

A REVISION OF THE GENUS *IMPALAI* MÖNNIG, 1924

J. BOOMKER, Veterinary Research Institute, Onderstepoort, 0110

ABSTRACT

BOOMKER, J., 1977. A revision of the genus *Impalaia* Mönnig, 1924. *Onderstepoort Journal of Veterinary Research*. 44 (3), 131-138 (1977).

A revision of the genus *Impalaia* Mönnig, 1924 forms the subject of this report. Besides the type species, *Impalaia tuberculata* Mönnig, 1924, there are 2 valid species, viz., *I. nudicollis* Mönnig, 1931 and *I. okapiae* (Van den Berghe, 1937). *I. tuberculata longispiculata* (Wetzel & Fortmeyer, 1960), *I. somaliensis* (Crovieri, 1929) and *I. aegyptiaca* Soliman, 1956 are synonymous with *I. tuberculata*. *I. taurotragi* (Le Roux, 1936) appears to be an aberrant form of *I. nudicollis*. A parasite/host check-list is included.

Résumé

LA RÉVISION DU GENRE *IMPALAI* MÖNNIG, 1924

Ce rapport a pour objet une révision du genre *Impalaia* Mönnig, 1924. Outre l'espèce-type, *Impalaia tuberculata* Mönnig, 1924, il y a 2 espèces valides, soit *I. nudicollis* Mönnig, 1931, et *I. okapiae* (Van den Berghe, 1937). *I. tuberculata longispiculata* (Wetzel & Fortmeyer, 1960), *I. somaliensis* (Crovieri, 1929) et *I. aegyptiaca* Soliman, 1956 sont synonymes de *I. tuberculata*. *I. taurotragi* (Le Roux, 1936) semble être une forme irrégulière d'*I. nudicollis*. Une liste de contrôle des parasites et de leurs hôtes est jointe à cette révision.

INTRODUCTION

In July 1970, a giraffe (*Giraffa camelopardalis* Linn., 1758) died in the National Zoological Gardens, Pretoria, Republic of South Africa. At autopsy the animal was found to be infested with *Cooperia punctata* (von Linstow, 1907), *Nematodirus spathiger* (Railliet, 1896), *Trichuris globulosa* (von Linstow, 1901) as well as with a number of specimens belonging to the genus *Impalaia*. In an attempt to identify these nematodes, type specimens of *Impalaia tuberculata* Mönnig, 1924, *I. nudicollis* Mönnig, 1931, *I. aegyptiaca* Soliman, 1956 and *I. taurotragi* (Le Roux, 1936), as well as specimens of *I. tuberculata* and *I. nudicollis* from different species of herbivores were examined. The range of variation of the different characters was determined and used to assess the validity of the various species.

DIAGNOSIS OF THE GENUS

Trichostrongylidae, Heligmosominae: The body is filiform and not spirally coiled. The cuticle bears about 14 longitudinal ridges which are supported by sclerotized rods. The cephalic region is inflated and bears 18-20 fine cross striations. The mouth is terminal and is surrounded by 3 small lips. The bursa is hoodshaped with an indistinct dorsal lobe. The arrangement of the bursal rays is typical for the genus. The vulva is located near the anus in the terminal tenth of the body. The female tail is knob-like and bears 3 subterminal papillae.

Redescription of *Impalaia tuberculata* Mönnig, 1924

Type host

Aepyceros melampus (Lichtenstein, 1812)—impala.

Other recorded hosts

Capra hircus Linn., 1758—domestic goat
Damaliscus dorcas dorcas (Pallas, 1766)—bontebok
Damaliscus dorcas phillipsi (Harper, 1939)—blesbok
Damaliscus lunatus (Burchell, 1823)—tsesseebe
Giraffa camelopardalis (Linn., 1758)—giraffe
Hippotragus niger (Harris, 1838)—sable antelope
Raphicerus campestris (Thunberg, 1811)—steenbok
Raphicerus melanotis (Thunberg, 1811)—Cape grysbok

Redunca fulvorufula (Afzelius, 1815)—mountain reedbuck

Material examined

A. melampus—Type specimens (Onderstepoort Helminthological Collection, No. T 2010), 3 males, 6 females. Additional material: 15 males, 12 females, from 6 impala.

D. d. phillipsi—1 male and 2 females

D. lunatus—3 females

G. camelopardalis—5 males and 6 females

H. niger—5 males and 6 females

R. campestris—1 male and 1 female, both damaged anteriorly

R. fulvorufula—9 males and 9 females

Description

The principal measurements are listed in Table 1.

