COMPARATIVE MORPHOLOGY OF THE STING APPARATUS FOR SOME HYMENOPTEROUS SPECIES

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ABSTRACT

The morphology of the sting apparatus for some vespoids, apoids and sphecoid species collected from southern Sinai was studied. Vespoidea species shared in a muscular, egg-shaped poison sac and a single Dufour's gland. The Xylocopini species have an elongate poison sac and a well deveoped Dufour's gand. For Sphecidae, the glandular parts are simple. The scanning electron micrographs of different sclerites in the sting apparatus indicate some sort of variations.

INTRODUCTION

The sting apparatus of Hymenoptera which is used mainly for poisoning animals, defence, or capturing consists of two functionally different parts. The first; glandular in which the venom is produced. The second part has very complicated chitinous and muscular structures which play a role in the ejection of the venom and the protrousion and injection of the sting.

The present study describes the venom apparatus in a number of stinged hymenopterous insects, collected from Sinai which is one of the most characteristic Egyptian faunistic areas as it includes many geomorphological units.

MATERIALS and METHODS

Adult specimens were dissected at room temperature with a fine-tipped

forceps and pins under a light microscope. Soft parts of glands were drawn with the help of a camera lucida and measured with the aid of an eyepiece graticule. Gland's hard parts were observed with a scanning electron microscope after cleaning, drying and coating under vacuum with palladium-gold.

RESULTS

A. *Soft parts study (Plate 1) :*

For one species, *Vespa orientalis,* description is more or less complete, but it is brief for the rest. In this way, for all species, the glandular parts consist of : the poison sac (PS), its filaments (FF), and Dufour's gland (DG). In some wasps, within the poison sac, a convoluted or venom gland (CG) is seen.

