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EGGSHELL MORPHOLOGY OF SELECTED INDIAN BIRD LICE (PHTHIRAPTERA: AMBLYCERA AND ISCHNOCERA)[1]

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ABSTRACT: Microtopography of the eggshell of eight phthirapteran species infesting different avian hosts was studied by SEM. Nature of the markings present on the egg chorion of species studied was compared to the eggshells of already described species. It was found that the markings present on the egg cases of avian lice could be used to differentiate the genera and species. The occurrence of *Goniocotes jirufti* and *Menacanthus kalatitar* on brown partridges is noted for the first time.

KEYWORDS: Phthiraptera, Ischnocera, Amblycera, eggshell, microtopography, India, bird lice

The eggshells of avian Phthiraptera are polymorphic. Balter (1968 a, 1968b) indicated the role of egg morphology as a guide to louse taxonomy and recommended the use of SEM for this purpose. Since then, selected workers have recorded the microtopography of eggshells of few lice (Bilinski and Jankowska, 1987; Castro et al., 1996; Zawadzka et al., 1997; Saxena et al., 2000; Gupta et al., 2004; Beg et al., 2004; Kumar et al. 2004, 07). A list of avian Phthiraptera examined by the authors has been given in Table 1. In this report, we attempt to study the eggshells of eight species of phthirapterans whose eggs have not been studied previously via SEM to assess the possible role of egg morphology, as a guide to louse taxonomy in these species.

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Table 1. List of avian Phthiraptera already investigated to record the egg morphology with the help of SEM.

Host Bird	Species of Lice	References
Columba livia, Gmelin	*Columbicola columbae* (L., 1758)	Balter, 1968b; Zawadzka et al., 1997; Saxena et al., 2000
	Companulotes bidentatus compar (Burm., 1838)	Saxena et al., 2000
	Colpocephalum turbinatum (Denny, 1842)	Saxena et al., 2000
	Hohorstiella lata (Piaget, 1880)	Saxena et al., 2000
Gallus domesticus, L.	*Menacanthus stramineus* (Nitzsch, 1818)	Balter, 1968b; Bilinski and Jankowska, 1987; Zawadzka et al., 1997
	Uchida (= Menacanthus) pallidulus (Newmann, 1912a)	Zawadzka et al., 1997
	Menacanthus cornutus (Schommer, 1913)	Kumar et al., 2007
	Menopon gallinae (L. 1758)	Zawadzka et al., 1997
	Goniocotes gallinae (De Geer, 1778)	Zawadzka et al., 1997; Kumar et al., 2007
	Lipeurus caponis (L., 1758)	Kumar et al., 2004
	Lipeurus tropicalis (Peters, 1931b)	Kumar et al., 2004
	Lipeurus heterographus (Nitzsch, 1866)	Kumar et al., 2004
Phasianus colchicus, L.	*Lipeurus maculosus* (Clay, 1938b)	Zawadzka et al., 1997
	Amyrsidea megalsoma (Overgaard, 1943)	Balter, 1968b
Aquila clanga, Pallas	*Falcolipeurus suturalis* (Rudow, 1869b)	Balter, 1968b
Falco tinnunculus, L.	*Laemobothrion tinnunculi* (L., 1758)	Balter, 1968b
Bucorvus leadveateri, Vigors	*Bucerophagous africanus* (Bedford, 1929)	Balter, 1968b
Corvus splendens, Vieillot	*Menacanthus gonophaeus* (Burm., 1838)	Beg et al., 2004
	Myrsidea bakttitar (Ansari, 1951)	Beg et al., 2004
	Allocolpocephalum fregili (Denny, 1842)	Beg et al., 2004
	Philopterus lahorensis (Ansari, 1955b)	Beg et al., 2004
	Corvonirmus saliemi (Ansari, 1957d)	Beg et al., 2004
Amandava amandava, L.	*Brueelia amandavae* (Rekasi and Saxena, 2005)	Gupta et al., 2004
	Myrsidea amandava (Clay, 1970b)	Gupta et al., 2004