Male: The copulatory bursa has 2 large lateral lobes and an indistinct dorsal lobe (Fig. 1). The latero-ventral and ventro-ventral rays originate separately and both curve ventrally and anteriorly. The antero-lateral and medio-lateral rays run parallel for about one-half of their length. When they diverge, the antero-lateral ray curves anteriorly and the medio-lateral ray ventrally. The postero-lateral ray diverges from the medio-lateral ray at about one-fourth of its length and runs caudally and ventrally. The postero-lateral ray is the longest and the antero-lateral ray the shortest of the lateral rays. The length of the dorsal ray could not be determined in the type specimens. In the additional specimens from the type host, the 2 externo-dorsal rays arise at different levels from the dorsal ray, about one-fourth of its length from its origin. The right externo-dorsal ray is longer than the left one and shows a characteristic curvature near its end. Distally, the dorsal ray divides and each of the divisions redivides into laterally and caudally directed branches which give it a wide and squat appearance. The caudally directed branches each bear a small median protuberance. The lateral branches are longer than the caudally directed ones and end in small hooks that usually point anteriorly (Fig. 3).

The spicules are equal, slender, and end in fine points. Their proximal ends are clavate and do not show the hooks illustrated by Mönnig (1924) (Fig. 5a). The gubernaculum is boat-shaped and poorly sclerotized.

Female: The vulva is simple and slightly protruding and is situated in the caudal tenth of the body. The single ovjector consists of a muscular *pars ejaculatrix* which is separated from the *pars haustrix* by a well-

developed sphincter. There is a single uterus and one ovary. The tail is blunt and bears 3 subterminal papillae (Fig. 6a). Eggs are slightly elongated, thin-walled and contain a morula. Occasional eggs contain a larva.

Description of Impalala tuberculata longispiculata
(Wetzel & Fortmeyer, 1960)

Type host

Litocranius walleri (Brooke, 1878)—gerenuk

Other recorded hosts

Capra hircus (experimental)—domestic goat

Description

The principal measurements as recorded by Wetzel & Fortmeyer (1960) are listed in Table 1.

The following is an abridged version of the description given by Wetzel & Fortmeyer (1960):

Males: The copulatory bursa has the same structure and ray pattern as that of *I. tuberculata*. The almost symmetrical, long, thin externo-dorsal rays emerge from the dorsal ray about one-sixth of its length from its origin. Distally, the dorsal ray divides and redivides as in *I. tuberculata*. The spicules show greater variation in their lengths than those of *I. tuberculata* from the impala and are enclosed in a sheath for most of their length.

Females: The females conform to the description of *I. tuberculata* from the impala.

Redescription of I. aegyptiaca Soliman, 1956

Type host

Camelus dromedarius Linn., 1758—camel.

Material examined

Six paratype males and 10 paratype females.

Description

The principal measurements are listed in Table 1.

Males: The copulatory bursa has the same structure and ray pattern as that of *I. tuberculata*. The externo-dorsal rays arise from the dorsal ray at about one-seventh of its length from the base. The right externo-dorsal ray is longer than or equals the length of the left externo-dorsal ray. Distally, the dorsal ray divides and redivides as in *I. tuberculata*. A small protuberance on the caudally directed branch is present. The spicules are equal and slender. The gubernaculum is boat-shaped.

Females: The tail is blunt and bears 3 subterminal papillae. The vulva is a transverse slit. The single ovijector resembles that of *I. tuberculata*. Eggs are subspherical to elongate. The larger eggs contain larvae.

Description of Impalala somaliensis (Crovieri, 1929)
Travassos, 1937

Syn. Anthostrongylus somaliensis Crovieri, 1929

Host

Camelus dromedarius Linn., 1758—camel.

Description

The principal measurements recorded by Crovieri (1929) and cited by Travassos (1937) are listed in Table 1. The following is an abridged version of the description given by Travassos (1937).

Males: They are about 9 mm in length. Spicules are of uniform width in the middle and are dilated at the proximal end and acute and curving inwards at the distal end. The gubernaculum is 0,090 mm long.

Females: They are larger than the males. The posterior extremity is conical and ends in a very sharp point. The anus is at the base of the tail and the vulva is slightly in front of the anus. A prominent muscular vagina which divides into 2 uteri is present.

Description of Impalala okapiae (Van den Berghe, 1937)

Syn. Anthostrongylus okapiae Van den Berghe, 1937

Type host

Okapia johnstoni (Sclater, 1901)—okapi.

Description

The principal measurements as recorded by Van den Berghe (1937) are listed in Table 4. The description is that given by Van den Berghe (1937).

