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SCANNING ELECTRON MICROSCOPY OF *HYMENOLEPIS NANA* AND *H. DIMINUTA* FROM NATURAL INFECTIONS

By

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دراسة بالميكروسكوب الإليكتروني الماسح للدودتين الشريطيتين هيمينوليبس نانا وهيمينو ليبس ديمنيوتا من العدوى الطبيعية

أمـــين عاشـــــور

في هذا البحث تمت دراسة السطح الخارجي لنوعين من الديدان الشريطية هيمينوليبس نانا وهيمينو ليبس ديمنيوتا باستخدام الميكروسكوب الإلكتروني الماسح وقد وجد أن أسطح الجسم والممصات والرؤيس (Scolex) والقنة (Rostellum)كلها مغطاه بزوائد خيطية دقيقة ومتشابهة (ميكروتركس) . وقد لوحظ أن الزوائد التي تغطي الممصات أصغر حجماً من تلك التي تغطي أسطح الأسلات الناضجة من الجسم .

Key Words: Surface ultrastructure, *Hymenolepis nana* and *H. diminuta*.

ABSTRACT

The surface ultrastructure of two cestodes: *Hymenolepis nana* and *H. diminuta* was studied by scanning electron microscopy. The scolex, suckers, rostellum and strobila are all covered with dense populations of microtriches which are all of the same size and shape except on the scolex and suckers which are slightly more slender than those on the strobila. No regional differences were seen.

INTRODUCTION

Cestode surface has been the subject of much investigation in the last two decades. Since cestodes lack mouth or a digestive system they have a metabolically active surface through which nutrients can be absorbed and waste materials eliminated. Light microscope studies have revealed the presence of microtriches in the larval as well as in adult stages and that they are probably of universal occurrence (Jha and Smyth, 1969 and 1971, Lumsden, 1966 and Morseth, 1966).

Studies have also shown that the tegument is a complex living structure which is probably of great importance in the physiology of the worm. (Lumsden, 1966) suggested that cestode tegument may be involved in the synthesis and secretions of proteinaceous materials to the exterior of the worm.

Recently, scanning electron microscope (SEM) studies of cestode surface have shown that it provides a suitable technique for obtaining information regarding the three-dimensional relationship of surface structures. (Rothman, 1959 and 1963) reported that in *Hymenolepis diminuta* "the apical region of the scolex is devoid of microtriches or has very fine ones". Ubelaker, Allison and Specian, (1973), however, reported the presence of these microtriches on the scolex of *H. diminuta*.

Berger and Mettrick, (1971) using SEM compared the tegumental structures of three species of *Hymenolepis* and they reported the presence of microtrichoid polymorphism along the strobilar length in these species. Jha and Smyth, (1971) using transmission electron microscopy reported the presence of special branched microtriches on the scolex of *Hymenolepis diminuta*.

Ubelader, Allison and Specian, (1973) described the surface ultrastructure of *Hymenolepis diminuta* from experimental infections and they were unable to confirm the presence of any dimorphism in the microtriches. Andersen, (1975), using SEM compared the surface structure of adults and larva of three species of *Diphyllobothrium* and reported the presence of regional differrence in microthrix appearance in the larva, but not in the adult cestodes. He also reported that no microtrichoid polymorphism was observed in *Diphyllobothrium*.

Whittaker, *et al*, (1985), using SEM, reported the presence of microtriches of different sizes on scolices of the cestodes *Parachristianella monomegacantha* and *Phyllobothrim sp.*

In the present work, the surface topography of *H. nana* and *H. diminuta* is studied with SEM. The study is based on cestodes collected from naturally infected rats and mice.

MATERIALS AND METHODS

Adult *Hymenolepis nana* were found in naturally infected *Mus musculus* collected at Cairo. *H. diminuta* worms were also

