ANTENNAL AND MAXILLARY PALP SENSILLAE OF MALE AND FEMALE *LIOSARCOPHAGA BABIYARI* LEHRER (DIPTERA: SARCOPHAGIDAE)

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INTRODUCTION

Liosarcophaga babiyari, is recorded for the first time in Saudi Arabia Kingdom This species was incorrectly identified by some authors as *Parasarcophaga dux* (Zumpt, 1951 and Povolony, 1987), as *Parasarcophaga (Liosarcophaga) exuberans* (Rohdendorf (1963), as *Sarcophaga exuberans* (Zumpt, 1964 & 1972) and finally as *Thyrsocnema exuberans* (Dear, 1980). Lehrer (1995 & 2006a) differentiated between the *P. dux* and *L. babiyari* using the morphology and the structure of the male genitalia and came to the conclusion that *L. babiyari* is a new species.

The flesh fly *L. babiyari* was recorded in Egypt, Cameron, South Africa, Congo, Malawi (Lehrer, 2003), Israel and western part of Jordan (Lehrer, 2006).

The aim of the present work is to give an initiative illustration of the fine morphology of male and female antennae and maxillary palp sensillae of *L. babiyari* as taxa which could be used to support the findings of Lehrer (1995 & 2006).

MATERIAL AND METHODS

Collection of the flies

Adult flesh flies were collected from baited traps established at Gebel el-Zaher, Al-Baha Governorate, Saudi Arabia Kingdom. Traps were baited with fresh liver, beef and fishes which were re-newed twice weekly. Traps were hold in two rows, 4 traps each; the distance between each trap was 10 meters away (unpublished ecological data). The flies were anaesthetized by freezing for half an hour, then it was soaked in 70% alcohol and few drops of glycerin until used for scanning.

Ultra structural preparation

Protienacious substances that could obscure cuticular details were removed according to Dyer *et al*. (1982) procedure. The specimens were immersed in a solution in tris buffer (0.0115 M Ca C12, pH7.5) for 1 hr at 37°C, and rinsed 3 times for 15 min in the same buffer. Specimens were dehydrated in a graded ethanol series (70%, 90%, 100%, 100% for 5 min each), then rinsed in acetone, and air-dried. Alternatively, critical point drying from liquid carbon dioxide was used. The isolated head capsule, antennae, and maxillary palpi, were mounted on standard horizontal Philips aluminum stubs with conductive carbon glue. Specimens were coated with gold in an Oxford/Hexland CT1500 evaporator, and viewed with a Philips EM 525 scanning microscope (SEM) in the secondary electron imaging mode at accelerating voltage ranging from 15-30 kV.

The Terminology of the sensillae follows the morphological and functional typology reviewed by Zacharuk (1985) and Zacharuk and Shields (1991).

RESULTS AND DISCUSSION

A- ANTENNA

The sarcophagid fly *L. babiyari*, like all members of this family, possesses an aristate antenna. It lies in the front and central part of the head capsule in-between the two compound eyes, enclosed within a groove or antennal fossa (Fig. 1). In freshly examined specimens, the antennae are yellow brownish in colour. Each antenna consists of three segments namely: scape, pedicel and the funicle which carries a plumose arista (Ar) The female antenna is larger (1525 μm in length) than that of the male (1275 μm), Fig. (1 a & b).

Similar findings were reported in case of *P. argyrostoma* (Shehata. 2004).

1- The scape (Sc)

The scape is a very narrow area (75 μm in length) that attaches the antenna with the head capsule. It is reinforced by some bristles (Figs. 1 & 2) and carries the following sensillae.

a- Trichodea sensilla (Tr3)

One row of bristle-like structure the trichodea sensillae (Tr 3) run in the middle area of the scape (Fig. 2). It has a stout and very long shaft measuring 10.7-

17.8 μm in thickness and 100-135.7 μm in length. Each shaft arises from a rounded cavity in the surface of the cuticle.

b- Basiconical sensilla (Bs 1)

The basiconical sensilla (Bs 1) is scattered over the surface area of the scape. It has a characteristic curvature with swollen base and pointed short neck shaft. The length of each sensillum ranges from 5.35-7.14 μm (Fig. 2). Meanwhile, Sukontason *et al*., (2004) recorded only one type of trichoid sensillae on the scape of *P. dux* meanwhile the basiconic type was absent. Also Shehata (2004) noted that the scape of *P. argyrostoma* was devoid from both the trichodea and the basiconic sensillae.

2- The pedicel: (P)

The pedicel is a cone-like structure which measures 275 μm in its maximum width and 250 μm in its maximum length (Fig. 3). It is reinforced and fringed with many types of sensillae these are:

a- Trichoid sensillae Types 1, 2 & 4 (Tr 1, 2 & 4)

Each sensillum has a pointed tip. Its shaft is smoothly curved towards its free end and shows longitudinal striations. Each sensillum arises from a depression of the surface of the cuticle or socket. Three types of sensillae are present. Based on the measurements of the thickness and the length of the shaft (Fig. 3 & 4) these are: The smallest trichoid sensillum (Tr1) measures 38.5 – 41.25 μm in length and 8.75 - 10μm in width and have a very stout shaft. Such sensillum is arranged in a row situated around the base or the socket of the largest trichoid sensillum (Tr4) (Fig. 4). The intermediate trichoid sensillae (Tr 2), measures 80-83 μm in length and 10-12.5μm in width. It lies near the base of the pedicel close to the scape. The largest trichoid sensillum (Tr 4) is found at the lateral margin of the pedicel. It measures 140 – 180 μm in length and 15 – 25 μm in width (Fig. 3).

b- Blunt tipped sensillum type 1 (Bt 1)

It is found in-between the row of the smallest trichoid sensillae. It resembles in appearance the trichoid (Tr 1) but is shorter (12.7-13 μm in length) and it seems much thick (10-12.5μm) and has a blunt free end (Figs. 3 & 4).

c- Multiporous Coeloconic sensillae (MPCo 1)

Each sensillum arises from a depression of the integument or cavity called sacculus. Sacculus has a single opening which has irregular rounded margin at the cuticle surface with a diameter of 25-27 μm. Each sacculus contains only one

coeloconic sensillum (Co 1). Its shaft closely resembles that of the trichoid sensillum, but ends with a blunt tip (Fig. 5). It has an average length of 43.47 μm over the cuticular surface and an average width of 13 μm. Examination of the shaft revealed the presence of multiple pores along the length of the shaft. The pedicel contains 5-6 MPCo1 sensillae at the inner surface of the pedicel.