Males: The dorsal lobe is separated from the 2 lateral lobes by a small ridge. The lateral lobes are asymmetrical, the left lobe and rays being larger than those on the right. The structure and disposition of the bursal rays are similar to those of *I. tuberculata*.

Females: According to Van den Berghe (1937), "the posterior extremity is enlarged at the height of the vulva and rings and terminates in a fine point. The vulva and the rings are closely approximated".

Redescription of Impalala nudicollis Mönnig, 1931

Type host

Damaliscus dorcas phillipsi (Harper, 1939)—blesbok.

Other recorded hosts:

- A. melampus*—impala
- Bos* spp.—domestic cattle
- C. dromedarius*—camel
- D. lunatus*—tsessebe
- Gazella thomsoni* (Günther, 1884)—Thomson's gazelle
- Kobus ellipsiprymnus* (Ogilby, 1833)—waterbuck
- O. aries*—domestic sheep
- R. campestris*—steenbok
- Sylvicapra grimmia* (Linn., 1758)—grey duiker

Material examined

D. d. phillipsi—Type specimens (Onderstepoort Helminthological Collection, No. T 2030), males and females. Additional material: 4 males and 6 females from 3 blesbok.

O. aries—8 males and 6 females from experimental infestations, 14 and 30 days after infestation.

Taurotragus oryx (Pallas, 1776)—3 males and 3 females.

Description

The principal measurements are listed in Table 2.

Males: The bursa is fairly large, but markedly smaller than that of *I. tuberculata*, having 2 distinct lateral lobes and an indistinct dorsal lobe (Fig. 2). The origin and disposition of the lateral and ventral rays are identical with those of *I. tuberculata*. The dorsal ray does not have the characteristic bend of *I. tuberculata* but may be slightly curved and though the externo-dorsal rays are usually equal in number, they may differ slightly in length. They originate about one-fifth of the length of the dorsal ray from its base, at the same or slightly different levels. Distally, the

TABLE 1 Comparison of primary measurements of *I. tuberculata* from different hosts*

Host	Synonym	Author	Length (mm)	Width
<i>A. melampus</i>		Mönnig (2924).....	7,2-7,5 18,5	120 120
		Types, this paper.....	7,0-8,0 16,0-18,7	103-129 148
		Additional material.....	7,5 15,5-16,9	122,1-148 137,9-192,4
<i>D. d. phillipsi</i>			4,2-6,3 10,7-12,6	140,6 166-185
<i>G. camelopardalis</i>			8,8-9,2 12,5-13,6	136-160 166-185
<i>H. niger</i>			7,1-9,5 13,1-15,6	142-172,8 161,5-192
<i>R. fulvorufula</i>			7,2-8,0 12,5-14,7	103-147,4 166,5-177
<i>C. dromedarius</i>	<i>I. somaliensis</i>	Travassos (1937).....	9,0 14,0-17,0	163 —
	<i>I. aegyptiaca</i>	Soliman (1956).....	8,5-11,5 15,0-21,0	130-160 140-170
		Paratypes, this paper....	7,4-9,6 14,8-19,6	129,5-177,6 187,6-214,6
<i>L. walleri</i>	<i>I. t. longispiculata</i>	Wetzel & Fortmeyer (1960)	6,7-7,9 12,5-16,1	50-63 at oesophagus 52-69
<i>G. thomsoni</i>	<i>I. nudicollis</i>	Yeh (1956).....	6,2-8,2 14,6-15,3	120-130 130-150
<i>O. aries</i>	<i>I. nudicollis</i>	Daubney (1933).....	7,5-9,0 11,0-13,0	100 200

* All measurements given in μm unless stated otherwise

TABLE 2 The principal measurements of *I. nudicollis* from different hosts*

Host	Author	Length (mm)	Width
<i>D. d. phillipsi</i>	Mönnig (1931).....	7,5-8,2 14,8-16,7	110-120 140-160
	Types, this paper.....	6,5-7,5 14,0-16,0	98-105 107-114
	Additional material.....	7,0-8,0 14,0-16,5	114,7-155,4 159,1-203,5
<i>O. aries</i> 14 days in sheep.....		6,3-7,0 12,5-13,7	111-136,9 148
	30 days in sheep.....	6,0-6,7 10,8-12,9	100-133,6 125-137
<i>T. oryx</i>		6,3-7,0 12,5-14,0	118,4-140,6 122,1-136,9

* All measurements are given in μm unless stated otherwise

TABLE 3 The principal measurements of *I. taurotragi**

Host	Author	Length (mm)	Width
<i>T. oryx</i>	Le Roux (1936).....	4,8 6,1	56 88
	Holotype this paper.....	3,1	46,8
	Allotype this paper.....	4,85	93,6

