



## Records of Chromosomal Data of Some Scorpions (Arachnida: Scorpiones) from Turkey

### Türkiye'deki Bazı Akreplere ait Kromozomal Veri Kayıtları

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#### ABSTRACT

In this study, the karyological features of three species *Mesobuthus eupeus* and *Mesobuthus gibbosus* was investigated from the family *Buthidae* and *Euscorpius (Euscorpius) aladaglarensis* from the family *Euscorpiidae*, ranging in Niğde Province. As a result of karyological studies, it was determined that the diploid chromosome number of *Mesobuthus eupeus*, *Mesobuthus gibbosus*, and *Euscorpius aladaglarensis* as  $2n=20$ ,  $2n=28$  and  $2n=88$  respectively. Two buthid species have holocentric chromosomes, while the euscorpoid species has monocentric chromosomes. During first meiotic division, we observed multivalent in one male of *E. aladaglarensis*.

#### Keywords

Buthidae, Euscorpiidae, karyotype, multivalents.

#### Öz

Bu çalışmada, Niğde'de dağılım gösteren *Buthidae* familyasından *Mesobuthus eupeus* ve *Mesobuthus gibbosus* ile *Euscorpiidae* familyasından *Euscorpius (Euscorpius) aladaglarensis* türlerinin karyolojik özellikleri incelenmiştir. Yapılan karyolojik çalışmalara göre *Mesobuthus eupeus*, *Mesobuthus gibbosus* ve *Euscorpius aladaglarensis* türlerine ait diploid kromozom sayıları sırasıyla  $2n=20$ ;  $2n=28$  ve  $2n=88$  olarak belirlenmiştir. İki buthid türü holosentrik kromozomlara sahip iken, euscorpoid türü monosentrik kromozomlara sahiptir. *E. aladaglarensis* türüne ait bir erkekte birinci mayoz bölünme sırasında multivalent gözlenmiştir.

#### Anahtar Kelimeler

Buthidae, Euscorpiidae, karyotip, multivalent.

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## INTRODUCTION

The order Scorpiones which has 1981 actual species belonging to 192 genera [1] is known from tropic and subtropic regions of all continents and large islands except from Antarctica and New Zealand [2]. Up to now only 120 species of scorpions were studied cytogenetically. Karyotype analysis of scorpions showed that the diploid number of chromosomes varies between  $2n=5$  to  $2n=175$  [3]. Until now karyotype of 71 species of 120 known scorpion karyotypes is related to the family Buthidae and one species is related to the family Euscorpidae [4]. Recently karyotypes of two species from Turkey: *Leiurus abduhbayrami* and *Compsobuthus matthiesseni* were reported which had a fairly uniform  $2n=22$  [5]. Sadilek et al. [6] made a cytogenetic analysis of four geographically distant *Androctonus* species and reported extraordinary stability of *Androctonus* karyotypes ( $2n=24$ ). In this study, the chromosomes of *Mesobuthus gibbosus* and *Euscorpis aladaglensis* collected from Niğde province, is presented for the first time and chromosomes of *Mesobuthus eupeus* is presented for the first time for Turkey.

