

**New data on *Ancylostoma martinezi* Miquel, Torres, Casanova et Feliu, 1994  
(Nematoda: Ancylostomataida e) parasitizing *Genetta genetta*  
(Carnivora: Viverridae e) in Spain**

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### Summary

New data on *Ancylostoma martinezi* Miquel, Torres, Casanova et Feliu, 1994 (Nematoda: Ancylostomataida e), an oioxenous parasite from the small intestine of the common genet, *Genetta genetta* (Linnaeus, 1758) (Carnivora: Viverridae e). *A. martinezi* is characterized by: a) the presence of three pairs of ventro-lateral teeth in the buccal capsule; and b) cuticular prominences in the shape of serrations on the dorso-lateral borders of the oral cavity. This Nematode is mainly distributed in Northeastern Spain, with a prevalence of 9.4 % in its host.

Key words: Nematoda; *Ancylostoma martinezi*; Carnivora; *Genetta genetta*; Iberian Peninsula

### Introduction

The faunistic studies on the helminth parasites of the common genet, *Genetta genetta* (Linnaeus, 1758) (Carnivora: Viverridae e) are diverse (Bernard, 1968; Simon-Vicente, 1975; Fassbender and Meyer, 1976; Macchioni *et al.*, 1982; Alvarez *et al.*, 1990; Navarrete *et al.*, 1990; Miquel *et al.*, 1992, 1994a, b). However, the only reports on species of the genus *Ancylostoma* parasitizing this carnivore throughout its African and European distribution areas are those by Simon-Vicente (1975) and Macchioni *et al.* (1982). Recently, Miquel *et al.* (1994a, b) added ample information on the helminth fauna isolated in this carnivore. Simon-Vicente (l. c.) detected a common genet, captured in the Northwest of the Iberian Peninsula, parasitized by several nematodes which could only be identified to genus level (*Ancylostoma* sp.). Macchioni *et al.* (l. c.) reported the species *A. caninum* also parasitizing a sole specimen of common genet in Somalia. On the other hand, in an earlier study of helminths that parasitize wild carnivores

in Catalonia (Northeast Spain), a new species of Ancylostomatid, *Ancylostoma martinezi*, was created parasitizing *G. genetta* (Miquel *et al.*, 1994b).

*A. martinezi*, also cited in Miquel *et al.* (1994a), was not described sufficiently in the original paper (Miquel *et al.*, 1994b). Thus, the aim of this study is to provide a general characterization, describe the holotype and the allotype, and revise the available chorological and ecological data. To this end, the number of animals analyzed has been increased from 144 (in earlier studies) to 277. The study also aims to describe the distinctive characters of *A. martinezi* in relation to the other species of the genus that parasitize carnivores that present three pairs of ventro-lateral teeth in the buccal capsule.

### Material and Methods

277 common genets were studied from 105 localities distributed in 36 Spanish provinces. 135 specimens came from Barcelona (B) and Girona (GI) and the remainder were from the other provinces indicated in Fig. 1. The hosts were sent to the laboratory frozen or preserved in 70 % alcohol.

The helminths removed from the hosts were preserved in a 70 % alcohol and were subsequently examined by light microscopy, following a rinse in lactophenol. Several specimens of *A. martinezi* were studied, but only those fixed in good extension (30 males and 30 females) were used for measurements.

### Results

*Ancylostoma martinezi* Miquel, Torres, Casanova et Feliu, 1994 was found in the small intestine of several (n = 26) common genets, *Genetta genetta*, most of which (n = 24) came from Barcelona (B) and Girona (GI) pro-