* All measurements are given in μm unless stated otherwise

p133b

Cephalic inflation, length	Head width	Oesophagus length	Nerve ring from anterior extremity	Excretory pore from anterior extremity	Spicule length	Gubernaculum length	Bursa length
86-100	40-45	440	Just behind	—	600	—	—
86-100	40-45	440	middle of	—	—	—	—
81,4-92	25,9	440-445	oesophagus	—	850-858	74	—
79,9-96	29,5	555-603	240-307	—	—	—	—
96-114,7	25,9-29,6	425-477	277	—	—	—	—
103-129,5	29,6-37	451-499,5	266,4-300	499-569,5	804-851	81,4-92,5	562-737
85,1	33,3	362,6	285-314	495-529,1	—	—	—
122,1-125,8	33,3	410-444	—	403,3	950,9	92,5	737
95-107	26	333-338	240-278	481	—	—	—
118-125	37	429-455	240-277	420-490	871-898	88,8-93,8	743-777
98,4-156	31,2-36	417-494	311-318	490-560	—	—	—
108-121,8	33,6-38,4	454-532	211-261,8	537-600	1 016-1 168	84-112,8	684-807
85,1-129,5	25,9-33,6	388,5-425	228-319,2	603-607	—	—	—
107,3-118,4	33,3-37	462,5-499,5	259-277,5	—	780-832	74-92,5	469-603
—	—	—	259-314,5	507,6-525,4	—	—	—
—	—	—	—	—	1 080	90	—
—	32-38	380-520	320-330	3 800-4 200	1 300-1 600	82-100	—
—	34-36	460-620	320-370	3 800-4 200	—	—	—
111-136,9	29,6-33,3	418-499,5	227-344	426,5-617,9	1 246-1 380	89-103,6	573,5-740
114,7-140,6	33,3-40,7	480-585	300-343	535-660	—	—	—
—	—	300-365	207-246	391-437	838,1-1 202	79-104	—
—	—	316-382	206-246	418-478	—	—	—
60-100	40-50	380-430	—	330-440	835-1 160	90-100	—
60-100	40-50	400-490	—	330-440	—	—	—
100-130	30	350-450	—	—	900-1 000	85	—
100-130	45	350-450	—	—	—	—	—

p133a

p133c

Cephalic inflation, length	Head width	Oesophagus length	Nerve ring from anterior extremity	Excretory pore from anterior extremity	Spicule length	Gubernaculum length	Bursa length
130-140	51	440-480	370-410	—	910-980	94-100	—
140-150	46-59	440-520	330-390	—	—	—	—
107-114	22,2-25,9	322-370	222-226	422	740-795	92,5	333-351
118-125	29,6	396-414	270-274	440	—	—	—
107-122	25,9	344,1-384	222-296	491	788-910	81,4-92,5	351-407
118-129	29,6-33,3	370-407	240-296	524	—	—	—
99,1-107,3	22,2-25,9	351-403	185-240	370-440	871-951	81,4-96,2	333-370
111	33-37	407-410	259	462-484	—	—	—
100-114,7	25,9	314-340	240-259	388-462	777-832,5	85,1-92,5	296-333
111-118,4	29,6-33,3	370-384,5	240-259	425-458	—	—	—
48,1-62,9	25,9-29,6	333-370	215,7-227,8	388,5	743-802	81,4	296-333
92,5-99,9	25,9-29,6	395-447	203-258	402,8-528,4	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
32,4	14,4	637	136,8	—	580	±60	—
—	—	645	—	165	—	—	—
—	—	—	—	—	554,4	57,6	92,2
—	—	—	—	—	—	—	—

Externo-dorsal length		Dorsal length	Anus to tail	Anus to vulva	Vulva to tail	Ovijector	Eggs
Right	Left						
—	—	—	40	60	100	—	60 × 32
—	—	—	—	—	—	—	—
384-684	284,9-351	415-576	51,8-59,2	185-188,7	240,5-244	—	—
473,3	351	603	44,4-66,6	136,9-203,5	181,3-270,1	407	55-66 × 26-44
407-585	340-384	627-670	51,8-59,2	143-159	194,8-218,2	358,4-362,6	62,9 × 37
420-484	330-367,2	607,5-704,5	63	137-177	200-240	314-415	63-65 × 35-45
351-432,9	259-330	402-495	52-72	136-172	188-224	408-589	60-76 × 28-55
—	—	—	55,5-59,2	118,4-162,8	173,9-222	351-370	55,5-59,2 × 37-44,4
—	—	—	—	—	—	—	80-90 × 50-54
—	—	600-700	—	—	—	—	—
370-469,9	318,2-388	522-643	52-68	114-192	182-260	400-600	65-73 × 37-41
—	—	—	51,8-77,7	148-203,5	199,8-281,2	462-629	55,5-70,3 × 33,3-40,7
—	—	—	—	—	—	—	—
—	—	—	38-49	—	139-224	—	63-79 × 41-46
—	—	440	—	—	—	—	—
—	—	—	54-63	—	170-220	500-600	67-73 × 38-44
—	—	400-500	—	—	—	—	—
—	—	—	55-60	—	200	500-700	78 × 40

