



Anais da Academia Brasileira de Ciências

ISSN: 0001-3765

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Academia Brasileira de Ciências
Brasil

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Anais da Academia Brasileira de Ciências, vol. 87, núm. 3, 2015, pp. 1763-1770
Academia Brasileira de Ciências
Rio de Janeiro, Brasil

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**Abdominal macrochaetae of female *Hylesia oratex* Dyar,
1913 (Insecta: Lepidoptera: Saturniidae):
external morphology and medical significance**

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Manuscript received on April 12, 2013; accepted for publication on January 19, 2015

ABSTRACT

The representatives of the genus *Hylesia* Hübner, [1820] are significant among the medically important Lepidoptera. Adult females use abdominal setae to wrap and protect the eggs that remain for months in nature. These setae, in contact with human skin, may cause allergic reactions including swelling, itching and local erythema, known as lepidopterism. The morphology of the abdominal scales and setae from the female *H. oratex* Dyar, 1913 is herein described and aspects related to their medical significance are discussed. Portions of each abdominal segment were examined through a scanning electron microscope. Two types of scales without medical importance, and two types of setae with medical importance, classified as "true setae" and "modified setae" were found. The true setae, which are slightly fusiform and have radially arranged lateral projections, are responsible for the allergic reactions caused by skin penetration. The modified setae, which are larger, curved, with the median enlarged and serrated margins, can be responsible for the release of chemical substances. This information provides a better understanding of the structure of the urticating setae, which are responsible for lepidopterism outbreaks in humans, and contributes towards the identification of the moth species involved.

Key words: allergic outbreaks, lepidopterism, morphology, urticating moths.

INTRODUCTION

Butterflies and moths belong to one of the largest orders of insects (Lepidoptera), known and admired

worldwide because their diversity. A small number of species in this order is known to cause injuries to humans by direct contact with the larval form or by indirect contact with the adult (Hossler 2010a). The exclusively neotropical moths of the genus

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Hylesia Hübner [1820], receive significant medical attention due to their females which bear urticating setae that come off the abdomen, causing several outbreaks of dermatitis (Haddad and Cardoso 2003, Hossler 2009, 2010a, b, Polar et al. 2010, Battisti et al. 2011). Once an urticating seta penetrates into the tissue, it may cause skin reactions, persisting for hours or days and resulting in swelling, itching and local erythema, known as lepidopterism, and ultimately forms pruritic plaques, causing fever and malaise (Battisti et al. 2011). Epidemic outbreaks of dermatitis have been reported in Mexico, Venezuela, Guyana, Peru, Argentina, and in some Brazilian states such as Amapá, Bahia, Minas Gerais, São Paulo and Rio Grande do Sul. However, there are very few publications that deal with this phenomenon (Gusmão et al. 1961, Mascarenhas et al. 1980, Glasser et al. 1993, Iserhard et al. 2007, Moreira et al. 2007).

Battisti et al. (2011) classified the "urticating hairs" of arthropods into three categories: true setae, modified setae and spines. The first is characterized by the loss of its neural connection and by the detachment of its integument at the proximal end. The second is characterized by its robust base and connection with the integument, while its neural connection is lacking. However, another type of cell is connected to the scale and hypothetically has a secretory function. The latter has a more complex structure and can be considered as a structure formed from the integument, involving a large number of specialized cells with a sensory function. True setae have been recorded in *Hylesia* females (Battisti et al. 2011). Kristensen and Simonsen (1998) attributed the term "macrochaetes" for bristles or setae and scales present in Lepidoptera. Another possible classification for the macrochaetes was proposed by Rodriguez et al. (2004), who, based on *H. metabus* (Cramer, 1775), classified them as S1, S2, S3, S4, with only the last two being urticating.