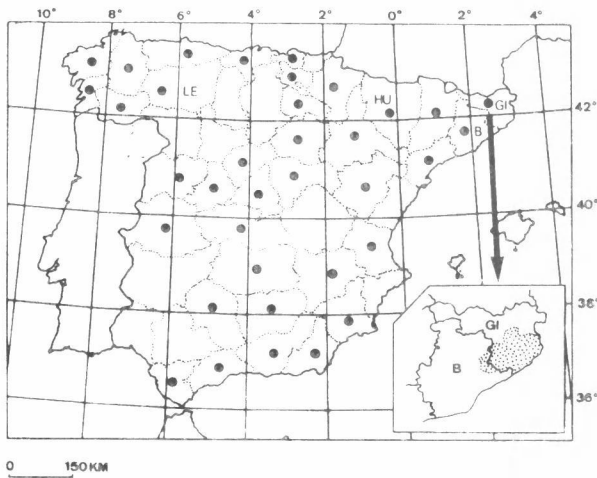


Fig. 1. Analyses host's source (●) and provinces where *A. martinezi* has been detected [Barcelona (B), Girona (GI), Huesca (HU) and León (LE)]

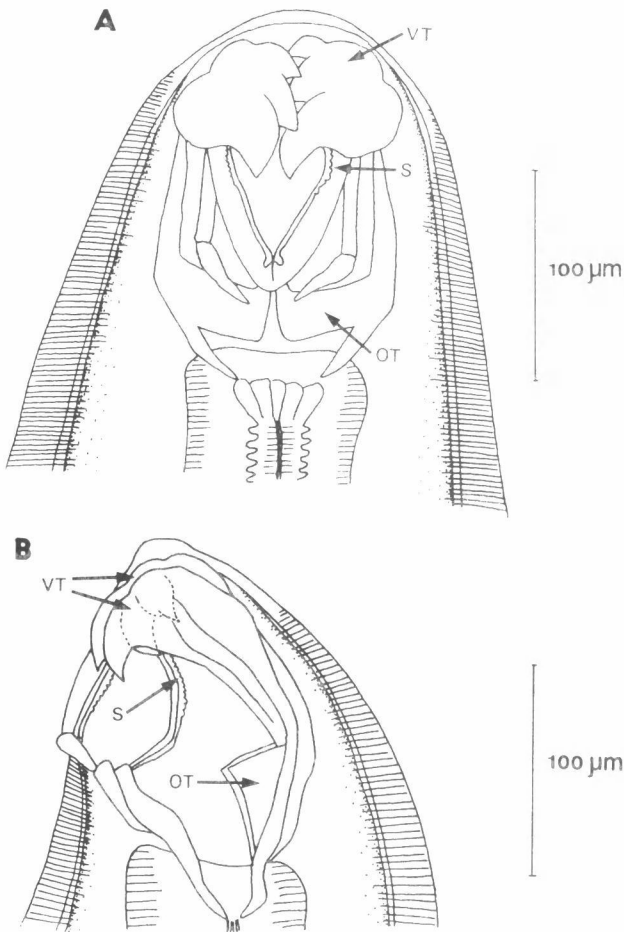


Fig. 2. *A. martinezi*. A and B—Anterior region, dorsal and lateral view, respectively. OT—oesophageal teeth; S—serrations; VT—ventral teeth

