

OESOPHAGOSTOMUM RAFIAE SP.N. (NEMATODA: STRONGYLOIDEA) IN A GOAT FROM KARACHI, PAKISTAN

Gul-e-Lala¹, Nasira Khatoon¹, Aly Khan² and S.M.H.M. Naqvi³

¹Department of Zoology, University of Karachi, Karachi-75270, Pakistan.

²Crop Disease Research Institute, PARC, University of Karachi, Karachi-75270, Pakistan.

³Aquaculture and Fisheries Program, Animal Sciences Institute. P.A.R.C, Karachi, Pakistan.

ABSTRACT

Oesophagostomum rafiae sp.n is being reported from the small intestine in goat (*Capra hircus* Linn. 1758) from Karachi. The new species is characterized by having medium sized worms, male smaller and thinner than females, which are stouter and larger in size. Mouth directed straight forward, cephalic vesicle well developed. A single leaf crown is present containing 15-20 cuticular elements in both sexes. Oesophageal funnel dilated and contains facets. Bursa copulatrix well developed, gubernaculum not visible. Vulva at some distance, above anal opening, Vagina muscular directed backward, female tail tapering, short, pointed. Eggs small, globular or subglobular.

Keywords: *Oesophagostomum rafiae* sp.n; goat, small intestine, Karachi, Pakistan.

INTRODUCTION

Yamaguti (1961) has listed 52 species of the genus *Oesophagostomum* Molin, 1861, almost from all over the world, including 8 species from India. Most of the species are reported to be cosmopolitan in distribution recorded from various mammalian hosts including goats and sheep. *Oesophagostomum apiostomum* (Willach, 1891) Railliet et Henry, 1905, syn. *O. brumpti* Railliet et Henry, 1905 – Leiper (1911), Lane (1923), in *Macacus* spp.; Africa, Philippines, China, India, Brazil, Korea was also found infecting men in Africa and Indonesia.

O. stephanostomum Stossich, 1904 – Lane (1923) was also found from man in Brazil.

Further Yamaguti (1961) agrees with Goodey (1924a, b, c) and Thornton (1924) and also Baylis and Daubney (1926) in that the division of the genus into four subgenera (*Oesophagostomum*, *Proteracrum*, *Hyperteracrum* and *Conoweberia*). Schwartz and Alicata (1930) reported morphological description of *O. brevicaudum* and *O. georgianum* from the intestine of domestic swine.

Wyk (1977) stated that freshly recovered infective larvae of *Oesophagostomum columbianum* and *Chabertia ovina* were frozen in liquid nitrogen and subsequently thawed, conspicuous vesicles appeared in the intestinal cells of the larvae. The average number of vesicles, which differed in size according to the species were 20 for *O. columbianum* and 32 for *C. ovina*. Polderman et al. (1991) stated *Oesophagostomum* sp. is normally considered a rare zoonosis and the diagnosis has been based on demonstration of larvae and young adults in the typical nodules formed in the intestinal wall. Blotkamp et al. (1993) suggested that the infection with *Oesophagostomum* sp. appears very common in humans in Northern Togo and Ghana. They further studied that the eggs of *Oesophagostomum bifurcum* and that of *Necator americanum* are difficult to differentiate as both the infection occurred together in humans.

Krepel et al. (1995) reported that there was significant correlation between the number of *Oesophagostomum* and hookworm larvae and egg counts, along with a larval counts quantitative analysis. Nansen et al. (1996) used a microfungus *Duddingtonia flagrans* for the control of *Oesophagostomum dentatum*, as this microfungus are capable to prey on range of free living soil nematodes and are found in a number of countries. Neuhaus et al. (1997) suggested that in the three species *Oesophagostomum radiatum*, *O. dentatum* and *O. quadrispinulatum* the buccal leaves of the cornea radiate varies remarkably in the three adult species. Joachim et al. (1999) developed a method to differentiate between fourth stage larva (L4) of two species of porcine nodular worms namely *Oesophagostomum dentum* and *O. quadrispinulatum* by computer assisted analysis of digitized microphotographs of L4 *in vitro* for various time period and of L4 *ex vivo*. They further discussed that computer-based techniques facilitate the processing of the complete data and after the option for automation of measurements for routine applications. Ali et al. (2000) studied the prevalence of gastrointestinal parasites in sheep and goats at National Agricultural Research Centre, Islamabad and found 16% sheep and 10% goats infected with *Oesophagostomum* sp.

