TENORANEMA ALCOVERI G. N., SP. N. (TRICHURIDAE: CAPILLARIINAE), A NEMATODE PARASITIZING ELIOMYS QUERCINUS (RODENTIA: GLIRIDAE)

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Abstract. A new trichurid nematode species of the subfamily Capillariinae, Tenoranema acoveri g. n., sp. n., parasitizing the intestine of the garden dormouse, Eliomys quercinus L., 1766, on the Island of Mallorca (Balearics, Spain) is described. The new genus Tenoranema g. n. is proposed to include the new species, which mostly resembles species of the genus Anclostoma López-Neyra, 1947. Tenoranesma acoveri g. n., sp. n. differs from members of Anclostoma and all other subfamiliar genera in the presence of a true caudal double bulb (instead of a pseudobulb) constituted by a first anterior one with ventrally bent caudal lateral side and a second terminal and smaller one supported by the most complex symmetric system of rays known among Capillariinae.

During the study on the helminthfauna of small mammals (insectivores and rodents) from the Spanish Mediterranean Balearic and Pityusic Islands, a curious trichurid nematode species was found in the intestine of the garden dormouse on the Island of Mallorca. The morphoanatomic and systematic study demonstrated that it was a new species, which we describe in the following text.

Tenoranema acoveri g. n., sp. n.

Definitive host: Eliomys quercinus L. 1766 (Rodentia: Gliridae); for the characterization of the garden dormouse inhabiting the Island of Mallorca see Acover (1983).

Location: intestine.

Locality: Son Gual, Island of Mallorca (Balearics, Spain).

Material: 6 males and 5 females fixed in situ with 70 % alcohol and studied after clearing in lactophenol.

Type specimens: holotype (male) deposited in the Department of Parasitology of the Faculty of Pharmacy of the University of Valencia, paratypes in the same collection and in the Helminthological collection of the Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice.

GENERAL CHARACTERISTICS

The nematodes are typical Capillariinae with long and slender filiform body, with a relatively thin cuticle with fine transverse striations and two lateral bacillary bands. The cephalic extremity is simple, with slightly protruding mouth. The muscular oesophagus sometimes shows more or less pronounced collings (Fig. 1A, B). The stichosome is composed of a single row of stichocytes, these glandular oesophageal cells being longer and narrow anteriorly and wider and ring-shaped in appearance posteriorly. Two conspicuous mesenchymal cells with prominent nuclei at the oesophago-intestinal junction, as usually found in Capillariinae, cannot be clearly distinguished (Fig. 1C, D).
DESCRIPTION

Male. The length of the male is 6.229—7.250 (mean 6.759). The maximum width is 65—78 (64), found at intestinal level. The cephalic extremity is 9—11 (10) wide, with slightly protruding mouth 6—7 if diameter. The width of body is 23—58 (25) at the level of the beginning of the stichosome, 48—60 (54) at the end of the glandular oesophagus, and 52—41 (36) at a precocial level, just before the beginning of lateral caudal alae.

The nerve ring is situated at 18—37 (27) from cephalic end. The muscular oesophagus is 238—277 (263) long. The length of the stichosome of glandular oesophagus is 2.433—3.145 (2.757), comprising stichocytes or glandular oesophageal cells of 73—65×16—23 (47×20) anteriorly and 48—78×37—41 (65×39) posteriorly. The total length of oesophagus is 2.702—3.426 (3.080). The relationship between the muscular and the glandular or stichosomal parts of oesophagus is 0.083—0.110 (0.096).

The posterior or intestinal region of body is 3.398—4.324 (3.739) long. The relationship between the length of anterior oesophageal region and that of posterior intestinal region is 0.625—0.886 (0.814).

On posterior extremity of body there are two caudal lateral alae, which show the particularity of their anterior parts being ventrally bent (Fig. 1G). The length of these alae is 62—85 (71) and their maximum width 16—23 (22). The terminal end of male presents a relatively small, membranous, terminal caudal bursa, 25—38 (28) and 44—51 (47) in maximum width. This terminal caudal bursa is one-lobed, symmetric, and is supported by a complex symmetric system of rays never reaching the external margins of the bursa. Anteriorly, this system comprises two simple, individual, short and narrow digitiform papillae or ventral rays disposed laterally, between which a median genital cone is found. Posteriorly it shows two complex, longer and wider lateral stems, which are directed posteriad. These lateral stems are tetrafurcate. They laterally divide into three rays, the antero-, medio- and posteralateral rays, among which only the mediodateral ray shows a short terminal bidigitation. Finally, in their most anterior part, both lateral stems show two respective extradorsal rays directed posteriad and with short terminal bidigitation. No dorsal caudal ray or projection is observed (Figs. 1G, H).

