MORPHOLOGY AND TAXONOMY OF TRICHOCEPHALUS MYOCASTORIS (ENIGK, 1933)

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Abstract. The morphology and metrical variability of *T. myocastor*is were studied in detail. *T. nutria* was synonymized with the species *T. myocastor*is. The detailed morphology of head end, shape and topography of spines on spicule sheath and surface structure of eggs were examined by means of scanning electron microscopy.

Two nematode species belonging to the genus *Trichocephalus* Schrank, 1877, namely *T. myocastor*is (Enigk, 1933) and *T. nutria* Shults et Petrov in Shults and Landia (1934), have been described from the host *Myocastor coopus* (Molina, 1782). The taxonomic status of these species suggests, already when comparing their original descriptions, the question of their synonymy. Skryabin et al. (1957) consider both species to be valid, whereas Yamaguti (1961) admits the possibility of their synonymy.

We have studied the specimens of *Trichocephalus* recovered from *M. coopus* and on the basis of their morphology and metrical variability we can express our opinion on the taxonomic status of the above-mentioned species. Besides the usual methods we applied also scanning electron microscopy, which enabled us to complement and document the morphological characteristics of *T. myocastor*is in some details.

MATERIAL AND METHODS

Our collection comprised 43 nematodes recovered from the large intestine of *M. coopus*. The definitive host originated from the Azerbaijan SSR and was collected in the locality Divichiinskii liman in 1972. Besides the common methods of light microscopy used for the study of the morphological and metrical variability, 3 males and 2 females were examined also by means of scanning electron microscopy, in order to study some details, as head end, spicule, spicule sheath and eggs. For this purpose, the material was processed in the following manner: The specimens prefixed in 4% formaldehyde were thoroughly washed in distilled water. The anterior end of female, posterior end of male and eggs were placed on separate stubs containing glue on a drop of water. The samples were then quenched in liquid nitrogen and freeze dried. After coating with carbon and gold they were observed under an electron microscope having scanning image displaying device (JEM 100 B) and operating at accelerating voltage of 40 kV. Magnifications of micrographs are mentioned specifically in each case.

RESULTS

Description of *T. myocastor*is (Enigk, 1933): The body is white, of characteristic shape, with filiform anterior and swollen posterior part. The cuticle bears transverse
striations, which run at intervals of 0.006—0.007 mm and are markedly zigzagged especially on anterior part of body. A longitudinal bacillary band runs along the ventral side of body. It originates about 0.070 mm from the head end and ends at level of oesophagus end or a short distance below it. Width of the bacillary band is 0.005—0.125 mm in its middle part. It is formed by densely distributed, circular and slightly protruding outlets of hypodermal glands. The anterior part of body is gradually tapering towards the anterior end. In some specimens the head part is distinctly narrower than the oesophageal part of body and is covered with smooth cuticle. These differences in the width of body are smaller in other specimens, but the head part is always covered with a smooth cuticle. From lateral view, the head end is blunt (Fig. 1 A), protruding terminally in a small rounded papilla. A short distance below this papilla there is a small, elliptic depression with a pair of rounded sessile papillae on both its sides. Behind these papillae there is another pair of small, rudimentary papillae (situated more medially). It may be supposed that the total number of head papillae is 8 (4 + 4 rudimentary). The stylet was not observed.