Afridi *et al.* (2007) suggested that buffaloes in Peshawar had 18.02 percent infection with *Oesophagostomum* sp. Raza *et al.* (2012) studied the presence of helminths in 500 faecal samples of buffaloes from different localities of Tehsil Muzaffargarh, Pakistan and found 3.2% infection of *Oesophagostomum radiatum*. Farooq *et al.* (2012) recorded *Oesophagostomum* in domesticated and wild ruminants in Cholistan desert of Pakistan, the nematode was either present as a single species or was present in mixed population with other helminths. Ondrovics *et al.* (2013) reported *in vitro* drug testing in combination with proteomic and bioinformatic analysis to identify and characterize proteins involved in larval development of *Oesophagostomum dentatum*. Tomass *et al.* (2013) observed prevalence of gastrointestinal parasites in pigs from Mekelle and urban areas of southern zone of Tigray region of Ethiopia. The parasites included *Oesophagostomum dentatum*, *Trichuris suis*; *Ascaris suum*, *O. quadrispinulatum*, *Trichostrongylus axei*, *Strongyloides ransomi*; *Yostrongylus rubidus* and *Physocephalus sexalutus*. Makouloutou *et al.* (2014) studied coprocultured larvae from young goat having diarrhea were morphologically and genetically characterized as *Oesophagostomum asperm.* Jan *et al.* (2015) studied prevalence of ovine gastrointestinal parasites in found 2.5 percent of domesticated male sheep, 5.5 percent of female domesticated sheep and 10.5 percent of female farmed sheep infected with *Oesophagostomum columbianum*. Wyk and Mayhew (2013) prepared a practical guide for identification of parasitic nematode infective larvae of cattle and small ruminants. Cibot *et al.* (2015) found *Oesophagostomum* genus which is a major public health concern in some African regions and which can be deadly to humans. They stated that the role of animals as reservoirs of infection in Eastern Africa has not been properly investigated.

MATERIALS AND METHODS

The gastrointestinal tracts of slaughtered goats were collected from Gulsha- e-Iqbal, Karachi. A total number of 42 gastrointestinal tracts of goats were collected within 4 hours of its slaughtering. The viscera were carefully kept in polythene bags to avoid any leakage. Later they were transported to the Parasitological section, University of Karachi, Karachi.

The intestinal tract was cut longitudinally into different parts to examine parasites of different portions.

The abomasum, small intestine and large intestinal contents of the above portions were poured individually in a separate bucket filled with 2 litres of water.

Abomasum wall was washed thoroughly under stream of water to avoid any adhering worm. The contents of the bucket were sieved by a wire mesh screen with an aperture of 0.15 mm. The screen having food material and worms were shifted into another bucket and examined carefully. The worms collected were kept in separate petri dishes for further processing. Kidneys, spleen, liver, lungs, heart and pancreas were also examined.

The parasites recovered from small intestine were washed with tap water to avoid any abomasums or intestine adhering to the parasites and nematodes were kept into 70% alcohol, with two or three drops of glycerin in glass vials.

The diagrams were made with camera Lucida attached to a light microscope and measurements were given length by width in millimeters. The specimens are in possession of the second author (N.K.)

Order: Strongylidea Diesing, 1851
 Family: Cyathostomidae (n.family) Yamaguti, 1961
 Subfamily: Oesophagostominae Railliet, 1916
 Genus: *Oesophagostomum* Molin, 1861
 Syn. *Hypostomum* Stewart, 1898
 Boargelatoides Chandler, 1931
 Paraesophagostomum Scheidegger et Kreis, 1934
 Daubneyia Lerous, 1940