Thus three types of trichoid sensillae (T_r 1, 2 & 4) were found on the pedicel of *L.babiyari.* However, Sukontason *et al*., (2004) reported the presence of only one type of the trichoid sensillae on the pedicel of *P. dux* and also Shehata (2004) noted the presence of sensilla chaetica on the pedicel of *P. argyrostoma* although trichoid sensillae function as a mechano receptors in numerous insects as stated by Fernandes *et al*., (2002) for *Dermatobia hominis,* by Merivee *et al.,* (2002) for the ground beetle *Bembidion properans.*, by Renthal *et al.,* (2003) in the red imported fire ant *Solenpsis invicta,* by Ochieng *et al*., (2002) for the parasitoid wasp *Microplitis croceipes*. Multiporous coeloconic sensillae (MPCo1) were observed on the pedicel of the antennae of male and female *L. babiyari.* In contrast coeloconic type of sensillum was not reported nor on the antennae of *P. dux* (Sukontason *et al.,* 2004) neither on both the antennae of *W. nuba* (Kheder,1997) and *P. argyrostoma* (Shehata, 2004) might have also a dual function as mechano and chemoreceptors in case of the weevil *Hypera postica* (Bland, 1981).

Multiporous sensillae either grooved or pitted, were considered to be primarily olfactory receptors (Rahal *et al.***,** 1996; Shields and Hildebrand, 1999; Broeckling and Salom, 2003) or are chemosensory in function (Zacharuk, 1971; Steinbrecht and Muller, 1971; Slifer, 1972; Steinbrecht, 1969 & 1973; Schneider, 1971; Zacharuk, 1980; Altner *et al.,* 1977 and Keil, 1978).

3- The funicle

The funicle is the prominent antennal segment of the flesh flies. In male it measures 900 μm in length and 250 μm in width, while in case of the female, it measures 975μm in length and 475 in width (Fig 1 a & b). According to the size, two types of sensillae are detected which belong to the basiconic sensillae (Bs). Such sensillae covers the whole area of the funicle and also interspersed with small cuticular outgrowths, the so-called microtrichia (m) (Fig. 6).

Basiconic sensillum type 1 & 2 (Bs 1 & 2)

Small hooklet-like in appearance (Fig 6), The basiconical sensillae (Bs 1 & 2) possess a stout wide base carrying a shaft which is curved and became tapered

towards the rounded tip They vary widely in size ranging from 5.5-9 μm (Bs 1) and 10.4-17.6μm (Bs 2).

Basiconical sensillae type 1 and 2 were observed on both the scape and the funicle of the antennae of *L. babiyari*. Also, two types of basiconical sensillae a small and a large ones were reported on the funicle of the antennae of *P. dux* by Sukontason *et al.,* (2004). Observation on the antennae of *N. bullata* (Diptera: Sarcophagidae) was in agreement with our results, since basiconic sensillae were found on the funicle, (Wasserman & Itagaki, 2003). These basiconical sensillae was known to play an olfactory role as stated by Zacharuk, (1985); Hunter and Adserballe, (1996). Rahal *et al.,* (1996); Shields and Hilderbrand, (1999) and Broeckling and Salom. (2003).

From the results obtained, the funicle of both male and female antennae of *L.babiyari* didn't possess any olfactory pits. However, the funicle of the antennae of both male and female *P. dux* showed from 0-6 (male) and 8-15 (female) olfactory pits (Sukontason *et al.,* 2004). Also both males of *S. argyrostoma* and *W. nuba*, were found to have 52 pits (Slifer & Sekhon, 1964 and Kheder, 1997, respectively). also 50 pits were recorded on the funicle of male *Sarcophaga* sp. (Chapman, 1982). Moreover aporous coeloconic sensillae were reported on the funicle (not on the pedicel) of *Neobellieria bullata* (Diptera: Sarcophagidae) (Wasserman & Itagaki, 2003) Also, coeloconic sensillae were reported on the funicle of *Chrysomya penguins* (Sukontason *et al*., 2007).

4- The Arista: (A 2)

The arista, a plumose hair-like appendage, is as long as the funicle (1500 μm). The arista, is located proximally near the base of the funicle and it is found along the dorsolateral margin of the pedicel (Fig 1). The arista consists of 3 segments. Two of which are small (31.25 and 50μm) bearing non-sensory cuticular outgrowths: the macrotrichia (M) and the microtrichia (m), (Fig 7a). However, the third segment is the longest one (1418 μm), bearing on both the ventral and the dorsal sides, styloconic sensillae of two types (ST 1 & ST 2) as well as the macrotrichia (M) the microtrichia (m) (Fig 7 a & b).

Styloconic sensillae (St) Type 1 & 2

An elevated part of the integument of the arista encloses, at its upper tip, a slender hair-like structure of variable size: A large hairy shaft (St 2) which measures 37.5-40μm and a small shaft (St 1) which measures 15-25 μm. Both of the two hairy shaft end with a very fine pointed tip (Fig 7 a & b).

Ultrastructural studies reveal that the arista of *L.babiyari* showed the presence of two types of styloconic sensillae. This finding might support the fact that *L. babiyari* is neither *Sarcophaga exuberans* nor *S. dux* as none of the previously investigated species of Sarcophagidae namely, *P. dux, P. argyrostoma, N. bullata* and *W. nuba* (Sukontason *et al.,* 2004; Shehata, 2004; Wasserman & Itagaki, 2003 and Kheder, 1997 respectively) showed any sense organs located on their arista. These styloconical sensillae act as mechano and/or chemoreceptors as suggested by Zacharuk, (1985) and Mitchell *et al*., (1999).

