SCANNING ELECTRON MICROSCOPIC STUDY OF THE MORPHOLOGY OF ASCARIS SUUM GOEZE, 1782

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Abstract. The morphology of head and caudal portions of males and females of Ascaris suum Goeze, 1782 was studied by scanning electron microscopy. The teeth of ascarids are first sharply pointed and conical, but they are gradually ground off and become cylindrical in old worms. The teeth in the middle of lips are used most of all and consequently they are ground off sooner than the remaining ones. The surface structure of cuticle, arrangement and morphology of preanal and postanal papillae on the caudal end of males, morphology of male spicule and caudal end of females were also studied.

The present scanning electron microscopic (SEM) study of the morphology of Ascaris suum Goeze, 1782 is the first part of investigations into the identity of Ascaris suum and Ascaris lumbricoides Linné, 1758.

MATERIAL AND METHODS

Preparation methods described by Hammond (1969), Green (1967), Madden et al. (1970), Madden and Tromba (1976), Anderson et al. (1971), Wise (1973) and others were used in our experiments. Live specimens of A. suum (50 males and 50 females of various age) were recovered from the small intestine of pigs Sus scrofa domestica and placed into saline 0.9 % NaCl at room temperature. After repeated thorough washing in saline, 3—5 mm long portions of head and caudal parts of worms were transferred to distilled water and washed for 1 h in a shaker. The water was changed every 10 min. After being fixed in 4% formaldehyde for 24 h the material was again washed with distilled water and then dehydrated through graded alcohols (30 %, 50 %, 60 %, 70 %, 90 %, 96 %, 100 %). Then it was transferred from absolute alcohol to a mixture of absolute alcoholacetone and, eventually, to pure acetylacetate. After critical point drying (CO2) the material was coated with gold in vacuum. Each piece of worm was then mounted on a special stub and examined in Joel Scanning Electron Microscope.

RESULTS AND DISCUSSION

Three lips closing the mouth cavity were studied in detail on the head end (Plate I, Fig. 1). The dorsal lip (left) is provided with two sensible papillae. Latero-ventral lips possess only one sensible papilla each (Fig. 1). The inner margin of lips bears a row of teeth, conical in young specimens and cylindrical in old ones. Since their variability has already been studied by means of SEM by Madden et al. (1970) and Madden and Tromba (1976), these structures have been left out from our observations.

It should be noted that the morphology of teeth of A. suum is very variable, as it was reported by Sprent (1952) and Abdulrahman and Joe (1954) who considered them to be of taxonomic importance. Lýsek (1963) compared the morphology of teeth of A. suum and A. lumbricoides and arrived at the conclusion that these two species are identical. He stated that the shape and size of teeth do not change with the age.
In agreement with the results of Madden and Tromba (1976) we have found that the pointed conical teeth of young specimens are gradually ground off and become cylindrical in old parasites. Also other authors (Ubelaker and Allison 1972, Maung 1973, Weise 1973, Ansell and Thibaut 1973) studied the variability of teeth of A. suum by means of SEM and they observed even two rows of teeth. Our specimens possessed always only one row of teeth and usually corresponding pits on the opposite side of the groove. The morphology of teeth of A. suum is so much variable and changing with the age of the parasite that it is of no taxonomic importance.

![Fig. 1. Lateroventral lip of A. suum with sensible papilla. (90×)](image1)

![Fig. 2. Furrowed end of spicules of male of A. suum. (2,000×)](image2)

The body cuticle of A. suum is thick and transversely striated (Plate I, Figs. 3—6). Two types of striae may be distinguished: narrow in the anterior portion and much wider in posterior portion of the worm. Dorso-lateral and ventro-lateral striations terminate near cervical alae of males. The wide striae in the posterior portion of male body (Plate I, Fig. 4) have a fine narrow wrinkling (Plate I, Fig. 5) enabling the worm to bend. Bird and Deutsch (1975) mentioned rod-shaped bacteria in the anterior portion between transverse striations of the cuticle which were not observed in our material. Anderson et al. (1971) studied the formation of cuticular lesions caused by these bacteria.

The caudal portion of male (Plate I, Fig 2) is terminated by a knob-like structure from which often protrudes a finger-like process (Plate I, Fig. 3). Two papillae are situated in front of this process. An inconstant, large number of papillae are on the ventral side of posterior end of male (Plate I, Fig. 2). According to Skryabin and Shults (1931) there are 75 pairs of these papillae. Ozerskaya (1930) reported an irregular and inconstant arrangement of these papillae, 54 on one side and 52 on the other side, five pairs being postanal and the remaining ones preanal. In our studies of 50 males, no regular arrangement or constant number of these papillae was observed (Plate II, Figs. 3—6). Some papillae protrude above the surface of cuticle (Plate II, Figs. 4, 6), others are almost at its level (Plate II, Fig. 5) or submerged in a pit under the level of cuticle (Plate II, Fig. 2).

The tip of papillae (Plate II, Figs. 2, 3) is terminated by a small crater from which
protrudes a small, tubular, funnel-shaped or knob-shaped protrusion (Plate II, Fig. 3). Sometimes this protrusion has no distinct pore. Also this process on the tip of papilla either protrudes from the crater (Plate II, Fig. 3) or is situated at its level (Plate II, Fig. 2) or under its level. A secretion, from which the impurities can be only hardly removed, is usually secreted in the pit around the base of papilla and its top pit. Weise (1973) described bacteria in this place around cloacal papillae. The anterior papillae are the smallest. Two pairs of double papillae are situated behind cloaca (Plate I, Fig. 2).