## MATERIALS and METHODS

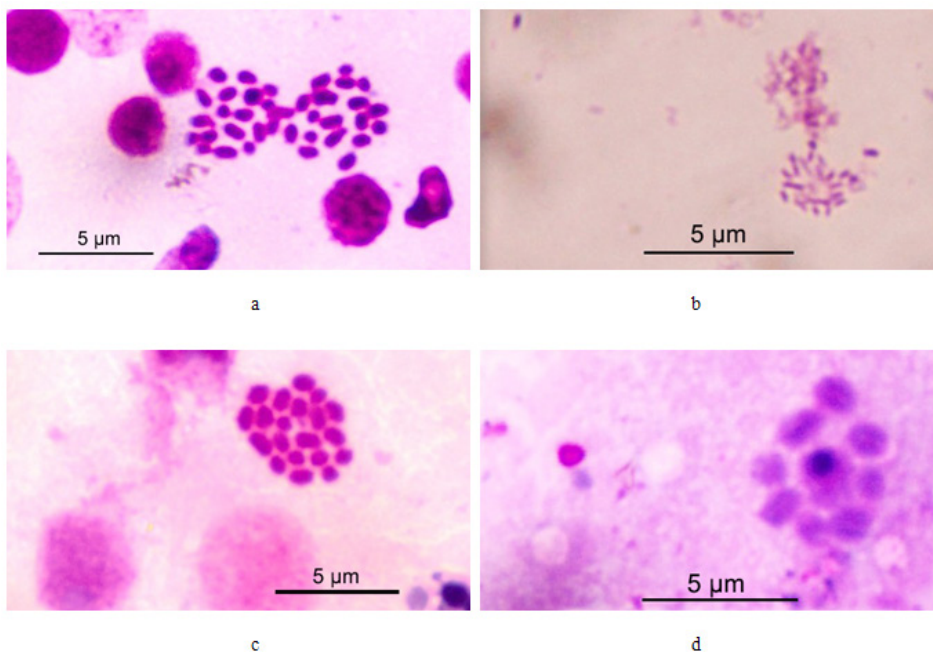
Scorpions were collected under stones during the day time and at night by UV light from different localities in Niğde province. Collected specimens were kept in individual terrariums and fed once a week with the

larva of *Tenebrio molitor*. Morphological identification and sex determination of species were made by using Krüss MSZ5400 stereomicroscope. Chromosome preparations were made from gonadal tissue of living specimens as in the method given by Schneider et al. [3]. Only male and female gonads were used for buthid species, both male gonads and embryo were used for preparation for euscorpidae species. Gonads and embryos were prepared by the same method. Chromosome slides were examined by the Olympus SZX9 microscope with DP25 camera. Photographs were taken at magnification 100x with oil immersion. Both mitotic and meiotic metaphase stages were used for determining the karyotypes. Monocentric chromosomes were determined as to Sakamoto & Zacaro [7].

## RESULTS

### Chromosomes of *Mesobuthus eupeus* (C.L. Koch, 1838)

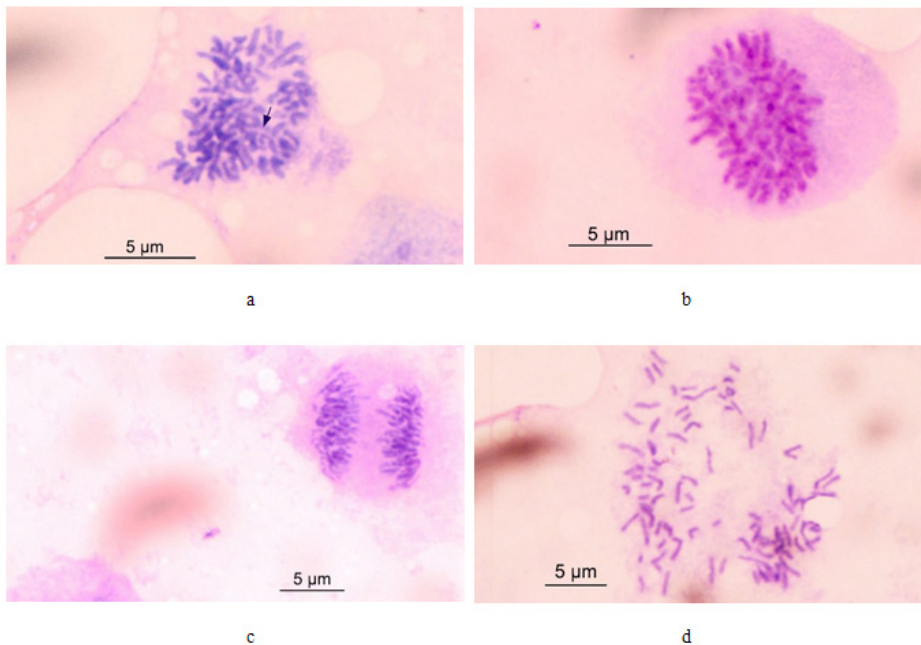
Diploid chromosome number was obtained as  $2n=20$  in three specimens collected from three different localities. These chromosomes were holocentric structurally, and small chromosomes were less than  $2\mu$ . Morphologically different heteropycnotic bivalents sex chromosomes were not determined.



