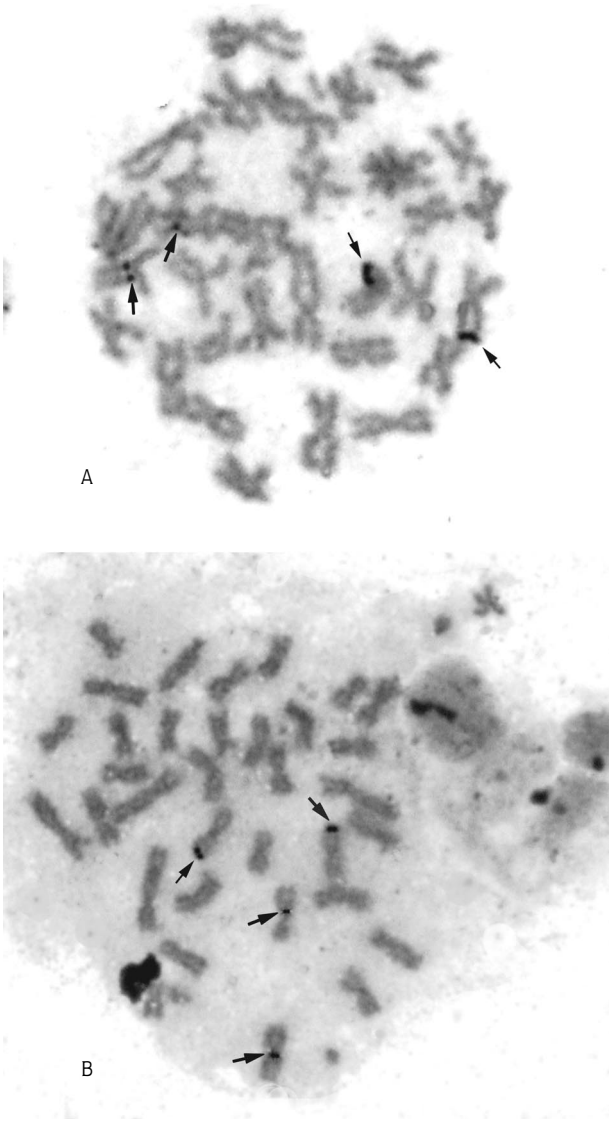

Figure 2. Silver-stained metaphases (A and B) of a male *Acomys cilicicus*. Arrow indicates the Ag-NOR.

able to distinguish the site of NOR as a secondary constriction in no. 6 without using silver staining, but they did not find Ag-NORs at the telomeric region of the long arm of no 5. Silver staining, under properly controlled conditions, is a highly selective method for staining NORs on mitotic chromosomes and is a principal method for identifying sites of NORs on chromosomes, although FISH is more specific (Sumner, 1990). Mandahl (1979) indicated a good correlation between the absence or presence of C-bands and Ag-NORs in hedgehog chromosomes of Eastern and Western Europe. Zima et al. (1999) reported that C-bands of *A. cilicicus* are located in centromeric and pericentromeric regions of chromosomes. However, one of the Ag-NORs of this species was detected on the terminal end of the long arm of the chromosome. Studies with different mice subspecies were used to understand the number of the Ag-NORs and their distribution on the chromosome. *Mus musculus molossinus*, unlike *M. musculus musculus,* had one Ag-NOR on chromosome 17 (Dev et al., 1977). Although the number of Ag-NORs is the same between *Rattus norvegicus* and *Rattus rattus*, their distributions differ between these 2 species (Yosida, 1978; Hofgartner et al., 1979). Obviously, number and distribution on chromosomes of Ag-NORs differ among species of a genus and even among subspecies of a species. The results of this study may lead to a similar study in *A. nesiotes* and can add significantly to the knowledge of the taxonomy of these 2 species.

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