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Functional Morphology of Venom Apparatus of *Euscorpius mingrelicus* (Scorpiones: Euscorpiidae)

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Abstract

The objective of the present study is to describe the functional morphology of venom apparatus of *Euscorpius mingrelicus* (Kessler, 1874) by using light microscope and scanning electron microscope (SEM). The venom apparatus, situates in the last segment of metasoma (telson), is composed of a pair of venom glands and sting. Telson is covered by cuticular exoskeleton as well as all body, and there are cuticular setae and pits on it as serve sensory organ. The general organization of the venom apparatus of *E. mingrelicus* is similar to the other scorpions' venom apparatus. The venom glands fill in the telson and are a pair and are equal size. Each venom gland is surrounded by gross striated muscular bundles. The venom is produced in the venom glands, carried by venom ducts passing through the sting and exiting from the venom pores during the muscular contractions. The venom pores situate both side of the tip of sting and are used for injecting venom. The venom produces left venom gland is carried by left venom duct and exited from left venom pore as well as right. In the transverse section of the sting, both venom ducts can be easily seen by light microscope.

Key words: Scorpion, telson, venom gland, sting, morphology.

INTRODUCTION

Scorpions are chelicerate arthropods, members of class Arachnida. Compared to spiders and mites, scorpions are modest group containing 1259 described species in 16 living families and 155 genera [1].

Scorpions have long been of interest to humans primarily because of their ability to give painful and sometimes life threatening stings. Scorpions are also an important and beneficial component of many ecosystems and they are one of the oldest known terrestrial arthropods. Fossil scorpions found in Paleozoic strata 430 million years old appear very similar to actual species. Scorpions have an elongated body. The abdomen consists of 12 distinct segments, with the last five segments forming the metasoma what most people refer to as tail. At the end of the metasoma is the telson, which is a bulb shaped structure containing the venom gland and a sharp, curved stinger to deliver venom [2].

The venom of scorpions is used for both prey capture, defense and possibly to subdue mates. All scorpions do posses venom and can sting, but their natural tendencies are to hide and escape. Scorpion venoms are complex mixtures of neurotoxins (toxins which affect the victim's nervous system) and other substances; each species has a unique mixture. Despite their bad reputation, about 30 species worldwide have venom potent enough to be considered dangerous to human beings [2].

In this study, we describe morphology of the venom apparatus of *Euscorpius mingrelicus* (Kessler, 1874) that widely distributed throughout the Blacksea, Marmara, Mediterranean and Aegean Regions in Turkey [3].

MATERIALS AND METHODS

In this study, 12 adult of *E. mingrelicus* scorpions were used. They were collected from Çamlıdere-Çamkoru forest (Ankara, Turkey) under the stones on September 2005. The scorpions were identified and then they were reared in special cages and fed with insects at the Biology Department of Kırıkkale University. In order to dissect, scorpions were narcotized with chloroform or ether. The telsons were removed, and the venom apparatuses were taken for microscopic specimens under a stereo microscope (Nikon SMZ800). The exoskeleton was removed, and venom glands were taken.

The venom glands and telson were fixed in 3 % glutaraldehyde buffered with 0.1 M sodium phosphate buffer (pH 7.2) for two hours at +4 ºC temperature and then rinsed for 12 hours in sodium phosphate buffer, and postfixed in 1 % osmium tetroxide in the same buffer for 2 hours. They were then dehydrated in a graded ethanol series. To clean the surfaces of the telson were washed for 10 minutes with a stream 100 % ethanol. The last stages of dehydration were performed with propylene oxide and acetone. The specimens were then dried in the incubator at 30^{o}C overnight. These specimens were coated with a thin layer of gold by Polaron SC 500 sputter coater. The materials were examined at an accelerating voltage of 10-20 kV under Jeol JSM 5800 Scanning Electron Microscope, and the electron micrographs were recorded [4].

After fixation and dehydration, the a few telson and stings were embedded in Araldite CY 212. Semi-thin sections were cut with glass knife on RMC MT-X ultra-microtome and mounted on slides. The sections were stained with toluidine blue and examined in Nikon FDX 35 light microscope [5]. All materials that investigated were deposited at the Zoological Research Laboratory of Kırıkkale University.

RESULTS

The morphology of venom apparatus of *Euscorpius mingrelicus* was studied by using light microscope and SEM. Fig. 1 shows the last segment of metasoma.