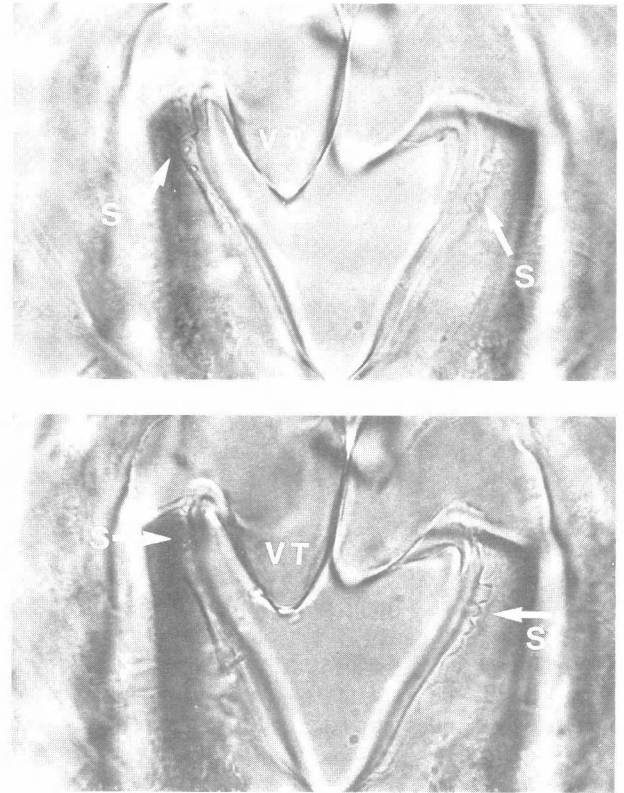


Fig. 3. Photographic prints of the cuticular prominences on the dorso-lateral border. S—serrations; VT—ventral teeth

vinces (Northeast of Spain) and also ( $n = 1$ ) from Barbas- tro [Huesca province (HU)] and ( $n = 1$ ) from Bembibre [León province (LE)] (Fig. 1). In the whole sample ( $n = 277$ ) the prevalence, range and mean intensity were respectively 9.4 %, 1—29 and 5.8. The holotype, allotype and paratypes were deposited in the Parasitological Institute SAS, Košice (Reg. No. 875).

*Ancylostoma martinezi* is relatively short, thick and anteriorly bent towards the dorsal side. The cuticle is strong and transversely striated. The cephalic region is almost totally occupied by the infundibular buccal capsule. The reduced mouth opening is antero-dorsally directed. The ventral border holds two chitinous plates, each bearing on three teeth. The median teeth are the smallest and the lateral ones the largest. It also presents two pairs of lateral plates and a pair of prominent oesophageal teeth, with a straight or slightly convex anterior margin that penetrates 30  $\mu\text{m}$  into the buccal capsule. *A. martinezi* has additional cuticular prominences, situated in the anterior part of both dorso-lateral borders of the oral cavity. They have the shape of serrations (Figs. 2A, 2B and 3). The cervical papillae have an inverted cone shape with a large base and are arranged in the same

transversal plane between the excretory pore and the nerve ring.

*Male (holotype)*

Body length 6790  $\mu\text{m}$ ; maximum width 413  $\mu\text{m}$ . The nerve ring, cervical papillae and excretory pore are located 388, 481 and 437  $\mu\text{m}$  from the cephalic extremity, respectively. The length and maximum width of the claviform oesophagus are 653 by 108  $\mu\text{m}$ . The dimensions of the two filiform spicules, with a scoop-shaped anterior (Fig. 4C) and narrow posterior extremities, are: length 1111  $\mu\text{m}$ ; maximum width 15  $\mu\text{m}$ ; length of the scoop-shaped opening 46  $\mu\text{m}$ . The ratio between length of the scoop-shaped opening and maximum width of the spicule is 3. The gubernaculum dimensions, wider on its

dorsal side, are 98 x 21  $\mu\text{m}$  (Fig. 4D). The dimensions of the paratypes are given in Table 1.

The copulatrix bursa is symmetrical. It presents well-developed lateral lobes and a rather reduced dorsal one. The ventral ribs fuse in a common trunk and become independent in the last third. The lateral ribs also arise from a common trunk. Before the middle-lateral and antero-lateral ribs become independent, the postero-lateral one detaches somewhat from the common trunk. The antero-lateral rib, clearly distant from the other two lateral ribs, presents a well defined ventral orientation. The middle-lateral and postero-lateral ribs are arranged divergently to each other, although they do not present either dorsal or ventral orientation (Fig. 4A). The externo-dorsal ribs arise from a common trunk from which the dorsal rib also originates and branches off distally. Each

