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Identification of parasites in goatfish (*Upeneus* sp.) sold at Asem Traditional Market, Surabaya, Indonesia

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ABSTRACT

Goatfish (*Upeneus* sp.) is a marine fish commonly sold in traditional markets and widely consumed by the community. However, fish sold in markets may carry parasites that can potentially pose health risks to consumers. Therefore, parasite identification is necessary to provide information regarding parasite occurrence in marketed fish. In this study, eight goatfish samples obtained from the Asem Traditional Market, Surabaya, Indonesia, were examined using macroscopic and microscopic methods. The results showed that 37.5% of the samples were infected with *Anisakis* sp., with a total of 15 larvae and an average intensity of five larvae per infected fish. The larvae were found in the digestive organs and exhibited distinctive morphological characteristics, including a boring tooth on the anterior end and a mucron on the posterior end, which support the parasite's invasive ability. These findings indicate a potential health risk to consumers, particularly if the fish is consumed raw or undercooked. Prevention can be achieved through proper post-harvest handling and adequate cooking temperatures to ensure the larvae become non-infective.

Key words: *Anisakis* sp., food safety; goatfish, parasite morphology; *Upeneus* sp.

INTRODUCTION

Fish is an important source of animal protein for the community. Fish is highly sought after for its nutritional value, ease of availability, and relatively affordable price. As a popular food source, fish safety and quality are primary concerns for both consumers and the fishing industry. However, both wild-caught and farmed fish are susceptible to disease. These infections can be caused by parasites, which can harm the fish and affect the economic impact on the fishing and aquaculture industries (Koepper *et al*., 2021). Parasites that infect fish for consumption also pose a serious threat to public health (Siagian *et al*., 2023).

Parasites that infect fish can degrade product quality and value, ultimately leading to financial losses for local fisheries (Palomba *et al*., 2021). Some parasites are zoonotic, meaning they can be transmitted to humans and cause disease, especially when consumed raw or undercooked. Symptoms in humans can include diarrhea or digestive disorders (Siagian *et al*., 2023). Based on this, identifying parasites in fish for consumption, especially those sold in markets, is crucial for ensuring food safety and protecting consumer health.

In Indonesia, research on parasitic infections in fish sold in markets for consumption remains scarce (Siagian *et al*., 2023). Traditional markets, such as Pasar Asem in Surabaya, are major distribution points for freshly caught fish that reach consumers directly. The goatfish (*Upeneus*

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sp.) is a common fish found and traded in Indonesian markets. Several species of *Upeneus*, such as *Upeneus asymmetricus* and *Upeneus moluccensis*, have been the subject of research on metazoan endoparasitic fauna on the island of Java, Indonesia (Koepper *et al*., 2022). This suggests that fish of the genus *Upeneus* can host various parasites.

Research on parasite identification in goatfish in traditional markets is crucial given its role as a food fish and the potential health risks posed by zoonotic parasites. A similar study by Siagian *et al*. (2023) at a fish market in Indonesia has shown significant parasite infections. Examination of fish parts allows the determination of parasite infection levels and the potential threat to humans (Cipriani *et al*., 2018). Therefore, this study aims to identify the parasites found in goatfish (*Upeneus* sp.) sold at the Asem Traditional Market in Surabaya. The results of this study are expected to provide additional literature and essential information for the broader community of fish consumers and to contribute to food safety and monitoring efforts in Indonesia.

MATERIALS AND METHODS

Research period and location

This exploratory descriptive study was conducted from October to November 2025. Eight samples of goatfish (*Upeneus* sp.) were obtained from the Asem Traditional Market, Sawahan District, Surabaya City. The entire process of identifying ectoparasites and endoparasites was conducted at the Taxonomy Laboratory in the Faculty of Mathematics and Natural Sciences, Surabaya State University.

Materials and equipment

The equipment used included a stereo microscope, a compound microscope, an analytical balance, a ruler, a dissection kit, a dis-section tray, microscope slides, cover slips, a dropper pipette, petri dishes, stationery, a camera, gloves, and plastic bags. The materials included eight samples of goatfish (*Upeneus* sp.), distilled water, 70% alcohol, 0.9% physiological saline, and lactophenol.

Procedure

Fish samples were stored in ice-filled containers during transport to maintain freshness and were then cleaned under running water. Each sample was measured for total length and body weight prior to parasite examination. Ectoparasite identification was performed by observing the body surface, mucus, scales, fins, and gills. Mucus and gill samples were collected using sterile surgical instruments, placed on glass slides, dripped 0.9% physiological NaCl solution, covered with a coverslip, and observed under a microscope at 40×–400× magnification. Parasite morphological identification was based on diagnostic characters referred to by Kabata (1985), Woo & Buchmann (2012), and related scientific literature.