B- THE MAXILLARY PALP

It is composed of one segment ending in a club-shaped free end (Fig 8). Many types of sensillae were recorded covering its surface. These are:

a- Trichoid sensillae type 4 & 5 (Tr 4 & 5)

These trichoid sensillae (Tr2 & Tr5) are usually found over the dorsal surface of the palp. It arises from a deep invagination of the integument of the palp or socket-like cavity with a very thick diameter (Fig. 9). From such socket a long shaft arises which gradually decreases in width to end with sharp pointed tip. Based on the measurements of the shaft, two types of the trichoid sensillae are found, type 4 and type 5. The length of type (T_r4) varies from 136 up to 160μm while the width is 13.6-18μm (Fig 10) in the trichoid sensilla (T_r5) the length of the shaft ranges from 186-191.3 μm with a diameter ranging from 13.6-18.1 μm (Fig. 8). Its shaft is standing erect nearly straight ending with a sharp pointed tip.

b- Basiconic sensillae (Bs 3)

It has an enlarged stout base and curved crescent hook-like shaft (10.5-17 μm in length) which is pointed at the tip. Basiconic sensillae (Bs2) are found all over the background area of the palp (Fig 11).

c- Coeloconic sensilla type 2 (Co 2)

(Co2) are usually found interspersed between the basiconical sensillae. They also resemble the (MPCo1) examined on the pedicel, but with shorter finger-like shaft (Fig 11). Each shaft arises from a single cavity in the floor of the maxillary palp.

d- Blunt tipped sensillae type 2 (Bt 2)

They resembles the basiconic sensillae (Bt 1) observed on the antennae of *L. babiyari.* But the shaft ends with a blunt tip. The length of the shaft ranges from

26-29 μm. Meanwhile the diameter ranges from 7.1 – 8.9μm. Such type of sensillae is usually nearby the tip of the free end of the maxillary palp (Figs 8 & 12).

e- Multiporous trichoid sensillae (MPTr 2)

They are found nearby the tip of the free end of the maxillary palp. The shaft is thick at the base (8.26-10.7 μm) and is somewhat short (19-26 μm). The shaft seems to have bundles of the cuticle that are firmly united together (Fig. 13). The shaft bends toward the ventral surface of the sensillum giving rise to a characteristic curvature which terminates with a pointed tip. A black rounded spots are observed along the axis of the shaft, which represents the pores.

From the results obtained, the maxillary palp of *L. babiyari* supported 5 types of aporous sensillae: trichodea sensilla types (4 & 5), sensilla basiconica (Bs 3), sensilla coeloconica (Co 2) and blunt tipped sensilla (Bt2). Similar results were reported in case of *N. bullata* by Wasserman & Itagaki (2003), the author described aporous basiconic sensilla together with long mechanoreceptive bristles. In contrast, a different pattern of sensillae was recorded on the maxillary palp of *W. nuba* since sensilla trichodea is absent and was replaced by sensillae chaetica in addition to four types of multi-porous basiconic sensillae (Kheder, 1997). Shehata (2004) in case of *P. argyrostoma,* mentioned the presence of aporous basiconical sensillae type (2) together with sensilla chaetica on the maxillary palp.

In contrast to the present findings porous small basiconical sensillae were described on the maxillary palpi of *Chrysomya penguins* (Sukontason *et al.*, 2007), of *Cochliomyia hominivorax* (Fernandes *et al.*, 2004), of *Hydrotaea chalcogaster* (Sukontason *et al.*, 2007a). Moreover coeloconical sensillae were not reported on the palp of either *P. argyrostoma* (Shehata, 2004) or *W. nuba* (Kheder, 1997)

Ultrastructural studies revealed the presence of two types of aporous blunt tipped sensillae (Bt 1 & Bt 2), on the pedicel of the antenna, and the tip of the maxillary palp of *L.babiyari.* Similar types of blunt tipped sensillae were demonstrated on the flagellum of *Phlebotomus argentipes* (ILango, 2000). A single type of multiporous trichoid sensillae (MPTr) is found on the tip of the maxillary palp of *L.babiyari.* Similar findings were reported by ILango (2000) who reported multiporous trichoid sensillae on the flagellum of *Phlebotomus argentipes.* Also, multiporous trichoid sensillae were reported, on the funicle of *Pseudoperichaeta nigrolineata* (Rahal *et al.*, 1996).

CONCLUSION

Scanning electron microscopy of the antennae and the maxillary palpi of both sexes of the flesh fly *L. babiyari,* revealed a unique and uncomparable features for the types of sensillae, among different dipterous and sarcophagid species.

The first unique criterion is the presence of a basiconical sensilla (Bs1) on the scape of the antennae. The second peculiar feature is the presence of two types of styloconic sensillae (St 1 & St2) on the arista of the antenna. The third criterion is the presence of multiporous coeloconic sensillae (MPCo1) on the pedicel of the antenna. The fourth is the complete absence of the olfactory pits from the surface of the funicle of the antenna.

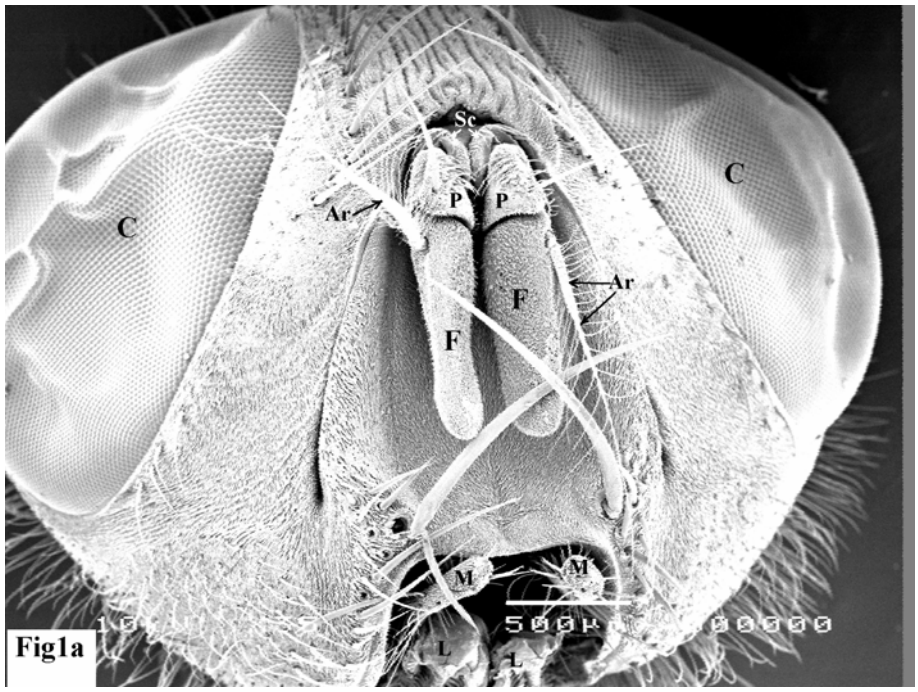
At the ultra-structural level or the fine morphology of the antennae of *L.babiyari,* data illustrated here confirmed, as prescribed morphologically before by Lehrer (1995 & 2006), a sharp and clear differentiation between the two closely related fleshflies, *L.babiyari* and *P. dux.*

SUMMARY

The flesh fly *L.babiyari* is not known to inhabit the southern west part of the Arabian region of the Kingdom Saudi Arabia. This is the first record of this species inhabiting this area of the Old world.

