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Nucleolar organizer region distribution in *Nannospalax ehrenbergi* (Nehring, 1898) (Rodentia: Spalacidae) from Iraq

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Abstract: The distribution of nucleolar organizer regions (NORs) in *Nannospalax ehrenbergi* from Iraq was determined for the first time. In the karyotype of *N. ehrenbergi* the diploid number, fundamental number, and fundamental autosomal number were 52, 76, and 72, respectively. NORs occur in the telomeric regions of submetacentric and acrocentric autosome pairs.

Key words: Ag-NOR banding, chromosomal form, Palestine mole rat, Iraq

Blind mole rats (family Spalacidae) are highly adapted to subterranean life and occupy dry and arid grassland regions in the eastern Mediterranean region and Europe (Topachevskii, 1969; Musser and Carleton, 2005). According to Nevo et al. (1995), Musser and Carleton (2005), and Kryštufek and Vohralik (2009), the subfamily Spalacinae consists of either a single genus, *Spalax*, or 2 genera, *Spalax* and *Nannospalax* (Topachevskii, 1969; Lyapunova et al., 1974; Gromov and Baranova, 1981; Zima and Kral, 1984). Musser and Carleton (2005) accepted the name *Nannospalax* as a synonym of *Spalax*. However, recently Németh et al. (2009), Kryštufek and Vohralik (2009), and Kandemir et al. (2012) discussed the taxonomic status of the taxon and decided to use the *Nannospalax* species as a superspecies. According to Kryštufek and Vohralik (2009) and Kandemir et al. (2012), the genus *Nannospalax* is represented by 3 superspecies in Turkey: *N. leucodon* in Turkish Thrace, *N. xanthodon* all over Anatolia, and *N. ehrenbergi* in southeastern Anatolia.

Nannospalax ehrenbergi was first described by Nehring in 1898 from Jaffa, Israel (Nehring, 1898). This species is distributed in southeastern Turkey, northern Iraq, Syria, Lebanon, Jordan, Israel, and North Africa (Topachevskii, 1969; Savic and Nevo, 1990; Musser and Carleton, 2005; Kryštufek and Vohralik, 2009). However, Seçkin and Coşkun (2006) determined that *N. ehrenbergi* is preferred by *Asio otus* as one of the mammalian diets from Diyarbakır Province, southeastern Turkey. Although more than 30 chromosomal forms were recorded from Turkey for the genus *Nannospalax* (Coşkun, 2003; Aşan and Yağcı, 2006; Sözen et al., 2006b, 2011, 2013; Coşkun et al., 2009; Kandemir et al., 2012; Matur et al., 2013), and in addition several different karyotypes of *N. ehrenbergi* were described from across the distribution area (Coşkun 2004; Coşkun et al., 2006; Sözen et al., 2006a), only 1 chromosomal form was presented by Coşkun et al. (2012) from Mosul, Iraq.

So far G-, C-, and AgNOR-banding of different chromosomal forms of *Nannospalax xanthodon* and *N. leucodon* were achieved from Turkey by various authors (Ivanitskaya et al., 1997, 2008; Gülkaç and Küçükdumlu, 1999; Arslan and Bölükbaş, 2010; Arslan et al., 2011a, 2011b; Aşan Baydemir et al., 2013; Arslan et al., 2013; Arslan and Zima, 2013). However, only a few banded karyotypes of *N. ehrenbergi* were determined (Ivanitskaya et al., 1997; Gülkaç and Küçükdumlu, 1999). The aim of the present study was to present the nucleolar organizer region (NOR) distribution of the Palestine mole rat, *Nannospalax ehrenbergi*, from Iraq for the first time.

Two male specimens of *Nannospalax ehrenbergi* from the southwest of Mosul, Iraq (36°10′N, 43°03′E and 36°08′N, 43°01′E), were karyotyped. Mitotic metaphases were obtained from the bone marrow as described by Lee and Elder (1980). NORs were detected by the technique of Howell and Black (1980). At least 20 well-spread and Ag-NOR banded metaphase plates were photographed. The voucher specimens and the slides are deposited in the Department of Biology, Faculty of Science, Dicle University.