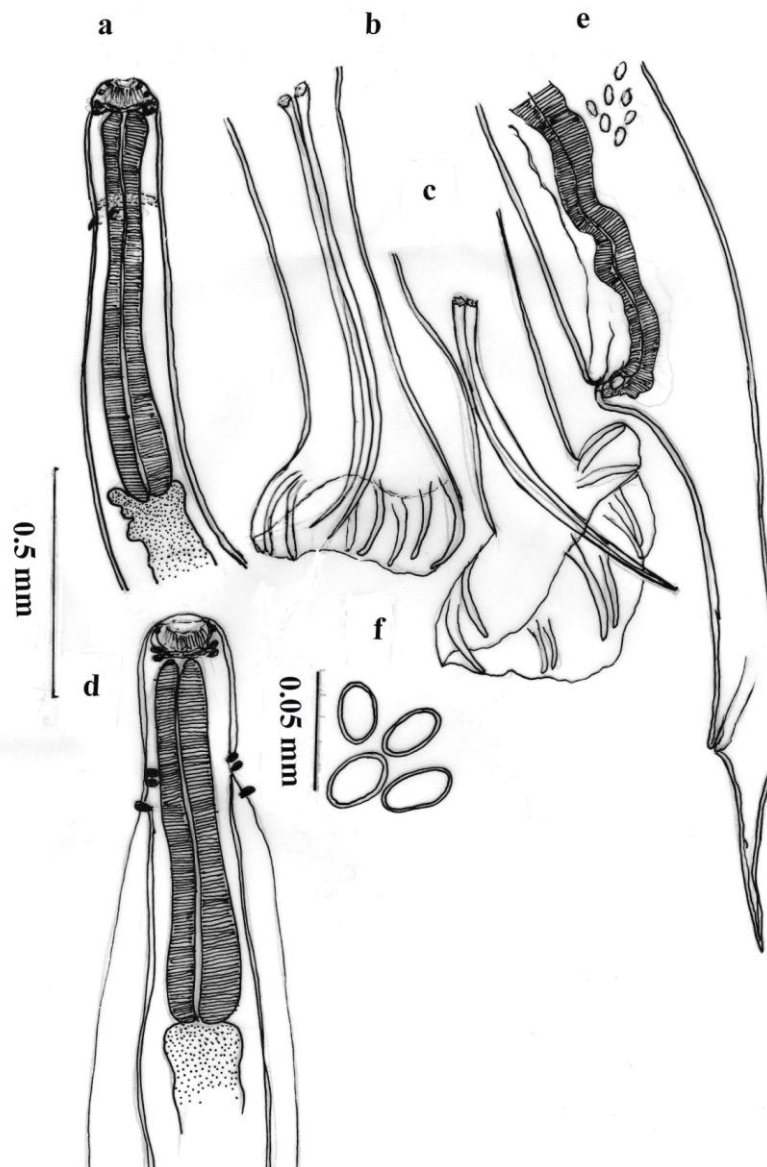
Oesophagostomum rafiae n.sp

(Figs. 1 a-f)

Host: *Capra hircus*. Linnaeus, 1758
 Locality: Gulshan e Iqbal, Karachi, Sindh, Pakistan.
 Location: Small intestine
 No. of hosts examined: 42
 No. of hosts infected: 30
 No. of specimens studied: 10 ♂ + 28 ♀
 No. of specimens recovered: 25 ♂ + 35 ♀

DESCRIPTION

It is based on 10 male and 28 female specimens – Medium-sized body, male being smaller and thinner than the females which are comparatively stouter and larger in size. Mouth directed straight forwards, cephalic vesicle well developed. Mouth collar with two lateral and four sub-median head papillae, behind the deep annular constriction. Shortly in front of the excretory pore is a transverse ventral groove extending around the body, the cuticular between the mouth collar and ventral groove is often dilated and extends beyond the oesophagus. A single leaf crown is present containing 15-20 cuticular elements in both sexes. Oesophageal funnel dilated and contain facets. Bursa copulatrix well developed, supported by cuticular rows, spicules equal, gubernaculum not obvious. The female tail tapering, sharp pointed. Vulva situated at some distance above the anal opening, the vagina, muscular and directed backwards. Eggs small, globular or subglobular.



Fi.g.1a-f. *Oesophagostomum rafiae* n.sp.

a: Anterior extremity of male; b: Posterior extremity of male; c: Posterior extremity of male showing spicule;
d: Anterior extremity of female; e: Posterior extremity of female; f: Eggs enlarged.

Male: Entire body 12-16 long, maximum width obtained near the mid-body region or some distance below 0.25-0.33 wide, 01 while width at the cephalic vesicle is 0.12-0.15 and width above the bursa copulatrix is 0.31-0.33. Cephalic vesicle, small, well developed, mouth directed straight forwards, mouth collar with two prominent, lateral pair of papillae, situated above the oesophagus, below the cephalic vesicle, additionally a pair of lateral papillae are present around the cephalic vesicle. Head delimited behind by a deep end. A single leaf crown, containing 15-20 cuticular elements is present. Esophagus slightly dilated, containing lancets, 0.72-0.74 long and 0.11-0.12 wide at the base. Bursa well developed, ventral ray cleft, medio-lateral and postero lateral fused proximally, externo-dorsal arise from the common trunk with which it gives off a short lateral twig. Spicules, equal, simple 0.81-0.85 long and 0.01 wide. Gubernaculum not obvious.

