

On the recovery of horsehair worms, *Gordius* sp. (Nematomorpha: Gordiida) from pork in Shillong, India

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Received: 21 August 2015 / Accepted: 23 May 2016 / Published online: 31 May 2016
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Abstract The members of the phylum Nematomorpha, called as horsehair or gordian worms, are the parasites of arthropods and emerge from their host for reproduction and early development in water. There are about 360 species of nematomorphs described till date. Although, horsehair worms are parasites of arthropod species, sporadic cases of their occurrence have also been reported from several other hosts, including man. This paper describes a case history of the occurrence of two nematomorph worms in the meat of a pig in Shillong, India. The worms were reported to have emerged in live condition from pork bought by a consumer from local market in Shillong. One of the recovered specimens was studied by scanning electron microscopy for species determination and identified as *Gordius* sp., mainly on the basis of flat polygonal areoles and fine bristles on the cuticle.

Keywords Nematomorpha · Gordian worms · Pig meat · Infection

Introduction

The phylum Nematomorpha comprises of one of three animal phyla specializing fully on a parasitic life style. The members of this phylum, called as horsehair or gordian

worms, are the common parasites of arthropods which leave their host for reproduction and early development in water. So far about 360 species of nematomorphs have been described worldwide (Schmidt-Rhaesa 2013), of which only 18 nematomorph species have been reported from India (Schmidt-Rhaesa et al. 2015). Although, these worms are the natural parasites of arthropod species, but in many instances their occurrence has also been reported from accidental hosts, such as man, cats, dogs, etc. (Schmidt-Rhaesa 2013). Recently, two worms were reported to have emerged in live condition from pork bought by a consumer from local market in Shillong, India (Nongspung 2014). The news about recovery of these worms from pork was published by a newspaper which increased awareness among people about any potential health hazards associated with infected pig meat (Nongspung 2014). Later, these specimens were identified as horsehair worms, but not further determined and reported to be harmless to humans in newspaper (Anonymous 2014). Therefore, the purpose of our study was to systematically identify these worms to species level and throw some light as to how these worms could have been reached in pig meat. One of the recovered specimens was studied by scanning electron microscopy for species determination and findings are discussed.

Materials and methods

One of the worms that emerged from pig meat in Shillong was fixed in formalin. The anterior and posterior ends of the body, together with 2–3 mm long pieces excised from the mid-body region of this worm, were processed for Scanning Electron Microscopy (SEM). The material was dehydrated in an increasing acetone series, air-dried in tetramethylsilane, and coated with gold in a sputter coater.

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Observations were made using JSM-6360 (JEOL) SEM. Digital images of various regions of the body were taken.

Results

Gordius sp. *Gordius* Linné, 1758

The specimen measured 220 mm in length and 0.52 mm in maximum diameter (Fig. 1a). The color of the body is light brown. The anterior end of body possesses a white cap, followed by a black band, while the posterior end is round with a terminal cloacal opening. The cuticle is covered along most of the body by a pattern of polygonal structures called areoles (Fig. 1b, c). The polygonal areoles are most evident in the anterior and in the posterior part of the body. In the midbody region, several zig-zag lines were observed (Fig. 1d). These are interpreted as being related to the polygonal areoles by pronouncing their upper or lower borders. In addition, several bristles were observed on the cuticle, in the anterior region of the body they are about 10 μ m long (Fig. 1b), but in the remaining body they are much shorter.

