

Comparison of Scanning Electron Microscopy on *Baylisascaris transfuga*, *Toxascaris leonina* and *Ascaris lumbricoides* (Nematoda: Ascarididae)

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Genus *Baylisascaris* was created by Sprent (1968), comprising seven species which had formerly been included in either genus *Toxascaris* or *Ascaris* of the family Ascarididae.

Prior to the creation of this genus, for at least some of the species, the distinctions between them when studied under light microscopy were the cause of considerable debate concerning their classification (Mozgovoi, 1953; Sprehn and Haakh, 1956; Hartwich, 1962).

Recently we reported the finding of *B. transfuga* in the wild black bear of Japan (Uni *et al.*, 1981). As a supplementary study to that report, we describe herein the details of the external structures of three genotypes—*B. transfuga*, *T. leonina* and *A. lumbricoides*—examined under scanning electron microscopy (SEM) in order to obtain a better knowledge of the differences and similarities between them.

Materials and Methods

B. transfuga: One thousand fifty specimens, 104–274 mm long, collected from 2 polar bears (*Thalarctos maritimus*) by anthelmintic worming treatments at Tennoji

Zoological Gardens, Osaka. Five specimens, preserved in 70% ethyl alcohol, were used.

T. leonina: Forty specimens, 62–102 mm long, collected from the small intestines of two dogs in the animal laboratory of this medical school. Ten specimens were used.

A. lumbricoides: Twelve specimens, 123–258 mm long, obtained by anthelmintic treatments given 2 patients in the hospital of this medical school.

The anterior and posterior parts of the adult worms and the eggs from the uterus were prepared for SEM examination by the same method previously described (Uni and Takada, 1975).

Results

The Anterior Part

En face view of head of *B. transfuga* showed three lips with dentigerous ridges, amphidial pores, internal labial papillae, lateral papillae, subventral labial papillae and dorsal labial papillae (Fig. 1). The teeth of this species were larger and blunter than those of *A. lumbricoides*. Those of *T. leonina* were much fewer in number and were arranged with greater distance between each other. Total number of teeth counted on the three lips was approximately 650 in *B. transfuga*, 730 in *A. lumbricoides* and 210 in *T. leonina*, respectively

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(Figs. 2, 13, 22). Lateral papillae near amphidial pores showed a walnut-like surface in all specimens of the three species (Figs. 3, 14, 23). Six internal labial papillae were recognizable as small pores on the tops of the three lips in each species. In *B. transfuga* and *T. leonina* the dorsal and subventral labial papillae exhibited distinctly divided surfaces (Figs. 4, 15), while in *A. lumbricoides* they were undivided, appearing like a single elevation (Fig. 24).

The Cervical Part

Cervical alae of *B. transfuga* and *T. leonina* were salient (Figs. 1, 12). In *A. lumbricoides* the alae, though vestigial, could be found on the lateral lines in this part in almost all specimens examined by SEM (Fig. 25). Deirids of *B. transfuga* and *T. leonina* were smaller than those of *A. lumbricoides*, all being situated on the dorsal side of the alae (Figs. 5, 16, 25).

The Posterior Part

Pericloacal area of male *B. transfuga* showed 4 to 5 transverse lines composed of tiny spines preloacally, and 9 to 10 such lines postloacally (Figs. 6, 7). Such a unique configuration, having a rather rough surface, was found in all male specimens of *A. lumbricoides* (Fig. 27 *). (A similar structure was also found in a specimen of *A. suum* taken from a pig). In *T. leonina* this area closely anterior and posterior to cloaca appeared as a rather smooth cuticular elevation (Fig. 20 *). Regarding spicule, the surface of their distal part was wrinkled in *B. transfuga* (Fig. 7), but was smooth in other species. Preloacal central papilla could be recognized at the top of the area in all specimens of three species (Figs. 7, 20, 27). Postloacally, in *B. transfuga* there were two pairs of double papillae, the second one smaller (frequently two closely associated single papillae instead of the double papilla at one side, as

shown in Fig. 6), and two pairs of single papillae posteriorly. A phasmidial pore was located between the last two papillae on each side. This postloacal papillar arrangement was similar to that of *A. lumbricoides*, except for the position of the phasmidial pores (Fig. 27), but was distinctly different from that of *T. leonina*, as shown in Fig. 17. In the female tail of the three species, only one pair of phasmidial pores was recognized, situated laterally, near the terminal end (Fig. 9). Terminal ends of both male and female specimens of all three species usually exhibited a pointed spiny formation (Figs. 8, 9, 19), but blunt or button-like tips were noted exceptionally, as shown in Fig. 27.

The Egg

Eggs from *B. transfuga* showed an uneven, crepuscular surface in high magnification (Fig. 11), and under light microscopy we believe the operculum-like area was probably there, as seen in one pole of the egg shell in some eggs. In *A. lumbricoides* the egg showed distinct depressions and ridges all over the surface except one small area, where it appears differently at one end, probably corresponding to the operculum-like structure by Ubelaker and Allison (1975) (Fig. 26). In *T. leonina* the egg surface was smooth (Fig. 18).

Discussion

SEM of the surface structures of *Ascaris* species and *Baylisascaris* species had been reported in part by various researchers (Weise, 1973; Sprent *et al.*, 1973; Kurimoto, 1974; Kikuchi *et al.*, 1979).

