

# Alteration in gills, skin, and fins of snakehead fish (*Channa striata*) due to ectoparasite infection: a macropathological and histopathological approach

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**Abstract.** Snakehead fish (*Channa striata*) is a freshwater fish with high economic value both as ornamental and consumed fish. However, the ability to adapt to fluctuating environmental states prompts snakehead fish to be susceptible to parasites, ectoparasites, and endoparasites. Gills, skin, and fins are the major body parts that are often infected with ectoparasites. This study aims to discover the macro pathology in gills, skin, and fins of ectoparasites-infected snakehead fish and its histopathology. This study was conducted from April to June 2021. Observational data on macro pathology and histopathology were analyzed qualitatively. The results indicated that the macro pathology of the skin, gills, and fins of snakehead fish infected with ectoparasites indicates discoloration, excess mucus production, the dull coloration of the gills, and irritation of the gills body surfaces, and skin hemorrhages. In conclusion, infection of ectoparasites affects several alterations in the skin, gills, and fins, both macro pathological and histopathological.

## 1 Introduction

Snakehead fish (*Channa striata*) is a freshwater fish with high economic value both as ornamental and consumed fish [1]. In addition, this fish also contains higher nutrients and albumin than other fish [2]. Snakehead fish are commonly distributed in freshwater habitats, including rivers, rice fields, ponds, swamps, and even community ditches. In Indonesia's freshwater ecosystem, snakehead fish has a high abundance, including in Aceh water [3]. The ability to adapt to fluctuating environmental conditions makes this fish vulnerable to parasites infection, both ectoparasites, and endoparasites.

Ectoparasites often infect the skin, fins, and gills of fish. Fish infected with ectoparasites usually show specific changes, for instance small and large skin rashes as well as changes in skin color [4]. Gills, skin, and fins are the main body parts of fish that are often infected with ectoparasites. Several types of ectoparasites that infect gills, skin, and fins of snakehead fish are *Trichodina* sp., *Dactylogyrus* sp., *Oodinium* sp., and *Epistylis* sp [5]. Ectoparasite infection causes alteration to the gill filaments, resulting in disrupting the respiratory process [6].

*Trichodina* sp. infection in fish gill has reported caused excessive mucus secretion, provoking stress and inflammation or hemorrhaging. Meanwhile, *Trichodina* sp. infection on the skin and fins induces inflammation, necrosis, and excessive mucus secretion [7]. Histologically, gills infected with ectoparasites were reported to suffered tissue damage. Previous studies reported alteration in the secondary lamellae of goldfish (*Carassius auratus*) gills, including hyperplasia and necrosis due to infection of ectoparasites of *Argulus* sp. [8]. To date, the study related the macro pathology and histopathology of snakehead fish's gills, skin, and fins due to ectoparasite infection have not been well investigated. Thus, this study aims to investigate the macro pathology and histopathology alteration in gills, skin, and fins of snakehead fish due to ectoparasites infection.

## 2 Materials and Methods

### 2.1 Place and Duration of the Research

This study was conducted from April to June 2021. A total of 90 snakehead fish were collecting from rice fields, swamps, and ditches in the Aceh Besar District

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covering the Kajhu area in Baitussalam Subdistrict (N 5°35'51.11" E 95°22'32.30"), Limpok in Darussalam Subdistrict (N 05°33'43.88" E 095°22'27.56"), Cot Keung area in Kuta Baro Subdistrict (N 5°33'19.54" E 95°24'10.49"), Samahani in Kuta Malaka Subdistrict (N 5°26'39.73" E 95°24'11.16"), and Mata Ie in Montasik Subdistrict (N 5°28'23.51" E 95°23'52.40"). Aceh Besar District was chosen due to its diversity of habitat of snakehead. Observing parameters was carried out at the Multi-Function Laboratory of the Ar-Raniry State Islamic University, Banda Aceh. Histological preparation was conducted at the Center of Brackish Aquaculture Fisheries (CBAF) Ujong Batee.

