



***Toxocara Canis* Werner (1782) (Nematoda) From the Dog, *Canis familiaris* (Canidae):
A Light and Scanning Electron Microscopic Study**

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ABSTRACT

Toxocara canis is one of the most prevalent and pathogenic gastrointestinal nematodes infecting dogs. The present study aimed for the description of this nematode isolated from the dog, *Canis familiaris* (Canidae) based on light and scanning electron microscopy. The recovered worms were long and yellow by naked eyes. Light and SEM observations showed that the anterior ends of both sexes constitute mouth and buccal capsule, which were surrounded by three well-defined interlocked lips, distinctly offset from the anterior end, one dorsal, and two laterals, the dorsal lip swollen with narrowed dentigerous ridges bordered the outer margin of the internal surface. Two fine cuticular pits were seen on the apex of the external surface of the apical part of the lips with narrow cervical alae that tapered gradually, merged into the cuticle, giving the anterior end a lancet-like appearance. The cuticle is transversely annulated. Male worms 19-31 (24.2± 1) mm long x 0.48-0.62 (0.51± 0.3) mm wide. The posterior end equipped by 32 pairs of papillae. Females long measured 33-42 (35.1± 1) mm long x 0.55-1.33 (0.9±0.02) mm wide. Semicircular anal opening at conical posterior end with no anal lips nor papillae were observed.

INTRODUCTION

Ascaridid nematodes of the genus *Toxocara* including *Toxocara canis*, *Toxocara cati*, *Toxocara malaysiensis*, and *Toxocara isleonina* are the most common gastrointestinal helminths infecting predatory Canidae and Felidae mammalian families (Fischer, 2003 and Bojar and Kłapeć, 2018) causing Toxocarosis which is a zoonotic disease among animal-borne diseases transmitted through their larvae. The most common enteric nematode parasites of dogs are *Toxocara canis* (Palmer *et al.*, 2008 and Khante *et al.*, 2009). Since dogs share house and bed with their owners, these conditions are considered as the main source of infection to human, which can be transmitted also when *Toxocara* eggs persist in dog's fur (Moura *et al.*, 2018). Therefore, it is important to study the biology and epidemiology of this parasite (Raza *et al.*, 2018). The life cycle of this parasite, which depends on the close linkages with their hosts and the environment, started after shedding of eggs into the environment via feces of the host (Fischer *et al.*, 2018).

These eggs are not infective when firstly shed, where under suitable conditions of temperature and humidity, they take from two to seven weeks to be embryonated into L2 stage (Lylod, 1998). Dogs will be infected when they ingest the second larvae from the contaminated soil. Larvae penetrate the intestinal wall to the blood circulation where they move to the liver and lungs, where, they will be swallowed and then move to the intestinal lumen and matured (Urquhart *et al.*, 1996 and Abu-Madi *et al.*, 2008). Transplacental infection into dog embryos was recorded (Squire *et al.*, 2018). Also, suckling as well as consuming a paratenic host such as small rodents represents other ways on infection. The complex life cycle as well as the modes of infection either by the ingestion of the embryonated eggs from the environment or through larvae from paratenic hosts as well as intrauterine or lactogenic transmission should be understood for efficient prevention of infections in dogs (Sherif *et al.*, 2007). The present study introduced a full morphological description of the nematode *Toxocara canis* recovered from the gastrointestinal tract of the dog *Canis familiaris* (canidae), these was done using light and electron microscopy.

MATERIALS AND METHODS

Nematode worms were freshly isolated from the gastrointestinal tracts of the dogs *Canis familiaris* (Canidae) dissected by members of the Faculty of Veterinary Medicine for students learning and training in accordance with the guidelines of animal use in experiments. Worms were immediately washed several times in physiologic saline and then in 10 % acetic acid in order to remove any mucus or host debris. They were fixed in 10% formalin solution for light microscopy and 3% Glutaraldehyde (pH 7.4) buffered in 0.1 Sodium cacodylate buffer for scanning electron microscopy (SEM), Five to 10 mm from cephalic and caudal ends of male and female worms were cut away with a blade. For light microscopy, samples were cleared in a solution of lactophenol and photomicrographs were taken using Carl

Zeiss 19386 photomicroscope equipped by a power shot Canon digital Camera (A 630). Identification was according to the key published by Soulsby (1965, 1986). Measurements were taken as a range (mean \pm SD). Scanning electron microscopy was according to Madden and Tromba (1976). Fixed worms were post-fixed in buffered osmium tetroxide, and then dehydration in ascending alcohol series was employed. After passing through an ascending series of Genosolv-D, they were processed in a critical point drier BBomer-900 with Freon 13 and sputter-coated with gold-palladium in a Technics Hummer V and examined with an Etec Autoscan at 20 kV Jeol scanning EM.

