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Scanning electron microscopic study of antennal of the female Bee louse fly *Braula coeca* Nitzsch (Diptera: Braulidae)

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Abstract
The antenna of the female bee louse *Braula coeca* consists of a scape, a pedicel and a Funicle (enlarged basal flagella subsegment). The scape is not visible and does not carry any type of sensilla. The pedicel is approximately triangular in cross section and it carries a group of long grooved articulated bristles. The Funicle is cover with microtrichia; it contains three types of sensilla: long sharp-tipped sensilla, basiconica sensilla and ribbed peg sensilla. There is only one olfactory pit on the basal side of the Funicle and it contains 3 – 4 ribbed peg sensilla. The arista long, cylindrical, fringed and on the first quarter of the basal part, there are very small six cone-shaped sensilla on the dorsal surface. The suggested function of each sensilla was based on comparison with results of other investigation on similar sensilla.

Keywords: Bee louse, Fly, Antenna, Sensilla, Scanning electron microscopy

Introduction

Bee louse *Braula coeca* Nitzsch 1818 is a tinny parasitic wingless fly found in colonies of the honeybee *Apis mellifera* L. where it lives on the bodies of the bees and literally steals its food out of the mouth of its host. This fly is blind, reddish- brown in

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color having a length of about 1.5 mm and width of about 0.75 mm (Burgett, 1971). Currentlyse is wide spread, being found in every continent and it exoparasitic on all races of *Apis mellifera* species (Smith and Caron, 1984; Zaitoun and Alghzawi, 2008).

Antenna of many insects including flies have been extensively recorded as bearing different types of sensilla receptors (Merivee, et al., 2002). These sensilla made the insects to be able to perform recognize host and different odors and other substances like pheromones and kairommnes (Davis and Bowen. 1994; Dougherty, et al., 1999; Rebora et al., 2012 and Suwannapong et al., 2012).

As this fly is a blind insect, so the antenna and its sense organs should play an important role in its different life activities, where it lives inside dark hives, so the aim of this paper was conducted to describe the general structure of the antenna of female bee louse and its different types of sensilla.

Materials and methods

Specimens of bee louse were collected from beehives in a farm at AL-Bieda city (Libya) where flies had killed with ethyl acetate and transported to the laboratory, where they had processed within 24 h. The separation of the female flies had done according to Orosi-Pal (1966) by noting the 5 abdominal sternites of the female and 4 abdominal sternites of the male. In addition, the cerci of the female and the hypopygium of the male appear distinctly different in the two sexes.

For examination of the external surface by scanning electron microscope (SEM), antennae had excised from the head under a stereo microscope and after critical point drying with carbon dioxide in a Balzer CPD 030, the specimens had mounted on aluminum stubs with two-sided adhesive tape in different orientation, and coated with gold in Edwards's coater S 130 B. Observation had made using a JEOL JSM S200 scanning electron microscope at 10 _ 15 KV.

Results and discussion

The antenna of female Bee louse, *Braula coeca* consists of a scape, pedical and funicle and an arista. (Fig. 1) and both antenna are situated in deep fosse on each side of head.

We have identified six types of sansilla, on the antenna of *B. coeca*. The number of the sensilla found in the antenna seems to be different among Diptera flies. While Sukontason et al. (2004), found only five types of sensilla in the antenna in six

species of flies in three fly families calliphoridae, sarcophagidae and muscidae. Fernandes et al. (2004) found thirteen subtypes of sensilla in the antenna of screwworm fly. However, it could be stated that the *B. coeca* does not have every type of sansilla homologous to those discovered in other Diptera. This may results from being a blind and ectoparasitic fly on the honeybees and its existence inside hives. Also it may depends on the other sense organs, that it may located in the other parts of the body, like mouth parts and legs as drosophila flies (Ayer and Carlson, 1992 ; Thorne et al., 2004) and house fly (Griff and Kane, 2010). Glendinning et al. (2006) and Marella et al., (2006) stated that the insects could distinguish tastes of different modalities such as bitter, and sweet by the labial palps.

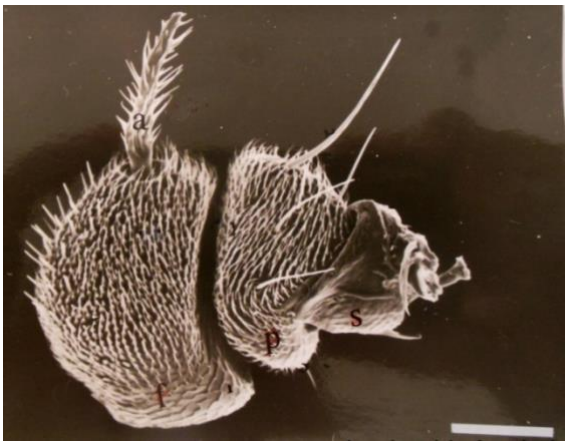

Figure 1. Antenna of *Braula coeca*: a, arista ; f, funicle ; p, pedicel and s, scape. Scale = 50 µm.