## 2.2 Macro pathology and Histopathology Observation

Ectoparasite infection was observed in the gill, skin, and fins. The mucus was collected and placed on a slide, dripped with 0.85% physiological NaCl solution, covered with a coverslip, and observed under a microscope (Olympus CX 23; Japan). Gills and fins were cut and placed on a slide and dripped with 0.85% physiological NaCl solution then covered with a slide and observed under a microscope. The ectoparasites found were identified by comparing the morphology of ectoparasite with identification references [9]. Macropathological symptoms were analyzed by observing the alteration in snakehead fish's gills, skin, and fins. The ectoparasites found were identified by comparing the morphology of ectoparasite with identification references.

Histological preparations was based on histotechnique method [10]. Briefly, The fish gills were preserved with Davidson's solution. Briefly, histological preparation consists of five stages: fixation, dehydration, clearing, wax infiltration, embedding, cutting, and staining. In the fixation stage, the organs were immersed in Davidson's solution for 24 hours. The organs were then dipped in an alcohol solution with 70%, 80%, 90%, and 100% graded concentrations in the dehydration stage. In the clearing stage, the dehydrated sample was transferred to Xylene/Xylol solution for 2 hours. Paraffin or samples were cut using microtome at 5µm thick. The tissue was stained using hematoxylin and eosin for ten minutes. The histology preparations were then observed with a microscope equipped with a camera (Olympus CX 23; Japan). Observational data on macro pathological and histopathological changes were analyzed qualitatively.

## 3 Results and Discussion

Snakehead fish infected by ectoparasites showed several macro pathological symptoms, including irritation and hemorrhage on the skin, pale color, white nodules on the gills, and irritation of the tail fin (Table 1 and Figure 1). Normal snakehead fish skin color is greenish-gray. The abdomen is white, the body surface and head have thick scales, and there are no sores or irritations on the entire body

surface. The gills of normal snakehead fish is fresh red and without white nodules. In contrast, infected fish was indicated with dull or pale in color and with white nodules. The skin showed irritation, has white nodules, and produces excessive mucus

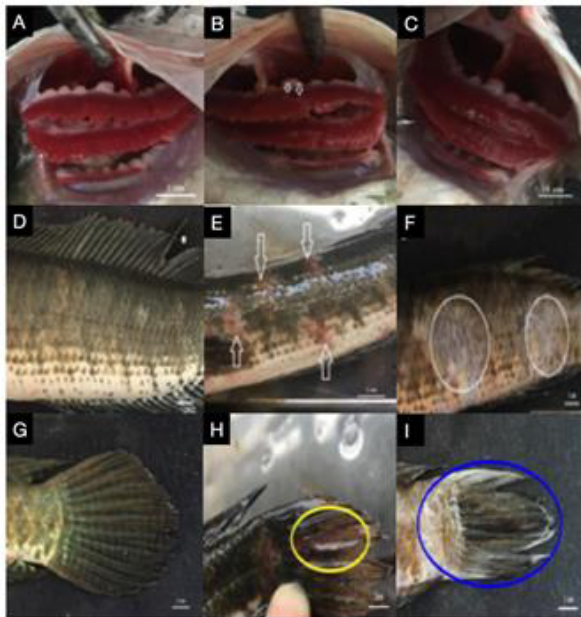
**Table 1.** Normal appearance and macro pathological symptoms observed in ectoparasites-infected snakehead fish.

No	Organs	Normal	Infected with Parasites	Ectoparasite
1.	Gill	Reddish Normal mucus secretion	White nodules on gills The gills are pale red. Excessive mucus secretion	<i>Tricodina sp.</i> <i>Tetrahymena sp.</i> <i>Epistylis sp.</i> <i>Gyrodactylus sp.</i> <i>Dactylogyrus sp.</i>
2.	Skin	The skin is greenish-grey, and the abdomen is white with thick, rough scales covering the surface of the body and head. No excess mucus secretion	The skin is pale gray, and the fins are peeling off excessive mucus secretion in the whole body irritations on the body surface.	<i>Tetrahymena sp.</i> <i>Dactylogyrus sp.</i>
3.	Fin	No excess mucus secretion The fins are blackish gray.	The tail is pale white, and there are sores on the fins and edges of the fins. The fins are reddish.	<i>Tricodina sp.</i> <i>Epistylis sp.</i>

