External egg morphology of common stored-product pests from the families Anobiidae (Ptininae) and Dermestidae (Coleoptera)

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Abstract

External egg morphology of some common stored-product pests from the families Anobiidae (*Ptininae*: *Ptinus*, *Niptus*) and Dermestidae (*Trogoderma*, *Reesa*) based on optical and scanning electron microscope (SEM) micrographs are presented. Diagnostic characteristics are described. Differences in the eggs of these families, genera and some species were found with respect to shape, size and surface structures.

Keywords: Egg morphology, SEM micrographs, Stored-product pest identification

1. Introduction

Some species from the family Anobiidae, subfamily Ptininae (*Ptinus*, *Niptus*) are common stored-product pests and can develop in a wide variety of substrates of both plant and animal origin (grain, seeds, drugs, dried insects and skin). These pests are frequently found in grain stores (Stejskal et al., 2003) and other locations such as mills, warehouses, museums and households. They are classified as secondary pests, but under optimal conditions, they can build up large populations, e.g., *Niptus hololeucus* (Faldermann) (Weidner, 1982). These pests are known to infest and develop in pet food and also in rodent baits (Stejskal et al., 1994). Their natural habitats include bird nests, animals and insects, which can be the source of stored commodity infestations if they are in the vicinity of the stores. Dermestid beetles from the genera *Trogoderma* and *Reesa* are stored-product pests that mainly damage stored grain and seed, but are also associated with other dried materials of plant or animal origin (Stejskal and Kučerová, 1996; Rees, 2004). The most important pest is *Trogoderma granarium* Everts, formerly classified as a quarantine species (Stuart et al., 1993; Stejskal and Kučerová, 1996).

In spite of the fact that the identification of adults and larvae is difficult, descriptions for diagnostic purposes are available for many species from the aforementioned families (Weidner, 1982; Gorham, 1991; Peacock, 1993; Rees, 2004). There are no data that include descriptions of the eggs of these organisms. Rather, the descriptions consist of brief notes without SEM micrographs of select species from these genera, as reported by Le Cato and Flaherty (1974). Therefore, the aim of this paper is to present preliminary results of the measurements and external morphology of the eggs based on detailed microscopic examination to enable better identification of these most common stored product species in the Czech Republic from above mentioned genera.

2. Materials and methods

Studied species were reared at one of the following two conditions: 20ºC and 75% relative humidity (r.h.) on a mixture of whole and ground wheat, wheat germ, yeast, oak flakes and granular dog food (Ptininae), or 25ºC and 75% r.h. on a mixture of ground wheat, yeast and oak flakes (Dermestidae). Isolated females were allowed to oviposit in small containers (4 cm deep, 3 cm inner diameter) containing a small amount of food. Eggs were collected with a brush, gently cleaned in a drop of distilled water and used for optical microscopic examination (stereomicroscope Nikon SMZ 800 – Nikon spol. s.r.o., Prague, Czech Republic, Axioscope Zeiss – Carl Zeiss spol. s.r.o., Prague, Czech Republic). Size measurements were taken using a light microscope with an objective micrometre. A minimum of 30 eggs were measured for each species. Measurements taken included length (L), width (W) and L/W ratio of eggs. The eggs used for scanning electron microscopy were placed on stubs covered with double-sided sticky tape and sputter-coated with platinum in a Sputter Coater (model SDC 050 – Balzers s.r.o., Prague, Czech Republic). The egg surface (chorion) was then studied with a JSM 6400 (JEOL (Europe)

S.A., Prague, Czech Republic) scanning electron microscope (SEM) at magnifications of 200 to 20,000 x. Approximately 10-30 eggs were examined with the SEM for each species.

3. Results

The dimensions (µm) of the eggs studied are shown in Table 1.

Table 1 The size dimensions (mean ± S.D.) of eggs (µm).