The spicule is slender, moderately sclerotized, not easily visible, 231—254 (241) long. The spicular sheath is smooth, aspinose.

Female. The female is slightly longer than the male. Its length is 8.806—10.741 (10.067). The maximum width is always reached at the level of mid-uterine region, being 104—130 (117). The apex bears a slightly protruding mouth 7 in diameter. The width of the female is 9—11.5 (9.7) at the level of cephalic extremity, 29—38 (36) at the beginning of stichosome, 63—76 (75) at vulvar level, and 58—76 (70) at a posterior level just before the beginning of a pronounced narrowing, which extends to the terminal rounded extremity, the width at anal level being 18—23 (21) (Fig. 1E).

The nerve ring is situated at 30—48 (39) from cephalic end. The muscular oesophagus is 305—335 (314) long. The length of the stichosome is 3.934—4.723 (4.301). The total length of the oesophageal region is 4.259—5.056 (4.656). The dimensions of the stichocytes are very variable, 53—76×16—18 (65×17) anteriorly and 51—104×51—58 (76×54) posteriorly. The relationship between the muscular and stichosomal portions of oesophagus is 0.070—0.079 (0.074).

Fig. 1. Tenuinema ascomer g. n., sp. n.: A, B — anterior extremities of male and female; C, D — vulvar region of two females in lateral view showing variability; E — posterior extremity of female showing typical terminal narrowing; F — egg showing peculiar external ornamentation; G, H — posterior extremity of two males showing caudal bursa in ventral and lateral views. A: scale 125 μm; B, D, E: 100 μm; C, D: 150 μm; F: read 400 μm; G: 75 μm; H: 50 μm.
The posterior or intestinal region of body is 4.547—5.926 (5.502) long. The relationship between both oesophageal and intestinal regions of body is 0.746—0.936 (0.838). The rectum is 35—104 (56) long, ending in a subterminal anus situated scarcely at 14 from posterior tip of body (Fig. 1E).

The vulva opens ventrally at a distance of 23—58 (46) from the posterior margin of the last stichosomean cell. There are always two well developed vulvar appendages, a smaller, simple, prevulvar, protruding, and a bigger, double (sometimes this double conformation is not conspicuous), postvulvar one. Two small, more or less evaginated vulvar lips can also be observed (Figs. 1C, D). The vagina is 135—231 (205) long, harbouring eggs always disposed in one row. Posteriorly, at anterior uterine level, the eggs are centrally distributed in two rows, more posteriorly in three rows and, in oval gravid females, even in four more or less irregularly aligned rows. Finally, there are the immature eggs, yet in initial period of formation, which are found at a relatively long distance from the terminal extremity, 1.915—2.168 (2 032) from the posterior tip of body.

The eggs are lemon-shaped and with two polar protruding plugs, typical in members of the subfamily Capillariaea. The eggs measure 45.5—55.4 (52.9) in length and 27.7—36.9 (32.7) in maximum width. The thickness of the egg shell is 2.5 at median level, broadening to 4.5 on both poles. The polar plugs measure 8—9 in diameter. The eggs are non-embryonated when laid, containing non-divided germinal cell which sometimes occupies the whole interior space of egg, but sometimes appears contracted and separated from the shell. The dimensions of this internal germinal mass are 32.3—41.5 x 18.4—26.5 (36.9 x 22.8). The peculiar external ornamentation of the eggshell is worth mentioning. The egg-shell surface shows small irregular depressions, also irregularly distributed but apparently following a slightly inclined longitudinal orientation (Fig. 17).

DISCUSSION

The morphoanatomic characteristics of the above-described nematode species allow its classification within the subfamily Capillariaeae Bailliet, 1915, within the family Capillariidae Bailliet, 1915 (see Anderson and Bain, 1982).