**Figure 1.** Chromosomes of *Mesobuthus eupeus*  $2n=20$ ; a.) spermatogoneal metaphase; b.) mitotic metaphase I of female, c.) mitotic metaphase, d.) metaphase I.



**Figure 2.** Chromosomes of *Mesobuthus gibbosus* during spermatogoneal metaphase.



**Figure 3.** Chromosomes of *E. aladaglarensis*: a.) Metaphase I of males show chromosomes of multivalent; b.) Mitotic metaphase with chromosomes inside of the cell, c.) Mitotic anaphase; d.) Mitotic metaphase of embryo cell.

**Chromosomes of *Mesobuthus gibbosus* (Brullé, 1832):**

Diploid chromosome number was obtained as  $2n= 28$  in *M. gibbosus* specimens from three different localities. These were holocentric structurally, and small chromosomes were less than  $2 \mu$ . Morphologically different heteropycnotic bivalents were not observed, so sex chromosomes were not determined.

**Chromosomes of *Euscorpis aladaglarensis* Tropea, 2016**

Karyotype of *E. aladaglarensis* was obtained by meiotic cells of male and mitotic cells of the embryo.

Monocentric chromosomes were determined in the mitotic metaphase stage. These chromosomes were differed one from another in term of morphology and size. Diploid chromosome number was determined as  $2n= 88$  in two specimens collected from different localities. In those chromosomes, 15 pairs were detected as metacentric, 17 pairs were submetacentric, 10 pairs were subtelocentric and two pairs were telocentric. Morphologically different heteropycnotic bivalents were not observed, so sex chromosomes were not determined.

## DISCUSSION

In this study, the karyotypes for three scorpion species were given for the first time, and we determined the diploid chromosome number as  $2n=28$  for *Mesobuthus gibbosus*;  $2n=20$  for *Mesobuthus eupeus* and  $2n=88$  for *Euscorpis aladaglarensis*. The diploid chromosome numbers of *Mesobuthus gibbosus* is  $2n=28$  and karyotype of this species has been reported for the first time and there is no comparative data about this species. The diploid number was given as  $2n=24$  for *M. martensi* and *M. macmahoni*;  $2n=22$  for *M. eupeus* and *M. tamulus* by Schneider et al. [4]. However, we found the diploid number  $2n=20$  for *M. eupeus*. Sokolow [8] studied on spermatogenesis of the scorpions and gave diploid chromosome numbers as  $2n=20-22$  for *M. eupeus* for specimens from Baku (Azerbaijan). It seems that the intraspecific karyotype variability can be seen in the genus *M. eupeus*. The diploid number in the family Buthidae differs between  $2n=5$  and  $56$  and mostly it is  $20$  [4]. Both karyotypes of two buthid species in this study have low number of chromosomes appropriate with the characteristic low number of chromosomes in buthid karyotypes. Following previous reports, we found holocentric chromosomes and achiasmatic male meiosis in all species [3,9-11]. However, during the first meiotic division, we could not observe multivalent in males of *M. eupeus* as previously documented within some buthid genera: *Tityus* [3,11], *Compsobuthus*, *Leiurus* [5], *Isometrus*, *Isometroides* [9], *Urodacus* [10], *Ananteris*, *Rhopalurus* [11], *Androctonus* [12], *Gint* [13], and *Lychas* [14]. Although some studies giving information about XY sex chromosomes Adilardi et al. [15] proposed that the presence of multivalents in males and homologous pairs in females could be related to the presence of cryptic sex chromosomes, with the male being the heterogametic sex in *Tityus confluens*. They proposed that the ancestral karyotype of *T. confluens* could have had homomorphic XY/XX (male/female) sex chromosomes and fusion could have occurred between the Y chromosome and an autosome. Sokolow [8] reported diploid chromosomes as  $2n=70-80$  for *Euscorpis carpathicus* specimens from France. We found  $2n=88$  for *E. aladaglarensis* and karyotype of this species has been reported for the first time. Also during first meiotic division, we observed multivalent in one male of *E. aladaglarensis* like presented as some genera from other families: *Euscorplops*, *Alloscorplops* from Scorpionidae [16,17], and *Heterometrus* from Scorpionidae [18]. This multivalent indicates centric fusion or fissions that can lead to the differentiation of the karyotypes within the genus *Euscorpis*.

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