In this report we have included some new findings through SEM examinations of these species and have made a comparison of the SEM of the species on the basis of our present results. The surface of the subventral and dorsal labial papillae of *B. transfuga* was more similar to that of

T. leonina than to that of *A. lumbricoides*. The surfaces of the lateral papillae were similar among the species which were included in the subfamily Ascaridinae, but different from those of the *Toxocara* species (Uni and Takada, 1975). The cervical alae could be recognized vestigially in *A. lumbricoides*, but here the cuticular bars were distinctly different from those of *B. transfuga* (Uni *et al.*, 1980a) and *T. leonina* as revealed in the previous examination (Uni *et al.*, 1980b). With regard to the pericloacal rough area, it was revealed in *A. lumbricoides* as being vestigial. Our present findings confirmed the probability of the operculum-like structure of the eggs of *A. lumbricoides*.

Through our SEM examination we found that *B. transfuga* showed close morphological affinity to both *A. lumbricoides* and *T. leonina* in various parts of the body. The detailed SEM comparison of particular points should be useful in clarifying the affinities and differences between the species of the subfamily Ascaridinae.

Summary

The external structures of adult worms and eggs of species *B. transfuga*, *T. leonina* and *A. lumbricoides* were examined under SEM. Cervical alae were found vestigially in the specimens of *A. lumbricoides*. The unique pericloacal structure of *B. transfuga* was clearly visualized, and the corresponding structure could be found vestigially in *A. lumbricoides*. The surface structures of the three species were compared.

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***Baylisascaris transfuga*, イヌ小蛔虫 (*T. leonina*) および 蛔虫 (*A. lumbricoides*) の走査電子顕微鏡による表面構造の比較研究**

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B. transfuga, イヌ小蛔虫, 蛔虫の雌雄成虫, 虫卵の表面構造を走査電子顕微鏡を用いて調べた. 頭部の lateral papilla は三種において極めて類似していた. *B. transfuga* の亜腹側口唇乳頭 (subventral labial papilla) および背側口唇乳頭 (dorsal labial papilla) はイヌ小蛔虫のそれに類似していたが, 蛔虫とは異なっていた. 蛔虫の頸部において頸翼が, 痕跡的であるが, 見い出された. 三種の頸翼の背側基部に頸乳頭 (deirid) が位置していた. *Baylisascaris* の属標徴であ

る pericloacal rough area の詳細が明らかになり, それに相当する構造物が蛔虫においても, 痕跡的であるが, 見い出された. 雄虫体尾部の乳頭の配列は *B. transfuga* および 蛔虫において互いに極めて類似していたが, ファスミッドの位置は異なっていた. 蛔虫卵において卵蓋様構造物と考えられるものが認められた. これらの知見より *B. transfuga* は蛔虫およびイヌ小蛔虫と, その虫体の異なった部位において, 極めて類似した構造を示す様に考えられる.

Explanation of Figures

Figs. 1-11 *Baylisascaris transfuga*.

Fig. 1 *En face* view of head of female. The area marked with * is enlarged in Fig. 4. $\times 100$.

Fig. 2 Denticles in central area of subventral lip. $\times 2,000$.

Fig. 3 Amphidial pore and lateral papilla. $\times 1,000$.

Fig. 4 Dorsal labial papilla. $\times 1,000$.

Fig. 5 Deirid. $\times 2,000$.

Fig. 6 Ventral view of male posterior part. * shows posterior part of pericloacal rough area. $\times 150$.

Fig. 7 Pericloacal rough area and precloacal central papilla. $\times 200$.

Fig. 8 Lateral view of male tail. $\times 400$.

Fig. 9 Posterior part of female. $\times 100$.

Fig. 10 Egg. $\times 350$.

Fig. 11 Surface of egg. $\times 5,600$.

Figs. 12-20 *Toxascaris leonina*.

Fig. 12 *En face* view of head of male. The area marked with * is enlarged in Fig. 15. $\times 200$.

Fig. 13 Denticles in central area of dorsal lip. $\times 2,000$.

Fig. 14 Amphidial pore and lateral papilla. $\times 1,400$.

Fig. 15 Dorsal labial papilla. $\times 1,400$.

Fig. 16 Deirid. $\times 1,800$.

Fig. 17 Ventral view of male posterior part. The area marked with * is enlarged in Fig. 19. $\times 200$.

Fig. 18 Egg. $\times 350$.

Fig. 19 Lateral view of male tail. $\times 500$.

Fig. 20 Area around cloaca. $\times 400$.

Figs. 21-28 *Ascaris lumbricoides*.

Fig. 21 *En face* view of head of female. The area marked with * is enlarged in Fig. 24. $\times 100$.

Fig. 22 Denticles in central area of dorsal lip. $\times 2,000$.

Fig. 23 Amphidial pore and lateral papilla. $\times 1,000$.

Fig. 24 Dorsal labial papilla. $\times 700$.

Fig. 25 Cervical ala and deirid. $\times 350$.

Fig. 26 Presumptive operculum-like structure (*) of egg. $\times 3,500$.

Fig. 27 Ventral view of male posterior part. * shows rough area. $\times 200$.

Fig. 28 Phasmidial pore. $\times 3,500$.

Abbreviations

- A: anus
- AM: amphidial pore
- CA: cervical ala
- D: deirid
- IP: internal labial papilla
- LP: lateral papilla
- PCP: precloacal central papilla
- PH: phasmidial pore
- S: spicule