Scape: It is not visible in normal resting position, and does not carry any type of sansilla. This is similar in *Stomoxys calcitrans* (Lewis, 1971) but there are other fly species which have scape sansilla as onion fly (Honda et al., 1983), cabbage root fly (Ross and Anderson, 1987) and golden rod gall fly (Vasey and Ritter, 1987). All these species have a scape with socketed bristles, which also appear in the pedicel, but Sukontason et al. (2004) found only trichoid sensilla on the scape of the antenna of six species in three families of fly. In *B. coeca* this type of sansilla, appears only on the pedicle while the scape, is hidden in the antennal fosse.

Pedicel: It is approximately triangular in cross section. It is about 90-µm long and 69.5 µm in diameter. The sensory structures in the pedicle are restricted to a group of articulated grooved bristles. It is a long articulated bristle arising from a socket and presenting thick walls with longitudinal grooves (Fig. 2).

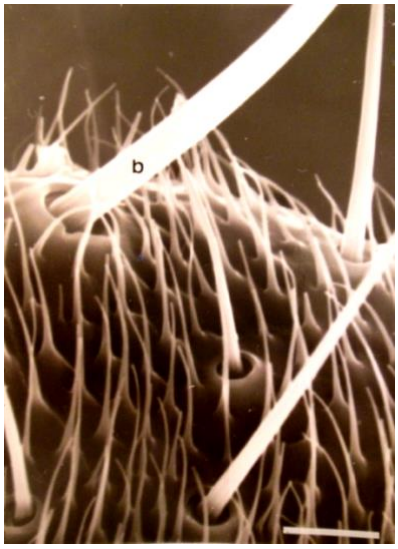

Figure 2. Articulated grooved bristle (b) on the pedicel. Scale = 10µm.

The peculiar feature of these sensilla is different in length and size, where the longest bristle is located on the apex of the pedicle, extends parallel to the arista with length about 113 µm (Fig 3). These types of sansilla are common throughout the Diptera (Ross and Anderson, 1987) and indicate their function to be mechanotactile. Bee louse probably depends more on this type of sansilla and its tactile sense because of its blindness. The pedicel also does not have the setiferous plaques, which are found on the pledicel in several other Dipteran species (Greenberg and Ash, 1972) and in cabbage root fly (Ross and Anderson, 1987), which do not think to have an olfactory function. The pedicel has dense microtrichia (non-sensory hair-like projections) which are minutes, Abouzied (2008) reported similar finding in tachinid fly.

Funicle: It is approximately ovoid, and it is the largest segment in the antenna. It is about 79.7 to 127.5 µm in diameter. The funicle is also, covered with large numbers of microtrichia interspersed with three distinct types of sansilla and the arista.

Long sharp –tipped sensillum: this type of sansilla, is the largest and most conspicuous among the other funicular sensilla. These sensilla may be with a

characteristic length, of about 16 µm and the basal diameter is about 2.3 µm. These sensilla are spear like in shape and taper gradually towards the apex, ending in a sharp tip. The base is surrounded by a cuticular rim (Fig. 4). This type of sansilla, is distributed mainly over the outside edge of the funicle.

Figure 3. Arista (a) and the longest articulated bristle (b) on the pedicel. Scale = 10 µm.

Figure 4. Long sharp-tipped sensilla (s). Scale = 5 µm.

This type of sansilla is the most analogous to trichoidea sensilla in terms of the length and it is the most conspicuous among the funicular sensilla. This also occurs in cabbage root fly (Ross and Anderson, 1987), blow fly (Sukontason et al., 2004) and onion fly (Honda et. al., 1983). In addition, it has approximately the same length and diameter, but if the other characteristics, which usually frequent with trichoidea are considered, such as its hair like structure (Richards and Davies, 1977) the differences are evident. It is not articulated, arises from a completely clear area of cuticle (Desser and Hong, 1992) and it has distal curvature along the longitudinal axis (Ross and Anderson, 1987; Been et al., 1988). Therefore, it seems undesirable to refer to it as " trichoidea", in spite of the other characteristics, which were mentioned earlier, Its function may be additionally protective.

Basiconica sensilla: this type has the same appearance of other basiconica sensilla, and measures about 8.4 µm in length and the basal diameter is about 1.9 µm. These sensilla appear to be without any wall pores and each is a shallow circular depression (Fig. 5). They are distributed over most of the funicular surface and are more abundant than the other sensilla on the funicle.