Tab. 1. Measurements (in micrometres) of *Ancylostoma martinezi*

	males (n = 30)			females (n = 30)		
	min.	max.	mean $\pm$ S.D.	min.	max.	mean $\pm$ S.D.
Serrations	4	8		4	8	
Body length	4324	7842	6043.8 $\pm$ 1070.7	4747	9555	7013.3 $\pm$ 1350.2
Maximum body width	330	454	396.0 $\pm$ 39.4	413	615	482.3 $\pm$ 53.6
Width at anus				57	93	73.3 $\pm$ 8.2
Nerve ring *	314	463	383.7 $\pm$ 26.4	368	532	432.8 $\pm$ 37.4
Cervical papillae *	370	550	449.6 $\pm$ 51.2	391	609	479.0 $\pm$ 50.9
Excretory pore *	383	627	485.2 $\pm$ 63.7	378	617	503.6 $\pm$ 59.0
Oesophagus (length)	537	849	633.5 $\pm$ 56.3	591	846	725.3 $\pm$ 59.6
Oesophagus (max. width)	103	129	114.4 $\pm$ 7.5	108	157	127.3 $\pm$ 11.7
Spicules (length)	1041	1268	1158.2 $\pm$ 63.9			
Spicules (max. width)	13	18	15.2 $\pm$ 1.7			
Length of the scoop-shaped opening	31	49	39.9 $\pm$ 4.8			
Length of the scoop-shaped / max. width	1.9	3.8	2.6 $\pm$ 0.4			
Gubernaculum (length)	85	103	95.9 $\pm$ 5.2			
Gubernaculum (max. width)	10	23	16.9 $\pm$ 3.2			
Vulva **				1950	3580	2562.0 $\pm$ 476.5
as % of body length				60.6	69.4	65.1 $\pm$ 2.5
Tail				85	134	109.5 $\pm$ 13.9
Terminal spine				13	21	17.8 $\pm$ 2.6
Eggs (length)				50	64	58.4 $\pm$ 3.6
Eggs (width)				26	39	32.6 $\pm$ 3.7

Distance from anterior \* and posterior \*\* extremities

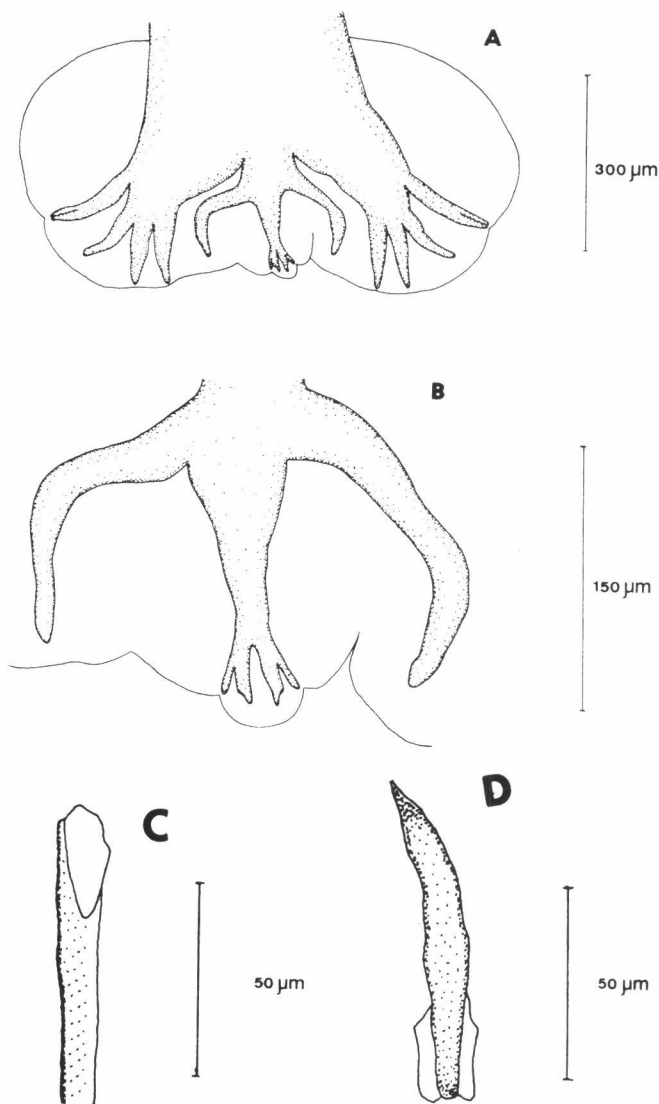


Fig. 4. *A. martinezi* male. A—bursa copulatrix; B—dorsal rays of the bursa copulatrix; C—scoop-shaped opening of the spicules; D—gubernaculum, dorsal view

branch shows three fingerings of very similar width. The external fingerings are clearly separated from the respective middle and internal ones, which are very slightly separated from each other and sometimes they even show a simple depression. The innermost fingerings are longer than the respective middle and external ones, which are similar in length (Fig. 4B).