Telson was covered by cuticle, and there were cuticular setae and pits on it (Fig. 2 A, B). As could be easily seen in Fig. 2, there were setae and cuticular pits were scattered all over the telson.

The general organization of the venom apparatus of *E. mingrelicus* was similar to the other scorpions' venom apparatus was composed of a pair of venom glands and sting (Fig. 3).

The two venom glands were completely separate but similar each other. The glands opened separately own duct at the base of the sting. In fact, there were two ducts which opened distinct venom gland in the sting. The venom glands that produced venom filled in the telson and were a pair and were equal size. Each venom gland was surrounded by gross striated muscular bundles (Fig. 4). The venom was produced in the venom glands, carried by venom ducts passing through the sting and exiting from the venom pores during the muscular contractions.

The tip of curved sting was pointed and sharp. The venom pores situated both side of the tip of sting and were used for injecting venom (Fig. 5 A, B).

The venom produced left venom gland was carried by left venom duct and exited from left venom pore as well as right. In the transverse section of the sting, both venom ducts could be easily seen by light microscope (Fig. 6).

DISCUSSION

There are setae and cuticular pits are scattered all over the telson of *E. mingrelicus*. Cuticular sensory organs are common in all arachnids. In scorpions, short, curved chemosensory setae are scattered all over the animal's body. Fet [6] studied metasoma of *Orthochirus*. A peculiar array of over 1000 cuticular pits was found ventrally and laterally on the posterior segments of metasoma and telson. SEM showed those pits adorned with variable size setae, which exhibited microanatomical features characteristic for chemoreceptors.

The venom apparatus of *E. mingrelicus* is composed of a pair of venom glands produce the venom and sting are used for injecting venom. The venom apparatus of *Leiurus quinquestriatus* is composed of two completely separate but similar glands, each with its own canal, which fuse into a single common canal [7]. The differentiation of the venom gland into lobes was observed by Kanwar [8] in the venom gland *Buthus tamulus* where the glands divided longitudinally into parts by septum. Quiroga [9] studied the histology of the venom gland of adult females *Tityus caripitensis*. The venom gland of *T. caripitensis* is made of two ovoid lobes that fill the vesicle except a small cavity (lumen) where the venom accumulates; the cavity continuants distally with excretory duct. These characters are similar to *E. mingrelicus* and the others. Samano-Bishop [10] studied the Mexican scorpions from three genera: *Vejovis*, *Diplocentrus*, and *Centrurus*, and also concluded that the morphology of the venom gland presents highly constant generic characteristic which could be used to classify the scorpion to family.

The scorpion's sting is a curved organ at the end of its tail. It possess hollow each side and has a needle like structure. Two glands at the base give out venom that flows from two pores. The sharp and pointed sting is used for injecting venom.

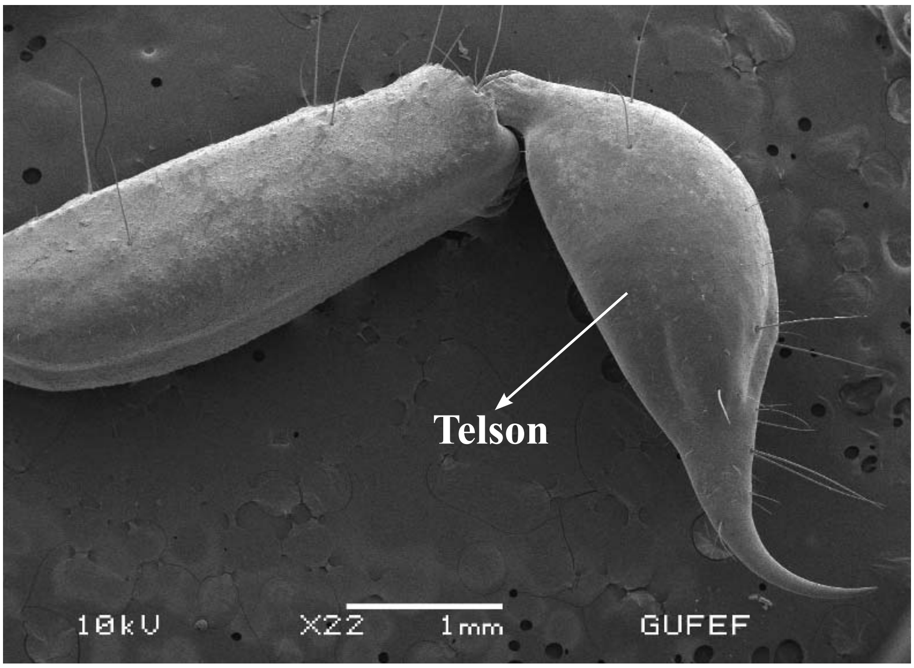

Figure 1. The lateral view of the last part of metasoma of *Euscorpius mingrelicus*, showing the venom apparatus.