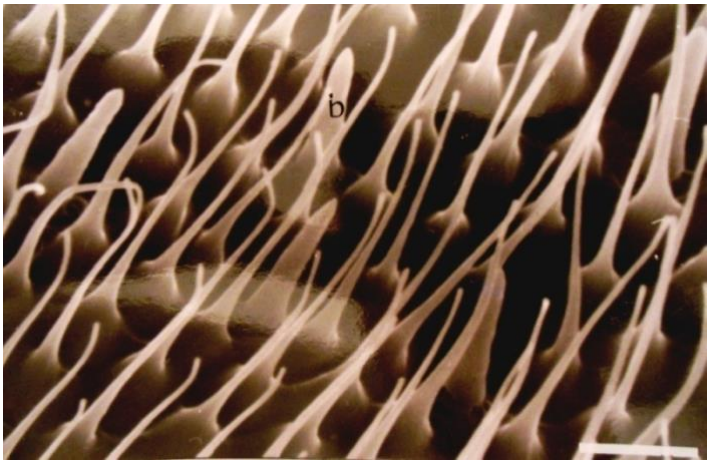

Figure 5. Basiconica sensilla (b). Scale = 5 µm.

Basiconica sansilla are the most common on the Dipteran antennae, they are found in sand fly (Chu-Wang et al., 1975), golden rod gall fly (Vasey and Ritter, 1987), black fly (Sutcliffe et al., 1990), tachinid fly (Abouzied, 2008) and in other six species in the three fly families (Sukontason et al., 2004). In addition it is also, found in antenna of honeybee (Suwannapong et al., 2012). In *B. coeca*, basiconica sensilla appear to be similar to the basiconica sensilla described in other species of Diptera since they have the same shape, and approximately the same length and diameter; on the other hand, on the antennae of *B. coeca* there is only one type of basiconica sensillum, but some other species have more. Honda et al. (1983), Ross and Anderson, (1987) and Vasey and Ritter (1987), found two subtypes while Been et al. (1988) found seven subtypes of sensilla. The most important difference in *B. coeca* sensilla is wall pores, which cannot be detected.

Generally, bassiconica sensilla have an olfactory function and these are associated with wall pores in most Dipteran antennae. There are many studies in different orders of insects showing that, all sensilla with multiporous walls have an olfactory function. Altner (1977) and Shanbhag et al. (1999) stated that, basiconica sensilla differ by the size and density of odor pores, and may or may not have pores. Therefore, in this case and according to his suggestion, these basiconica sensilla in the bee louse will be designated (no pore) sensilla type, where the function may be mechanosensitive or hygro or thermo sensitive.

Ribbed peg sensilla: these sensilla are easily recognizable owing to their peculiar shape, shortness and the relatively wide diameter. Each measures about 4.7 in length and the basal diameter is about 1.7 µm. It has an obvious arrow-shaped head and broad base, which arise from the center of a circular plate. The cuticle has sparse big grooves, which appear at high magnification as huge longitudinal ribs extended along the shaft (Fig. 6).

Figure 6. Ribbed peg sensilla (p). Scale = 1 µm.

This type of sensilla is less numerous than the other types and is not evenly distributed over the funicle. It is more abundant on the proximal region where it is situated in a small cavity.

This type of sensillum, has not been described on the antennae of other Diptera. Similar sensilla were found in previous studies on *B. coeca*. Some grooved sensilla do occur on other Dipteran antennae. The lack of reporting of this type may result from its low abundance (Honda et al., 1983, Ross and Anderson, 1987, Been et al., 1988; Sutcliffe et al., 1990). This type of sensillum is the only one found in the olfactory pit of *B. coeca* and this may indicate its function to be olfactory although this cannot be assumed.

Olfactory pit: this pit has an irregular circular opening and contains 3-4 ribbed peg sensilla located facing each other on the inner wall of the pit and sometimes 1-3 of the same type of sensilla are positioned outside and close to the pit orifice (Fig. 7). There is only one olfactory pit located antipodal to the arista at the basal side of the funicle. In addition, this is the smallest number found in the family of muscidae (Been et al., 1988). Great differences were found among many species varying from one olfactory pit to over 260, Honda et al. (1983) hypothesized that antennae in fly species, which rely largely on odor to locate food, contain numerous olfactory pits.

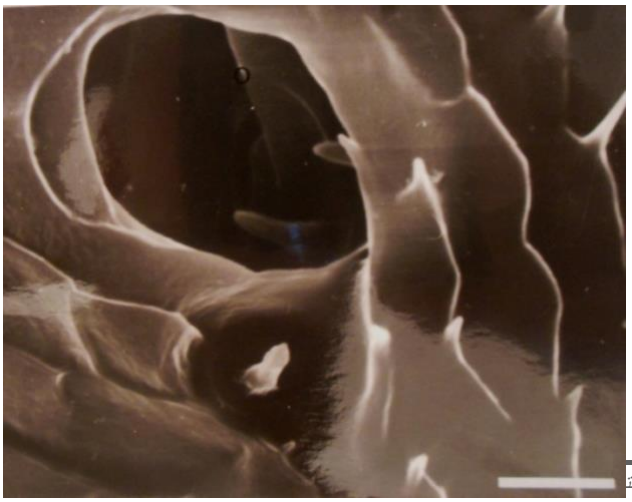

Figure 7. Olfactory pit. Scale = 5 µm.

