

Original article

Assessment of *Anisakis* Larvae Contamination in Atlantic Mackerel (*Trachurus trachurus* L. 1758) from the Western Libyan Coast

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Abstract

Anisakis is a parasitic nematode of marine mammals that utilizes a wide range of fish species as intermediate or paratenic hosts. These larvae are commonly found in commercially important fish, posing public health risks and reducing marketability. Atlantic horse mackerel (*Trachurus trachurus*) is a known host for *Anisakis* third-stage (L3) larvae. This study aimed to investigate the presence, prevalence, and intensity of *Anisakis* larvae infecting *T. trachurus* from the western Libyan coast. A total of 108 random samples of *T. trachurus* were collected from the fishing port of Tripoli city. Morphological measurements (total length and weight) were recorded. Fish were dissected, and larvae were collected, counted, and morphologically identified at the genus level using light microscopy. The overall prevalence of *Anisakis* spp. was 99.07%. Larvae were predominantly found in the muscle tissue, with a lower percentage observed in the body cavity. The intensity of infection was higher in longer fish (19–22 cm), which harbored 35–50 larvae, compared to 10–15 larvae in smaller fish (17–18.5 cm). All larvae were identified as third-stage (L3) larvae of the genus *Anisakis*. The extremely high infection rate renders *T. trachurus* less desirable for human consumption and diminishes its economic value in the Libyan market. These findings highlight a significant public health concern and emphasize the need for preventive measures and molecular identification of the species involved.

Keywords: *Trachurus trachurus*, *Anisakis* spp., Western Libyan coast, Prevalence, Zoonosis.

Introduction

Nematodes of the genus *Anisakis* (family Anisakidae) are globally distributed parasites that mature in the digestive tract of cetaceans (1). Their life cycle involves a series of intermediate hosts, primarily marine crustaceans and fish, which harbor the third-stage larvae (L3) (2). Infection with anisakid nematodes is considered one of the major fish-borne parasitic diseases, as the larvae are known to infect a broad range of fish species and are capable of infecting humans, causing severe pathological conditions (3). Humans become accidental hosts by consuming raw or undercooked seafood that harbors the anisakid larvae in the muscle tissue (4). Although the larvae do not further develop in humans, they can penetrate the gastrointestinal tract and form eosinophilic granulomas, often with pathogenic consequences (5,6).

Anisakids parasites are commonly found in the viscera and musculature of many teleost fish species (7). *Trachurus trachurus* (Atlantic horse mackerel) is a highly valued and commercially important fish for fishermen and consumers in the North African region (8). This pelagic species is migratory and forms schools, feeding on intermediate hosts of *Anisakis* spp. larvae, such as small fish and planktonic crustaceans (9). This feeding behavior makes it highly susceptible to infection (10). Despite the public health and economic importance of this parasite, studies on its prevalence in Libyan waters remain limited (11,12). Therefore, the present study aimed to investigate *Anisakis* spp. Infection in Atlantic horse mackerel (*Trachurus trachurus*) collected from commercial fishers along the western Libyan coast (the fishing port of Tripoli city).

Methods

Sample Collection

A total of 108 specimens of *Trachurus trachurus* were randomly purchased from local fishermen at the fishing port of Tripoli city in August 2022. Samples were placed in an icebox and immediately transported to the Marine Laboratory, Department of Zoology, University of Tripoli, for examination.

Fish Examination

Each fish was measured for total length (cm) and total weight (g) (Fig. 1). Fish were then dissected, and the body cavity was opened. Internal organs were removed, placed in Petri dishes, and washed with physiological saline (0.9% NaCl). Both the organs and the muscle tissue were examined under a stereoscopic microscope for the presence of *Anisakis* larvae.

Larval Collection and Identification

All detected nematodes were collected, counted, and preserved in 70% alcohol with glycerin (9:1 v/v). Larvae were cleared in glycerin and identified based on key morphological characteristics using light microscopy. Identification focused on features such as the presence of a boring tooth, the shape of the ventriculus, and the presence of a mucron, following established taxonomic keys (13-16).

Statistical analysis

Data were compiled and analyzed using Microsoft Excel. Descriptive statistics were calculated for fish biometrics, including mean, range, and standard deviation (SD) for total length and total weight. Prevalence of infection was calculated as the percentage of infected fish relative to the total number examined. Intensity of infection was recorded as the range of larvae counted per fish. The relationship between fish length and infection intensity was assessed by grouping fish into two size categories (17.0–18.5 cm and 19.0–22.0 cm) and comparing the range of larvae observed in each group.

Results

Fish Biometrics

A total of 108 *T. trachurus* specimens were examined. The total length of the fish ranged from 17 to 22 cm, with a mean of 17.6 cm. The total weight ranged from 40 to 80 g, with a mean of 55.75 g (Table 1), measurement of the total length and total weight of *T. trachurus* is shown in Figure 1.