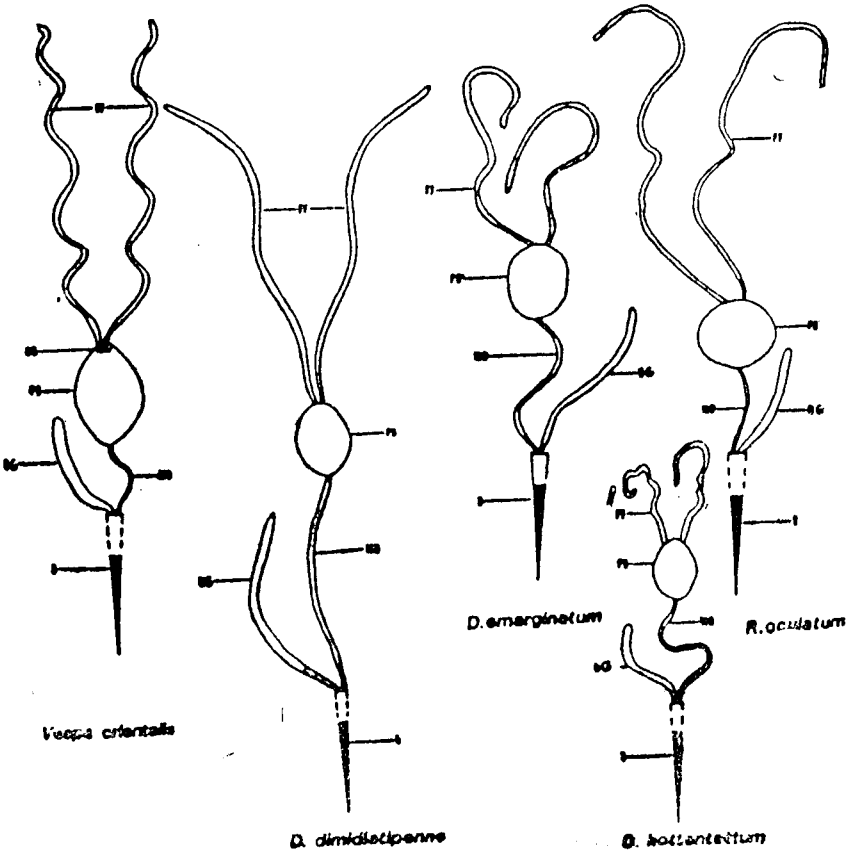

PLATE 1

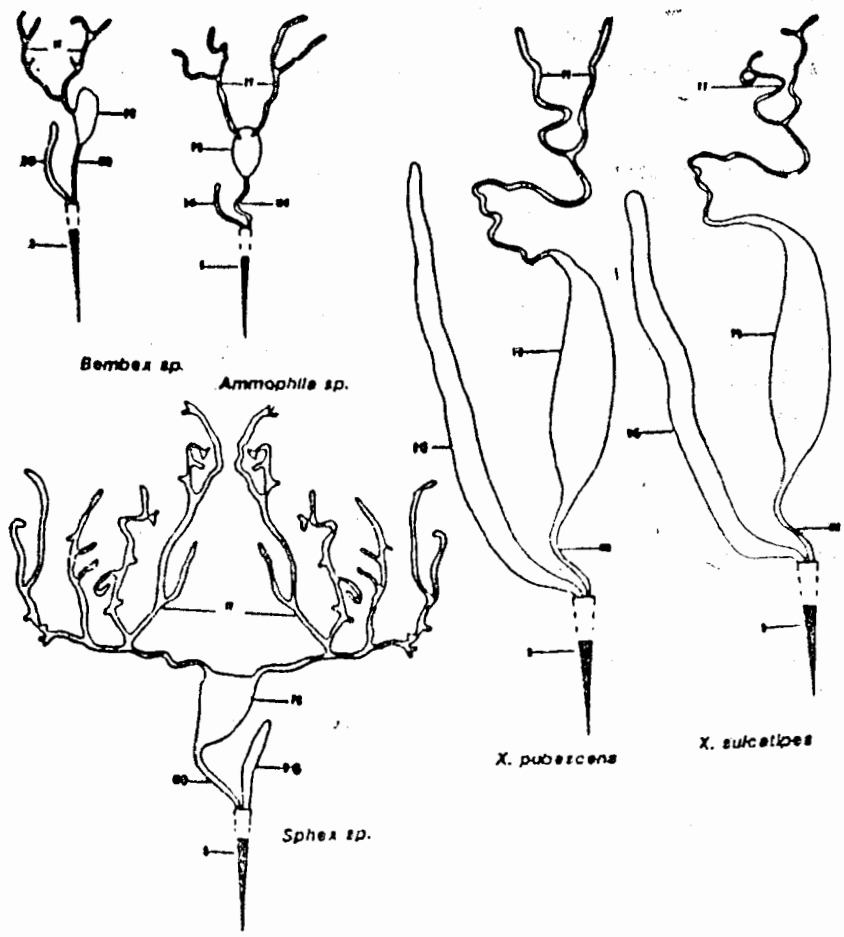

PLATE 1 : (Continued) : Semi-diagrammatic representation of the venom apparatus of some venomous Hymenoptera (all approximately X = 7; DG, Dufour's gland; PS, poison sac; FF, free filament; MD, main duct; S, sting; CG, convoluted gland).
Vespoidea : *Vespa orientalis, Delta dimidiatipenne, Delta* Apoidea *Xylocopa pubescens* and *Rhychium oculatum*, Sphecoidea : *Ammophila* sp., *Bembex* sp, *Sphex* sp.

For *Vespa orientalis*, the poison sac (PS) which may be called venom reservoir is a sizable oval shaped sac. It is slightly longer than wide with a dense thick wall arranged in the form of four bundles. Its dimensions are 3 - 4 mm long and 1.8 - 3 mm at its maximum width. It is connected with the sting by a narrow and short tube nearly as long as the poison sac called the main duct of poison sac (MD). Dufour's gland (sometimes called the alkaline gland) is a single uniform tube arising from the sting with the poison sac. It is much longer than wide (Length 3 - 5 mm and width 0.3 - 0.5 mm.).

The free filaments are two similar tubes with relatively uniform diameter throughout their length and terminate sparately on the median part of the poison sac. The convoluted gland is situated within the distal part of the poison sac.

The venom apparatus of *Delta dimidiatipenne* and *Delta emarginatum* are representative of the solitary eumenid wasps. The glandular soft parts are more or less similar to those of *V. orientalis.*

In *Delta hottentottum elegans,* the venom appartus is structurally similar to the other *Delta* species but the poison sac is more rounded and is smaller (length 1.5 - 2.5 mm, width 1 - 2 mm). Also, the main duct is slightly shorter and narrower.

For *Rhynchium oculatum,* the poison sac is slightly wider than long (length 2 - 3 mm, width 2.2 - 3.4 mm). The Dufour's gland is wider than the free filaments and the main duct (length 3.5 - 4 mm, width 0.25 - 0.35 mm).

For *Xylocopa pubescens* the poison sac is joined to the sting by a short narrow duct (MD). This duct is swollen distally forming elongate poison sac which is much longer than wide (length 6 - 10 mm, width 0.8 - 1.5 mm), transparent, with a very thin wall without any muscles at all. It appears that there is no convoluted or venom gland within the poison sac, only a single filament extends from the distal margin (length 10 - 20 mm) divided into two simple branches and float free in the haemocoel. In this case, Dufour's gland is extremely well developed and slightly shorter than the poison sac (length 15 - 20 mm), but nearly as wide. (width 0.8 - 1.2 mm). This giant gland is a single, unbranched tube floating free in the haemocoel. For *Xylocopa sulcatipes,* the venom gland is similar to that of *X. pubescens.* However, the length of the Dufour's gland is slightly shorter.