Endoparasite identification was performed through a ventral incision, starting from the ventral side (anus) towards the operculum. Two incisions were then made perpendicular to the main incision: one behind the operculum and one in front of the anus, leading towards the spine. The digestive tract was removed intact, placed in a Petridish containing 0.9% physiological saline, and then the stomach and intestines were opened and examined. Initial observations were made with a stereo microscope to detect large parasites, and subsequent observations were made with a compound microscope at 40×–400× magnification to detect small parasites or parasite eggs. The nematodes were soaked in a lactophenol solution to clarify their anatomy before morphological identification, in accordance with the relevant literature.

Data analysis

The data obtained from the identification of parasites in fish were analyzed descriptively and presented in figures and tables. Parasite prevalence and intensity were calculated according to Kabata (1985):

$$Prevalence\ (\%) = \frac{\Sigma\ Fish\ infected\ with\ parasite\ A}{\Sigma\ \text{Fish Examined}}\ x\ 100$$

$$Intensity\ (ind/fish) = \frac{\sum Parasite\ A\ found}{\sum Infected\ fish}$$

The results of the parasite prevalence calculations in fish were categorized according to the following criteria (Table 1).

Table 1. Parasite prevalence categories.

No.	Prevalence (%)	Category	Infection Level
1.	100-99	Always	Very severe
2.	98-90	Almost always	Severe
3.	89-70	Usually	Moderate
4.	69-50	Very frequent	Very frequent
5.	49-30	Generally	Common
6.	29-10	Frequent	Frequent
7.	9-1	Occasionally	Occasional
8.	< 1- 0.1	Rare	Rare
9.	< 0.1 – 0.01	Very rare	Very rare
10.	< 0.01	Almost never	Never

The results of the parasite intensity calculations in fish were categorized according to the following criteria (Table 2).

Table 2. Parasite intensity categories.

No.	Intensity	Category
1.	< 1	Very low
2.	1 - 5	Low
3.	6 - 50	Moderate
4.	51 - 100	Severe
5.	> 100	Very severe
6.	> 1000	Super infection

RESULTS AND DISCUSSION

Morphological characteristics of *Upeneus* sp.

The genus *Upeneus* belongs to the Mullidae family and is characterized by consistent morphometric, meristic, and color patterns across its species. All species in this genus have an elongated and slightly flat body with the characteristic of a pair of long and sensitive barbels under the chin, which are used to detect prey on the bottom of sandy or muddy waters (Parkavi *et al*., 2025). The head is shorter than the body and varies among species. Body coloration varies, but the basic pattern generally lacks a bar on the lower caudal lobe, and some species display a dark oblique line on the upper caudal lobe (Uiblein *et al*., 2017). This fish also has a streamlined body shape that supports rapid movement in tropical waters.

Habitat and feeding behavior of *Upeneus* sp.

The goatfish is widely distributed in tropical to subtropical waters. This species generally inhabits coastal waters at depths of 10–90 m (Azizah *et al*., 2019). In Indonesia, the goatfish is found across various regions, including Sumatra, Java, Bali, Kalimantan, Maluku, and the Sunda Strait. Taxonomically, it belongs to the genus *Upeneus*, with commonly recorded species in Indonesia such as *Upeneus asymmetricus* and *Upeneus moluccensis* (Koepper *et al*., 2022). This fish lives close to the seabed and is carnivorous, feeding on small invertebrates such as crustaceans, gastropods, and zooplankton.

Potential infection of *Anisakis* sp. in goatfish

As predators of small invertebrates, *Upeneus* sp. may serve as hosts for the parasitic nematode *Anisakis* sp. Infection can occur when fish consume infected invertebrates containing larvae, which later migrate into the organs and muscle tissue. Seasonal migration between coastal and offshore waters may also increase contact with *Anisakis* sp. eggs released by marine mammals, thereby increasing the risk of exposure (Martin-Carrillo *et al*., 2022). Similar infection mechanisms have been described in *Engraulis encrasicolus*, where larvae were distributed throughout the body, including muscle tissue (Díez *et al*., 2024). In mackerel (*Scomber scombrus*), high rates of muscle infection were reported in samples from Spanish and Portuguese waters, indicating that larvae can penetrate muscle tissue (Levsen *et al*., 2018).