Hylesia oratex Dyar, 1913 occurs within Brazil, in the states of Goiás, Rio de Janeiro, São Paulo,

Paraná, (D'Abrera 1995, Lemaire 2002, Borges et al. 2003), Santa Catarina (Lima 1947), and Rio Grande do Sul (Corseuil et al. 2002, Specht et al. 2005), in addition to being found in Paraguay and Argentina (Köhler 1931). It is known that its larvae feed on "erva mate" leaves (*Ilex paraguariensis* St. Hill. - Aquifoliaceae) (Lima 1947) and, as in *H. nigricans* (Berg 1876), form collective silk shelters by joining leaves (Specht et al. 2006). Female *H. oratex*, as well as in other species of the genus, also bear urticating setae used to surround their eggs for protection, unlike males that lack these structures in their bodies (Rodriguez et al. 2004). Lamy and Lemaire (1983) reported the setae as corresponding to the type S3 described by Rodriguez et al. (2004), indicating the possibility of using their morphology for species level identification of *Hylesia* representatives. However, *H. oratex*'s setae were not included in the Lamy and Lemaire (1983) study, so the knowledge of this species is limited, especially with respect the types and morphology of macrochaetes including their clinical significance, which lack detailed information regarding. Thus, the main goal of this article is to describe the external morphology of the macrochaetes found on the abdomen of female *H. oratex*, relative to their medical significance in relation to humans.

MATERIALS AND METHODS

H. oratex (Figs. 1a and 1b) were obtained from an egg mass collected in nature at Anta Gorda, Rio Grande do Sul, on a branch of "erva-mate", and taken to the laboratory in order to obtain adults. The larvae were reared at the Laboratório de Entomologia in the Campus Universitário da Região dos Vinhedos, Universidade de Caxias do Sul, in a room at 25 ± 1 °C, $80 \pm 10\%$ RH, and 14h photo phase, and fed on "erva-mate" leaves until the emergence of adults. Adults were sacrificed by freezing (-17 °C). Samples were prepared and maintained in the laboratory collection and adults (five couples) were deposited in the Coleção Padre

Jesus Santiago Moure, in the Departamento de Zoologia at the Universidade Federal do Paraná, Curitiba, Paraná as voucher specimens. Abdomens were dissected to obtain samples of macrochaetes from the dorsal, ventral and lateral regions. Scales and setae of each region were removed and prepared for histological analysis using scanning electron

microscopy (SEM) at the Centro de Microscopia Eletrônica of the Universidade Federal do Rio Grande do Sul (CME-UFRGS/RS). All procedures were carried out according to the international practices for animals use and care under the control of an internal committee of the Universidade de Caxias do Sul, Brazil.

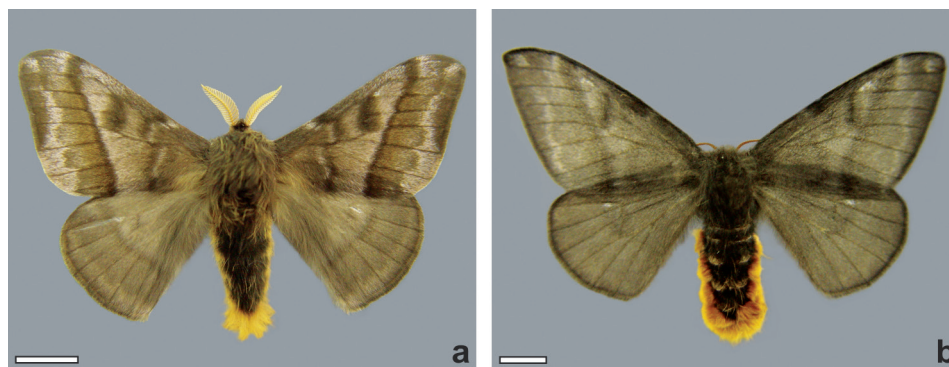


Figure 1 - *Hylesia oratex*. (a) male; (b) female (scale = 5 mm, respectively).

RESULTS

Only non-urticating scales are found on the dorsal region of the abdomen which can be divided into two types: filiform and spatulate scales. The filiform scales, corresponding to the seta S1 of Rodriguez et al. (2004), are filiform, cylindrical at the base, connected to the integument cuticle, and have a porous surface, with a length from 1000 to 2000 μ m (Figs. 2a-c). The spatulate scales, corresponding to the seta S2 of Rodriguez et al. (2004), have a narrow base which is connected to the integument, widening toward the apex with an undulated distal end with three, four or slightly more pointed projections, and, as the previous type, is porous and also shorter, ranging from 200 to 220 μ m (Figs. 2d-f).