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The karyotype had 2n = 52, NF = 76, and NFa = 72. The chromosome set consisted of 11 meta-/submetacentric autosome pairs (nos. 1–11), and 14 acrocentric pairs decreasing in size (nos. 12–25). The X chromosome was a large metacentric chromosome while the Y was a small acrocentric. No secondary constriction was detected in the examined metaphase plates (Figure 1).

NORs were located only on 3 pairs of autosomes, at the telomeric regions of the short arms of 1 large (no. 2) and 1 small submetacentric chromosome (no. 11) pair and 1 acrocentric pair (no. 25) (Figure 2).

Five chromosomal forms (2n = 48, 52, 54, 56, and 58) were recorded for *N. ehrenbergi* by various authors from southeastern Anatolia (Ivanitskaya et al., 1997; Sözen et al., 1999, 2006; Coşkun et al., 2006, 2009; Kankılıç et al., 2007). According to Ivanitskaya et al. (1997), the most widely distributed chromosomal form of *N. ehrenbergi* is 2n = 52 and NFa = 72. Coşkun et al. (2012) stated that the chromosomal set of the Iraqi population of *Nannospalax ehrenbergi* was in accordance with the 2n = 52 population distributed in southeastern Anatolia.

Ag-NOR banded karyotypes of the 2n = 52 chromosomal form of *N. ehrenbergi* from Turkey were achieved by Ivanitskaya et al. (1997), and Gülkaç and Küçükdumlu (1999). Ivanitskaya et al. (1997) determined terminally located NORs in 3 pairs of biarmed autosomes whereas Gülkaç and Küçükdumlu (1999) recorded NORs in 2 pairs of large subtelocentric autosomes. In addition to the Ag-NOR banded chromosomes recorded by Ivanitskaya et al. (1997) and Gülkaç and Küçükdumlu (1999), NORs were determined in an acrocentric pair in Iraqi specimens. As a consequence, the number of NOR-bearing chromosomes of *N. ehrenbergi* may facilitate future cytotaxonomic studies in the subfamily Spalacinae. However, molecular studies will also determine the genetic diversity of the genus *Spalax* in Turkey (Kankılıç et al., 2005; Arslan et al., 2010; Kandemir et al., 2012; Kankılıç and Gürpınar, 2013).

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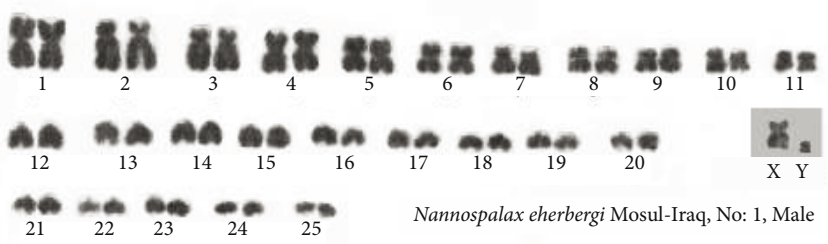

Figure 1. Conventionally stained karyotype of *Nannospalax ehrenbergi* in Mosul province (Al-Jurn), Iraq (male).

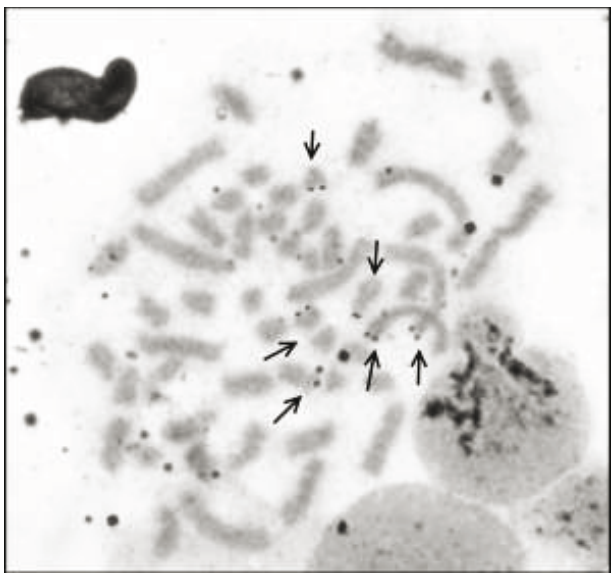

Figure 2. Ag-NOR stained metaphase plate of *Nannospalax ehrenbergi* (arrows indicate NOR-bearing chromosomes).

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