Parasite examination results in *Upeneus* sp. samples

Based on the examination of eight goatfish (*Upeneus* sp.) samples measuring 20–23 cm in length and weighing 135–150 g, three samples were positive for *Anisakis* sp. infection. Identification was conducted for both ectoparasites and endoparasites. The results showed no ectoparasites on the body surface of goatfish (*Upeneus* sp.) (Figure 1). However, endoparasites in the form of *Anisakis* sp. were detected in the digestive tract (Figure 2).

The total number of parasites recorded from the infected samples was 15 larvae. A detailed summary of fish size, number of parasites, and parasite size is provided in Table 3. These results support previous findings that *Anisakis* sp. is an endoparasitic nematode commonly located in the body cavity or digestive system of fish hosts (Putra *et al*., 2025; Labhu *et al*., 2022).

Table 3. Fish size and *Anisakis* sp. parasite infestation in goatfish (*Upeneus* sp.).

Fish size		Number of parasites	Parasite size (mm)
Length (cm)	Weight (g)		
20	135	3	5, 10, 12
21	140	5	8, 8, 12, 12, 13
23	150	7	9, 10, 11, 12, 14, 15, 15

The observations in Table 3. indicate that longer and heavier fish harbored more parasites. This is consistent with the research by Schleicherová *et al*. (2023) on *Mullus barbatus* in the Ligurian Sea, which reported a positive relationship between fish body size and *Anisakis* infection rates, with larger fish more likely to carry more parasites. This is explained by a shift in diet with increasing size and age, from microplankton to larger organisms such as crustaceans or small fish, which act as intermediate hosts, increasing the likelihood of exposure to infective larvae. Furthermore, *Anisakis* larvae persist within fish throughout their lifespans, leading to parasite accumulation in older individuals (Debenedetti *et al*., 2019; Macchioni *et al*., 2021). Although the sample size was relatively homogeneous, similar variation in larval abundance was observed among fish of different body sizes. The calculated prevalence was 37.5%, which, according to Kabata (1985), falls under the "general" category (Table 4). Epidemiologically, prevalence values of 30–49% are classified as common infections, consistent with findings from endoparasite studies on climbing perch infected with *Camallanus* sp. and *Procamallanus* sp. (Veronika *et al*., 2024).

The intensity of *Anisakis* infection is presented in Table 5, indicating an intensity value of 5 larvae per infected fish, which is categorized as "Low" based on Kabata (1985). This suggests that although infection was present, the number of larvae per infected host was relatively small.

The digestive organs, especially the intestines, are the central location of infestation because they provide a source of nutrients in the form of blood, body fluids, and food waste that support the survival of the parasite (Veronika *et al*., 2024). This condition is consistent with studies on tropical demersal fish, which have a higher risk of infection by marine nematodes such as *Anisakis* spp. due to a benthic lifestyle and consumption of bottom organisms, including crustaceans as intermediate hosts (Aibinu *et al*., 2019). This explanation is supported by macroscopic identification of stomach contents, which revealed the presence of crustaceans, as shown in (Figure 3), suggesting a possible route of larval transmission.

In Table 5, the parasite intensity averaged 5 larvae per infected fish, classified as "low". However, several clinical studies have reported that even a single larva or a small number of larvae is sufficient to cause anisakiasis in humans and trigger an inflammatory response in the gastrointestinal mucosa, especially if the larvae are ingested alive and still infective (Inoue *et al*., 2025; Papadopoulos *et al*., 2025; Nonković *et al*., 2025). Furthermore, histopathological studies in fish indicate that even relatively small numbers of anisakid larvae can cause local bleeding, an inflammatory response, and changes in tissue structure in the gastrointestinal tract and muscles, ultimately potentially reducing the quality of fish meat as a food product and impairing food safety (López-Verdejo *et al*., 2022; Alharbi *et al*., 2025).

Anisakis sp. larvae are generally found in the visceral organs of demersal fish, such as the intestines, liver, and peritoneal cavity, both in free and encapsulated conditions (Aibinu *et al.*, 2019). Under certain conditions, larvae can migrate to muscle tissue, primarily influenced by fish physiological factors, environmental temperature, and post-harvest handling. Delayed cooling or storage at inadequate temperatures increases the likelihood of larval migration to consumed fish meat (Ozuni *et al.*, 2021). This is in line with the findings of (Martin-Carrillo *et al.*, 2022), who stated that *Anisakis* sp. larval migration is more likely to occur if fish are not immediately stored at low temperatures after capture. Research on *Anisakis pegreffii* also shows that larval migration is influenced by tissue chemical conditions, including pH, temperature, and other environmental factors during storage (Šimat *et al.*, 2015). These findings emphasize the endoparasitic character of *Anisakis* sp. and the potential health risks that arise if larvae migrate to the flesh of fish consumed by humans (Solas *et al.*, 2008). Macroscopic examination of the digestive tract and visceral organs is therefore an essential initial step in early detection of this parasite.