RESULTS

Toxocara canis Werner (1782), Figs 1-17

Taxonomy: Animalia, Nematoda, Secernentea, Ascaridida, Toxocaridae

Description:

Light and scanning electron micrographs revealed that the anterior end contained the mouth opening which was surrounded by three prominent triangular lips. One dorsal and two laterals, the dorsal lip swollen with narrowed and fine dentigerous ridges bordered the outer margin of the internal surface. Two fine cuticular pits were seen on the apex of the external surface of the apical part of the lips with narrow cervical alae that tapered gradually, merged into the cuticle, giving the anterior end a lancet-like appearance. The cuticle was transversely annulated in all of the examined specimens with prominent longitudinal striation at the posterior end.

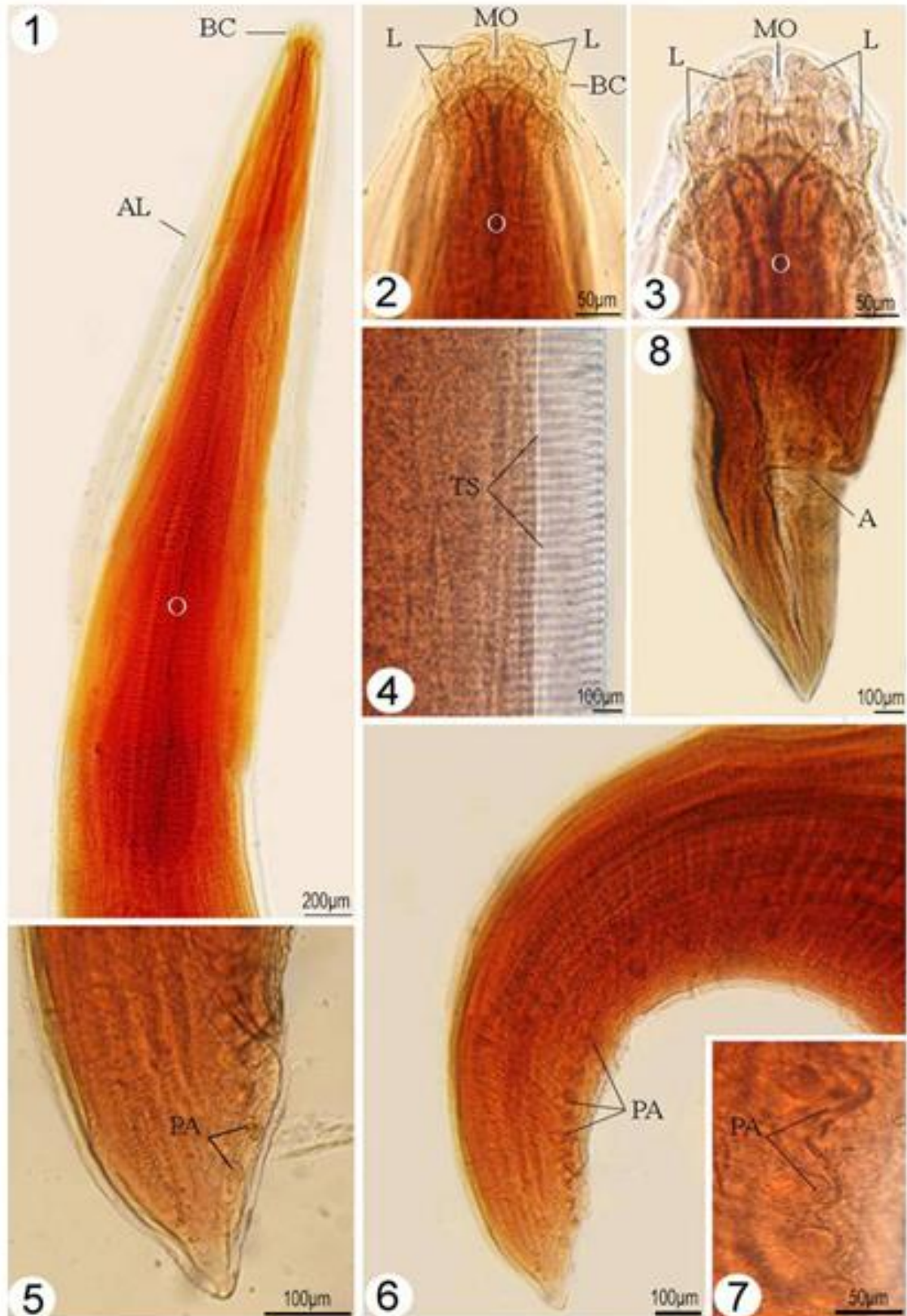
Male:

Body 19-31 (24.2 ± 1) mm long x 0.48-0.62 (0.51 ± 0.3) mm wide. The posterior end of the male was wrapped, spicules not observed. Cloacal opening surrounded by 32 pairs of papillae arranged as 26 pairs (precloacal), 4 pairs ventral (postcloacal), and 2 dorsal (postcloacal). These papillae arranged in the form of swollen cuticular bodies with apical buttons like structures. Esophagus 2.54-4.86 (3.4 ± 0.2) mm long x 0.06-0.18 (0.16 ± 0.02) mm wide anteriorly

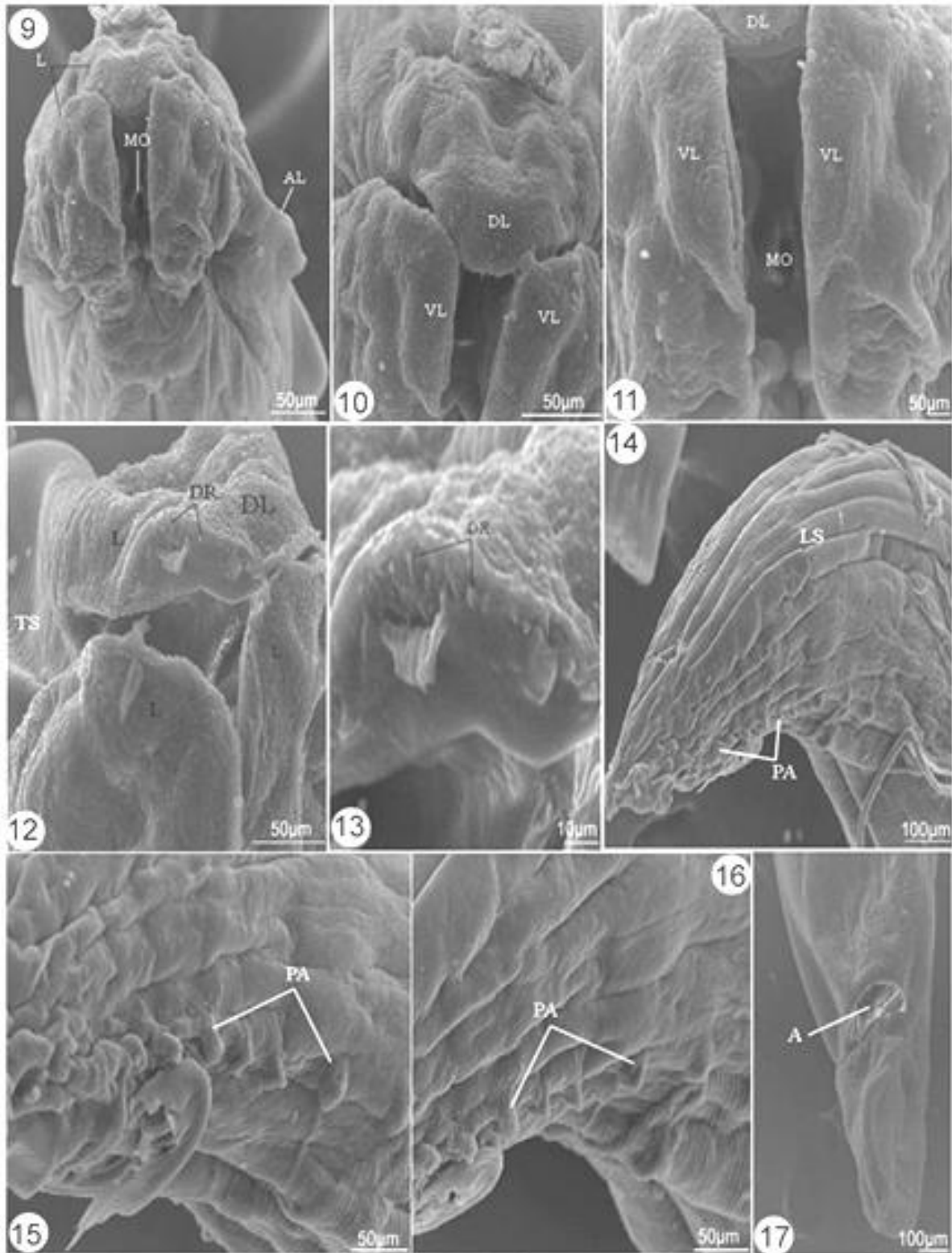
and 0.14-0.28 (0.20± 0.01) mm wide posteriorly. 0.18-0.56 (0.40± 0.02) mm wide at the posterior end. The anterior end of females

Female:

Body long, 33-42 (35.1± 1) mm long x 0.55-1.33 (0.9±0.02) mm wide. Esophagus 1.32-5.18 (1.12± 0.2) mm long x 0.10-0.24 (0.18± 0.02) mm wide at the anterior end, and was similar to those of males. Vulva situated at the body's anterior half. Anus semicircular not lipped. No anal papillae were observed in the tail region of all of the examined females.



