Scanning Electron Microscopy of Antennal Sensilla of *Goniocotes* Species infesting Helmeted Guinea fowl, *Numida meleagris* (Galliformes: Numididae)

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Abstract: Phthirapteran antennae are the principal sites of sensory structures. The antenna of ischnoceran Phthiraptera consists of three components viz. basal scape, a pedicel and the flagellum. The flagellum is further sub divided into three segments: first, second and third flagellomere. SEM study revealed that the second and third flagellomere of *Goniocotes* species infesting Helmeted Guinea fowl, *Numida melagris* carry a placodean sensilla and a sensilla coeloconica. The scape, pedicel and I flagellomere carry 1-3 sensilla chaetica and tectile hair. The nature of sensory organ of both the sexes of adult and different instars of nymphs of *Goniocotes* species appear quite similar. The present report thus furnishes information on the nature of antennal sensilla of three instars of nymphs and the adult of an ischnoceran louse *Gonicotes* species infesting Helmeted Guinea fowl.
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1. Introduction

Phthirapteran ectoparasites (lice) are very small arthropodan creatures which spend their life on different mammalian and avian hosts. Many morphological features of these tiny creatures are not visible under simple microscopic study and hence scanning electron microscopic (SEM) study is required for observing the specific details. Antennal sensillum is also one of the special features located on anterior part of the head of the louse.

The external morphology of different kinds of sensilla found on the surface of the head of phthirapteran ectoparasites vary in shape, size and patterns. It is also a useful tool for taxonomic study. Occasionally, outline drawing of the antenna under low magnification are included in systematic papers which provide only superficial impression of sense organ. Essig (1942) furnished a drawing of the antenna of *Menacanthus stramineus* in his description of the order for the first time. The occurrence of sensilla in five phthirapteran species was noted (Nuffer, 1954). Clay (1970) demonstrated the presence of saucer like sensilla on last antennal segments of three ischnoceran lice with the help of SEM. The sensilla of antennal flagellum of *Craspedorhynchus americanus* were demonstrated by (Slifer, 1976). Zlotorzyca and Kassner (1986) recorded the antennal sense organ of 14 phthirapteran species and concluded that its morphology can be used not only for systematics but also for recording the physiological properties. Zlotorzycka and Modrzejewska (1992) further studied the ultra-structure of antenna of an ischnoceran species, *Docophoroides brevis.* Cichino and Abrahomobich (1988) recorded the antennal sensilla of adult as well as three instars of nymphs of *Boroneilla bergi*. The morphology of antennal sensilla of sheep louse, *Bovicola bovis* (Clark, 1990) and scanning electron microscopy of the pit organs of several species of the same genus (Cruz and Mateo, 1996) have been studied from time to time. The tuft organs were studied on antennal flagellum of *Pediculus humanus* (Steinbrecht, 1994) but those of *P. humanus humanus* have comparatively received more attention (Miller, 1969; Szczesna, 1978, 1985; Slifer and Sekhon, 1980). Likewise, the three anopluran species viz., *Polyplax serrata*, *Solenopotes capillatus*, *Echinophthirius horridus* have also been studied from this point of view (Miller, 1970a, b; 1971a, b). Qadri (1936), Dethier (1957), Zacharuk (1985), Mclver (1987), Perez et al. (1995) and Cruz (1995) contributed to physiology and nature of blood sucking insects. Smith (2001) made attempts to review the work done on the subject.

Other significant contributors on scanning electron microscopy of antennal sensilla include workers like Clarke (1990) (*Damalinia ovis*); Baker and Chandrapatya (1992) (*Haematomyzus elephantis*); Steinbrecht (1994) (*Pediculus humanus corporis*); Green and Turner (2001) (louse fly); Cruz and Mateo (1996) (*Bovicola*), 1998 (*Damalinia*), 2001(*Damalinia*) and 2009 (*P. humanus* and *Haematopinus apri*); Turner (2003) (*Damalinia crenelata*); Turner (2004) (*Haematopinus bufali*) and Agarwal et al. (2011)

(*Upupicola upupae*) conducted scanning electron microscopy of antennal sensilla. Information on the sensory equipment of the antennal flagellum of several species of *Damalinia* was provided by Cruz and Mateo (1998). The distribution of sensilla on the antennal flagellum of five poultry lice was noted by Bhatnagar et al. (2004). Arya et al. (2010) compared the nature of antennal sensilla of selected *Brueelia* species. Recently, Arya and Singh (2012) described the antennal sensilla of head of poultry shaft louse, *Menopon gallinae*. The present report furnishes information on the nature of antennal sensilla of three nymphal instars and the adult of an ischnoceran louse *Gonicotes* species infesting Helmeted Guinea fowl.