p133b

Externo-dorsal length		Dorsal length	Anus to tail	Anus to vulva	Vulva to tail	Ovijector length	Eggs
Right	Left						
—	—	—	—	—	—	—	—
137-159	116-148	203-222	67-75	173-186	240-260	—	63-75 × 39-46
185-222	185-210	263,4-277	55,5-66,6	147,5-170,4	203-237	277-317	68 × 39
—	—	—	62,9-74	155-222	217-296	222-340	59,2-66,6 × 37-44,4
166-210,9	185-222	222-296	74	185-222	259-296	296-370	59,2-62,9 × 33,3-37
166-185	166-177,6	240-259	—	—	—	—	—
—	—	—	111-122,5	129-148	240,5-259	222-259	55,5-59,2 × 37-40,7
170-185	155-166,5	222-258	—	—	—	—	—
—	—	—	62,9-66,6	159-177,1	222,4-243,7	259-296	55,5-59,2 × 40,7-48,7

Externo-dorsal length		Dorsal length	Anus to tail	Anus to vulva	Vulva to tail	Ovijector length	Eggs
Right	Left						
—	—	40	—	—	—	—	—
64,8	57,6	39,6	52	126	178	—	78 × 35
—	—	—	54	111,6	165,6	342	61-68 × 36-39

End of table

TABLE 4 Principal measurements of *I. okapiae* as given by Van den Bergh, 1937*

	♂	♀
Length (mm).....	11,0	13,0
Width.....	247	330
Cephalic inflation length.....	53	—
Head width.....	—	—
Oesophagus length.....	478	462
Excretory pore.....	644	—
Spicule length.....	2,062	—
Gubernaculum length.....	170	—
Tail to anus.....	—	83
Anus to vulva.....	—	107
Vulva to tail.....	—	190
Ovijector.....	—	—
Eggs.....	—	82 × 65

* All measurements given in μm unless stated otherwise

dorsal ray divides and redivides immediately. The lateral branches are shorter than or equal to the median branches, which usually bear a protuberance (Fig. 4). In some specimens there is an additional small papilla immediately in front of the primary bifurcation. The spicules are slender, clavate, equal, and terminate in fine points. Proximally, they bear a small median process (Fig. 5b). The gubernaculum is boat-shaped.

Females: The tail is blunt and knob-like and bears 3 subterminal papillae (Fig. 6b). The vulva is a slightly protruding transverse slit situated in the caudal tenth of the body. The single ovijector consists of a muscular *pars ejaculatrix*, a well developed sphincter and a *pars haustrix*. The vagina is simple and muscular. There is a single uterus and one ovary. Eggs are slightly elongate.

Redescription of *Impalaia tauroraghi* (Le Roux, 1936)
Travassos, 1937.

Syn. *Minutostrongylus tauroraghi* Le Roux, 1936

Type host

Taurotragus oryx (Pallas, 1776)—Cape eland

Material examined

The slightly damaged holotype male and the allotype female.

Description

These worms are the smallest in the genus.

The principal measurements are listed in Table 3.

The nerve ring is situated 136,8 μm from the anterior extremity in the female. The excretory pore could not be located in either specimen.

Male: The bursal rays resemble those of the genus. The dorsal ray is straight and very short. The externo-dorsal rays arise at the same height and the left externo-dorsal ray is a little shorter than the right. Distally, the dorsal ray divides and immediately redivides. The median branches each bear a small protuberance and are shorter than the lateral branches. The spicules are lightly sclerotized, equal, and terminate in fine points. The gubernaculum is boat-shaped.

Females: The tail is blunt and no papillae are present. The vulva is a slightly protruding transverse slit situated in the caudal tenth of the body. The single ovijector consists of a muscular *pars ejaculatrix*, a well-developed sphincter and a *pars haustrix*. The eggs are slightly elongate.

DISCUSSION

The species in the genus *Impalaia* may be divided into (a) the *I. tuberculata* group, which includes *I. tuberculata*, *I. t. longispiculata*, *I. aegyptiaca*, *I. somaliensis* and *I. okapiae* and (b) the *I. nudicollis* group, which includes *I. nudicollis* and *I. tauroraghi*.