The urticating setae can be divided into two types: the first, corresponding to the true setae of Battisti et al. (2011) and to the seta S3 of Rodriguez et al. (2004), are found on the ventral and lateral regions inserted into a socket. These setae are more abundant in the central and posterior portions. They are slightly fusiform and smooth with four

longitudinal grooves (Figs. 3a and 3c) measuring 120-130 μ m in length with a few lateral projections arising near the base, extending radially towards the apex (Fig. 3b). These projections are rounded and barb-like, varying in numbers from 20 to 25. The distal end of these setae are ornamented with a discrete groove, lacking pores or orifices (Fig. 3d). The second type of setae, corresponding to the modified setae of Battisti et al. (2011) and to the S4 setae of Rodriguez et al. (2004), are found bordering the ventral side, together with some filiform and spatulate scales. The central portion is wider than the base and apex, with a length of 1200 to 1400 μ m (Fig. 4a). The base contains conspicuous pointed projections directed towards the distal region (Fig. 4b), being carinated with serrated edges (Fig. 4c). The apex has a tubular and rounded shape with small orifices which may be used for secretion (Fig. 4d). In egg masses collected in the field, the presence of intermixed true setae and modified setae forming only one layer covering the egg mass (Figs. 5a and 5b) was observed. However, due to their larger size, the modified setae are more conspicuous in relation to the true setae.

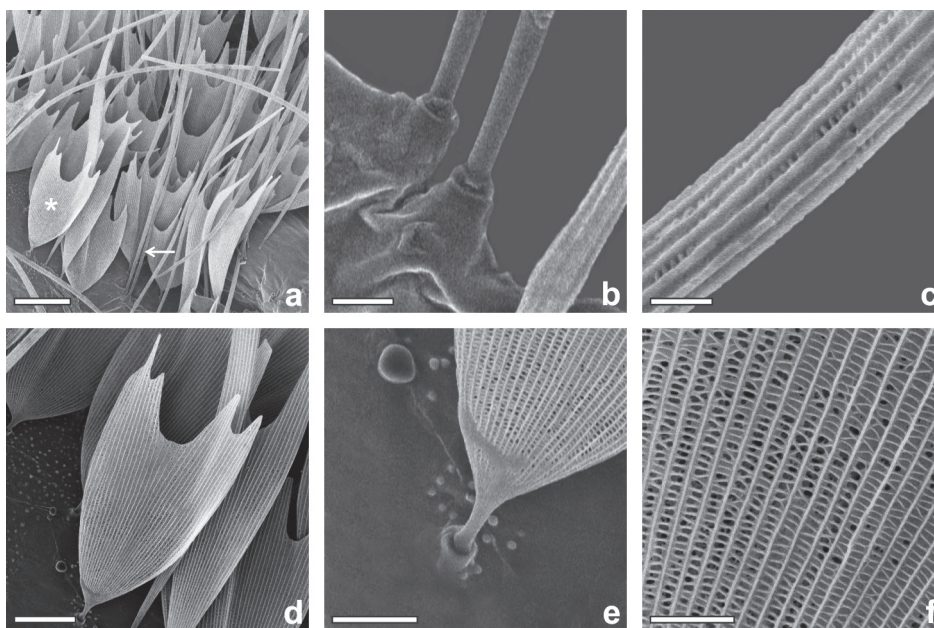


Figure 2 - Abdominal scales of the female *H. oratex*. **(a)** filiform and spatulate scales, an arrow indicates filiform and an asterisk indicates spatulate; **(b)** base of filiform scale; **(c)** median portion of filiform scale; **(d)** general view of spatulate scale; **(e)** base of spatulate scale; **(f)** medial portion of spatulate scale (scales = 100, 10, 5, 40, 20, 10 μm , respectively).

DISCUSSION

The filiform and spatulate scales (Fig. 2), especially those located in the dorsal portion of the abdomen of female *H. oratex*, were not considered urticating, due to their high porosity and lack of barb-like structures. Morphologically, these scales are very similar to the ones which cover other parts of *H. oratex*'s female body and have no medical importance, corresponding to the scales described by Rodriguez et al. (2004) for *H. metabus*.

The true setae found in *Hylesia* (Rodriguez et al. 2004, Specht et al. 2005, 2007, 2008, Hossler 2009, 2010a, b) correspond to those found in arthropods, such as spiders, and in larvae and adults of Lepidoptera (Battisti et al. 2011). Environmental or human factors are responsible for the release and/or detachment of the setae from the abdomen of the female, as they easily detach by mechanical stimulation (Novak et al. 1987). They are more likely to induce allergic reactions, which may cause recurrent dermatitis related to the

outbreaks of insects, affecting various parts of the body simultaneously (Hossler 2009). Consisting exclusively of chitin, wax and proteins, when the setae completely and abundantly penetrate the skin, they can trigger systemic symptoms and cause great discomfort, such as local itching, redness and swelling, while in rare cases they can lead to anaphylactic reactions (Battisti et al. 2011).