METHODS

Eggshells of three ischnocerans [*Lipeurus tropicalis* Peters, 1931 (infesting guinea fowl, *Numida meleagris*), *Goniocotes jirufti* Ansari, 1947 (infesting brown partridge, *Francolinus podicerianus*), *Brueelia cyclothorax* (Burmeister, 1838) (infesting house sparrow, *Passer domesticus*)] and five amblyceran species [*Holomenopon maxbeieri* Eichler, 1954 (parasitizing mallard duck, *Anas platyrhynchos*), *Trinoton querquedulae* (L., 1758) (parasitizing mallard duck), *Menacanthus kalatitar (*Ansari, 1951) (infesting brown partridge), *Myrsidea invadens* (Kellogg and Chapman, 1902) (infesting common myna, *Acridotheres tristis*), and *Menacanthus abdominalis* (Piaget, 1880) (infesting grey quail, *Coturnix coturnix*)] were subjected to SEM, for comparing the morphological features. The occurrence of *G. jirufti* and *M. kalatitar* on brown partridges is noted for the first time. The eggs of all the aforesaid species were collected from their respective hosts in district Rampur (U.P., India). Feathers bearing live eggs were gently cut from the host body.

Fresh eggs were teased out with the help of extremely sharpened entomological pins. For light microscopy studies, eggs were dehydrated (ethanol series, from 40% to 100%, 30 min. in each solution), cleared (pure clove oil (20-22 hrs.)) and mounted (DPX) following routine procedures (Palma, 1978). For scanning electron microscopy studies, the eggs were fixed in 3% gluteraldehyde (12 hrs.) and postfixed in 0.2M phosphate buffer (24 hrs., a few eggs were treated with OsO_4, 1 hr., (Sushila and Das, 1988), arranged on aluminum stubs, which were covered with double sided cellotape, gold coated, and examined under SEM (Mode Leo 435 VP SEM).

RESULTS

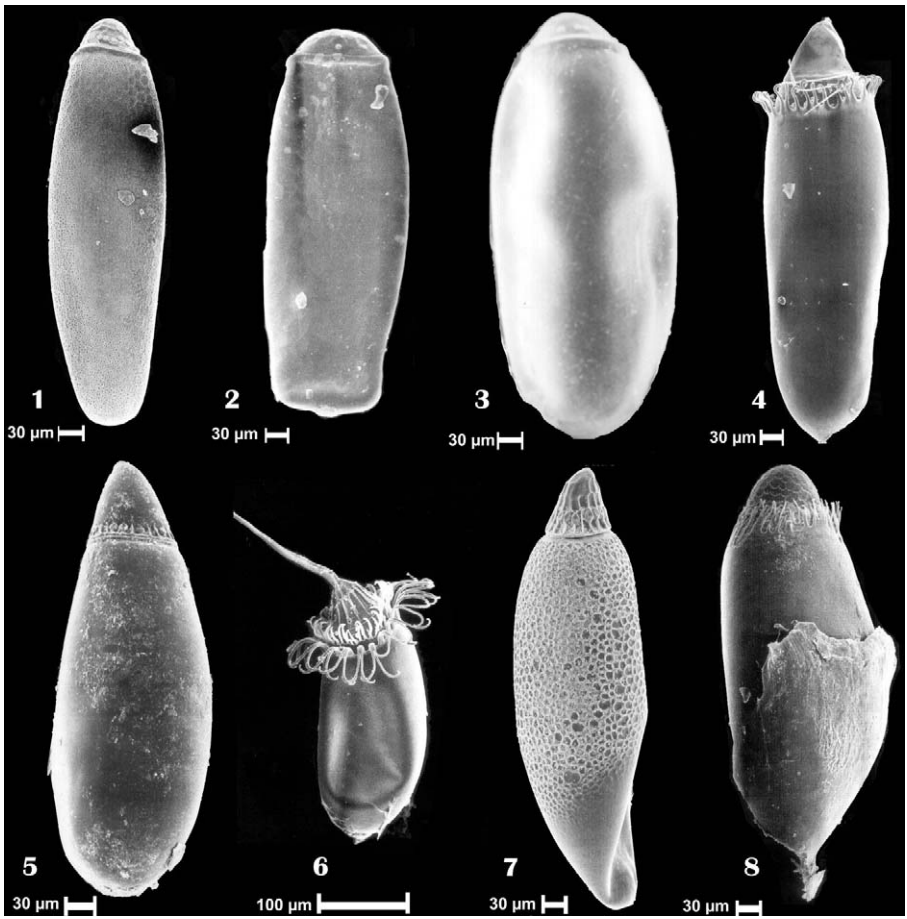
Zawadzka et al. (1997) has already provided a schematic representation of generalized phthirapteran eggshell. According to them, phthirapteran eggshell comprises of three basic components –1. operculum (disc covering the egg mouth), 2. main eggshell (covering the lateral aspects of oocyte) and 3. a hydropyle / stigma, located at the rear end of the eggshells. Minute apertures (located inside conical protuberances) found generally along the rim of opercular disc are termed as “micropyles” (meant for the entry of sperms / ventilation). The apical end of an opercular disc often leads to a tapering rod-like filament, termed polar thread / opercular projection. The main eggshell of certain phthirapteran species is generally equipped with variously shaped bristles, called apophyses (presumably meant for the attachment). The stigma / hydropyle occurring at the rear end of the eggshell stands for uptake of water / attachment.