Table 1: Biometric data of *Trachurus trachurus* samples (n=108)

Parameter	Range	Mean ± SD
Total Length (cm)	17.0 – 22.0	17.6 ± 1.8
Total Weight (g)	40.0 – 80.0	55.75 ± 12.4



Figure 1. Measurement of the total length and total weight of *T. trachurus*

Prevalence and Intensity of Infection

The overall prevalence of *Anisakis* spp. larvae was 99.07% (107 out of 108 fish). All recovered larvae were free (not encysted) and motile. A clear positive correlation was observed between fish length and the intensity of infection. Longer fish (19–22 cm) harbored a significantly higher number of larvae (ranging from 35 to 50 per fish) compared to smaller fish (17–18.5 cm), which had 10 to 15 larvae per fish (Table 2).

Table 2. Intensity of *Anisakis* infection in relation to fish length

Fish Length Group (cm)	Number of Fish (n)	Intensity Range (larvae/fish)
17.0 – 18.5	62	10 – 15
19.0 – 22.0	46	35 – 50

Distribution of Larvae

The distribution of larvae within the host was uneven. The majority of larvae were found in the muscle tissue, while a lower percentage was observed free in the body cavity and on the surface of internal organs (Fig. 2).



Figure 2. Detection of larvae in the body cavity of *T. trachurus*

Morphological Identification

All collected larvae were morphologically identified as third-stage (L3) larvae of the genus *Anisakis* (Fig. 3, Fig. 4). The larvae were white, measured 17–21 mm in length, and possessed the characteristic features of the genus. These features include a boring tooth at the anterior end, a long ventriculus, and a mucron at the posterior end. They lacked both a ventricular appendix and an intestinal caecum (13-16).



Fig. 3: Third stage (L3) larva of genus *Anisakis* sp.

Discussion

The results of this study demonstrated an extremely high prevalence (99.07%) of *Anisakis* larvae in *T. trachurus* from the western Libyan coast. This finding is consistent with several previous studies that have identified horse mackerel as a common host for these parasites (9,17,18). For instance, Tantanasi et al. (19) also reported high infection rates in *T. trachurus*, reinforcing the species' role as a significant intermediate host in the *Anisakis* life cycle. The near-total infection rate observed suggests that *T. trachurus* in this region is a key vector for the parasite, likely due to its feeding ecology and the high abundance of infected intermediate hosts in the local waters (10).

The study also revealed a direct relationship between fish length (a proxy for age) and parasite intensity, with larger fish harboring more larvae. This aligns with the findings of Eissa et al. (20) and Azbaid (9), who suggested that larger, older fish have a greater cumulative exposure to infected intermediate prey over their lifetime. As fish grow, their dietary intake increases, and they may consume a wider range of infected crustaceans and small fish, leading to a gradual accumulation of larvae. This pattern indicates that *T. trachurus* serves as a paratenic host, where larvae accumulate without significant development or mortality over time (2).