Upon comparing the true seta of *H. oratex* with other *Hylesia* species (Lamy and Lemaire 1983, Rodriguez et al. 2004), it was observed that the number of grooves are similar to the ones of *H. iola* Dyar, 1913, *H. lineata* Druce, 1886, *H. metapyrrha* (Walker, 1855), *H. annulata* Schaus, 1911, *H. ebalus* (Cramer, 1775), *H. gyrex* Dyar, 1913 and *H. tapareba* (Dyar, 1913). However, in *H. iola* and *H. lineata*, this seta does not have a fusiform shape. The number of barb-like structures on the true seta of *H. oratex* is similar to *H. metapyrrha*, while an apical groove was observed in all species studied by Lamy and Lemaire (1983). Differences and

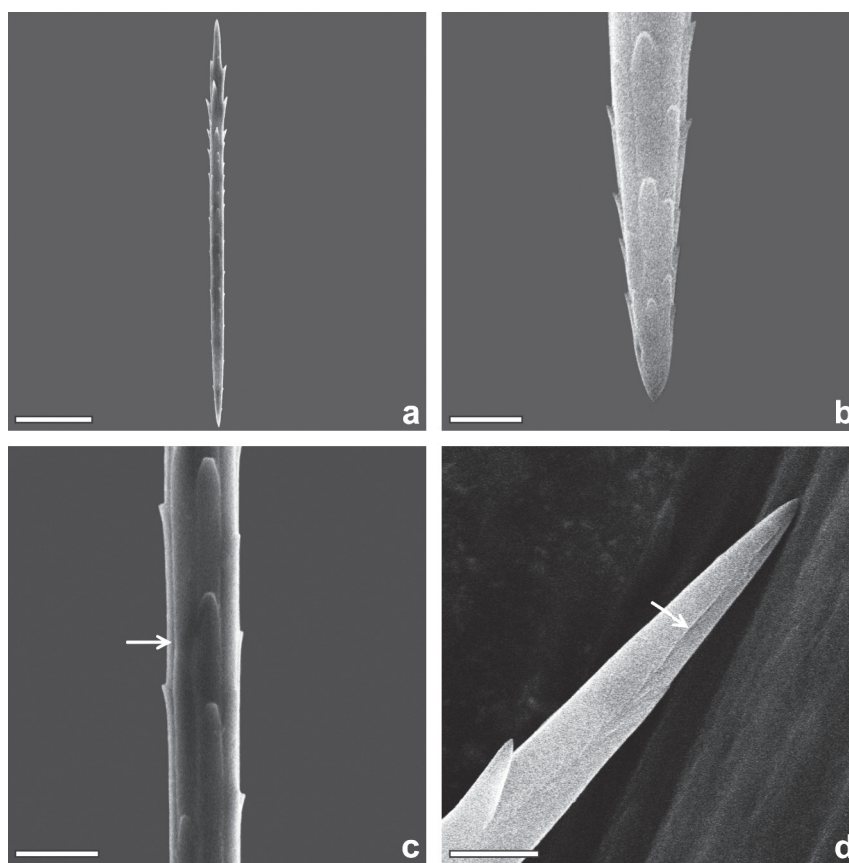


Figure 3 - True setae of the female *H. oratex*. **(a)** general view; **(b)** base; **(c)** medial portion, arrow indicates a longitudinal groove; **(d)** apex, arrow indicates the apical groove (scales = 25, 03, 05, 05 μm , respectively).

similarities among different true setae corroborate the idea of Lamy and Lemaire (1983) that this characteristic can be used for species identification based on the morphology of the true seta, which causes the dermatitis.

The modified seta is rigid and bears barb-like structures of various sizes around its base. This modified seta is present on the abdomen of female *H. oratex* at a much lower density than the true seta which agrees with the description by Battisti et al. (2011), reporting that its distribution is restricted to the edges of the "setae fields", covering the true setae.