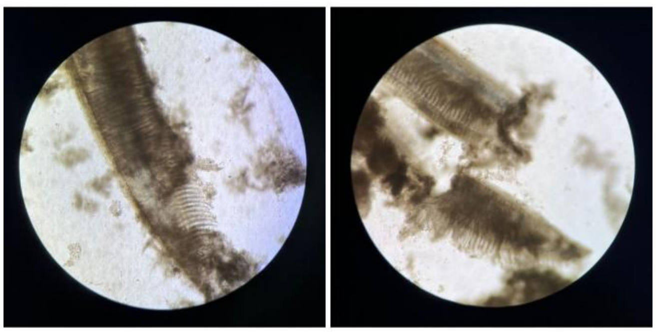

Figure 1. Identification of ectoparasites on the gills of the goatfish (*Upeneus* sp.).

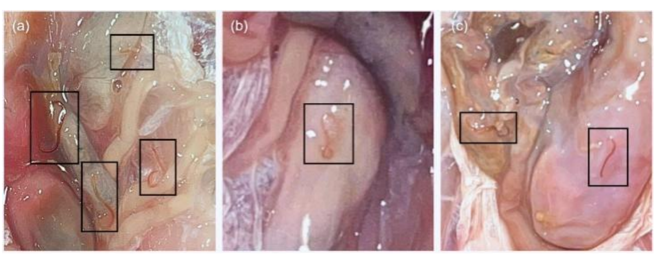

Figure 2. Endoparasites found in the digestive tract of the goatfish (*Upeneus* sp.).

Table 4. Prevalence of *Anisakis* sp. endoparasites in goatfish (*Upeneus* sp.).

Examined fish	Infected fish	Prevalence (%)	Category (Kabata, 1985)
8	3	37.5%	Generally

Table 5. Intensity of *Anisakis* sp. endoparasites in goatfish (*Upeneus* sp.).

Number of parasites found	Number of infected fish	Intensity	Category (Kabata, 1985)
15	3	5	Low

Morphologically, *Anisakis* sp. larvae are elongated, cylindrical, white, and generally found coiled (Ola *et al.*, 2024). Diagnostic characteristics observed include the presence of boring tooth on the anterior body, the mucron, rectum, and anus on the posterior body, the esophagus, ventricle, and excretory pore, as seen in microscopic identification (Figure 5). These findings are consistent with previous studies reporting that Anisakis sp. larvae are commonly found in visceral organs and exhibit distinctive morphological characteristics, such as a boring tooth and a mucron (See *et al.*, 2022; Setyobudi *et al.*, 2018). Other research has also suggested that *Anisakis* sp. can migrate from internal organs to the muscle tissue of fish (Mostafa *et al.*, 2023).

The boring tooth located at the anterior par is to perforate the intestinal wall. It also serves as a defensive structure that allows the parasite to attach to the intestinal mucosa during intestinal contractions associated with digestion, and as a suction device that draws food from the host's body (Detha *et al.*, 2018). This function explains why Anisakis sp. larvae can cause significant damage to both their primary and final hosts, including humans. The larvae's invasive ability can trigger inflammatory reactions, ulceration, and even an acute immune response in cases of anisakiasis, which correlates with the degree of pathogenicity and the larvae's ability to survive in host tissue (Martin-Carrillo *et al.*, 2022). Food

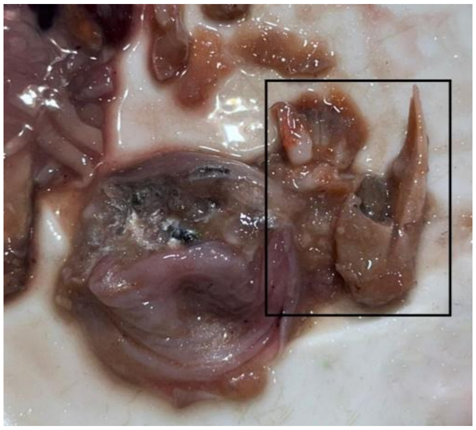

Figure 3. Crustaceans in the stomach of the goatfish (*Upeneus* sp.).