#### Female (allotype)

Body length 9256 µm; maximum width 90 µm at a slightly prevulvar level. Width at level of the anus 121 µm. The nerve ring, cervical papillae and excretory pore

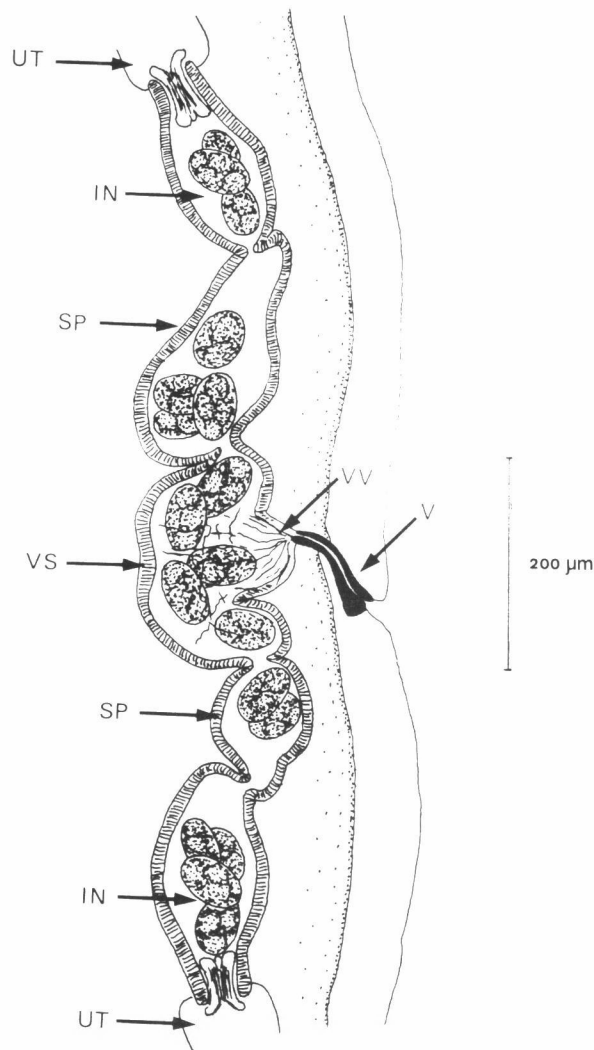


Fig. 5. *A. martinezi* female, vulvar region. IN—infundibulum; SP—sphincter; UT—uterus; V—vulva; VS—vestibule; VV—vagina vera

are located 419, 537 and 573 µm from the cephalic extremity, respectively. The length and maximum width of the oesophagus are 699 by 121 µm. The vulva presents robust lips and is located 3426 µm from the caudal extremity, at 63 % of body length (Fig. 5). The short narrow tail, often curved ventrally, measures 121 µm. It ends in a spine shaped appendix. Range and average of the eggs are 54—64 x 26—39 µm (58.4 x 32.6 µm). The dimension of the paratypes are given in Table 1.