Respecting the subdivision of this family in genera, the opinions of authors differ significantly. This old systematic problem has reached our time, the increasing number of data and new knowledge without having given rise to generally accepted criteria (see historie review made by Moravec 1982). Butterworth and Beverley-Burton (1982) and Anderson and Bain (1982) think that actual knowledge is insufficient to establish clear relationships between morphoanatomy and biology of the species, that is, relationships indicating evolutive lines with guarantees as to accept valid generic taxa. Thus, these authors suggest that it is momentaneoously preferable to consider only one genus in the subfamily, the type genus Capillaria Zeder, 1800, all other up till now described genera becoming synonyms of it. Similarly, Baruš et al. (1981b), basing on the review made by Skrjabin et al. (1957), consider that Capillariinae must be subdivided in different genera and make the first step on the way to the desirable definitive review. They study the species Capillaria anatis (Schräck, 1790), type-species of the genus, in detail and propose a new emended diagnosis of Capillaria. A short time after, Moravec (1982), in the latest review of the representative work and accepts a number of different genera after observing some relationships existing between morphoanatomy and biology of species.

In our opinion, in spite of the relatively scarce known data when considering the great number of species included in the group, today's knowledge about the heterogeneity of the group (significantly different morphoanatomies, monoxenous and heteroxenous biology, aquatic and terrestrial life cycles, different organic tropisms at the level of definitive host, different phylogenetic nature of definitive hosts, etc.) undoubtedly demonstrates the incoherence of maintaining the group as monogeneic. In this sense, we think that the paper by Moravec (1982) is supported by logic and valid arguments and the whole constitutes a starting base for understanding this difficult group better than what offers the consideration of all the numerous species within a unique genus. And independently of being in agreement or not with the new systematic rearrangement proposed by this author, it is evident that the differentiation of these genera, different generality makes the comparison and determination of a given species clearly easier. Accordingly, we follow the classification proposed by Moravec (1982) in this paper.

The above-described Capillariaaeae species parasitizing the garden dormouse in the Island of Mallorca presents some characteristics, as its simple stichosome, the presence of a spinule and a nonspiny spiral sheath, and the complexity of the caudal extremity of the male, which allow an easy differentiation from all genera, except Aenochloecephalopus López-Neyra, 1947, according to the diagnosis of this genus given by Moravec (1982). The comparison with all species included in Aenochloecephalopus by Moravec (1982) and reviewed by Mas-Couma (1984), Mas-Couma and Galán-Puchades (1984), Mas-Couma et al. (1984) and Mas-Couma and Esteban (1984) shows that some characteristics are unique among the members of this genus. These characteristics are namely the following: presence of caudal lateral alae ventrally bent; presence of a terminal caudal bursa supported by a complex system of rays; length of the spicule; presence of a single prevulvar appendage and a double postvulvar appendage; marked narrowing of the terminal extremity of the female; and peculiar ornamentation of the eggshell. This fact allows the adjudication of the trichurid between the garden dormouse to a new species, for which we propose the specific name aloveri in honour of Dr. J. A. Alover of Palma de Mallorca (Spain).

GENERIC CLASSIFICATION

We agree with Baruš et al. (1981b) and with Moravec (1982) in that the two fundamental facts, which can and will make possible the establishment of a coherent systematics of Capillariaeaeae, are: the consideration that generic taxa are above all given by the respective type species and the systematic value of the caudal configuration of the male.

As already pointed out by Mas-Couma (1984), according to the species included by Moravec (1982) in Aenochloecephalopus, this genus becomes a very heterogeneous, whole constituted by groups of morphologically well different species, sometimes showing clear relationships to different host groups. Moravec (1982) himself writes in respect to these parasitic groups: "in future some of them may prove to be justified independently of others". After Mas-Couma (1984), Mas-Couma and Galán-Puchades (1984) Mas-Couma et al. (1984) and Mas-Couma and Esteban (1984), there are at least two well defined groups of species according to the complexity of the rays supporting the terminal caudal bursa. One group shows a great simplicity in this character, presenting only two simple and more or less long rays usually directed anterad. The other group is determined by the type species of the genus Aenochloecephalopus (Rudolph, 1819) López-Neyra, 1947 (see Butterworth and Beverley-Burton 1980, Baruš et al. 1981a)."
The other group shows an intermediate complexity in this character, presenting two bidigitated or tridigitated expansions usually directed posteriorly (not anteriad). This group comprises species in its greater part nematodes parasitizing bats. Referring to this group, Mas-Coma and Esteban (1984) suggest the possible systematic validity of the genus Skrjabinocapillaria Skarbichov, 1945. This genus was originally characterized by the absence of a spine, and the presence of an aspino spicular sheath, as described in its type species S. eburna Skarbichov, 1946, and S. rutkowska (1980). Anyhow, Moravek (1982) thinks that the description of the type species was inadequate and consequently presupposes its future identity with Acanthochele. Spratt (1982) makes the review of a great part of world materials determined as Skrjabinocapillaria eburna and finds a fine, non-selerotized spine in the posterior part, thus concluding in the necessity of considering Skrjabinocapillaria as a synonym of Capillaria. Nevertheless, Mas-Coma and Esteban (1984) have pointed out that the possible systematic validity of Skrjabinocapillaria does not depend on the presence or absence of a spine, nor on the aspino nature of the sheath (similar to Acanthochele according to the review of Spratt 1982), but on the configuration of the system supporting the terminal caudal bursa.