Male (Fig. 1 B, D, E): The total length of body is 22.94—35.25 mm, the length of anterior oesophageal part is 13.26—19.65 mm. The ratio of the oesophageal part to the total length of body is 1 : 1.7—1.9. The head part is 0.018—0.022 mm wide. The width of body at level of oesophagus end is 0.22—0.37 mm. The swollen posterior part of body measures 9.69—15.60 mm in length and 0.39—0.51 mm in maximum width. The anterior (muscular) portion of oesophagus is 0.74—0.85 mm long. The testis is very long, originating at the distance of 0.54—2.41 mm from posterior end of body and running forwards at first straight and then in distinct meanders. A small distance behind the curve near oesophagus end it passes in vas deferens, which is 4.68—6.61 mm long and in its slightly tapered part joins ductus ejaculatorius. The length of ductus ejaculatorius is 2.73—4.07 mm. At place of the junction with intestine it enters the duct of cloaca, which measures 1.92—2.81 mm in total length. It has a distinct sinuous shape (Fig. 1 B). It turns at first forwards and then backwards, where it joins the spicule sheath at the distance of 1.25—2.07 mm from posterior end of body. The opening of cloaca is situated on ventral side of body. Its lower margin is 0.037—0.051 mm from posterior end of body. There is a small, rounded papilla (0.008 mm high) on each side of cloaca. Posterior end of body is rounded. The spicule is markedly selerotized and massive, measuring 3.47—3.74 mm in length. Its proximal end measures 0.059—0.074 mm, middle part 0.037—0.042 mm and distal end 0.014—0.016 mm in width. The surface of selerotized spicule is covered with a tight cuticle surrounding the tip of spicule on its distal end (Plate II, Fig. 6). If the spicule is invaginated, it is covered with the spicule sheath over its whole length. The shape of the spicule sheath varies according to the evagination of the spicule: if the spicule is slightly evaginated, then the spicule sheath has a tubular shape and if the spicule is fully evaginated, the spicule sheath forms a characteristic swelling, the bulb, which passes in distal portion of the tubular spicule sheath. Maximum length of the free part of evaginated spicule sheath measures 1.48 mm. At this length the distal tubular postbulbar part measures 0.34 mm in length and the bulb is 0.185 mm long and 0.148 mm wide. The proximal part of spicule sheath, including bulb, is densely covered with spines (Plate I, Figs. 1, 2). The distal part of bulb is only sparsely covered with spines, the distal tubular part is without spines (Plate II, Figs. 1, 2). The spines are arranged in longitudinal rows, their height is 0.002 mm. Total number of the longitudinal rows of spines on spicule sheath is 56—60. Each spine has a broad base on the spicule sheath and is tongue-shaped in appearance (Plate I, Figs. 3, 4, 5, 6). There is a small depression in each spine towards its base. The tips of spines are bent and directed anteriorly.

Female (Figs. 1 C, 2): The body is 38.36—43.05 mm long, the anterior oesophageal
portion is 24.64—28.08 mm long. The ratio of the oesophageal portion to the total length of body is 1:1.4—1.6. The head part of body is 0.020—0.026 mm wide, at level of oesophagus end it measures 0.29—0.33 mm in width. The swollen posterior part of body measures 13.14—14.97 mm in length and 0.48—0.66 mm in maximum width. The muscular part of oesophagus is 0.74—0.96 mm long. The vulva lies at level of oesophagus end or a small distance below it (0.074—0.148 mm). It has the shape of a transverse slit with slightly frilled margins (Fig. 2 A, B). It is situated in the centre

Fig. 1. Trichocephalus myocastoris (Enigk, 1933) from the host Myocastor coypus. A—head of female (lateral view); B—posterior end of male body (total, lateral view); C—egg; D—posterior part of male body (detail, lateral view); E—distal end of spicule. Original.
of a circular cuticular disc, which has a distinctly smooth surface, in contrast to transversely striated cuticle of body. This smooth cuticular disc measures 0.059—0.074 mm in diameter and is only moderately protruding above the surface. The vagina has strongly muscular walls and is directed posteriorly, forming 2—4 small waves. Its total length is 1.12—1.85 mm. Single uterus, oviduct and ovary are present. The posterior end of body is rounded. The anus is subterminal (Fig. 2 C). The rectum is 0.37—0.42 mm long. The eggs are lemon-shaped (Fig. 1 C) and possess polar plugs at both ends (Plate II, Figs. 3, 4, 7). The polar plugs are oval and set in a depression of the protein coat of egg. The margin of the egg shell around the plugs is markedly rounded. The surface of the egg exhibits faint longitudinal marking at high magnification (Plate II, Fig. 5). The eggs measure 0.052—0.060 × 0.030—0.034 mm.

**Fig. 2.** Trichocephalus myocastoris (Enigk, 1933) from the host Myocastor cuypus. A, B — vulva a (total and detail, lateral view); C — posterior end of female body (lateral view). Original.