2. Materials and Methods

Adult lice and three instars of nymphs were collected from Helmeted Guinea fowl from District Bareilly, India through survey work. The lice were stored in 70% alcohol, cleaned in distilled water (two changes) and ether (three changes), dehydrated, mounted on metal specimen stub using double sided tape, coated with gold palladium in Neo Coater 100-240V and observed under SEM (Neo JCM-6000). The samples were then observed under SEM at varying magnifications and selected areas were photographed. Some specimens were treated with Osmium tetra oxide (2%) for achieving better results.

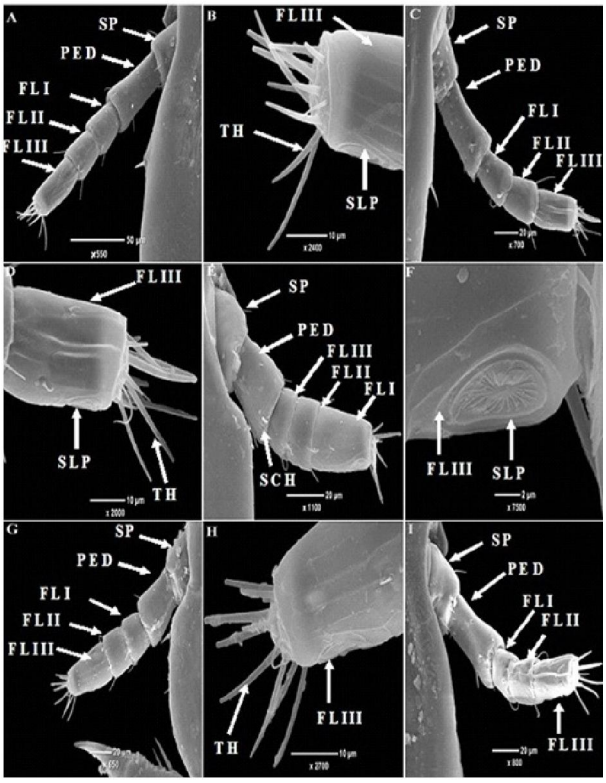
3. Results

The antennae of female *Goniocotes* species consist of a scape, a pedicel and three terminal flagellomeres (Figure 1A). The scape is a small rod like structure (30 µm) whereas, pedicel is elongated and cylindrical (46.5 µm). The Ist and IInd flagellomeres resemble pedicel (26 µm and 24 µm respectively). The terminal flagellomere is comparatively longer (45.1 µm). The scape, pedicel and first flagellomere bear 1-3 spines (sensilla chaetica) and tectile hair.

The IInd and IIIrd flagellomere bear a sensilla placodea and sensilla coeloconica. The former is saucer shaped with central raised area surrounded by varying number of radiating ridges, separated by narrow grooves. The apical end of IIIrd flagellomere bears 10-12 sensilla (Figure 1B). One of them appears whip like and tappers to a fine point. The remaining structures appear to be tectile pegs of varying sizes (6.01µm- 21.6 µm). Most of the tectile pegs possess broader bases and blunt terminated tips. The presence of aperture at the tips could not be ascertained.

The antennal sensilla of the male *Goniocotes* species are not sexually dimorphic (Figure 1C). The distribution of placodean sensilla and tectile pegs appears similar (Figure 1D). As far as the nature of antennal sensilla of nymphal instars is concerned the apex of terminal flagellomere of all the three nymphal instars carries 10-12 tectile pegs, as in case of adult (Figure1A-I). Likewise, side wall of IIIrd flagellomere bears sensilla placodea, as found in adults.