Comparing the modified setae of *H. metabus* with *H. oratex*, it is possible to find similarities regarding their size and shape, especially with respect to the carinate margin and the base and apex

being narrower than the middle portion. However, a few slight differences can be identified among the species (*H. metabus* and *H. oratex*), such as the shape of the barb-like structures, where in *H. metabus* the apex of these barbs have a triangular shape while in *H. oratex* the apex of the barbs are rounded and their points are directed toward its distal end. Furthermore, the former bears an apex, which is thin and tube-like, and has a single opening, whereas the latter species bears a rounded tube-like apex, with several openings. The presence of these openings in both species indicates a probable excretion of chemicals for protective function. There is a possibility, as described by Rodriguez et al. (2004), that there is a cell with secretory function which connects these setae to the integument (Lundberg et al. 2007).

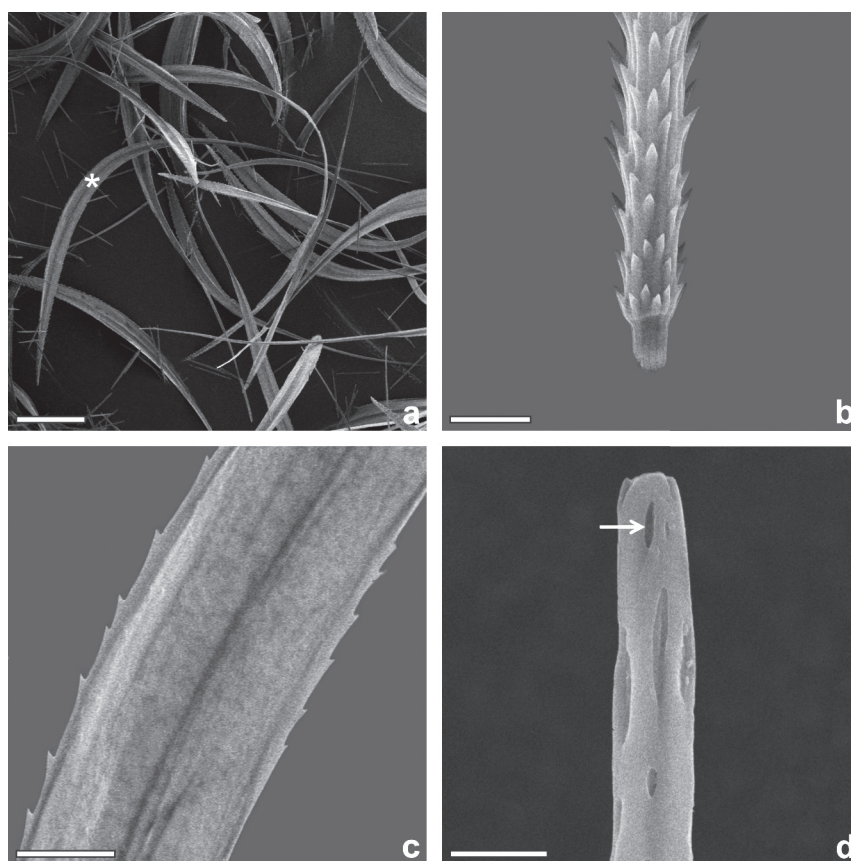


Figure 4 - Modified setae of the female *H. oratex*. **(a)** general view (asterisk); **(b)** pointed projections at base; **(c)** medial portion; **(d)** apex, arrow indicates apical orifices (scales = 200, 25, 10, 05 μm , respectively).

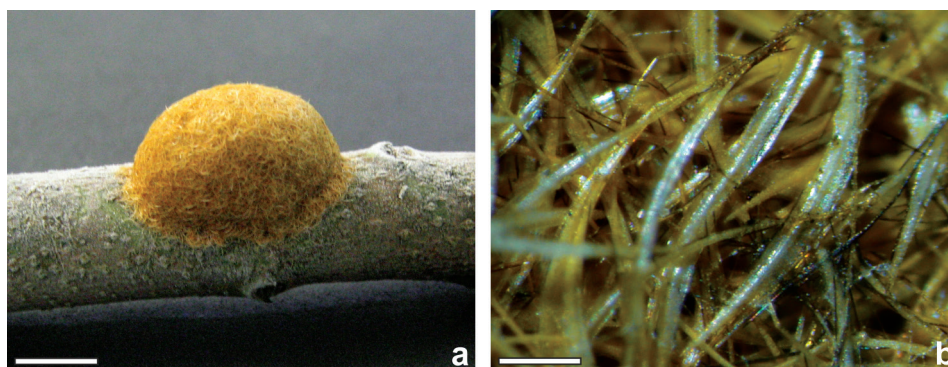


Figure 5 - Egg mass of *H. oratex*. **(a)** egg mass on a branch of the host plant; **(b)** detail of the layer composed of true and modified setae (scales = 5 mm; 200 μm , respectively).