The *I. tuberculata* group

All the species belonging to this group have a large copulatory bursa and a characteristic bend in the distal third of the dorsal ray. The tip of the dorsal ray spreads so that it is wider than long.

According to Mönning (1924), the cervical region of *I. tuberculata* bears numerous irregularly arranged tubercles. Mönning (1932), however, points out that these tubercles were artifacts and could not be used for specific identification. Daubney (1933) collected an *Impalaia* sp. from sheep in Kenya. The nematodes of this species did not have tubercles and were erroneously assigned to *I. nudicollis* instead of *I. tuberculata*. The measurements and illustrations given by Daubney (1933) are undoubtedly those of *I. tuberculata*. Wetzel & Fortmeyer (1960) described tubercles in the cervical region of *I. t. longispiculata*. The latter subspecies was based on specimens obtained from a goat which was infested with infective larvae derived from faecal cultures of gerenuk (Wetzel & Fortmeyer, 1960). Pande, Rai & Bhatia (1962) recovered an *Impalaia* sp. from a camel which they identified as *I. nudicollis*. They also provide a key for the genus *Impalaia* in which they erroneously use the presence of tubercles to differentiate between *I. tuberculata* and *I. nudicollis*.

It must be stressed that no tubercles were found in any of the specimens examined and their presence or absence cannot be used as a valid criterion for the separation of *I. tuberculata* and *I. nudicollis*.

Yeh (1956) identified nematodes from Thomson's gazelle as *I. nudicollis*. From the measurements he provides (Table 1), it is clear that these parasites are *I. tuberculata* and that they closely resemble *I. t. longispiculata* which differs from the type specimens only in the length of the spicules. The validity of *I. t. longispiculata* as a distinct subspecies is doubtful.

Pande *et al.*, (1962) compared *I. nudicollis* from the camel with those from Thomson's gazelle described by Yeh (1956). The parasites from the camel, however, cannot be assigned to any species as the measurements quoted in the text do not agree with those calculated from the illustrations.

I. aegyptiaca is the largest member of the genus. The excretory pore is situated 426–618 μm from the anterior extremity in the paratype males and 562–602 μm in the paratype females and not 3 800–4 200 μm as erroneously recorded by Soliman (1956). The shape and disposition of the bursal rays are identical with those of *I. tuberculata* type specimens. The length of the spicules is within the range of *I. tuberculata* as recorded by Yeh (1956) and Wetzel & Fortmeyer (1960).

Travassos (1937) stated that *I. somaliensis* differed from *I. tuberculata* in that it had a double uterus and larger spicules and eggs. The reference to the double uterus was evidently the result of an incorrect observation. The larger size of the spicules of *I. somaliensis* was not confirmed by a comparison with the figures of *I. tuberculata* as illustrated in Yorke & Mapleston (1926) (Travassos, 1937). Moreover, the size of the eggs is too variable to be considered a valid criterion for separating species.