**DISCUSSION**

On the basis of a detailed study of the morphology and metrical characters of our material and comparison it with the original descriptions of the species *T. myocastoris* and *T. nutria*, we arrived at the conclusion that they should be regarded as synonyms. The measurements of all comparable characters (i.e. those which were mentioned in both original descriptions) are given in Table 1. Although there are small differences between some of the characters, in our opinion they are due to the material examined by individual authors and they fall within the metrical variability of this species. Great intervals between minimum and maximum values of metrical characters occur frequently in the species of the genus *Trichocephalus* hitherto described. For example, Shikhobalova (1967) ex Skryabin et al. (1957) found the interval between minimum and maximum spicule length of *T. trichiurus* to be 1.2 mm. A similar value was also obtained when comparing the data on spicule length of *T. myocastoris*.

As far as the priority of the name *T. myocastoris* is concerned, we find it necessary to add some data. The findings of nematodes of the genus *Trichocephalus* in *Myocastor*
coyopus in Germany were surveyed by Enigk (1933), who also attached their valid original description and name T. mycastoridis. The first report from the territory of the USSR was published in the paper by Shults and Landa (1934), who mentioned the name as T. nutria Shults et Petrov, 1935 in the key of species of the genus Trichocephalus parasitizing rodents. The data on spicule length, length of body of males and females and size of eggs of this species are given in the key. It should be noted that Shults and Landa (1934) did not mention in the list of references any paper by Shults and Petrov dealing with this species. A more detailed description of T. nutria was published as late as in the monograph by Petrov (1941), but without figures. In the list of literary sources given by Petrov (1941) the paper by Shults and Petrov is cited as a manuscript. The name of species was mentioned as Trichocephalus nutria Schultz et Petrov, 1933.

Table 1. Measurements of some characters of Trichocephalus mycastoridis (Enigk, 1933) according to different authors (in mm)

<table>
<thead>
<tr>
<th>Measurements</th>
<th>After Enigk (1933)</th>
<th>After Petrov (1941)</th>
<th>Our data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male— length of body</td>
<td>30—38</td>
<td>38—46</td>
<td>22—35</td>
</tr>
<tr>
<td>Length of oesophagus</td>
<td>18—24</td>
<td>23.7—25.9</td>
<td>13.2—19.6</td>
</tr>
<tr>
<td>Width of body at level of oesophagus end</td>
<td>—</td>
<td>0.28—0.36</td>
<td>0.22—0.37</td>
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<tr>
<td>Maximum width of body</td>
<td>0.38—0.42</td>
<td>0.43—0.49</td>
<td>0.39—0.51</td>
</tr>
<tr>
<td>Length of spicule</td>
<td>2.7—3.2</td>
<td>3.7—3.9</td>
<td>3.4—3.7</td>
</tr>
<tr>
<td>Female—length of body</td>
<td>43—50</td>
<td>46—55</td>
<td>38—43</td>
</tr>
<tr>
<td>Length of oesophagus</td>
<td>26—32</td>
<td>27—34</td>
<td>24—28</td>
</tr>
<tr>
<td>Width of body at level of oesophagus end</td>
<td>—</td>
<td>0.24—0.28</td>
<td>0.29—0.33</td>
</tr>
<tr>
<td>Maximum width of body</td>
<td>0.48—0.54</td>
<td>0.35—0.39</td>
<td>0.48—0.66</td>
</tr>
<tr>
<td>Length of egg</td>
<td>0.06*)</td>
<td>0.060—0.063</td>
<td>0.053—0.060</td>
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<tr>
<td>Width of egg</td>
<td>—</td>
<td>0.030—0.033</td>
<td>0.030—0.034</td>
</tr>
</tbody>
</table>

*) The length of egg is only approximate, based on the photograph and the given scale (see Sprehn 1932).

The date of description of T. nutria in 1933 was also mentioned by Skryabin et al. (1947), but the reference given for this species evidently concerns the monograph by Petrov (1941). Yamaguti (1961) cited the above-mentioned paper by Shults and Landa with the date 1934, date of edition being 1935. However, according to a reprint available to us (see p. 315), No. 4 of Vol. 13 of the journal Vesta Mikrob. Epidemiol. i Parasitol. was published in 1934. Also Sarwar (1959) cited the species T. nutria with the authors Shults et Petrov, 1934, but did not mention the species T. mycastoridis in his monograph. On the basis of the above analysis we assume that the priority should be given to the name T. mycastoridis, which was used by Enigk (1933) and whose validity was proved. This species is known from Germany (Sprehn 1932, Enigk 1933), Czechoslovakia (Zajíček 1955) and the USSR — the Ukraine, RSFSR and Azerbaidzhian SSR (Petrov 1941). Sprehn (1932) and Yamaguti (1961) recorded this species also from South America, which is the area of original distribution of the nutria. The European and Asian records represent secondary distribution of this species as a result of introduction of its host into new regions.