The shape, size, nature of markings on egg cases, nature of operculum (including the number and disposition of micropyles) and the stigma of the studied species is summarized in Table 2.

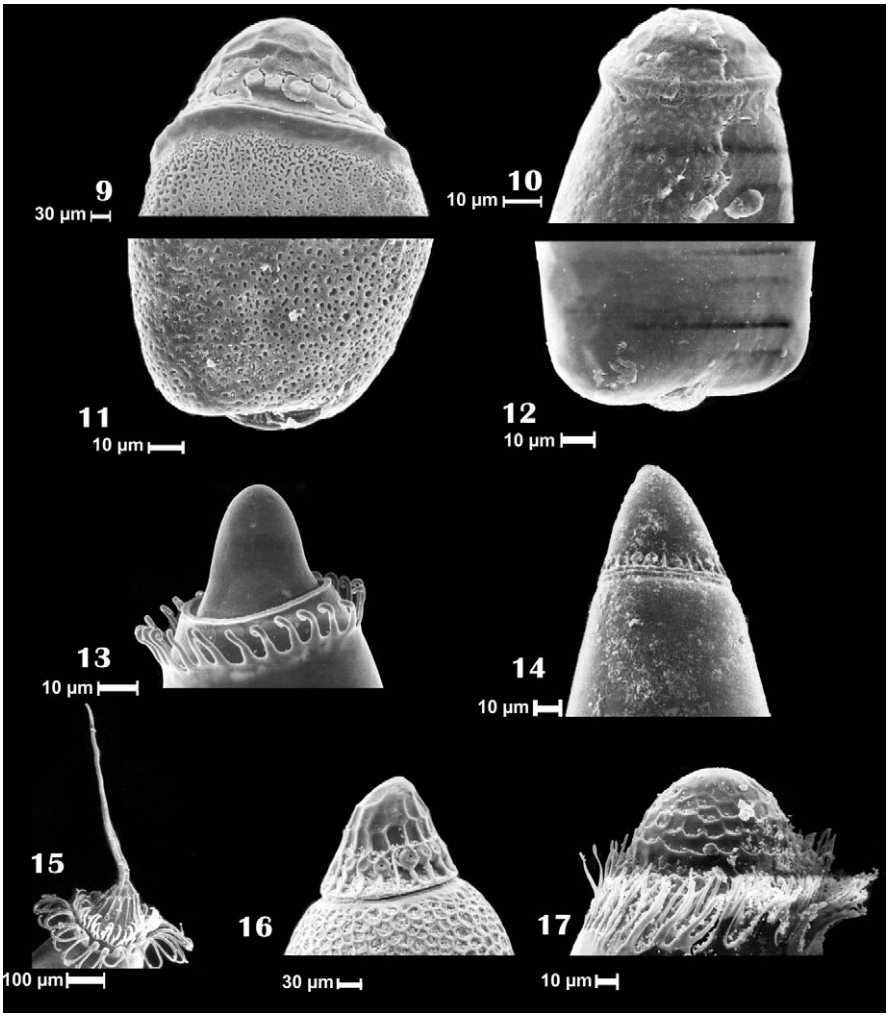
Table 2. The egg morphology of eight avian Phthiraptera. Measurements (given parenthetically) in mm.