Scanning electron microscopy revealed the presence of two types of multiporous sensillae as well as 13 types of aporous sensillae, distributed on the surface of the antennae and the maxillary palpi of both sexes.

Coeloconic multiporous sensillae (MPCo1), are found on the pedicel meanwhile, trichoid multiporous sensillae (MPTr) are found on the tip of the maxillary palpi. Three types of aporous basiconic sensillae (Bs 1) are found on both the antenna and the maxillary palp. Two types of basiconic sensillae (Bs 1 & 2) are found on the funicle. Type one (Bs1), is found also on the scape and the pedicel. The 3rd type of basiconic sensillae is found on the maxillary palp. Five types of the trichoid sensillae are distributed all over the surface of both the maxillary palp and the antennae. Two type of aporous styloconic sensilla (St 1 & 2) are found on the arista. One type of aporous coeloconic sensilla (Co2) are found on the ground area of the maxillary palp. Two types of blunt tipped sensillae (Bt 1 & 2) are found on the pedicel and the maxillary palp.



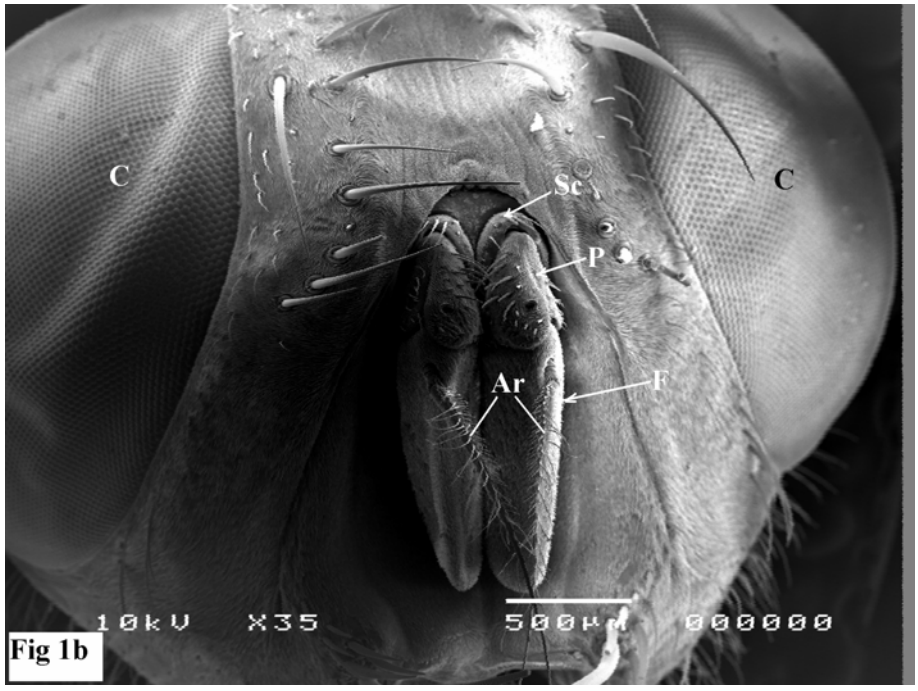


Fig 1: The head capsule of male (a) and female (b) *L babiyari.* C: compound eye, Sc: scape, P: pedicel, F: funicle, Ar: arista, M: maxillary palp, L: Labellum

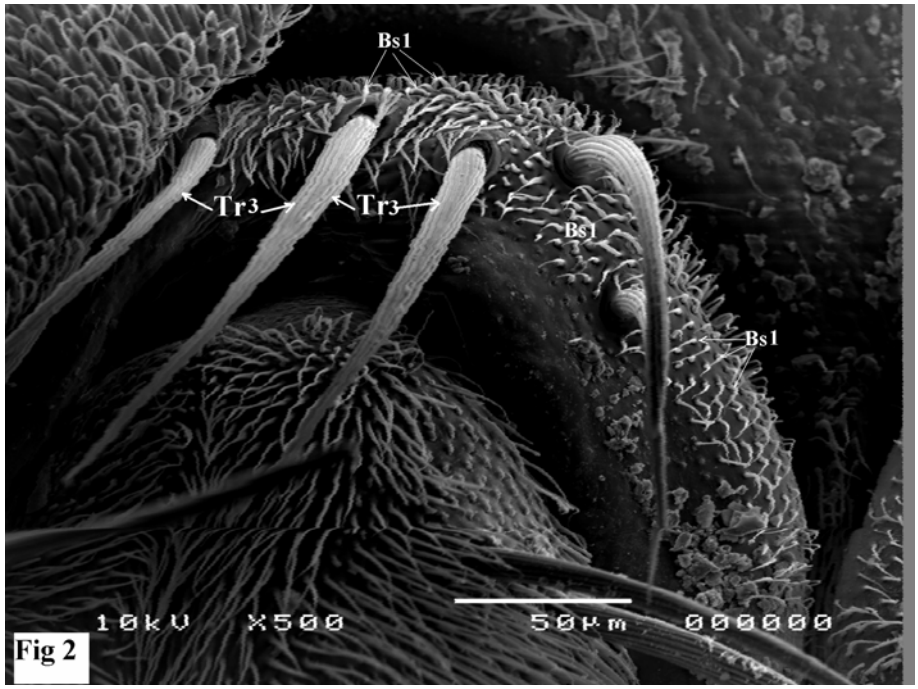


Fig 2: The scape (Sc) of the antenna of *L. babiyari.* Bs 1: basiconical sensilla type 1, Tr3: trichoid sensilla type 3.