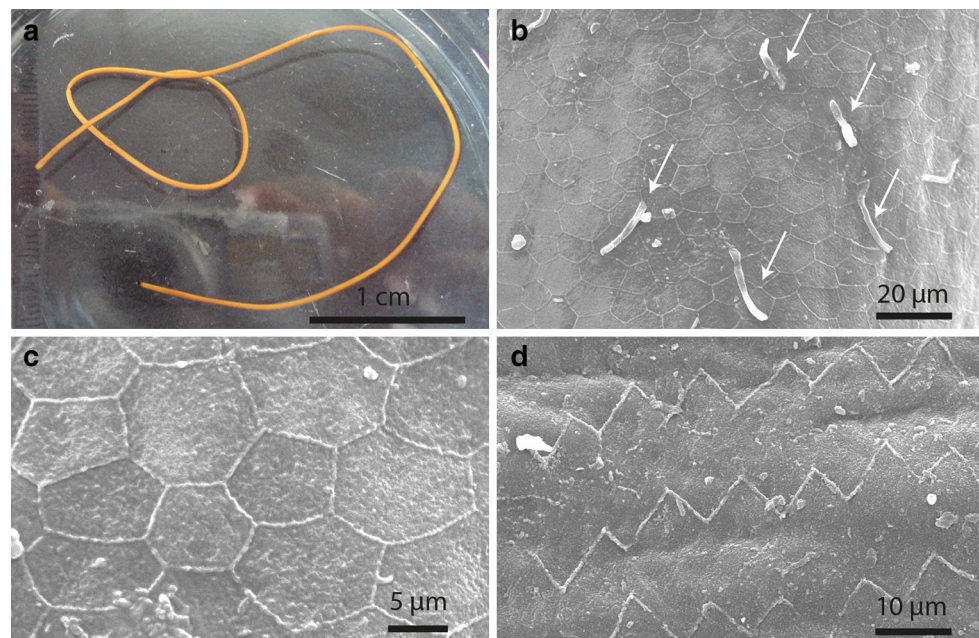
Discussion

The phylum Nematomorpha is comprised of two main groups, the gordiids and nectonematids. Most of the described nematomorph species belong to the freshwater gordiids, while only 5 species of the genus *Nectonema* are

parasites of marine invertebrates (Schmidt-Rhaesa 2013). The determination of species in Nematomorpha is mainly dependent upon the architectural details of cuticle bearing some specific shape and sized elevated structures called as areoles (Schmidt-Rhaesa and Prous 2010). Flat polygonal areoles and fine bristles on the cuticle are known only from species in the genus *Gordius* (Schmidt-Rhaesa 2009). In all other genera of Nematomorpha, the areoles are much more pronounced and elevated above the cuticular surface. The zig-zag lines have not been reported from any *Gordius* species yet, but because they were only locally present on the cuticle of the investigated worm we hesitate to evaluate them as species-specific until their presence has been confirmed from further specimens. Therefore, we treat the recovered specimen as a female *Gordius* sp. This specimen could not be further determined to species level as the major characters of taxonomic importance in *Gordius* sp. are found in the posterior end of male worms (Schmidt-Rhaesa 2009).

The species of the taxon Gordiida have been described either from free-living worms or as parasites of arthropods, mostly insects such as praying mantids, carabid beetles, crickets or cockroaches. Their life cycle is not yet completely resolved, but it includes intermediate hosts such as aquatic insect larvae or freshwater snails. There are several reports from gordiids found in association with humans, but it can be excluded that gordiids actively parasitize humans or other vertebrates (Schmidt-Rhaesa 2013). In most cases the worms are accidentally swallowed. In cases where the worms have been reported to be found in the urinary system, it cannot be excluded that worms emerged

Fig. 1 **a** The female specimen of *Gordius* sp. recovered from pork, **b** Cuticular surface structure of worm in the anterior body region with polygonal areoles and cuticular bristles (arrows). **c** Magnification of polygonal areoles. **d** Zig-zag lines in the median body region. **b–d** by Scanning Electron Microscopy



from their insect host into toilets or similar vessels (Schmidt-Rhaesa 2013). In no case they have been found directly inside the ureter. There remain a few unresolved cases.

Based on all reports and observations it seems extremely unlikely that the gordiids found in pig meat were active parasites of the pig. As insects release their gordiid parasites in moist places, it might be possible that a host, probably a cockroach or a beetle, landed on the fresh meat and released two gordiids that were later found. Apart from the fact that insects should be kept apart from meat, the consumption of the worms would have had no further consequences than possible irritation of the intestinal tract.

Acknowledgments We thank SAIF, NEHU, Shillong for SEM facilities. R Laha and A Sen thank the Director, ICAR Research Complex for NEH Region, Umiam for providing the necessary facilities.

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