	Main Eggshell			Operculum				
Species of Lice	**Shape/Size (length; width)**	**Markings**	**Apophyses**	**Shape**	**Polar thread (length)**	**Markings**	**Micropyles (diameter)**	**Stigma**
Lipeurus tropicalis	rice grain (0.94-0.96 0.26-0.28)	faint hexagonal ridges, pitted appearance	absent	hat shaped	absent	faint hexagonal ridges, except the apical end	18-20, closely set, arranged in single row (0.010-0.012)	beehive like
Goniocotes jirufti	ovoid (0.40-0.45, 0.15-0.17)	smooth	absent	dome shaped	absent	faint hexagonal marks	4-6, small (0.006-0.008)	beehive like
Brueelia cyclothorax	rice grain (0.50-0.55; (0.22-0.26)	smooth	24-26 short, tapering, terminally bent	dome shaped	absent	absent	8-10, small irregularly placed (0.004-0.005)	beehive like
Holomenopon maxbeieri	rice grain (0.60-0.80; 0.22-0.26)	smooth	absent	hat shaped	absent	absent	indistinct	
Trinoton querquedulae	oval (0.90-1.0; 0.20-0.30)	smooth	two rows near apical end; apophyses belonging to	conical	absent	absent	9-12, separated by vertical ridges (0.011-0.012)	

			outer row apically bifid and hang outwards					
Menacanthus kalatitar	oval (0.90-1.0) (0.20-0.24)	pitted near apical	absent	conical	long tapering thread (0.40-0.45)	distinct hexagonal ridges arranged in 2 tiers	8-10, small (0.007-0.008)	
Myrsidea invadens	ovoid (0.69-0.71; 0.28-0.30)	anterior 34th portion bears polygonal ridges	40-50 small filament like apophyses arranged in 2 rows	dome shaped	absent	few hexagonal ridges (2 tiers)	16-18, separated by vertical ridges (0.017-0.02)	rosette like
Menacanthus abdominalis	oval (0.76-0.78; 0.25-0.29)	smooth, heavily concealed with cementing material at the base		dome shaped	absent	distinct wave like ridges	18-20 closely set (0.009-0.011)	



Figures 1-8. Egg of several species of Indian Phthraptera: 1. *Lipeurus tropicalis*. 2. *Goniocotes jirufti*. 3. *Brueelia cyclothorax*. 4. *Holomenopon maxbeieri*. 5. *Trinoton querquedulae*. 6. *Menacanthus kalatitar*. 7. *Myrsidea invadens*. 8. *Menacanthus abdominalis*. Not all debris could be removed from eggs occasionally causing the electronic phenomenon known as charging.



Figures 9-17. Ends of eggs of several species of Indian Phthraptera: 9. *Lipeurus tropicalis,* apical end. 10. *Goniocotes jirufti,* apical end. 11. *Lipeurus tropicalis*, distal end. 12. *Goniocotes jirufti*, distal end. 13. *Holomenopon maxbeieri,* apical end. 14. *Trinoton querquedulae,* apical end. 15. *Menacanthus kalatitar,* apical end. 16. *Myrsidea invadens*, apical end. 17. *Menacanthus abdominalis,* apical end.

The eggs of *L. tropicalis*, *B. cyclothorax* and *H. maxbeieri* appear as rice grains (Figs. 9, 11, and 12). The eggshells of *G. jirufti* and *M. invadens* are ovoid while those of *T. querquedulae, M. kalatitar* and *M. abdominalis* are oval shaped (Figs. 10, 13-17). The eggshells of all the eight species, taken for the study, exhibit a lot of difference. Egg chorion of *L. tropicalis, G. jirufti, B. cyclothorax* and *T. querquedulae* is smooth and lacks apophyses. In case of *H. maxbeieri*, the apical end of the egg chorion gives out a row of 24-26 short, tapering bent apophyses extending up to the opercular rim (Fig. 13). In *M. abdominalis*, the egg mouth bears 40-50 small filaments like apophyses, which are arranged in 2 rows (Fig. 17). Apophyses belonging to the outer row are divided while the inner ones are undivided. *M. kalatitar* bears pitted egg chorion, and the apical end is beset with 2 rows of apophyses (Fig. 15). Apophyses belonging to the outer row are apically bifid and hang outwards, giving the eggshell a lotus-like appearance while those belonging to the inner row are quite small, undivided and remain inclined towards the inner side. The opercular disc of the eggs of two species (*L. tropicalis* and *H. maxbeieri*) is more or less a hat-shaped structure (Figs. 9 and 13), that of *T. querquedulae* is nearly conical (Fig. 14), while those of the other 3 species (*G. jirufti, M. invadens*, and *M. abdominalis*) are dome-shaped (Figs. 10, 16, and 17). The operculum of all the aforesaid seven species is devoid of the polar strand. On the other hand, the operculum of *M. kalatitar* is conical, bearing a long tapering polar thread (Fig. 15). The stigma/hydropyle of *L. tropicalis* and *G. jirufti* appears as a honeycomb-like structure (Figs. 11 and 12).