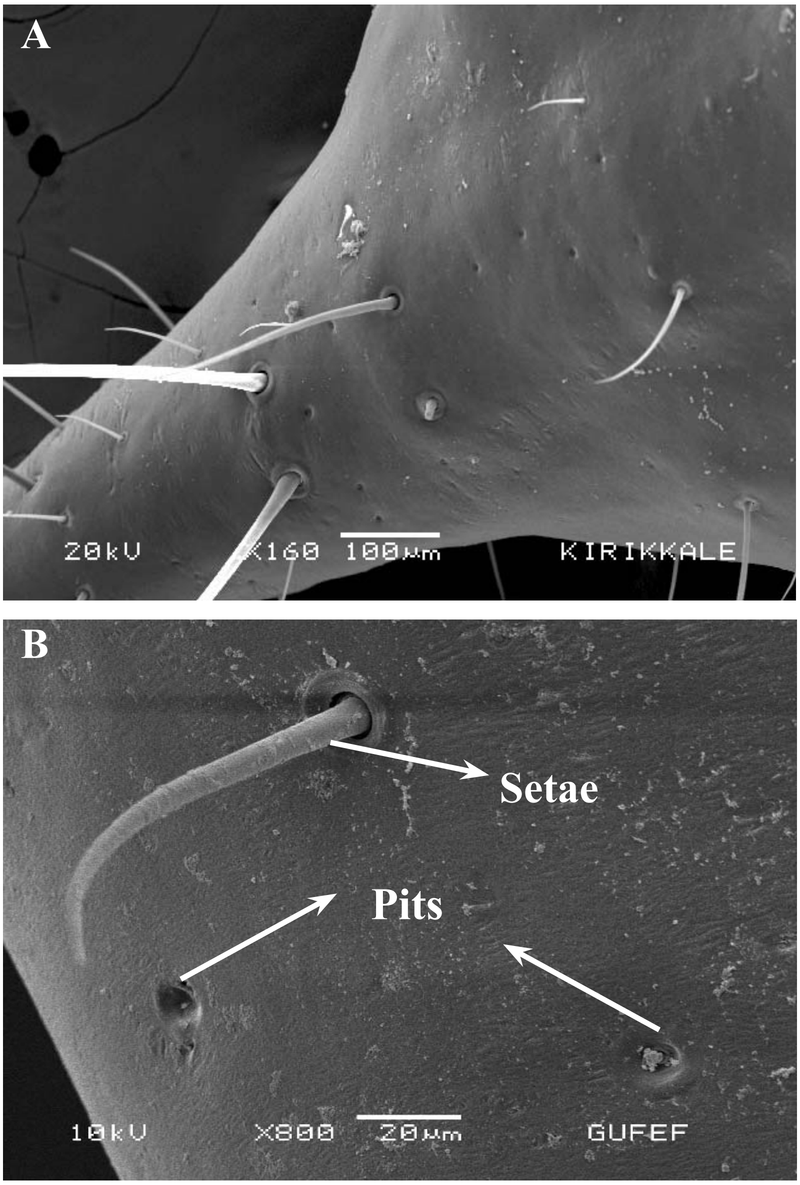

Figure 2. A, pits and setae on the surface of telson; B, depict is higher magnification of fig. A.

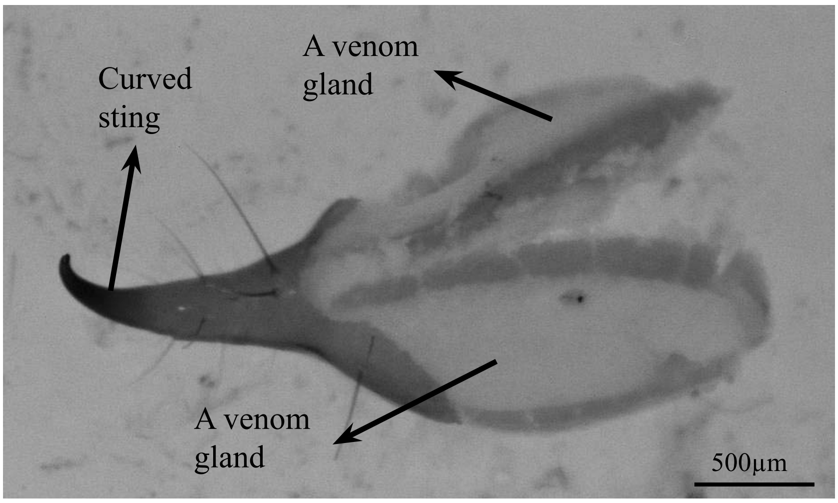

Figure 3. The general view of venom apparatus is composed of a pair of venom glands and sting. This depict was obtained by stereo microscope.