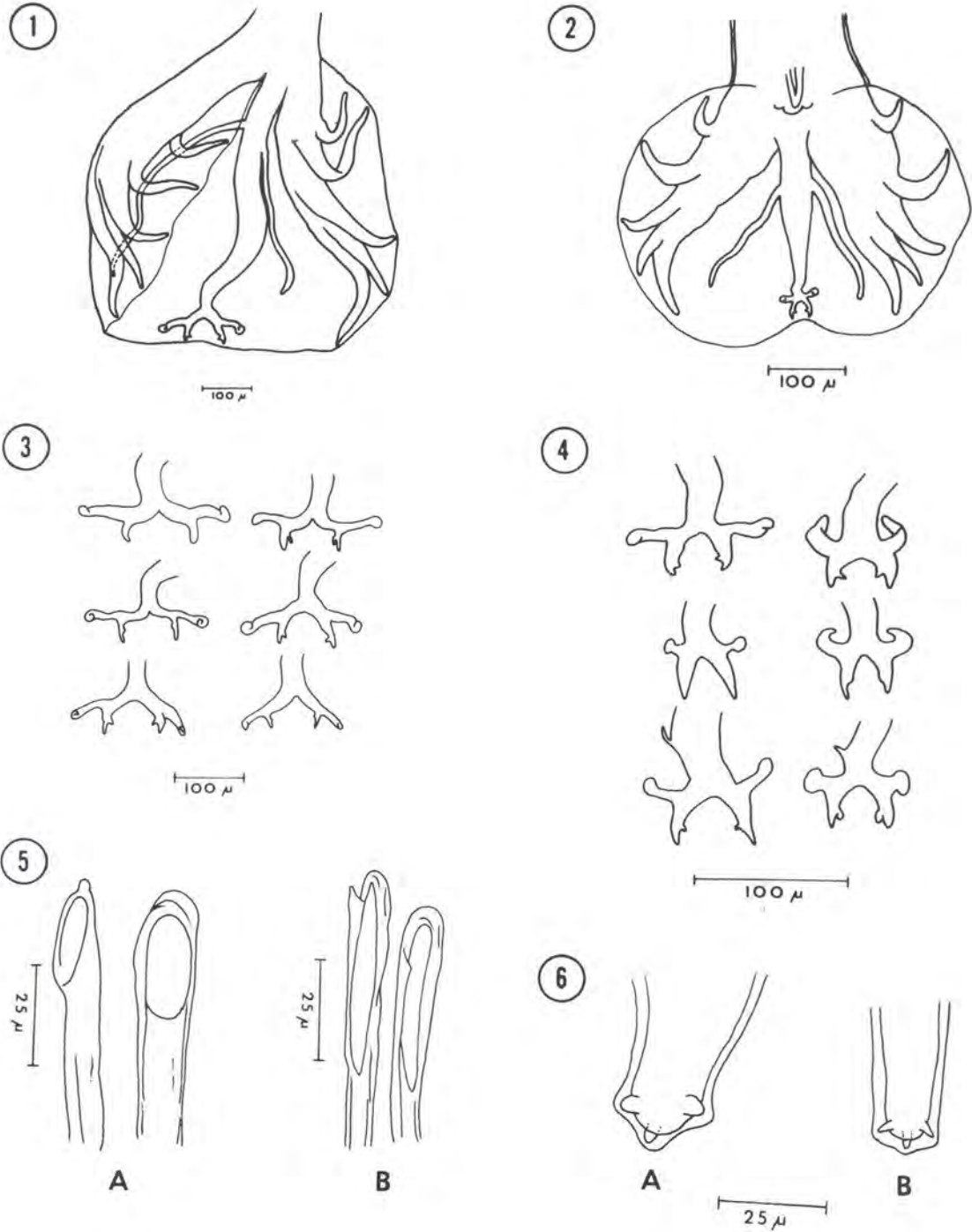


FIG. 1 Bursa of *I. tuberculata* from the type host, *A. melampus*. Ventral view

FIG. 2 Bursa of *I. nudicollis* from *T. oryx*. Dorsal view

FIG. 3 Variation in the tip of the dorsal ray of *I. tuberculata*. Top figures: from *C. dromedarius*; centre: from *R. fulvorufula*; bottom: from *A. melampus*

FIG. 4 Variation in the tip of the dorsal ray of *I. nudicollis*. Top figures: from *D. d. phillipsi*; centre and bottom: from *O. aries*

FIG. 5 Proximal end of spicules; (a) *I. tuberculata* from *A. melampus* (b) *I. nudicollis* from *D. d. phillipsi*

FIG. 6 Tail of female of (a) *I. tuberculata* from *A. melampus* (b) *I. nudicollis* from *D. d. phillipsi*

Both *I. aegyptiaca* and *I. somaliensis* are known only from the camel and have not been reported since their original description. *I. aegyptiaca* and *I. somaliensis* are considered synonyms of *I. tuberculata*.

Baer (1950) is of the opinion that *I. okapiae* and *I. somaliensis* should be retained as separate species as they differ from one another and from *I. tuberculata* in the length of the spicules and the size of the eggs. As no material of *I. okapiae* was available, the relationship of *I. okapiae* to the other members of the genus could not be determined.

I. tuberculata has been recorded from many species of antelope in Africa and the length of the spicules varies greatly in the different host animals. The spicules of *I. tuberculata* from the type host, the impala, are the shortest, while those from the reedbuck, giraffe, gerenuk, Thomson's gazelle, sable antelope and camel are longer. The specimens from the goat (Wetzel & Fortmeyer, 1960) showed a great variation in spicule length, viz., 838–1 202 μm . Such variation was also found in specimens from the Thomson's gazelle (Yeh, 1956) and may be due to the immune status of the host. This conclusion is supported by the findings of Keith (1967), who found that spicules of *Cooperia pectinata* (Ransom, 1907) were shorter in animals which had previously been exposed to the nematode. According to Keith (1967), the reduction in spicule length was due to a host reaction, stimulated by prior infestation and was not directly attributable to the presence of survivors of a previous infestation.