The above described new species clearly differs from the type species of both genera Acanthochele and Skrjabinocapillaria by the presence of caudal lateral alae with anterior parts uniting ventrally and by the existence of a complex symmetric system of rays supporting the small caudal terminal bursa. Only two species parasitizing bats show a similar or resembling caudal morphology: Acanthochele palmata (Chandler, 1938), 1947 (see Chanclay 1938, Rutkowska 1980), and Acanthochele rivoralai (Lent, Freitas et Proença 1946) Moravek, 1982, see Lent et al. 1946, Skrjabin et al. 1957). This last species shows a radial configuration, very similar to that of the new species described in the present paper. However, there are unfortunately neither detailed descriptions nor figures of the caudal bursa of these two species in ventral and lateral views as to reach a valid conclusion.

Both above mentioned differing elements are of enough taxonomic value to distinguish the new species even at generic level. Consequently, we propose the new genus Tenoraema g.n. to include the Balaric species. The diagnosis of the new proposed genus is made in the following.

**Tenoraema g.n.**

**Diagnosis:** Nematoda; Trichuridae Railliet, 1915; Capillarini Railliet, 1915. Stichosome consisting of one row of stichocytes. Male presenting two well developed, ventrally bent, caudal lateral alae; posterior end provided with a membranous, symmetric one-lobed bursa supported by various projections constituting a complex symmetric ray system; this system comprises a central individual, short and narrow ventral rays disposed laterally, between which a median genital cone is found, and posteriorly of two complex, posteriorly directed, longer and wider tetrafurcate lateral stems dividing into three lateral rays and last internally emerging exoventral-dorsal ray, some of these rays showing more or less numerous, very short terminal digitations; dorsal caudal ray or projection absent; moderately sclerotized, slender spicular sheath; spicular sheath nonemptying. Parasites of digestive tract of terrestrial mammals.

**Derivatio nominis:** this genus is named in honour of Prof. Dr. Franțesc Tenora of Boro (CSR).

**Type and only species:** **Tenoraema alcoveri** sp.n.
Until recently, the existing knowledge of fish histology and histopathology has been far below the level of data available in higher vertebrates, which has also been reflected in lack of suitable textbooks and atlases. The growing interest in ichthyopathology, and consequently, in normal and pathological histology, has prompted the publication of several important monographs on fish histology. Most of them, however, deal with one species or one group of fish. The present atlas tries to cover more varied representatives of teleosts and is especially concerned with three economically important fish species — carp, rainbow trout and eel which attract most of the attention of ichthyopathologists.

The book is subdivided into chapters describing individual organ systems, i.e., skin, mobile organs, nervous system, sensory organs, gills, vascular system, digestive system, kidney, gonads and endocrine system. An account of normal histology is followed by description of histopathology; both the morphology and physiological functions of tissues are emphasized. Illustrations have been carefully selected; most of them are black and white light micrographs, but there is a fair amount of colour photographs. A number of macrophotographs of various organs and diagrammatic line drawings assist in better understanding of organ and tissue structure. Figs. VIII-20—23 are not mentioned in the List of Plates. The picture on p. 33 has captions not explained in the legend, but these are very minor shortcomings in the carefully edited iconography.

The authors succeeded in choosing representative examples of histopathological changes likely to be encountered in some of the widespread diseases of the three above mentioned fish species. As a reliable descriptive source of reference to fish histopathology, the book not only is indispensable for fish pathologists but it is a valuable source of information for fish parasitologists as well. The effect on fish tissues is not specifically dealt with, but the range of histological changes the parasites may cause is well covered by the examples given. Incidentally, there are some parasites illustrated; those in renal tubules of cherry salmon and ayu in Fig. VIII-20 and VIII-21, designated as sporozoans, are in fact myxosporan stages. The fact that the book has been compiled in Japan (editor and contributors being Japanese) well documents the importance of ichthyopathology and histopathology in the thriving Japanese aquaculture. The need of this information is equally perceived in other countries.

We believe that this book will satisfactorily fulfill the requirements of all those who are interested in most varied aspects of fish health problems and is therefore highly recommended.

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