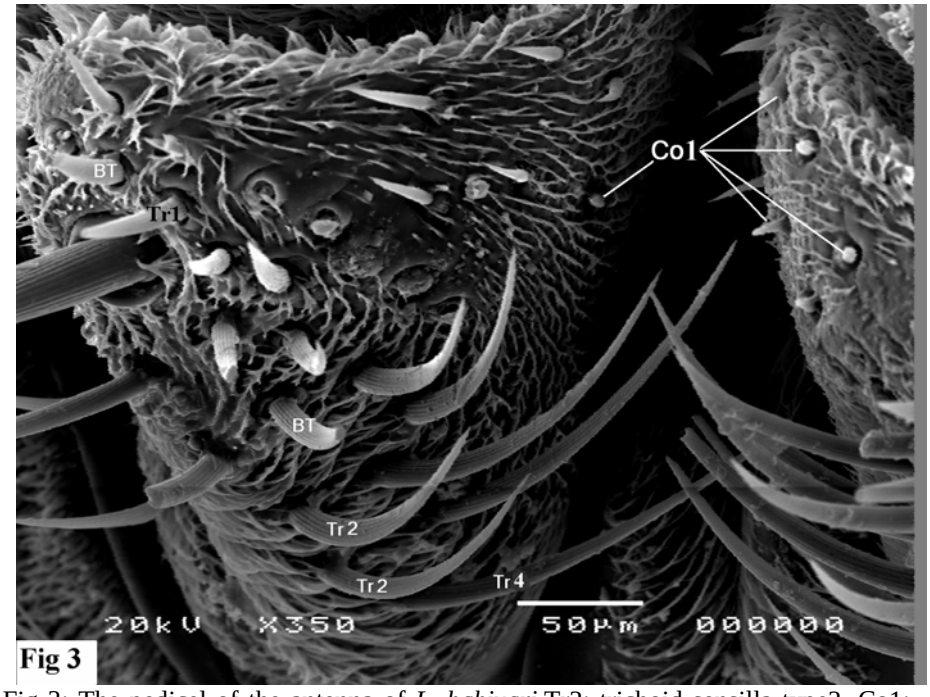


Fig 3: The pedicel of the antenna of *L. babiyari.*Tr2: trichoid sensilla type2, Co1: coeloconic sensilla type1, Bt1: blunt tipped sensilla.

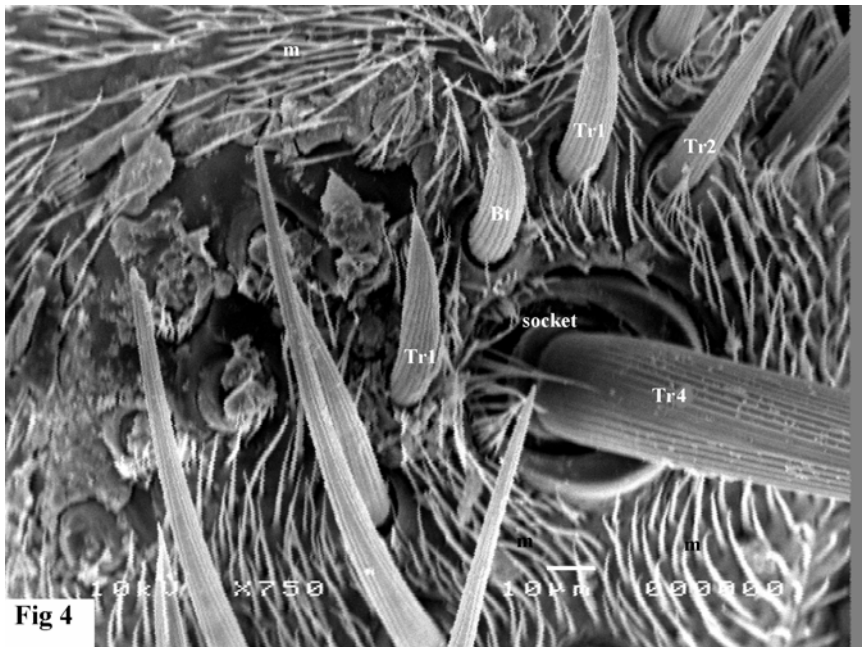


Fig 4: Types of trichoid sensillae (Tr) on the pedicel of ***L. babiyari*** antenna. Bt1: blunt tipped sensilla, Tr1: type 1 of the trichoid sensilla, Tr2: type 2 of the trichoid sensilla, Tr4: trichoid sensilla type 4.

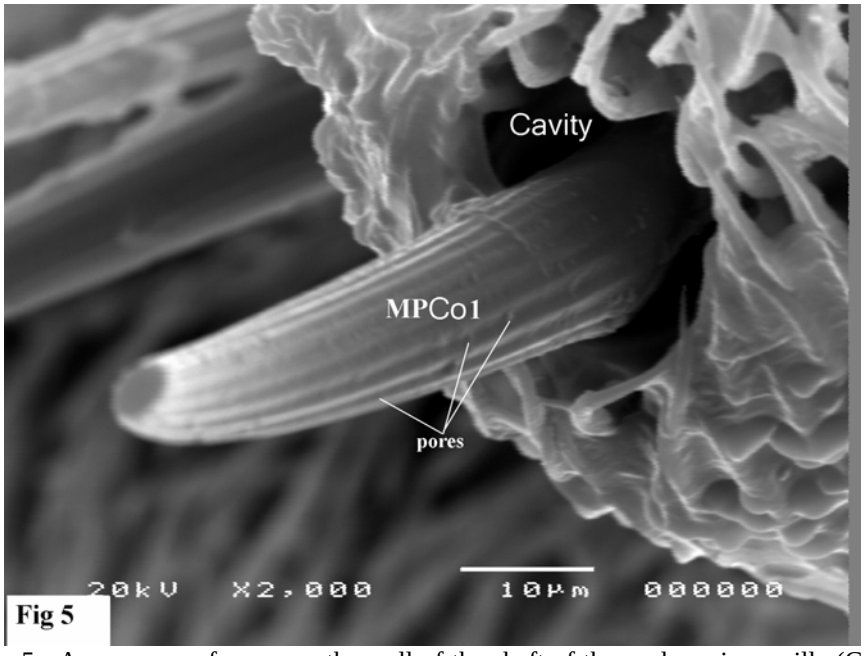


Fig 5: Appearance of pores on the wall of the shaft of the coeloconic sensilla (Co) on the pedicel of the antenna of ***L. babiyari.*** MPCo1: multiporous coeloconic sensilla.