Figure 1



A. Whole antennae of male (X 550)
B. Enlarged view of III flagellomere (X 2400)
C. Whole antennae of female (X 700)
D. Enlarged view of III flagellomere (X 2000)
E. Whole antenna of first instar (X 1100)
F. Enlarged view of III flagellomere (X 7500)
G. Whole antenna of second instar (X 650)
H. Enlarged view of apical end of IIIrd flagellomere (X 2700)
I. Whole antenna of third instar (X 800)

Figure1. A-I. Scanning Electron Micrographs of antennae of *Gonicotes* species

Abbreviations

FLI-Flagellomere I; FLII-Flagellomere II; FLIII-Flagellomere III; PED- Pedicel; SCH-Sensilla chaetica; SP-Scape; SLP-Sensilla Placodea; TH-Tectile hair.

4. Discussion

The primary function of insect antennae appears to be sensory. The antennae of most ischnoceran lice comprise of 5 annuli (scape, pedicel and three flagellomeres) but in some species (eg: *Coloceras* species), the three flagellomeres fuse to form a single structure. A scrutiny of literature reveals that there is considerable superficial diversity in the form of antennal sense organ, even within genera.

Bhatnager et al. (2004) studied the antennal sensilla of four ischnoceran species (*Lipeurus heterographus*, *L. caponis*, *L. lawrensis tropicalis* and *Goniocotes gallinae*) and one amblyceran species (*Menopon gallinae*) poultry lice by SEM. In this study, the IInd and IIIrd flagellomere of ischnoceran species bear sensilla coeloconica and the pore organ. The apex of terminal flagellomeres of four species carries a cluster of eleven tectile hairs. The IIIrd flagellomere of amblyceran lice bears a diverse assemblage of spines, cones and pits.

Surman and Suneel (2012) described the antennal sensilla of head of poultry shaft louse, *Menopon gallinae*. He observed a small, ovoid scape and pedicel (broad cup-like structure having narrower base) in antennal sensilla under SEM. In addition to sensory setae, sense organ was present on terminal segment. Tuft organ contains 6/7 small peg like structures. Pit organ was also visible at the sub-terminal area of fourth segment. Presence of any structure resembling coeloconic chaemo-receptor was not observed on any flagellar sub-segment of *M. gallinae*.

According to Clay (1970) the scape, pedicel and Ist flagellomere bear tectile sensilla while IIIrd flagellomere carries two plates and pit sensilla. Furthermore, 10-12 tectile sensilla occur at the tips of IIIrd flagellomere. In case of *Goniocotes* species, a IIIrd flagellomere appears to carry one plate and one pore organ. Clay (1970) further observed two sensilla coeloconica on terminal segment of species having four segmented antenna in a member of Menoponidae. She further stated that Boopidae and Ricinidae also have similar arrangements but Laemobothridae have three sensilla on terminal segments and Trimenoponidae and Gyropydae exhibit diversity in the form of antennal organs. However, Zlotorzycka and Kassner (1986) also reported that the terminal segments of several ischnocerans bear two pore organs and one sensilla coeloconica. In *Goniocotes* species, presence of any such sensilla coeloconicum was not observed. Miller (1969, 1971a) also recorded the presence of pore organ in certain species. He further noted that anopluran pore organ remains surrounded by a ring of radiating grooves. However, the presence of sensory setae and tuft organ (consisting of thin / or thick walled) chemo-receptors appears to be a common feature of most of phthirapterans investigated so far. The number, size and location of these structures on different components of antenna seem to be variable (Miller 1969, 1970a, b, 1971b; Clay 1969; Clay 1970; Slifer 1976; Szczesna 1978, 1984; Zlotorzycka and Kassner 1986; Kassner and Zlotorzycka 1987; Zlotorzycka and Modrzejewska 1992).

The present study further indicates that the nature and distribution of antennal sensilla was quite similar in the two sexes of *Goniocotes* species. Moreover, the nature and distribution of sensory equipments in I, II and IIIrd instar nymph was also quite similar. Cicchino and Abrohamovich (1988) also noted that the nature of antennal sensilla of different nymphal instars of nymphs and adults of *Vernoniella bergi* are quite similar. Thus, the present paper supports the observation of Cicchino and Abrohamovich (1988) as there is no major difference in the sensory equipments of different nymphal stages and adults of the ischnoceran phthiraptera, *Goniocotes*.

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