#### Discussion

Lichtenfels (1980) recognized four subgenera within the genus *Ancylostoma* (Dubini, 1843). They are the nominal *Ancylostoma* (*Ancylostoma*) Lane, 1916;

Tab. 2. Comparative morphometry (in micrometres) of males of *A. martinezi* and another *Ancylostoma* species parasitizing carnivores

Species	<i>A. tubaeforme</i>	<i>A. caninum</i>	<i>A. lucknowense</i>	<i>A. martinezi</i>
Host	Felidae	Canidae	<i>Felis bengalensis</i>	<i>Genetta genetta</i>
Chorology	Cosmopolite	Cosmopolite	India	Spain
Reference	Burrows (1962)	Burrows (1962)	Gupta & Kalia (1984)	Present study
Sample	(n = 20)	(n = 20)	(n = 4)	(n = 30)
Serrations	Absent	Absent	15—20	4—8
Body length	9500—11000 (10300)	11000—13000 (11700)	9120—9648	4324—7842 (6043.8)
Maximum body width	300—350 (320)	340—390 (370)	304—352	330—454 (396.0)
Nerve ring *	—	—	464—528	314—463 (383.7)
Cervical papillae *	—	—	576—608	370—550 (449.6)
Excretory pore *	—	—	560—600	383—627 (485.2)
Oesophagus (length)	810—950 (870)	1130—1260 (1180)	704—832	537—849 (633.5)
Oesophagus (max. width)	—	—	—	103—129 (114.4)
Spicules (length)	1100—1470 (1290)	730—960 (860)	1120—1248	1041—1268 (1158.2)
Spicules (max. width)	10—15	10—15	—	13—18 (15.2)
Length of the scoop-shaped opening	48—69	24—33	—	31—49 (39.9)
Length of the scoop-shaped / max. width	4	2	—	1.9—3.8 (2.6)
Gubernaculum (length)	—	—	92—104	85—103 (95.9)
Gubernaculum (max. width)	—	—	—	10—23 (16.9)

\* Distance from anterior extremity

*Ancylostoma* (*Ceylancylostoma*) Lane, 1916; *Ancylostoma* (*Afrancylostoma*) Biocca et Le Roux, 1958; and *Ancylostoma* (*Amerancylostoma*) Biocca et Le Roux, 1958. *Ancylostoma martinezi* belongs to the nominal subgenus, which is the only one that includes specimens with three pairs of ventro-lateral teeth in the buccal capsule. To date, this subgenus includes ten species that are parasites of carnivores: the cosmopolitan species *A. caninum* (Ercolani, 1859) and *A. tubaeforme* (Zeder, 1800), habitual

parasites of canids and felids, respectively; *A. taxideae* Kalkan et Hansen, 1966 and *A. conepti* (Solonet, 1911) parasites of mustelids in the New World; *A. martinagliai* Monning, 1931, reported to parasitize a black-backed jackal at Johannesburg Zoological Garden; *A. buckleyi* Le Roux et Biocca, 1957 and *A. iperodontatum* Le Roux et Biocca, 1957, which parasitize, respectively, *Felis concolor* Linnaeus, 1771 in Argentina and *Acinonyx jubatus* (Schreber, 1776) in Northern Rhodesia; *A. lucknowense*

Tab. 3. Comparative morphometry (in micrometres) of females of *A. martinezi* and another *Ancylostoma* species parasitizing carnivores

Species	<i>A. tubaeforme</i>	<i>A. caninum</i>	<i>A. lucknowense</i>	<i>A. martinezi</i>
Host	Felidae	Canidae	<i>Felis bengalensis</i>	<i>Genetta genetta</i>
Chorology	Cosmopolite	Cosmopolite	India	Spain
Reference	Burrows (1962)	Burrows (1962)	Gupta & Kalia (1984)	Present study
Sample	(n = 20)	(n = 20)	(n = 4)	(n = 30)
Serrations	Absent	Absent	15—20	4—8
Body length	12000—15000 (13200)	14000—20500 (17000)	13248	4747—9555 (7013.3)
Maximum body width	380—430 (410)	500—560 (520)	400	413—615 (482.3)
Width at anus	—	—	—	57—93 (73.3)
Nerve ring *	—	—	520	368—532 (432.8)
Cervical papillae *	—	—	676	391—609 (479.0)
Excretory pore *	—	—	656	378—617 (503.6)
Oesophagus (length)	810—950 (870)	1130—1260 (1180)	864	591—846 (725.3)
Oesophagus (max. width)	—	—	—	108—157 (127.3)
Vulva **	—	—	4640	1950—3580 (2562.0)
as % of body length	—	—	—	60.6—69.4 (65.1)
Tail	160—230 (180)	250—320 (280)	136	85—134 (109.5)
Terminal spine	—	—	20	13—21 (17.8)
Eggs (length)	55.0—75.7 (63.1)	55.0—72.2 (62.2)	56—60	54—64 (58.4)
Eggs (width)	34.4—44.7 (40.0)	34.4—44.7 (38.8)	36—40	26—39 (32.6)