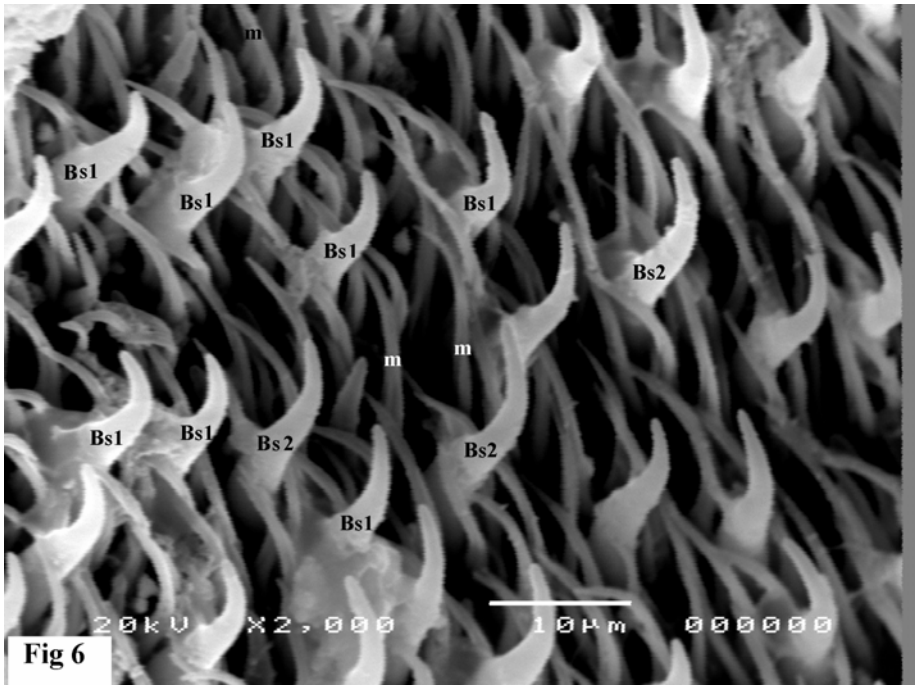


Fig 6: Basiconic sensilla type1 (Bs1) and type 2 (Bs2) found on the funicle of antenna of ***L. babiyari.***m: microtrichia

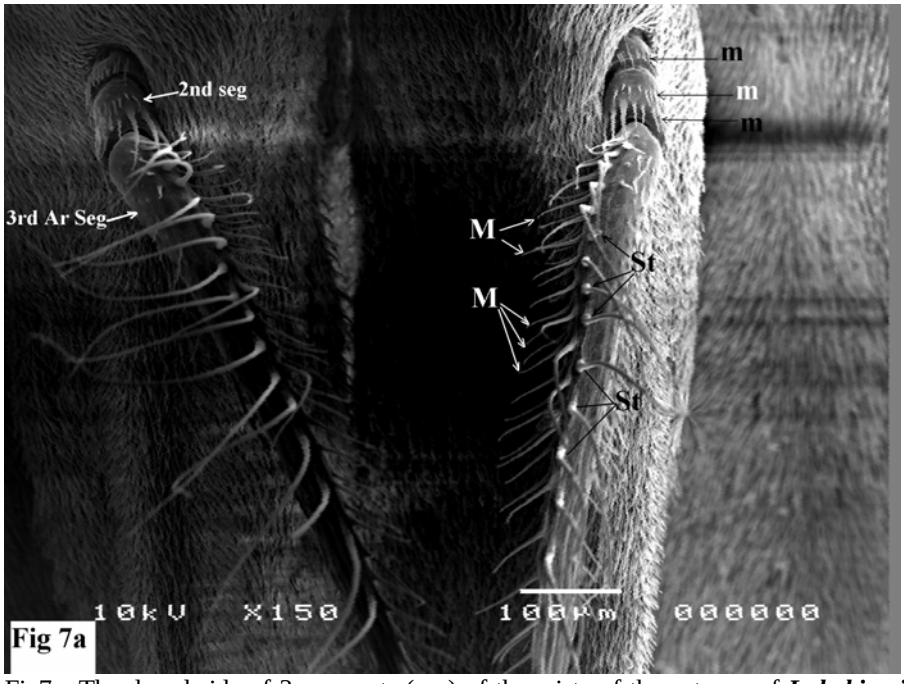


Fig7a: The dorsal side of 3 segments (seg) of the arista of the antenna of ***L. babiyari,*** showing the basal two segments free of any sensillae. St: stlyoconic sensillae.Ar:arista

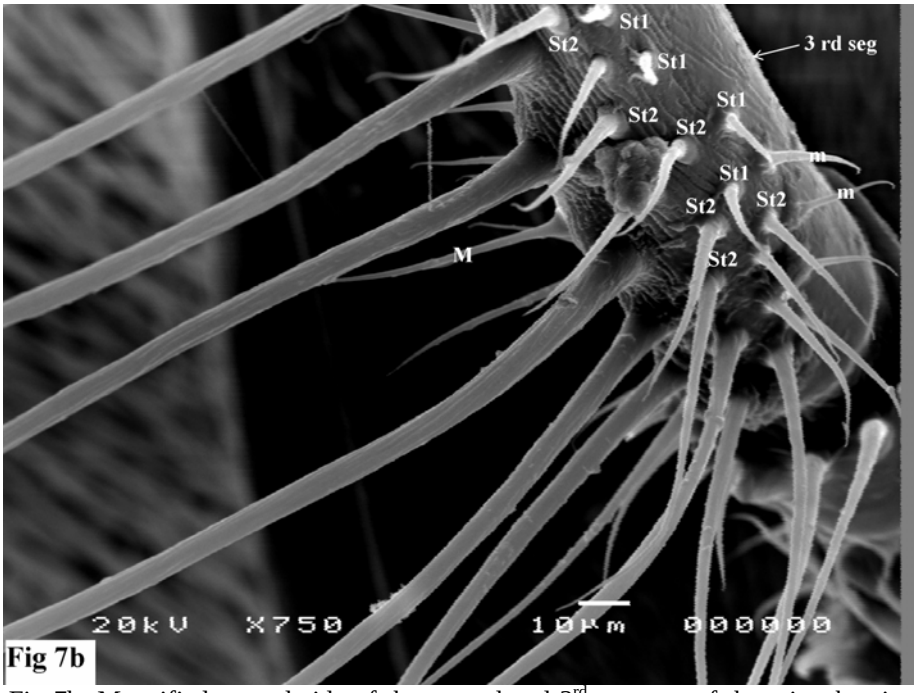


Fig 7b: Magnified ventral side of the second and 3rd segment of the arista bearing two types of styloconic sensillae (St1& St 2). M: macrotrichia, m: microtrichia.