The olfactory pit of *B. coeca* is different from the pits in many other Diptera in that it has only one type of sensillum, and has on microtrichia. This contrasts with many other species as stated by Ross and Anderson (1987) who reported that these pits found on the Cabbage root fly could be a way of increasing the receptive surface of the antennae and concentrating the stimuli in the locality of the sensilla. Some of the pit sensilla may be olfactory receptors, as has been alluded to for *Hylemya antique* (Honda et al., 1983).

Arista: The arista is long, cylindrical, fringed, and articulated at a regular circular opening on the dorsum of the funicle (Fig. 2). The length of the arista is about 126 µm and the basal diameter is about 14 µm. The arista is sparsely, covered with long thick non-articulated branches along the shaft except on the first quarter of the basal part where there are six cone-shaped sensilla on the dorsal surface, which are very small and length of about 2.4 µm (Fig. 8).

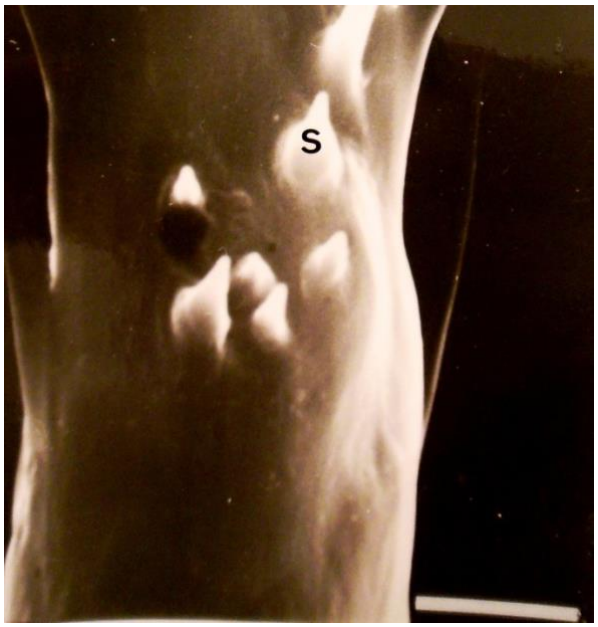

Figure 7. Small cone-shaped sensilla (S) on the arista. Scale = 5 µm.

These sansilla, look like chemoreceptors. A small sensillum present on the arista of the golden rod gall fly and human botfly structurally resembles it., and could be capable of detecting the pheromones (Vasey and Ritter, 1987) (Fernandes et al., 2002). On the other hand, many other flies are without any sensilla on the arista as screwworm fly (Fernandes et al., 2004) and many other fly species (Lewis, 1971; Honda et al., 1983; Ross and Anderson, 1987; and Been et al., 1988).

Further studies with transmission electron microscopy and electrophysiological techniques, are needed to better understand the physiological function of these external structures.

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Scanning electron microscopic study of antennal of the female Bee louse fly *Braula coeca* Nitzsch (Diptera: Braulidae)

الهاشمي على أغليو

الملخص

اوضحت هذه الدراسة التي تمت على قرن استشعار انثى قمل النحل *Braula coeca* بواسطة المجهر الالكتروني ان هذا القرن يتكون من ثلاثة عقل هي عقلة الاصل و العنق و الشمروخ حيث يظهر على السطح عقلتي العنق و الشمروخ فقط اما عقلة الاصل فتكون داخل نقرة قرن الاستشعار كما انها لا تحمل أي نوع من انواع اعضاء الحس اما عقلة العدق فهي مثلثة الشكل تقريبا و تحتوي على مجموعة من الشعيرات الطويله ذات اخاديد.اما عقلة الشمروخ فهي اكبر العقل و شكلها بيضاوي تقريبا و تحمل ثلاثة انواع من اعضاء الحس هي شعيرات وتدية قمعية و شعيرات طويلة مدببة الراس و شعيرات وتدية مضلعة الى جانب تجويف شمي واحد كما تحمل عقلة الشمروخ شعرة (الارستا) التي تبدو طويلة اسطوانية و تحمل على الجزء القاعدي منها ستة شعيرات قمعية صغيرة.تحديد وظائف اعضاء الحس هذه تمت بناء على مقارنتها بنتائج لدراسات سابقة لاعضاء الحس المشابهة لها.