Distance from anterior \* and posterior \*\* extremities

Gupta et Kalia, 1984 and *A. quentini* Gupta et Kalia, 1984, more recently described in India, parasitizing, respectively, *Felis bengalensis* Kerr, 1792 and *Canis aureus* Linnaeus, 1758; and *A. martinezi* Miquel, Torres, Casanova et Feliu, 1994, a common parasite of *Genetta genetta* in the Iberian Peninsula.

Gupta and Kalia (1984) divided all the species mentioned above (except *A. martinezi*) in two groups, depending on the presence or absence of cuticular prominences (teeth or serrations) on the dorso-lateral borders of the oral cavity. The species which have smooth dorso-lateral borders of the oral cavity (without any formation)

are *A. tubaeforme*, *A. caninum*, *A. conepti*, *A. taxideae* and *A. quentini*. The other group includes species with cuticular prominences (*A. martinagliai*, *A. buckleyi*, *A. iperodontatum*, *A. lucknowense*), and now also *A. martinezi*.

*A. martinezi* presents certain morphometric differences respect to the cosmopolitan species (*A. caninum* and *A. tubaeforme*) according to the redescrptions provided by Burrows (1962) (Tab. 2, 3). In this context, the body length of *A. martinezi* (near half that shown by *A. caninum*) and the different size of the spicules (they never reach 1 mm long in *A. caninum*) allows easy differentiation of the two species. On the other hand, the ratio "length of the scoop-shaped opening / maximum width of the spicule" and the cuticular striations distance (measured using scanning electron microscope) are differential aspects between *A. martinezi* (2.9 µm) and *A. tubaeforme* (1.6 µm).

The magnitude of the male's spicules (1.8—2.2 mm) of *A. conepti*, the asymmetrical morphology of the copulatrix bursa of *A. quentini* and the prominent vulvar lips of *A. taxideae* (Kalkan and Hansen, 1966; Gupta and Kalia, 1984) are clearly distinctive features from *A. martinezi*.

The other group proposed by Gupta and Kalia (l. c.) includes species presenting cuticular prominences on the dorso-lateral borders of the oral cavity always in the shape of teeth, except *A. lucknowense*, in which, as in *A. martinezi*, the cuticular prominences are in the shape of serrations. Thus, *A. martinezi* is clearly different from *A. martinagliai*, *A. buckleyi* and *A. iperodontatum* which present, respectively, one tooth, two and three teeth in each dorso-lateral border of the oral cavity (Monnin, 1931; LeRoux and Biocca, 1957).

The more important distinctive characters between *A. martinezi* and *A. lucknowense* are:

- the reduced general size of *A. martinezi* respect to *A. lucknowense*;
- the number of cuticular serrations;
- the arrangement of the middle-lateral and postero-lateral ribs of the copulatrix bursa; and
- the fingerings of the two parts in which the dorsal ribs is divided. The first aspect contrasts with the superposition of certain important structures such as the length of the spicules and the gubernaculum (Tab. 2).

After the analysis of more than 1300 wild carnivores in Spain, the qualitative and quantitative results obtained for species of the genus *Ancylostoma* are:

- A. caninum* in *Vulpes vulpes* (n = 237; 0.8 %);
- A. tubaeforme* in *Felis silvestris* (n = 68; 1.4 %) and
- A. martinezi* in *Genetta genetta* (n = 277; 9.4 %).

These data appear to confirm that *A. martinezi* is a specific helminth of *G. genetta*, as occurs in other iberian species (*Taenia parva* and *Toxocara genettae*) of this host (Alvarez *et al.* 1990).

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