Ptininae:	**Length (L)**	**Width (W)**	**L/W ratio**
Ptinus fur	546 ± 23	361 ± 22	1.52 ± 0.15
Ptinus tectus	437 ± 22	303 ± 18	1.45 ± 0.11
Niptus hololeucus	638 ± 43	474 ± 27	1.35 ± 0.10
Dermestidae:			
Trogoderma granarium	592 ± 40	251 ± 38	2.37 ± 0.23
Trogoderma glabrum	584 ± 47	236 ± 13	2.49 ± 0.28
Reesa vespulae	698 ± 49	247 ± 7	2.82 ± 0.18

3.1. Family Anobiidae (subfamily Ptininae = formerly family Ptinidae)

Ptinus fur L.: The shape of the eggs is irregular oval, considerably variable (Fig. 1a), with one end sometimes moderately or distinctly pointed (Fig. 1b). The eggs are opaque white in colour. Microstructures are formed from irregular dome-shaped protuberances that densely cover the entire surface of the eggs (Fig. 1c). Micropyles and aeropyles were not observed on the egg surface.

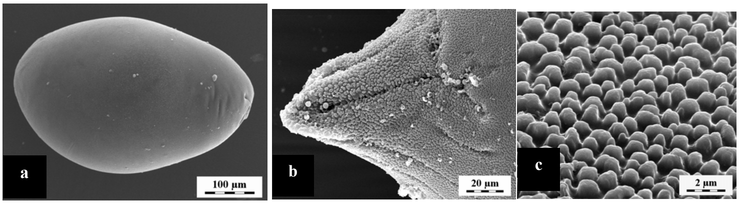

Figure 1 *Ptinus*: a) entire egg, ; b) end of the egg; c) surface structure.

Ptinus tectus Boieldieu: Egg shape is irregular oval (Fig. 2a) with more-or-less rounded ends (Fig. 2b). The eggs are opaque white in colour. Microstructures are composed of irregular dome-shaped protuberances that cover the entire surface of the eggs, but they are markedly larger and less dense at the posterior end (Fig. 2c). On the top of the same end, there is also a slightly visible area with 5 - 6 hollows, which resemble micropyle openings (Fig. 2d).

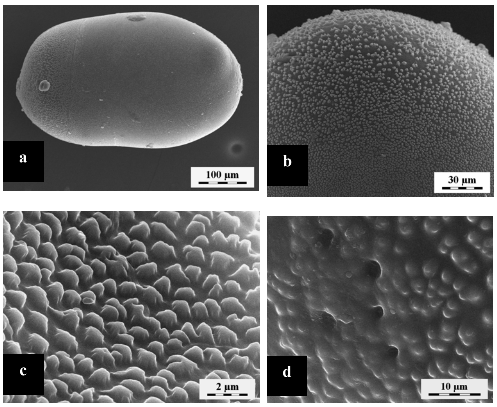

Figure 2 *Ptinus tectus*: a) entire egg; b) posterior end of the egg; c) surface structure; d) detail of the top of posterior end.

<u>*Niptus hololeucus* (Faldermann)</u>: Egg shape is oval to broadly ovoid (Fig. 3a) with both ends rounded (Fig. 3b). The eggs are opaque white in colour. The entire surface of the egg is covered with rugged, pointless protuberances of uniform density (Fig. 3c). Micropyles and aeropyles were not observed on the egg surface.

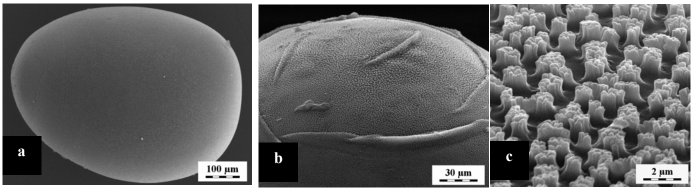

Figure 3 *Niptus hololeucus*: a) entire egg; b) end of the egg; c) surface structure.

3.2. Family Dermestidae

<u>*Trogoderma granarium* Everts</u>: The shape of the eggs is cylindrical (Fig. 4a). One end is usually moderately broader and terminated with fraying fibres (Fig. 4b). The eggs are creamy white in colour. The chorion surface is slightly wrinkled and has a microstructure created by longitudinal protruding ridges (Fig. 4c). Micropyles and aeropyles are absent on the egg surface.