When the spicules are exsheathed (Plate II, Fig. 1), they are usually directed to sides and bent forwards. The end of spicules is blunt and two crossing furrows are visible at higher magnification (Fig. 2). This character has not been described in the literature.

The caudal end of female is usually terminated by a knob-like structure which, in contrast to male, has a pit in the middle (Plate I, Fig. 6). The transverse striations of the cuticle start from this structure.

The present SEM studies of the morphology confirmed the finding of Madden and Tromba (1976) that the teeth are conical in young specimens and cylindrical in old specimens of ascarids. Some morphological structures, as crossing furrows at the distal end of spicules and detailed structure of tail end of male and female, which have not yet been studied by SEM, are described.

ИЗУЧЕНИЕ МОРФОЛОГИИ ASCARIS SUUM GOEZE, 1782
ПОД СКАНИРУЮЩИМ ЭЛЕКТРОННЫМ МИКРОСКОПОМ
Я. Прокопич

Резюме. С помощью сканирующего электронного микроскопа изучали морфологию головного и хвостового концов самцов и самок нематод Ascaris suum Goewe, 1782. Зубы аскарида сначала острые и клиновидные, но они постепенно колеблются и становятся цилиндрическими у старых червей. Зубы в середине губ обыкновенно используются чаще всех и поэтому они отшлифованы раньше, чем остальные. Научены также поверхностная структура кутикулы, расположение и морфология преналинальных и постаналинальных сосочков на хвостовом конце самца, морфология спикулы самца и хвостовой конец самки.

REFERENCES


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SKRYABIN K. L., SHULTS E. S., Gelmintozy

Professor S. N. Boev edited a monograph written by prominent Soviet specialists and dealing with trichinellosis which is one of the most dangerous zoonoses with a marked natural locality. Due to its pathology it is an important parasitic disease. According to literary data, about 28 millions of people suffer from trichinellosis, of them 21.1 millions in North America. At present it is the most dangerous disease with the Eskimos, occurring even in 95% of their population.

The monograph by Soviet authors summarizes the most recent information on *Trichinella* and trichinellosis lately published in the Soviet and world literature. A historical survey of the causative agents of trichinellosis is given in the introduction. *Trichinella* was first reported in muscles of man by Paget (1835), but this author did not determine it. Later Owen (1835) described nematode larvae from the same material and named them *Trichina spiralis*.

The second chapter deals with the systematics, morphology and anatomy of *Trichinella*. Until 1972, trichinellosis was considered a disease caused by a single species, *Trichinella spiralis* (Owen, 1835), but the Soviet authors demonstrate by modern methods that there are four species of the genus *Trichinella* Railliet, 1896, namely *T. spiralis* (Owen, 1835), *T. nativa* Britov et Boev, 1972, *T. nelsoni* Britov et Boev, 1972, and *T. pseudospiralis* Garkavi, 1972. A detailed morphology and anatomy of these species is described. The identification of species which are difficult to differentiate on the basis of their morphology is discussed in the following chapter. These species differ in their circulation in nature and consequently they are of different epizootological and epidemiological importance. A genetical method for species identification is here worked out for the first time.

The new view brings new knowledge of the circulation of these four species of *Trichinella*: *T. spiralis* circulates in synanthropic bioecoses and only rarely penetrates into free nature, whereas *T. nativa*, *T. nelsoni* and *T. pseudospiralis* are members of natural bioecoses. *T. nativa* and *T. nelsoni* may become a source of infection to man, but there are few data available on *T. pseudospiralis*. The biology of all four species and their circulation in nature are dealt with in detail. The questions of their epidemiology and epizootology are discussed in the fifth chapter. The list of hosts and their geographic distribution covers all hitherto reported host species. The problems of *Trichinella* resistance to various factors of the environment and of the sterilization of meat infected with *Trichinella* are also considered. The authors analyse the source and ways of man infection with *Trichinella* and thus contribute to the knowledge of trichinellosis showing a more effective prophylaxis in the fight against this zoonosis.

The immunity during trichinellosis and its diagnosis in the life-time and post mortem are the topics of further chapters. The eighth chapter concerns the pathogenic and clinic of trichinellosis, the ninth one is devoted to the therapy. The last chapter deals with the prophylaxis of trichinellosis. The list of references comprises 301 papers by Soviet and 253 papers by foreign authors.

The monograph is intended for scientists and practitioners in human and veterinary medicine, gamekeepers, teachers and students of medicine, veterinary medicine, zoology and biology. Its complex and wide conception based on newest information and views makes it a significant contribution to the helminthological literature.

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Fig. 1. General view of head end of *A. suum* (en face). (35×)
Fig. 2. Posterior end of male, rectal opening and papillae. (45×)
Fig. 3. Posterior end of male of *A. suum* (detail). (175×)
Fig. 4. Transverse striations of cuticle of *A. suum* (1,300×)
Fig. 5. Transverse striations of cuticle of *A. suum* (detail). (2,200×)
Fig. 6. Posterior end of male of *A. suum* (detail) (700×)