The soft parts of the third studied group: sphecoids have, a more or less triangular, transparent poison sac with no convoluted gland. Two short filaments are highly branched in Sphex sp. and very simple in *Ammophila* sp. The third species, Bembex sp., has a single filament extends from the lateral side of the poison sac and divided into two short branches. Dufour's gland is a simple unbranched tube in all sphecoid spp.

B. *Hard parts study (Plate 2) :*

Scanning electron microscope pictures of the gonostyli for some vespids (*V. orientalis* : plate 2.1 and *D. dimidiatipenne* : plate 2.2), show the occurrence of long and simple sensory setae on the distal margin. This stands in

contrast to the sphecoid species, *Sceliphron* sp. (plate 2.11 & 2.12) and *Ammophila* sp. (plate 2.8 & 2.9), in which both genera have scattered short bristles. In the apoids (Xylocopini), *X. pubescens* (plate 2.5) and *X. sulcatipes* (plate 2.6), the gonostyli have a set of simple and branched long dense hairs.

In *Sceliphron* sp., the gonostyli have a number of sensory structures in the form of pores provided with short setae (plate 2.11 & 2.12). However, in *Ammophila* sp., these sensory structures are found in the form of long and numerous setae on the distal tip of the gonostyli (plate 2.8 & 2.9).

The lancet of *Ammophila* sp. (plate 2.10), has ten small barbs in the form of "nodes" on the outer lateral sides. In vespoid species, the lancets are provided with barbs which are five in number in both of *D. dimidiatipenne* and *R. oculatum* (plate 2.3 & 2.4). In the Xylocopini (*X. sulcatipes*, plate 2.7), the lancet has only two acute barbs and sensory pores.