The *I. nudicollis* group

Mönnig (1931) experimentally infested sheep with infective larvae of *I. nudicollis* obtained from faecal cultures of a blesbok. The principal measurements of the parasites, recovered 14 and 30 days after infestation, are listed in Table 2.

Parasites from an eland, identified as *I. tuberculata* by Mönnig (1933), proved to be *I. nudicollis* upon re-examination and they are compared with *I. nudicollis* from blesbok in Table 2.

I. nudicollis may be differentiated from *I. tuberculata* by the smaller and shorter copulatory bursa, the straight dorsal ray and the narrow tip of the dorsal ray. The lateral branches of the tip of the dorsal ray of *I. nudicollis* are equal to or shorter than the median branches, whereas in *I. tuberculata* they are longer than the median branches and terminate in small hooks. The proximal ends of the spicules of *I. nudicollis* bear small median protuberances. Variations of the tip of the dorsal ray are illustrated in Fig. 4.

I. taurotragi males show characteristics of both *I. nudicollis* and *I. tuberculata*. The small size of the parasite, the copulatory bursa and the straight dorsal ray resemble those of *I. tuberculata* in that the lateral branches are longer than the median branches. Except for the smaller size, the females resemble those of *I. nudicollis*. Since *I. taurotragi* has not been recorded since its original finding and *I. nudicollis* has been recovered from the eland (Mönnig, 1933), *I. taurotragi* may possibly represent an aberrant form of *I. nudicollis*.

CONCLUSION

Specimens of *I. tuberculata* from different host species show great variation in the length of the spicules while the dorsal ray pattern remains constant. Those from the type host, the impala, have the

shortest spicules (804–851 μm) and those from the sable antelope the longest (1 016–1 068 μm). The spicules of nematodes from the gerenuk (838–1 075 μm), the sheep (900–1 000 μm) and Thomson's gazelle (835–1 160 μm) fall between the two extremes. Since *I. t. longispiculata*, *I. aegyptiaca* and *I. somaliensis* have spicule lengths within the range of *I. tuberculata* from different hosts and have a similar dorsal ray pattern, they are considered synonymous with *I. tuberculata*.

I. nudicollis shows little variation in different host animals and *I. taurotragi* is possibly an aberrant form of *I. nudicollis*.

I. okapiae must be retained until further material becomes available, so that its status may be determined.

The parasites from the camel, described by Pande *et al.* (1962) need further study to verify their identity.

Revised host-parasite list for the genus *Impalaila*

1. *Impalaila tuberculata*

Syn.:

- I. tuberculata longispiculata*
- I. aegyptiaca*
- I. somaliensis*
- I. nudicollis* from sheep (Daubney, 1933)
- I. nudicollis* from *G. thomsoni* (Yeh, 1956)

Host:

- Aepyceros melampus*—Mönnig, 1924
- Capra hircus*—Wetzel & Fortmeyer, 1960
- Camelus dromedarius*—Crovieri, 1929; Soliman, 1956
- Damaliscus dorcas dorcas*—Ortlepp, 1961
- D. dorcas phillipsi*—Ortlepp, 1961
- D. lunatus*—Ortlepp, 1961
- Gazella thomsoni*—Yeh, 1956
- **Giraffa camelopardalis*—this paper
- **Hippotragus niger*—Verster, 1976 (personal communication)
- Litocranius walleri*—Wetzel & Fortmeyer, 1960
- Ovis aries*—Daubney, 1933
- Raphicerus campestris*—Mönnig, 1931
- R. melanotus*—Mönnig, 1931
- Redunca fulvorufula*—Baker & Boomker, 1973

2. *Impalaila nudicollis*

Syn.:

- I. tuberculata*, from eland—Mönnig, 1933

Host:

- Aepyceros melampus*—Mönnig, 1933
- **Alcelaphus buselaphus*—this paper
- Camelus dromedarius*—Round, 1962
- Damaliscus dorcas phillipsi*—Mönnig, 1931
- D. lunatus*—Mönnig, 1932
- Kobus ellipsiprymnus*—Round, 1962
- Raphicerus campestris*—Mönnig, 1933
- Taurotragus oryx*—Mönnig, 1933

3. *Impalaila okapiae*

- Okapia johnstoni*—Van den Bergh, 1937

4. *Impalaila taurotragi*

- Taurotragus oryx*—Le Roux, 1936

* New host records

ACKNOWLEDGEMENTS

The author wishes to express his sincere gratitude to Mr S. Prudhoe of the British Museum (Natural History) for the loan of material, Drs Gertrud Theiler and Anna Verster for translations and valuable comments on the manuscript, and Mrs Deirdre Evans for technical assistance.

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