True setae and scales were found in the lateral region of *H. oratex*, beyond the modified setae, while in *H. metabus* the modified setae were predominant (Rodriguez et al. 2004). Observing

the setae layer over the egg mass in *H. oratex*, the true setae and modified setae are mixed into a single layer, whereas in *H. metabus*, according to Rodriguez et al. (2004), the modified setae

are predominant. The way the true setae and the modified setae are used in the preparation of the egg masses, indicates a complex protective behavior against possible natural enemies (Lemaire 2002, Rodriguez et al. 2004, Specht et al. 2005, 2007).

Lepidopterism, as caused by *Hylesia* moths, does not involve direct contact with the moths, but rather the presence of setae in the environment (i.e. Salomon et al. 2005). In this case, most lepidopterism episodes should be attributed to contact with the true setae that are released in large quantities in anthropogenic environments, especially when the moths are flying abundantly towards light (i.e. Gusmão et al. 1961, Mascarenhas et al. 1980, Glasser et al. 1993, Salomon et al. 2005, Iserhard et al. 2007, Moreira et al. 2007, Polar et al. 2010). Because the modified setae are heavier and do not easily stand out from females abdomens, their participation as a lepidopterism agent is restricted to events in which patients come in contact with egg masses during manual disinfection of trees (Casalá et al. 1967). In this case, lepidopterism occurs by physical contact with the true setae and modified setae, and the possible contact with the irritating substance can be released by the modified setae (Battisti et al. 2011). The coexistence of both setae may lead to the true setae becoming somewhat "coated" with the secretion that may be released from the modified setae, thus resulting in the venomous action in addition to the mechanical one.

For both types of urticating setae described in this article, it is noteworthy that the treatment of lepidopterism should be done according to the symptoms encountered in the patient. However, the first step should be the complete removal of the setae present on the skin, using adhesive tape or fine forceps, and an immediate cleaning with water. The shape and structure of the true and modified setae which affect humans may be used to assist in the indication of *Hylesia* representatives associated with the dermatitis or the egg masses collected in the field, as suggested by Lamy and Lemaire (1983).

ACKNOWLEDGMENTS

The authors are grateful to the Electron Microscopy Center of the Universidade Federal do Rio Grande do Sul, Denis Santos da Silva and Maurício Moraes Zenker for his cooperation in preparing the images.

RESUMO

Os representantes do gênero *Hylesia* Hübner, [1820] estão entre os principais lepidópteros de importância médica. As fêmeas adultas usam cerdas abdominais para envolver e proteger seus ovos que podem permanecer por meses na natureza. Essas cerdas, em contato com a pele humana podem causar reações alérgicas incluindo inchaço local, coceira e eritema conhecido como lepidopterismo. A morfologia das escamas e das cerdas abdominais das fêmeas de *H. oratex* Dyar, 1913 é aqui descrita e aspectos relacionados à sua importância médica são discutidos. Porções de cada segmento abdominal foram examinadas através de um microscópio eletrônico de varredura. Dois tipos de escamas sem importância médica, e dois tipos de cerdas com importância médica, classificadas como "cerdas verdadeiras" e "cerdas modificadas" foram encontradas. As cerdas verdadeiras que são levemente fusiformes e têm projeções laterais dispostas radialmente, são responsáveis por reações alérgicas provocadas pela penetração na pele. As cerdas modificadas que são maiores, curvadas, com as margens medianas alargadas e serrilhadas podem ser responsáveis pela liberação de substâncias químicas. Essa informação fornece melhor compreensão da estrutura das cerdas urticantes, que são responsáveis por surtos de lepidopterismo em humanos, e contribui para a identificação das espécies de mariposas envolvidas.

Palavras-chave: surtos alérgicos, lepidopterismo, morfologia, mariposas urticantes.

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