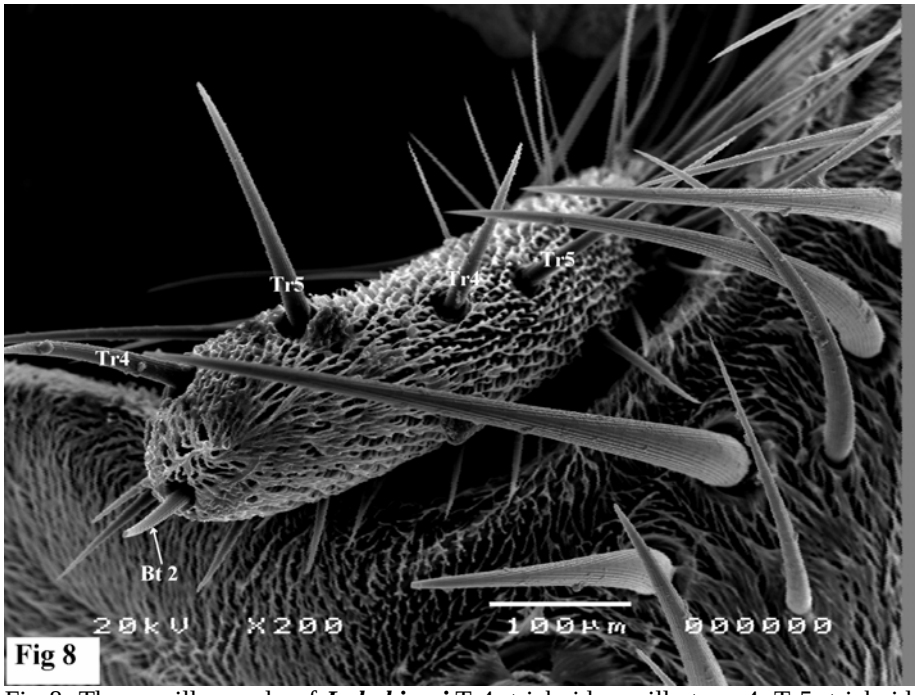


Fig 8: The maxillary palp of ***L. babiyari.***Tr4: trichoid sensilla type 4, Tr5: trichoid sensilla type 5 & Bt2: blunt tipped sensilla

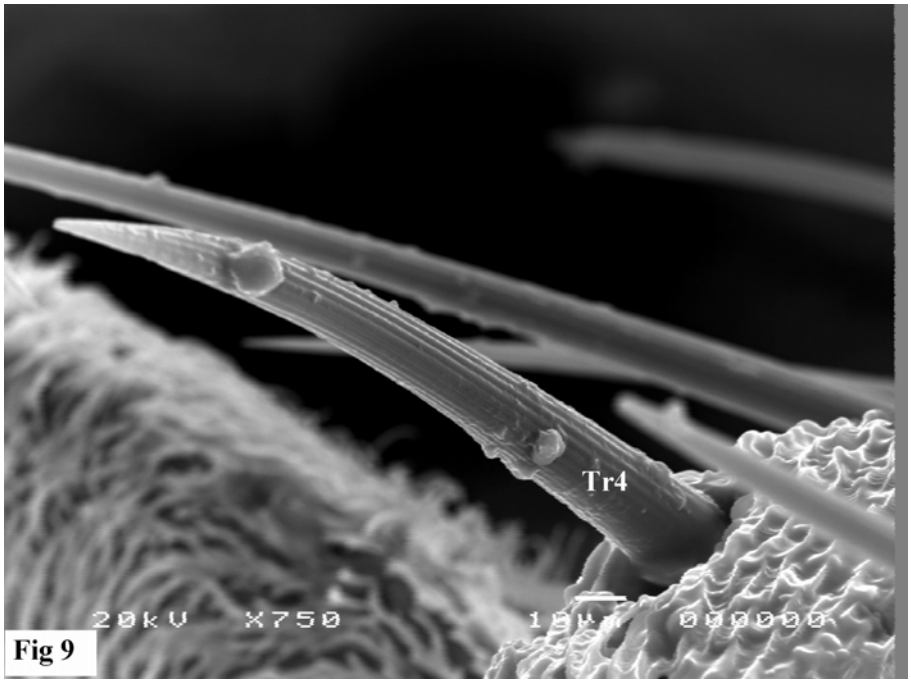


Fig 9: Trichoid sensilla type 4 (Tr4) on the maxillary palp of ***L. babiyari.***

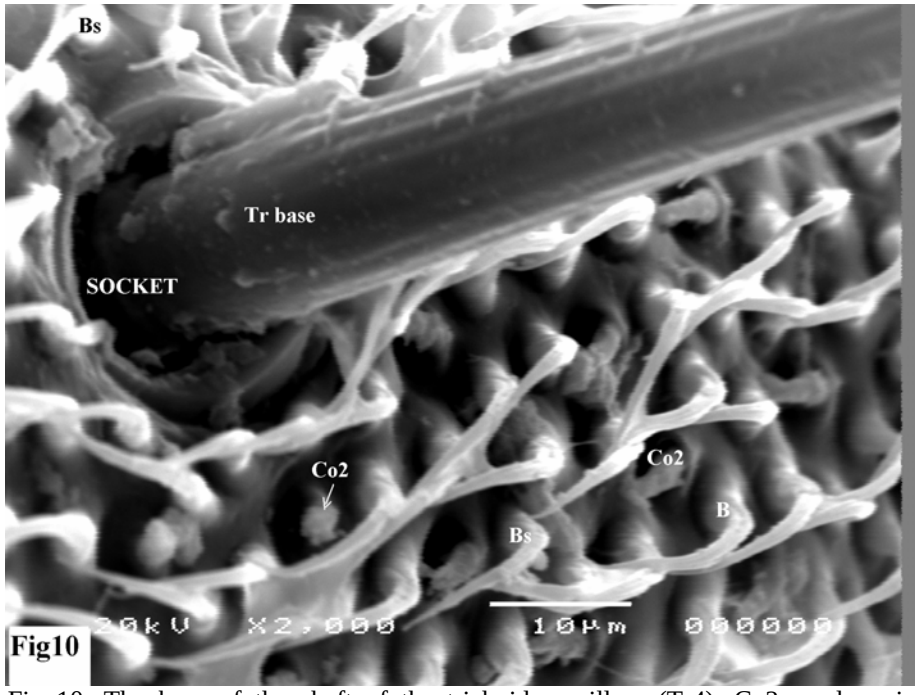


Fig 10: The base of the shaft of the trichoid sensillum (Tr4). Co2: coeloconic sensilla Type2 & Bs: basiconic sensilla