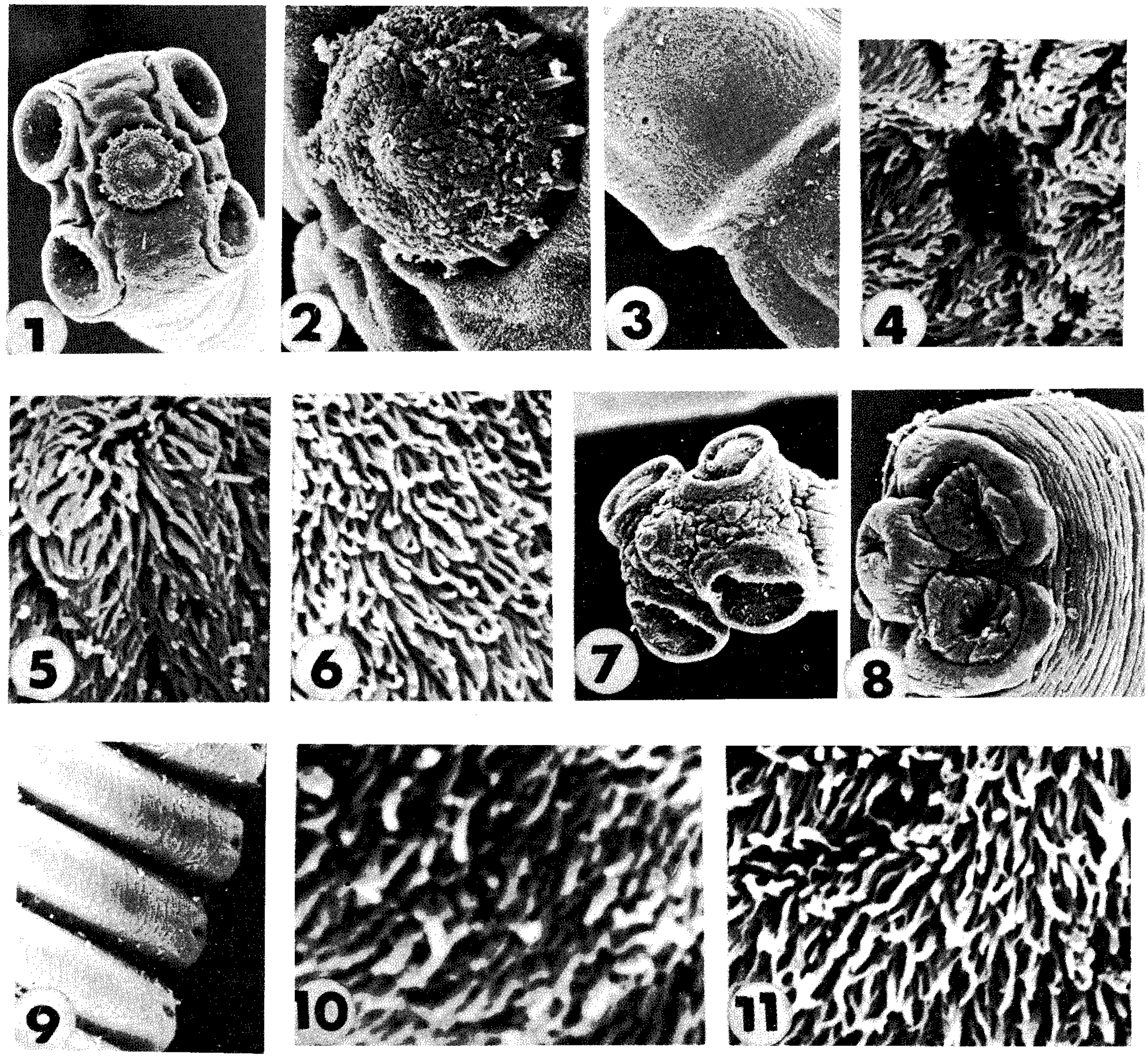

Fig. 1: Scanning electron of surface view of the scolex of *H. nana*. (× 450)

Fig. 2: S.E. micrograph of the rostellum of *H. nana* showing a circle of hooks. (× 1500)

Fig. 3: S.E. micrograph of the genital atria in *H. nana*. (× 700)

Fig. 4: S.E. micrograph of the genital atrium of *H. nana*. (× 700)

Fig. 5: S.E. micrograph of the strobilar surface of *H. nana* showing the microtriches. (× 15000)

Fig. 6: S.E. micrgrph of the scolex surface of *H. nana* showing the microtriches. (× 15000)

Fig. 7: S.E. micrgrph of the scolex of *H. diminuta* showing the everted rostellum and fully opened suckers. (× 450)

Fig. 8: S.E. micrograph of the scolex of *H. diminuta* showing the retrated rostellum and suckers. (× 450)

Fig. 9: S.E. micrograph of the genital atria of *H. diminuta*, note that genital atria are unilateral. (× 450)

Fig. 10: S.E. micrograph of the strobilar surface of *H. diminuta* showing the microtriches with their rounded tips. (× 30000)

Fig. 11: S.E. micrograph of the microtriches on their sucker surface of *H. diminuta* with their terminal ends pointed. (× 15000)

collected from naturally infected *Rattus norvegicus* from Abu Rawash area, Giza, Egypt. Worms were washed several times in saline before fixation in 4% formaldhyde, then dehydrated in ascending series of ethanol solutions, transferred through a series of intermediate fluids (3:1, 2:1 and 1:1) of 100% ethanol and amyl acetate to 100% amyl acetate according to procedures of Anderson, (1951 and 1966).