Female: Larger and stouter than males 16-22 long, maximum width 0.50-0.58 near the mid body region, width at the cephalic region is 0.14-0.16 and width at the base of oesophagus is 0.22-0.25 and width at the vulvular region is 0.34-0.38. Cephalic vesicle small, well developed, the cephalic papillae situated one on either side of the vesicle, cuticular elements 15-20 in number, cervical papillae situated well above the oesophageal swelling.

In some specimens two pairs of lateral papillae are present at a distance of 3.45-3.48 from the head end, additionally a pair of lancet structures are present at some distance below the pair of lateral papillae. Oesophagus dilated to some extent below 0.81-0.84 long and 0.06-0.08 wide at anterior extremity and 0.12-0.14 at the posterior dilated region. The cuticle is dilated and forms lateral aloe up to some distance behind the oesophagus. Intestine simple, uterus well developed, containing globular or subglobular eggs. Vagina muscular, directed backwards and opens posteriorly at a distance of 0.85-0.95 above the anal opening. The posterior extremity end into a sharply pointed end, while anal opening is situated at a distance of 0.42-0.48 from the posterior extremity. Eggs small globular to subglobular 0.028-0.031 by 0.018-0.020.

DISCUSSION

Present specimens although resemble the type species *O. dentatum* in general appearance but can be readily distinguished in the body size of both male and female which is 8-12 in male and 12-15 in female of the type species while the body size in the present specimens is 12-16 in male and 16-22 in female specimens, differences are also noted in the structure of cephalic vesicle which is small in present specimens. Vagina in present specimens is long, muscular and directed backwards whereas vagina in stated to be short and a little distance above the anus in the type species, the distance between the anal opening and the vulva opening is 0.85-0.95 in the present specimens while it appears quite less in the type species. Therefore, the present specimens are being regarded as a new species of the genus for which the name *Oesophagostomum rafiae* n.sp. is proposed.

The species name is in honour of Dr. Rafia Rehana Ghazi, ex-director, VPCL, SARC, Pakistan Agricultural Research Council, University of Karachi, Karachi for the immense contribution in the field of Parasitology.

REFERENCES

- Afridi, Z.K., K. Khan, G. Zaman, S. Ullah and Q Habibullah (2007). Prevalence of gastro-intestinal nematode parasites of economic importance in dairy buffaloes in Peshawar . *Sarhad Journal of Agriculture*, 23: 2007.
- Ali, S., M.Q. Khan and M.F. Khan (2000). Prevalence of gastrointestinal parasites in sheep and goats maintained at NARC, Islamabad. *Pakistan Veterinary Journal*, 20: 2000.
- Blotkamp, J., H.P. Krepel, V.Kumar, S. Baeta, J. M. van't Noordende and A. M. Polderman (1993). Observations on the morphology of adults and larval stages of *Oesophagostomum* sp. isolated from man in Northern Togo and Ghana. *Journal of Helminthology*, 67: 49-61.
- Baylis, H.A. and R. Daubney (1926). *A synopsis of the families and genera of Nematoda*, 277 pp.
- Cibot, M., J. Guillot, S. Lafosse, C. Bon, A. Seguya, and S. Krief (2015). Nodular Worm Infections in Wild Non-human Primates and Humans Living in the Sebitoli Area (Kibale National Park, Uganda): Do High Spatial Proximity Favor Zoonotic Transmission? *PloS Negl. Trop. Dis.*, 9 (10): e0004133.
- Diesing, K.M (1851). *Systema Helminthum*, Vo.2. Vindobonae. 588pp.
- Farooq, Z., S. Mushtaq, Z. Iqbal and S. Akhtar (2012). Parasitic helminths of domesticated and wild ruminants in Cholistan desert of Pakistan. *International Journal of Agricultural Biology*, 14: 63-68.
- Goodey, T. (1924a). The anatomy of *Oesophagostomum dentatum* (Rud.) a nematode parasite of the pig, with observations on the structure and biology of the free-living larvae. *Journal of Helminthology*, 2: 1-14.
- Goodey, T. (1924b). *Oesophagostomes* of goats, sheep and cattle. *Journal of Helminthology*, 2: 97-110.
- Goodey, T. (1924c). Some new members of the genus *Oesophagostomum* from the roan antelope and the wart hog. *Journal of Helminthology*, 2: 135-148.