Figure 4. The outer surface of the venom gland has clearly showed that was distinctive muscle bundles at higher

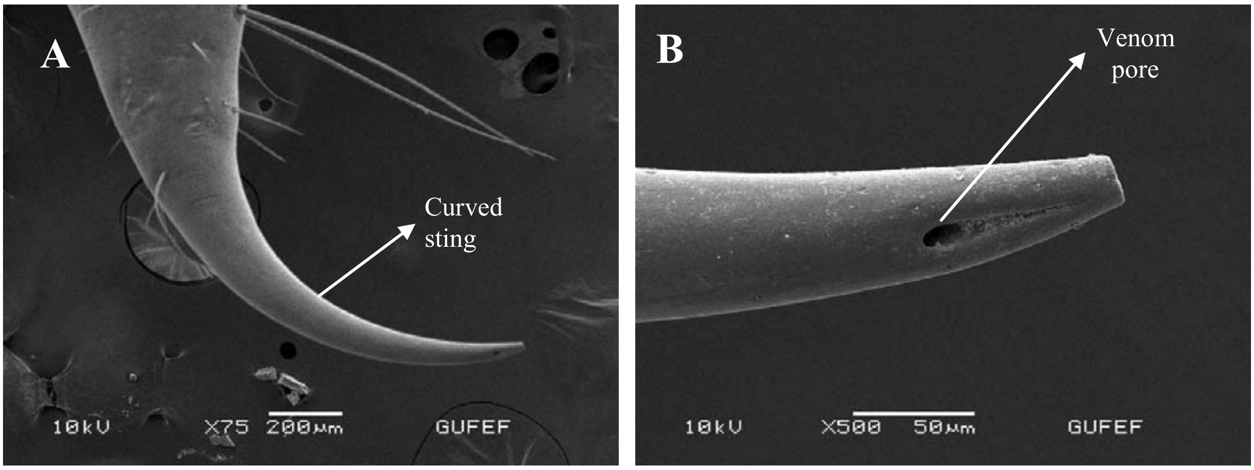

Figure 5. A, scanning electron micrograph of the curved sting; B, venom pore at higher magnification.

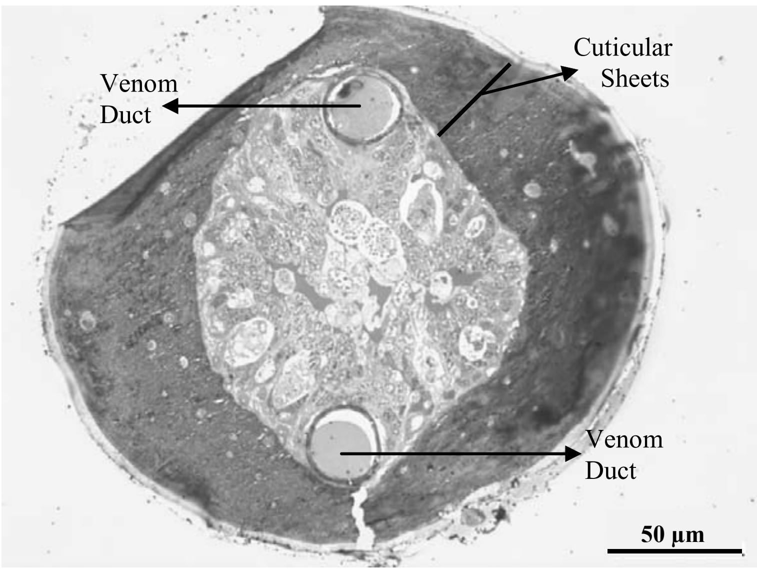

Figure 6. Two distinct venom ducts has been separately seen in the transverse section of the sting of *E. mingrelicus,* and also seen thick cuticular sheets. This depict was obtained by light microscope.

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