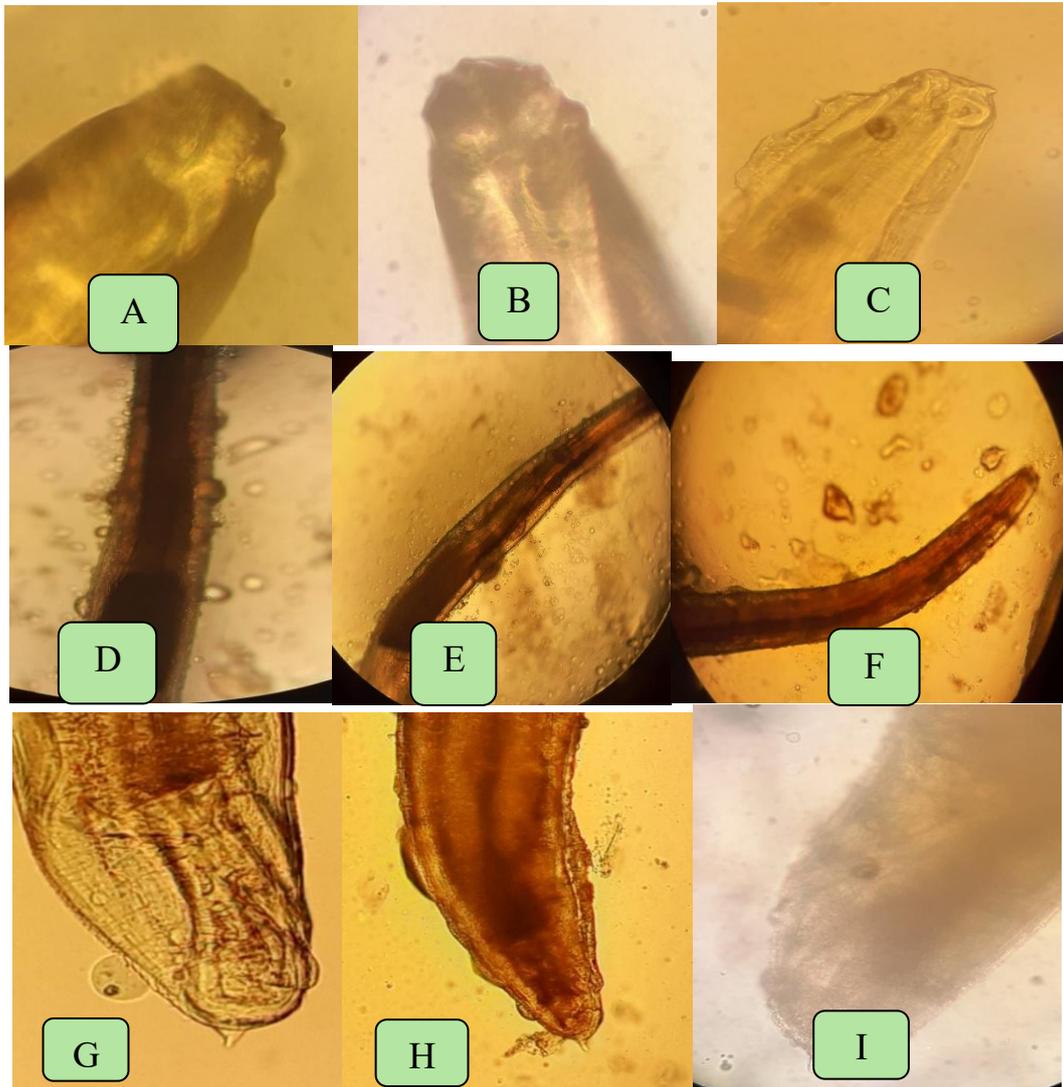


Fig. 4: Morphology of third-stage larvae of genus *Anisakis* from *T. trachurus*: A, B & C Anterior part of the body showing a boring tooth; D, E & F Anterior part of the body showing a long ventriculus; G, H & I Posterior end of the body showing a mucron.

The predominant localization of larvae in the muscle tissue is particularly concerning from a food safety perspective, as it is not easily removable by evisceration. This may be attributed to post-mortem larval migration from the viscera to the muscle, or to the lipid-rich nature of the muscle, which may attract the larvae (18). The presence of larvae in the musculature significantly increases the risk of human ingestion, especially in dishes that involve raw or lightly processed fish. All recovered larvae were identified as third-stage (L3) larvae belonging to the genus *Anisakis*. The morphological features observed were consistent with those described in previous taxonomic studies (13-16). The larvae were characterized by the presence of a boring tooth at the anterior end, a long ventriculus, and a mucron at the posterior tip, while lacking both a ventricular appendix and an intestinal caecum. These features are diagnostic for the genus and confirm that the specimens are indeed *Anisakis*.

The taxonomic placement of these larvae is as follows: they belong to the phylum Nematoda (Rudolphi, 1808), which encompasses all roundworms. Within this phylum, they are classified under the class Secernentea (Chitwood, 1958), a large group that includes many parasitic species. They fall within the order Ascaridida (Skrjabin & Schultz, 1940), which is characterized by parasites possessing three lips and a simple digestive system. Further classification places them in the superfamily Anisakinae (Railliet & Henry, 1912), a group defined by their aquatic life cycles involving intermediate hosts such as crustaceans and fish. Finally, all morphological features confirmed their placement within the

genus *Anisakis* (Dujardin, 1845), a genus of global medical and veterinary importance due to its role in human anisakiasis (1,24).

While morphological identification confirmed the genus as *Anisakis*, species-level identification remains challenging due to the high degree of morphological similarity among larvae of different species within the genus (14). Several species, such as *A. simplex* sensu stricto, *A. pegreffii*, and *A. physeteris*, are known to coexist in the Mediterranean region and have different zoonotic potentials and ecological niches (3). Therefore, future molecular analyses using techniques like PCR and DNA sequencing are essential to identify the specific *Anisakis* species involved and better understand their epidemiology and transmission dynamics (1,24).

The high prevalence and muscular localization observed pose a dual threat: a public health risk to consumers who prefer raw or undercooked preparations, and an economic threat to the Libyan fishing industry (12). Consumer rejection of visually contaminated fish leads to a significant decrease in market value (21). Fishermen and market workers have noted a growing aversion to this species in Libyan markets, directly impacting the livelihood of those dependent on its harvest. This economic loss can have ripple effects throughout the local supply chain, from fishermen to retailers.

These findings underscore the urgent need for preventive measures. As suggested by Macchioni et al. (22), interrupting the parasite's life cycle is crucial. This can be achieved by preventing the discharge of untreated sewage (which can contain parasite eggs) into the sea, educating fishermen not to discard infected viscera overboard, and promoting proper cooking or freezing of fish to kill larvae before consumption (23). Public awareness campaigns should also be implemented to inform consumers about the risks of consuming raw or undercooked fish and the importance of proper fish handling and preparation.

Conclusion

In conclusion, the high infection rate of *Anisakis* larvae in *T. trachurus* from the western Libyan coast represents a significant public health concern and a major economic challenge. While morphological identification has confirmed the genus, molecular studies are urgently needed to determine the specific species involved and to inform targeted risk assessment and management strategies.

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Authors Contributions

Morphological measurements of fish sample (total length & total weight): T.K; dissection, collection, and counting of larvae: N.G., A.D., T.K; Purchasing fish samples, classification of larvae, and writing the original draft of the manuscript: N.G.

Conflict of interest

The authors declare no conflict of interest.

Data availability

The data generated in this study are available within the publication.

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