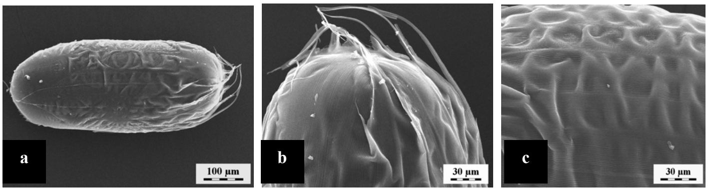

Figure 4 *Trogoderma granarium*: a) entire egg; b) end of the egg; c) surface structure.

<u>*Trogoderma glabrum* Herbst</u>: The general appearance of these eggs, including chorion structures (Fig. 5c), is similar to T. granarium, however, the shape is on average more elongate with slightly tapering ends (Fig. 5a,b).

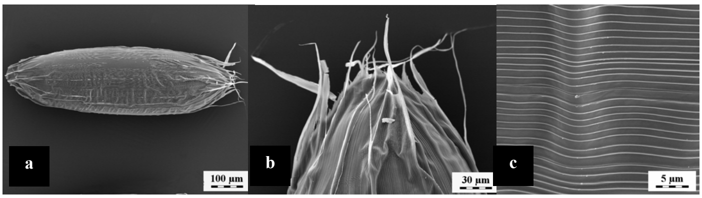

Figure 5 *Trogoderma glabrum*: a) entire egg; b) end of the egg; c) surface structure.

<u>*Reesa vespulae* Milliron</u>: The egg shape is cylindrical (Fig. 6a) with slightly tapering ends. One end is terminated with fraying fibres. (Fig. 6b). The eggs are opaque creamy white in colour. The chorion surface is wrinkled and microstructures create longitudinal protruding ridges, similar to Trogoderma spp. (Fig. 6c). Micropyles and aeropyles are absent on the egg surface.

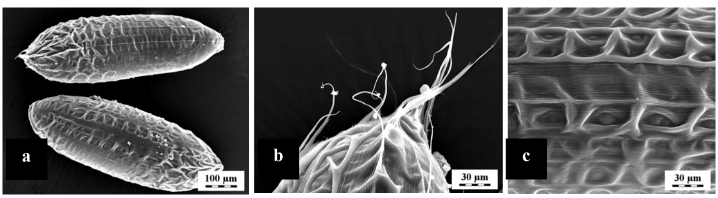

Figure 6 Reesa vespulae: a) entire egg; b) end of the egg; c) surface structure.

4. Discussion

The diagnostic characteristics reported here enable the accurate differentiation between eggs of both studied groups (ptinids and dermestids) through comparisons of their shape, size (L/W ratio) and surface structures (Table 2). Significant differences among studied species from the subfamily Ptininae were detected with respect to egg size and the character and density of surface microstructures. The egg shape is less useful for differentiating species, because of its considerable variability. Identifying both *Trogoderma* species is not consistently possible; the size measurements overlap and surface structures look similar. *Ressa vespulae* eggs are significantly larger than *Trogoderma* species eggs, but surface microstructures are considerably similar. The openings facilitating sperm penetration (micropyles) and respiration (aeropyles), which are frequently present in the insect chorion (Chapman, 1998; Kučerová, 2002) and provide useful taxonomic characters, were not found in the eggs studied (except possibly in the case of P. tectus).

Table 2 Morphological egg differences between families.

Family	Egg shape	Surface microstructure
Anobiidae (Ptininae) (*Ptinus, Niptus*)	Irregular oval to ovoid with rounded or one end pointed, quite variable	Surface covered with dome-shaped or rugged protuberances
Dermestidae (*Trogoderma*, *Reesa*)	Cylindrical with more or less rounded or slightly tapering ends, one end usually terminated with fraying fibres	Surface wrinkled with longitudinal protruding ridges

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