- Jan, A., H. Shah, I. Ahmad, M. Younas and R.U. Haroon (2015). Prevalence and Comparison of ovine gastrointestinal helminthes parasites in domesticated and farmed, male and female sheep at University Town Peshawar, Pakistan. *Journal of Entomology and Zoology Studies*, 3: 350-353.
- Joachim, A.N. Dulmer, A. Dauschies (1999). Differentiation of two *Oesophagostomum* sp. from pigs, *O. dentatum* and *O. quadrispinulatum* by computer assisted image analysis of fourth stage larvae. *Parasitological International*, 48: 63-71.
- Krepel, H.P., V.D.V. Earnewald, S. Baeta and A.M. Polderman (1995). Quantitative interpretation of coprocultures, in a population infected with *Oesophagostomum bifurcum*. *Tropical and Geographical Medicine*, 47: 157-159.
- Leiper. R.T (1911). The occurrence of *Oesophagostomum apiostomum* as an intestinal parasite of man in Nigeria. *The Journal Of Tropical Medicine and Hygiene*, 14: 116-118.
- Lane, C (1923). Some Strongylata. *Parasit.*, 15: 348-364.
- Makouloutou, P., M. Matsuda, K. Haradono, T. Yanagida and H. Sato (2014). *Oesophagostomum asperum* infection in a domestic goat in Yamaguchi, Japan. *The Japanese Journal of Veterinary Parasitology*. 13: 2014.
- Nansen, P., M. Larsen, A. Roepstorff, J. Gronvold, J. Wolstrup and S.A. Henriksen (1996). Control of *Oesophagostomum dentatum* and *Hyostrongylus rubidus* in outdoor-reared pigs by daily feeding with the microfungus *Duddingtonia flagrans*. *Parasitology Research*, 82: 580-584.
- Neuhaus, B.,J. Bresciani and C.M. Christensen (1997). Morphological Variation of the Corona Radiata in *Oesophagostomum dentatum*, *O. quadrispinulatum*, and *O. radiatum* (Nematoda: Strongyloidea). *Journal of Helminthology*, 64: 128- 136.
- Ondrovics, M., K. Silbermayr, M. Mitreva, N.D. Young, E. Razzazi-Fazeli, R.B.Gasser and A. Joachin (2013). Proteomic Analysis of *Oesophagostomum dentatum* (Nematoda) during larval transition, and the effects of Hydrolase Inhibitors on development. *Public Library of Science*, 8: 63955.
- Polderman, A.M., H.P. Krepel, S. Baeta, J. Blotkamp, and P. Gigase (1991). Oesophagostomiasis, a common infection of man in Northern Togo and Ghana. *The American Journal of Tropical Medicine and Hygiene*. 44: 336-344.
- Railliet, A. and A. Henry (1905). Encore un nouveau sclérostomien (*Oesophagostomum brumpti* nov. sp.) *Parasite de l'homme. Comptes Rendues de Société de Biologie*, 58: 643-645.
- Raza, M.A., H.A. Bachaya, M.S. Akhtar, H.M. Arshad, S. Murtaza, M. M. Ayaz, M. Naeem and A.Basit (2012). Point prevalence of gastrointestinal helminthiasis in buffaloes (*Bubalus bubalis*) at the vicinity of Jatoi, Punjab, Pakistan. *Science International*, 24: 465-469.
- Schwartz, B and J.E. Alicata (1930). Two species of Nodular worms (*Oesophagostomum*) parasitic in the intestine of domestic swine. *Journal of Agriculture research*, 40: 517-522.
- Stossich, M. (1904). Sopra alcuni nematode. *Ann.Mu.Zool.R.Uni.Napoli n.s.* 1: 1-4.
- Thornton, H. (1924). A review of the *Oesophagostomes* in the collection of the Liverpool School of Tropical Medicine. *Annals of Tropical Medicine and Parasitology*. 18(3): 393-408.
- Tomass, T., E.Imam, T. Kifleyohannes, Y. Tekle and K. Weldu (2013). Prevalence of gastrointestinal parasites and *Cryptosporidium* species in extensively managed pigs in Mekelle and urban areas of southern zone of Tigray region, Northern Ethiopia. *Veterinary World*, 6: 433-439.
- Willach, P. (1891). *Sclerostoma apiostomum* nov. sp. *Ein neuer und gefahr-licher Parasit der Affen. Arch. Wiss. U. Prakt. Tierh.*, 17: 340-346.
- Wyk, V.J.A and E. Mayhew (2013). Morphological identification of parasitic nematode infective larvae of small ruminants and cattle: A practical lab guide.
- Wyk, V.J.A. (1977). A rapid method for differentiating between the infective larvae of *Oesophagostomum columbianum* and *Chabertia ovina*. *Onderstepoort Journal of Veterinary Research*, 44: 197-200.
- Yamaguti, S. (1961). *Systema Helminthum. The Nematode Parasites of Vertebrate*. International Science Publisher, Inc. 3: 1261.

(Accepted for publication February 2019)