DISCUSSION

Kumar et al. (2004) have recorded the nature of the eggshells of 3 species of genus *Lipeurus* (*L. tropicalis, L. caponis* and *L. heterographus*) infesting poultry birds, *Gallus gallus domesticus*. The eggshell of *L. tropicalis* collected from guinea fowls (*N. melagris*) does not exhibit any dissimilarity from the egg of the tropical hen louse, *L. tropicalis*. The eggshell of brown partridge louse, *G. jirufti appears* broader than that of the poultry fluff louse, *G. gallinae*, described by Kumar et al. (2007). Furthermore, the egg mouth of *G. gallinae* is raised in the form of a thick ridge, and the opercular disc bears hexagonal markings.

The egg of the house sparrow louse, *B. cyclothorax* has a rice grain-like structure without chorionic specialization. Gupta et al. (2004) have described the eggshell of *Brueelia amandavae*, infesting red avadavat (*Amandava amandava*). The conical operculum of the eggshell of the latter louse bears a short thick rod-like structure (polar thread) which ends in a flat disc. Furthermore, the opercular disc of *B. amandavae* bears 14-16 micropyles, which are unequally placed. Beg et al. (2004) have also noted that the eggshell of *Corvonirmus* (=*Brueelia*) *saliemi* carries 14-16 micropyles arranged along the opercular rim. In comparison to the 2 aforesaid species of *Brueelia*, the egg mouth of *B. cyclothorax* is raised in the form of a ridge, and the opercular disc contains only 8-10 micropyles.

The eggshell of *H. maxbeieri* (mallard duck louse) provides an altogether different look. The operculum is nearly hat-shaped and appears to be sunken at the

egg mouth. The chorionic wall bears one row of short thick terminally bent apophyses. The eggshell of any other species of *Holomenopon* has not so far been studied.

The light microscopic structure of the eggs of *Trinoton anserinum* (infesting *Anser anser*) has been noted by Blagovestchensky (1955). The opercular disc of *T. anserinum* is flatter and obliquely placed over the egg mouth. On the other hand, the operculum of *T. querquedulae* (mallard duck louse) is nearly conical in appearance and the vertical ridges separate the micropyles.

The nature of the eggshell of the red avadavat louse, *Myrsidea amandava* (Gupta et al., 2004) and crow louse, *M. bakttitar* (Beg et al., 2004) is already known. The conical opercular disc of the common myna louse, *M. invadens* lacks polygonal ridges at the apical region. In the case of *M. bakttitar*, the complete opercular disc bears distinct hexagonal marks. On the other hand, the egg chorion of *M. invadens* lacks pentagonal ridges and bears a pitted appearance.

The eggshells of certain species belonging to genus *Menacanthus* have been extensively studied e.g. poultry shaft louse, *M. stramineus* (Balter, 1968b; Zawadzka *et al.*, 1997; Bilinski and Jankowska, 1997), *M. pallidulus* (Zawadzka et al., 1997), *M. cornutus* (Kumar et al., 2007) and *M. gonophaeus* (Beg et al., 2004). The egg's opercular disc of the four species of *Menacanthus*, studied thus far, bear a distinct polar thread and the anterior end of the egg chorion carries numerous threadlike apophyses. In the case of *M. stramineus*, numerous threadlike apophyses hang out of the anterior 1/4 portion of the eggshell (not arranged in layers). Structural details of the eggs of *M. pallidulus* have not been provided. Eggshells of two species (*M. cornutus* and *M. kalatitar*) resemble each other to a great extent (except the difference in size), as the egg mouth is provided with two rows of apophyses. In case of *M. cornutus*, the rim of egg mouth is provided with 2 rows of apophyses, while in the case of *M. gonophaeus*, the anterior half of the eggshell bears numerous apophyses (bristles) arranged in definite layers. The opercular disc of the grey quail louse, *M. abdominalis* lacks a polar thread and bears wave like ridges. The egg mouth is fringed with 2 rows of small thicker apophyses. Thus, present study further confirms that the markings present on the egg cases are species specific and can be used to differentiate the genera and species.

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