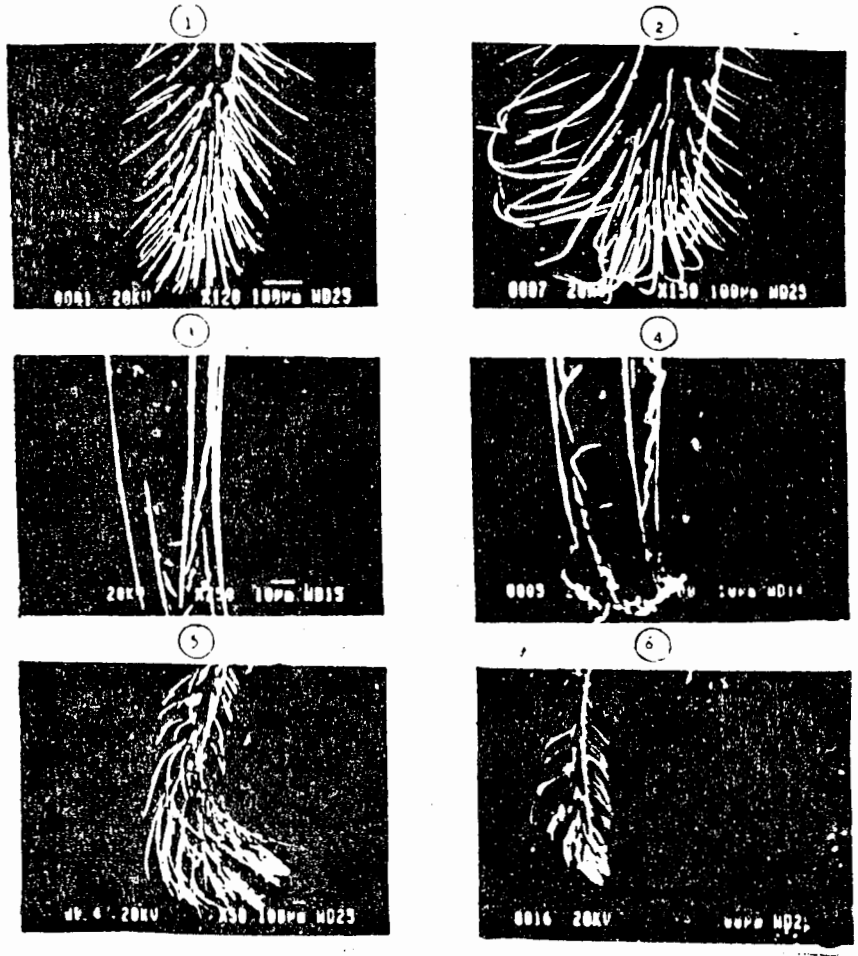

PLATE 2

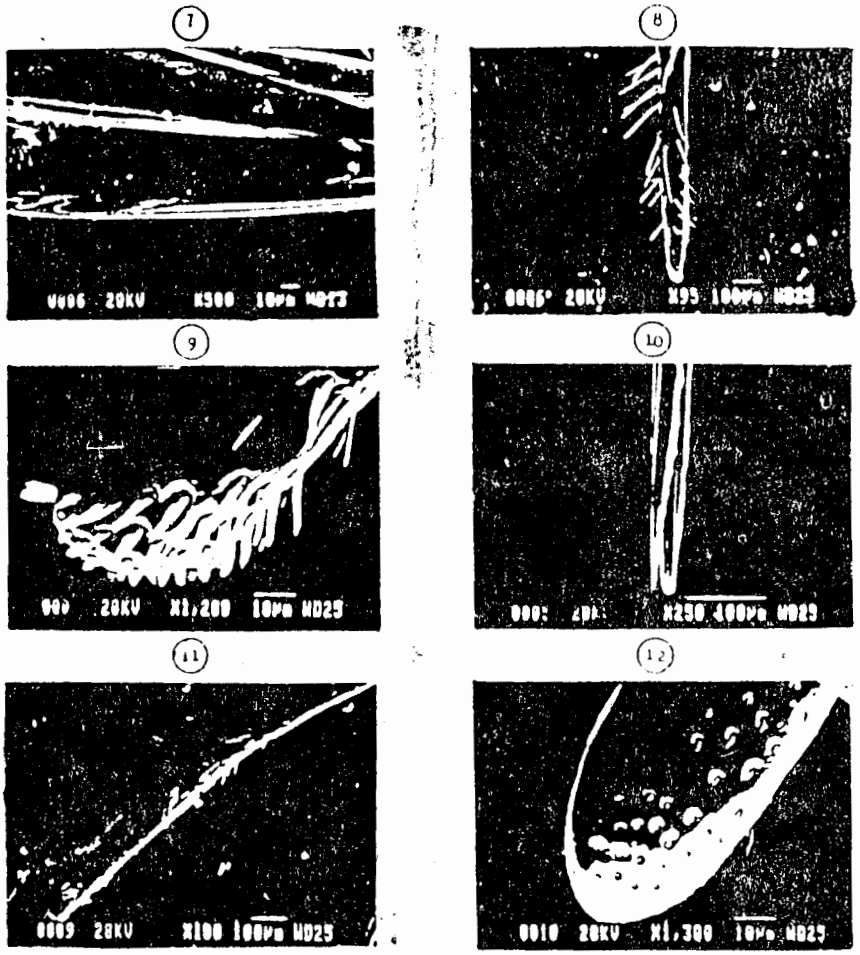

PLATE 2 (Continued) : Scanning electron micrographs of different sclerites in the sting apparatus of some venomous Hymenoptera.

Vespoidea : 1, *Vespa orientalis* (gonostylus); 2 & 3, *Delta dimidiatipenne* (gonostylus and sting barbs); 4, *Rhynchium oculatum* (sting barbs).

Apoidea : 5, *Xylocopa pubescens* (gonostylus); 6 & 7, *Xylocopa sulcatipes* (gonostylus and sting barbs).

Spheciodea : 8, 9 and 10, *Ammophila* sp. (gonostylus, gonostylus tip and sting barbs); 11, 12, *Sceliphron* sp. (gonostylus and gonostylus tip).

DISCUSSION

In previous study, the formaentoined insects were surveyed, identified and their seasonal incidence was formerly observed (Zalat and Kamal, 1985). In this one, the venom apparatus for some of these insects was compared.

Also, electron scanning micrographs for the fine parts of their sting apparatus were made. Vespoid species have a very similar sting apparatus, they are sharing a more or less muscular, egg-shaped poison sac. In Xylocopini, the poison sac is an elongate tube with only a single filament. For the third studied group, sphecoids, their poison sac is more or less triangular in shape and the free filaments are different.

In vespoid species, a transparent gland called the convoluted or venom gland appears within the distal margin of the poison sac. Its presence was confirmed by others (Hunt and Hermann, 1970). However, within many of our examined species it is lacking (as in xylocopini and sphecidae).

The so called Dufour's gland varies in form and function according to the species. In *Vespa orientalis*, for example, it is a moderate sized single tube that serves as a reservoir for its own secretion and possesses a toxic effect (Barr-Nea et al. 1976). In Xylocopini, however, this gland is extremely developed. Its size and the large amount of liquid inside indicate that its function may be behaviourally significant (Hermann and Mullen, 1974). In future studies, it is recommended to know more about these glands. Their biochemistry, histology and histochemical studies must be undertaken.

Obtained scanning electron micrographs revealed differences among studied insects for their gonostyli and lancets. Hence, in vespoids, gonostyli provided with simple dense sensory setae but few in sphecoid. In Xylocopini, setae are dense but either simple or branched. If the gonostyli function is proposed to have a tactile function (Hunt and Hermann, 1970), it is suggested to do more about it in our target species. Depriving insects from these sensory setae can strengthen or weaken the proposed function.

This will be done by observing their role in host acceptance and their defunctioning.

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