Figs.1-8: Photomicrographs of *Toxocara canis* showing high magnifications of: (1) The anterior part of the adult worm with a prominent cephalic alae (AL) and buccal capsule (BC). (2, 3) The region of buccal capsule (BC) and mouth (MO), there are prominent lips (L) offset from the anterior end. (O) Esophagus. (4) Transverse striations of cuticle (TS). (5-8) Posterior ends of: (5-7) male with numerous papillae (PA). (8) Female with Anus (A).



Figs. 9-17: Scanning electron micrographs showing high magnifications of: (9-11) The anterior part of the adult worm with three interlocked lips (L), one dorsal (DL) and two ventral lips (VL) surrounding mouth opening (MO). Cervical alae (AL) were seen lateral to the anterior part of the worm. (12, 13) Dentigerous ridges (DR) lining the apical part of the dorsal lip (DL). (14-16) Posterior ends of: (14-16) Male equipped by numerous papillae (PA), (LS) abbreviated for longitudinal striations. (17) Female with an anal opening (A).

DISCUSSION

Dogs among the most important domesticated animal worldwide, they play important roles for people such as hunting, pulling loads protection, assisting police, military work, and companionship and more recently aiding handicapped individuals (Tiekotter, 1985, O'Lorcain, 1994, Sadjjadi *et al.*, 2001 and Serrano-Moliner *et al.*, 2018). As a result of the dog's impact on human society, they are called "Man's Best Friend" as a nickname in the western world. In Egypt, they were used by the Egyptian police due to the high ability of these animals to smell things that cannot be detected and realized by humans. Recently, the intestinal parasites of dogs receive considerable attention because they serve as reservoirs, carriers, and transmitters of parasites, which may be zoonotic and/or of significant public health concern (Sowemimo and Asaolu 2008; Pereira *et al.*, 2016). The canine intestinal parasites have an oral-fecal transmission cycle and a major component for the spread of these parasites is the shedding of eggs or larvae into the environment (Ogundipe *et al.*, 2017 and Scaramozzino *et al.*, 2018). The nematodes found in the present study were identified as *T. canis* due to the presence of a lancet-shaped anterior part with cervical alae, the three interlocked lips, the lip ridges and the posterior architecture of the posterior region of male and females. The number of the recovered worms is about twenty in accordance with observations of Senlik (2006) who clarified that, even with a relatively high level of care, including veterinary attention; dogs frequently harbor intestinal nematodes with high worm burden. The high worm burden recorded in the present study may be due to factors like geographic and climatic conditions of a country, poor management practices and frequent mixing of pets with stray dogs which might have the infections (in accordance with Maqbool *et al.* 1998). Studies on *Toxocara* species in Egypt can be summarized as follows: based on stool examination, Arafa *et al.* (1978) reported a *T. cati* prevalence of

22.5% in Cairo. Morsy *et al.* (1981) reported a prevalence of 10.52%. Khalil *et al.* (1976) reported wild dog infection rates of 79.5% in Cairo, 81.5% in Giza, 83% in Luxor, 79% in Aswan, 68% in Siwa, and 50% in Dakahlia. In Mansoura, Abo Shady *et al.* (1983) reported a prevalence of 3.85% for *T. cati* infection; El-Sokkary *et al.* (1987) reported a prevalence of 29.8% in Behera Governorate. Lower prevalence's were reported by Selim (1967) in Cairo and Giza (8%) and by El Gwady and Fayek (1991) in Ismailia (10%). In Mansoura and Qena, 84.7% prevalence was reported by Abo-Shady (1980). The only study on *T. canis* was carried out by Radwan (2009) who reported an infection by the adult worms in 31 of 58 (53.4%) of the examined domestic dogs. Based on morphological characteristics, the worms collected in this study are clearly identified as *T. canis* in accordance with many studies based on light and scanning electron micrographs such as those of Radwan *et al.*, (2009) and Morsy *et al.* (1981) which revealed some important morphological traits, which guide the taxonomy of *Toxocara* spp. These were the mouth surrounded by 3 well-defined triangular lips, the presence of obvious ridges at the apical part of the dorsal lip, the cephalic alae that gave the worm a lancet-like appearance. Also, the morphometry of worms is largely agreed with previous reports.

CONCLUSION

Toxocara canis, a nematode parasite isolated from the intestine of the domesticated dog, *Canis familiaris* (Canidae), described with new morphological characterizations based on light microscopy and SEM. It is recommended to focus the further parasitological surveys on domesticated and wildlife, which may be infected by parasitic worms which most of them are zoonotic.

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