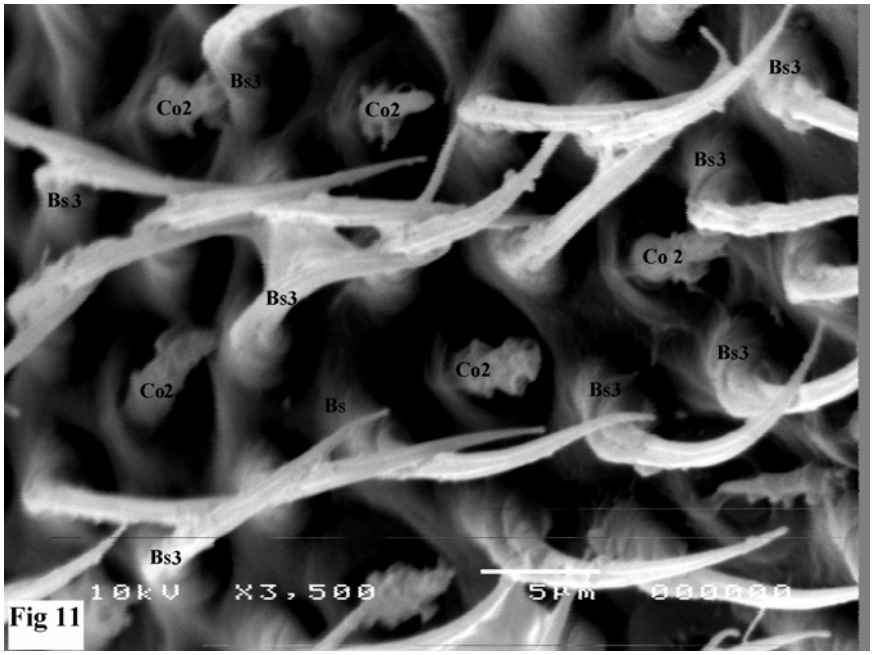


Fig 11: The ground area of the maxillay palp of ***L. babiyari***. Bs 3: basiconic sensilla type3 & Co2: coeloconic sensilla type 2

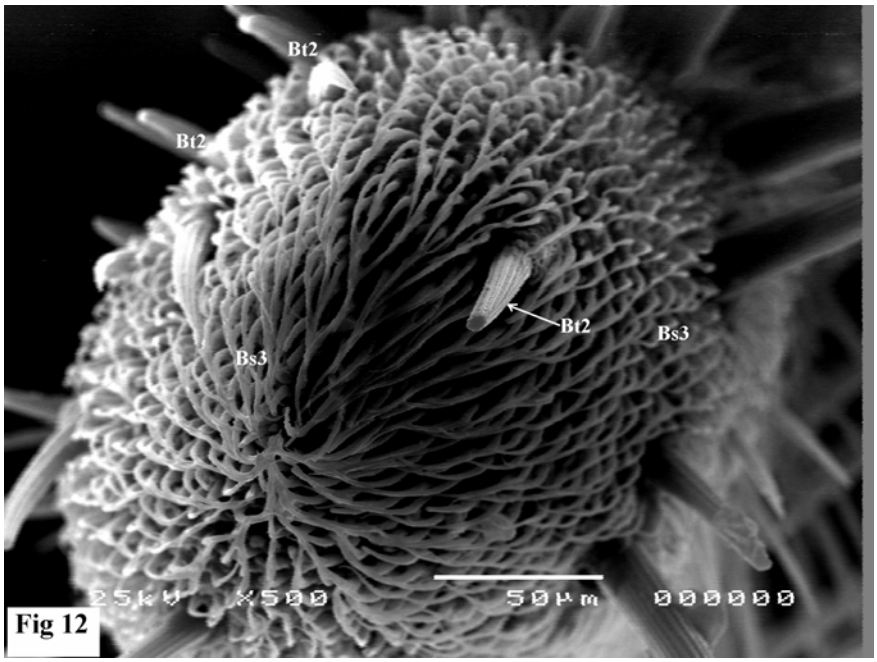


Fig 12: The tip of the free end of the maxillary palp of ***L.babiyari.*** Bt2: Blunt tipped sensillum type 2 & Bs3: basiconic sensillae type 3.

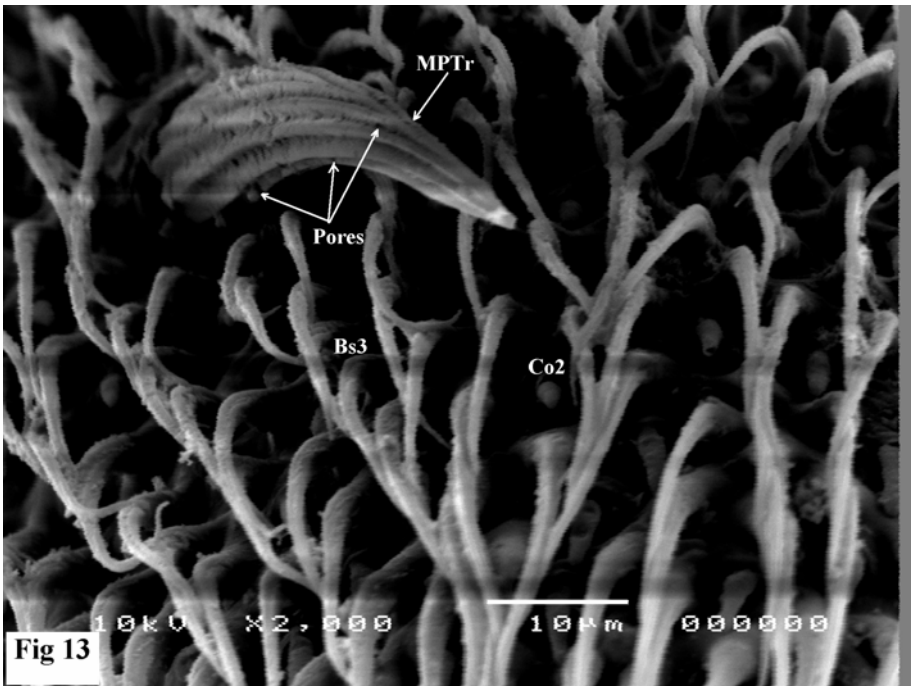


Fig 13: Multiporous trichoid sensillum (MPTr) at the tip of the maxillary palp. Bs3: basiconic sensilla type3 & Co2: coeloconic sensilla type 2

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