Specimens were then transferred to liquid CO_2 in Polaron critical point dryer. The dried specimens were then coated with gold palladium and examined with JOEL scanning electron microscope.

RESULTS

1. *Hymenolepis nana*

The scolex of *H. nana* appears roughly rectangular and is provided with a comparatively large hooked rostellum and four rounded suckers (Figs. 1 and 2). The suckers occupy the corners of the rectangular scolex while the rostellum lies at the center of the scolex and is provided with 16 pointed and posteriorly directed hooks.

Genital atria are unilateral, each has a rounded opening and is surrounded with ordinary microtriches (Figs. 3 and 4). The scolex, rostellum, suckers and strobila are all densely populated with long cylindrical microtriches. The microtriches appear all of uniform size and density, only those found on the scolex appear slightly thinner and longer compared with the strobilar microtriches. (Figs. 5 and 6). The mean density values of the microtriches was found to be $25.6/\mu^2$ on the strobilar surface and $27/\mu^2$ on the scolex surface. Measurements of the length of the microtriches were not possible, because they were so overlapped that it was difficult to observe their bases.

2. *H. diminuta*

The scolex of *H. diminuta*, like most other cestodes is extraordinary motile and capable of considerable extension and retraction. The extended scolex appears small and conical-shaped with an everted rostellum and fully opened suckers (Fig. 7). The retracted scolex, however, appears rounded in shape with an invaginated rostellum and the suckers are partially closed (Fig. 8). Genital atria are unilateral and, similar to *H. nana*, are not surrounded with any specialized structures but with ordinary microtriches (Fig. 9). The scolex, immature and mature proglottides are all covered with posteriorly directed microtriches of uniform size and density.

The microtriches covering the strobilar surface posses rounded tips (Fig. 10), while those on the inner surface of the suckers posses narrower pointed tips (Fig. 11). The density values of the microtriches were found to be about $25/\mu^2$ on the strobilar surface and $20/\mu^2$ on the inner surface of the suckers.

DISCUSSION

The view held by Rothman, (1959 and 1963) and Rosario, 1962) that the microtriches cover the entire surface of *H. diminuta* except the scolex is not supported by observations of the present study. However, in agreement with Ubelaker, *et al*, (1973) observations on *H. diminuta*, the present study showed that all the tegumental surface, including rostellum and suckers of both *H. nana* and *H. diminuta* is densely covered with microtriches.

Jha and Smyth, (1971) reported polymorphic microtriches on the rostellum of *Echinococcus granulosus* and Berger and Mettrick, (1971) described polymorphism of microtriches of *Hymenolepis*. In the present study neither in *H. nana* nor in *H. diminuta* this polymorphism was observed, and the microtriches appeared of uniform shape and length along the strobilar surface and were never seen to be branched. The present results agree with Ubelaker, *et al*, (1973) who reported that they were unable to confirm the presence of microtrichoid dimorphism in *H. diminuta*.

Concerning the density of the microtriches along the cestode surface, the present work showed that the mean density value in *H. nana* is $25/\mu^2$ on the strobilar surface and $27/\mu^2$ on the soclex surface. The corresponding value in *H. diminuta* is $20/\mu^2$ on the sucker surface and $25/\mu^2$ on the strobilar surface. For *H. diminuta*, Ubelaker, (1973) gave much higher values for microtrichoid density on rostellum ($49.2/\mu^2$), suckers ($64.8/\mu^2$) and scolex ($56.4\mu^2$). The reason for this variation in microtrichoid density may be due to the overlapping of the microtriches which precluded their correct counting. Also, it may be due to the effect of differences in host reactions as the present work is based on cestodes obtained from naturally infected hosts, while Ubelaker, *et al's*, work was based on cestodes from experimental infections.

Andersen's, (1975) described the presence of 'nipples' or papillae around genital atria in *Diphyllobothrium*. This was not observed in the present study, and genital atria of both *H. nana* and *H. diminuta* were found to be surrounded with ordinary microtriches.

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