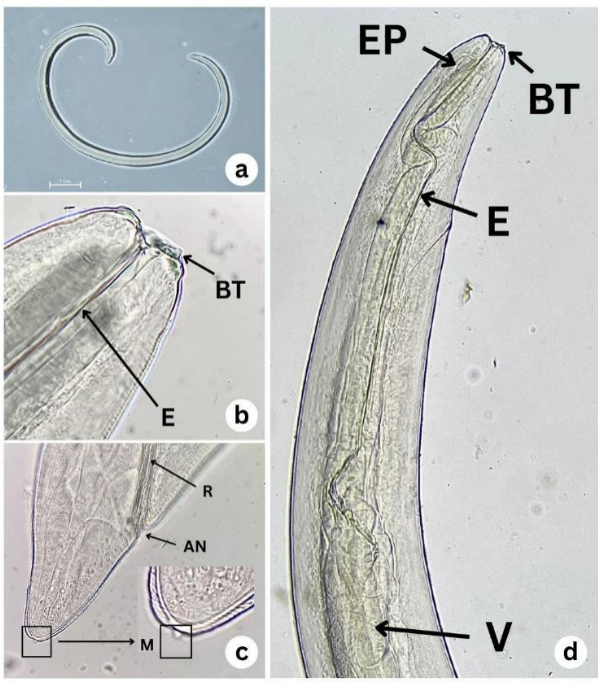

Figure 4. Morphology of the endoparasite *Anisakis* sp. isolated from the goatfish (*Upeneus* sp.): (a) overall body view (1x magnification), (b) anterior portion with boring tooth (400x magnification), (c) posterior portion with mucron (400x magnification), (d) anterior portion (40x magnification). Captions: BT- Boring Tooth, E- Esophagus, R- Rectum, A- Anus, M - Mucron, EP - Excretory Pore, V - Ventriculus.

sucked by Anisakis sp. larvae passes through the esophagus, ventricle, and intestinal tract (Ola *et al*., 2024).

After passing through the esophagus, food enters the ventricle before being passed to the intestine, allowing the larvae to obtain energy for migration into the tissue quickly (Bellini *et al*., 2022). The larval tail is characterized by a small mucron at the posterior end (Figure 5), which serves as an anchor, holding the larva in place within the host tissue and aiding nutrient absorption through direct contact with host cells. The combination of a boring tooth, a ventricle, and a sharp mucron explains why *Anisakis* sp. can cause wounds in the gastrointestinal tract and subsequently migrate to muscle tissue or other organs, including the final host, humans (Nonković *et al*., 2025).

The presence of *Anisakis* sp. larvae in goatfish (*Upeneus* sp.) sold at the Asem Traditional Market in Surabaya has important implications for consumer health. After ingestion, third-stage larvae (L3) can attach to or penetrate the gastrointestinal mucosa, causing acute abdominal pain, nausea, vomiting, and diarrhea, and can mimic gastritis, peptic ulcers, or appendicitis (Ivanovic *et al*., 2015; Shimamura *et al*., 2016). Clinically, anisakiasis is classified into gastric, intestinal, ectopic, and allergic forms depending on the location of the larvae and the host's immune response (Fujisawa *et al*., 2025). In addition, *Anisakis* sp. is a potent allergen that can trigger IgE sensitization and allergic manifestations ranging from urticaria to anaphylactic reactions, known as gastro-allergic anisakiasis (Aibinu *et al*., 2019; Nonković *et al*., 2025). Several studies have even reported that patients with gastric or colon cancer are more likely to exhibit antibodies to *Anisakis* antigens, suggesting that repeated infection or exposure is a potential risk factor for gastrointestinal tumors (Garcia-Perez *et al*., 2015). This parasite is considered an emerging public health threat in the context of fish-based food safety.

Several effective methods for inactivating Anisakis larvae in fish include freezing, heating, high hydrostatic pressure, and salting (Molina-García & Sanz, 2002; Oh *et al*., 2014). Freezing is the primary control method, with regulatory standards such as -20°C for 24-48 hours or -35°C for 15-24 hours, although effectiveness depends on the fish species and freezer capacity. Heating can also kill larvae, but research suggests that temperatures above 60°C are required, with optimal conditions of ≥ 70°C for ≥ 1 minute (Della-Morte *et al*., 2023). So, education for sellers and consumers regarding food safety, particularly in traditional markets, is also needed to reduce the risk of exposure to *Anisakis* larvae.

CONCLUSION

This study showed that 37.5% of the examined goatfish (*Upeneus* sp.) were infected with *Anisakis* sp. larvae at low intensity, yet they still pose a potential risk to human health. Larvae were found in the digestive tract and are morphologically characterized by a boring tooth on the anterior end and a mucron on the posterior end, which help them penetrate and survive in host tissue. The presence of these structures indicates the parasite's invasive ability and therefore requires caution when consuming it. Simple prevention measures include thoroughly cooking fish or freezing it before consumption to minimize the risk of anisakiasis.

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