We have also studied some morphological characters of T. mycastoridis by means of scanning electron microscopy. As it has already been stated by Hyman (1951), the morphology of the head end and topography of cephalic papillae of the species belonging
to Trichocephalidae has not been studied in detail. Chitwood and Chitwood (1950) mention the existence of six cephalic papillae in the species *T. suis* Schrank, 1788. In the present nematodes, the number of cephalic papillae is 8 and most probably all of them belong to the inner circle. Our observation can be compared with the data by Podyapolkskaya (1931) ex Skryabin et al. (1957), who figured the head part of *T. trichiurus* (Linné, 1771). The head part of *T. myocastoris* has a similar shape as that of *T. trichiurus*. Both of them possess a terminal projection, papillae in inner circle (only 4 were found in *T. trichiurus*) and a depression in the cuticle between the opposite pairs of papillae (probably porus-like amphids).

The digital bulb on the spicule sheath of males of the genus *Trichocephalus* may be either present or lacking, but this character may be considered only in specimens with fully evaginated spicule sheath. The spicule sheath of the species *T. myocastoris* studied by us consists of a proximal shaft and digital bulb (both with spines) and postbulbar tube (without spines). We have not found in the literature any data on the study of morphological details and distribution of spines on spicule sheath of trichocephalids, which could be compared with our observation. However, the SEM method used for the study of this character seems to be suitable for a more exact diagnosis of the species, their differentiation and the study of their relation.

The presence of plug-like opercula at both poles is a characteristic feature of trichocephalids. Although the fine cuticular membrane covering the surface of plug may have been deformed during the preparation of the material, the attached photographs show well the surface structure of the egg and situation of the plug in a depression of the protein coat of the egg. The coat forms a raised rim with rounded margin. Also comparative SEM studies of this character in different species may be of importance in solving the taxonomic problems of such difficult group as trichocephalids in the future.

МОРФОЛОГИЯ И ТАКСОНОМИЯ НЕМАТОДЫ TRICHOCEPHALUS MYOCASTORIS (ENIGK, 1933)

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Резюме. Авторы изучали морфологию и метрическую вариабельность *T. myocastoris*. *T. nutria* считают синонимом *T. myocastoris*. Подробную морфологию головного конца, форму и топографию шипиков на сипкулярном влагалище и поверхность строение яиц изучали с помощью сканирующего электронного микроскопа.
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Fig. 1—6. Scanning electron micrographs of spicule sheath of *Trichocephalus myocastoris* (Enigk 1933). Fig. 1. Distribution of spines on proximal part of spicule sheath just in front of the transition into bulbular swelling. (×1,500.) Fig. 2. Different topography of spines in transitive part of spicule sheath. Proximal part of spicule sheath (at the top) and bulbular swelling (at the bottom). (×3000.) Fig. 3. Shape of spines and their arrangement on proximal part of spicule sheath. (×10,000.) Fig. 4. Detailed shape of spines. (×30,000.) Fig. 5. Topography and shape of spines on proximal part of spicule sheath (lateral view). (×3,000.) Fig. 6. Detailed shape of spines (lateral view). (×10,000.)
Fig. 1—7. Scanning electron micrographs of spicule sheath and egg of *Trichocephalus myocatatoris* (Enigk, 1933). Fig. 1. Ending of distal part of spicule sheath (left) and protruding spicule (right) (×1,000.) Fig. 2. Detail of the surface of distal part of spicule sheath. (×3,000.) Fig. 3. Situation of plug on egg. (×10,000.) Fig. 4. Detail of plug margin. (×30,000.) Fig. 5. Surface structure of egg. (×100,000.) Fig. 6. Surface of distal end of spicule (tip of spicule slightly deformed in lower part). (×5,000.) Fig. 7. Egg surface (total view). (×1,000.)