High-intensity infection of parasites alters the gill structure, which eventually causes death. It also can attack the others fish organs, including the skin and fins [11]. Apart from *Trichodina sp.*, several other parasites can infect fish, such as *Dactylogyrus sp.*, which often attacks freshwater fish's gills. Clinical symptoms showed that infected fish tend to be defenseless, mucus production is excessive, and the gills is pale and swollen [11].

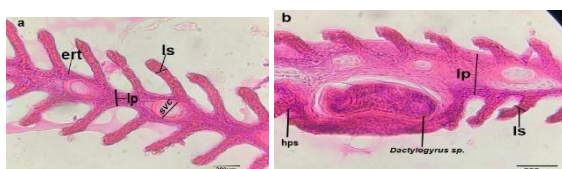
The macro pathology observations showed that the skin of infected snakehead fish endures a paler color change accompanied with irritation on the body surface. Clinical symptoms that appear are changes in body color to become dull and infection of the gills, which makes it difficult for fish to breathe. Besides *Tetrahymena sp.*, another parasite that attacks the skin of snakehead fish is *Dactylogyrus sp.* The clinical symptoms it generates are mucus and pale color on the skin's surface due to infection, which prompts excessive mucus production [12]. Macro pathology observation of snakehead fins

infected with ectoparasites indicated sores on the caudal fin and pale color on the edges of the fins.



**Fig. 1.** Macro view of gills, skin, and fins of normal and ectoparasite-infected snakehead fish. (a) Normal snakehead fish gills from rice field habitat (b) snakehead fish gills from ditches habitat are pale in color and have white nodules due to ectoparasite infection. (c) Snakehead fish gills from ditches habitat are pale in color and have white nodules due to ectoparasite infection. (d) Snakehead fish gills from ditches habitat that are dull red. (e) Normal snakehead fish skin from rice field habitat. (f) Irritation and hemorrhage due to ectoparasite infection in snakehead fish from ditches habitat. (g) Exfoliated skin scales due to ectoparasite infection in fish from ditches habitat. (h) Caudal fin of snakehead fish from swamp habitat. (i) Caudal fin irritation of snakehead fish from ditch habitat. (j) Pale white fin edges on snakehead fish from ditches habitat. Scale bar 1 cm.

The shape of the primary lamella (LP) of normal fish is clearly visible, the shape of each secondary lamella (LS) looks neatly arranged, and there is a central sinus venous (SVC) on it. In contrast, in the gills of ectoparasite-infected snakehead fish, the primary lamella (LP) is swollen, the shape of each secondary lamella (SL) is not clearly visible. Ectoparasites *Dactylogyrus* sp. was observed between the primary and secondary lamellae. The gill structure of normal and ectoparasites-infected snakehead fish is presented in Figure 2.



**Fig.2.** Histological appearance of normal snakehead fish gills and ectoparasite-infected snakehead fish gills. (a) Primary lamellae (LP), secondary lamellae (LS), erythrocytes (ERT), and central sinus venous (SVC) on the gills of normal snakehead fish. (b) swollen at primary lamellae (LP), secondary lamellae (LS) that are not clearly shaped, and hyperplasia (HPS). Ectoparasites *Dactylogyrus* sp. in the gills of ectoparasite-infected snakehead fish. Scale bar: 200  $\mu$ m, Magnification 100 X.

The gills are one of the fundamental organs of fish that act as the primary respiratory apparatus that works by diffusion of oxygen dissolved in water [13]. The gills are susceptible to water quality degradation due to their significant contact with water [14]. Gills infected with ectoparasites induce hyperplasia, a disorder that triggers cells between the secondary lamellae. These cells can prompt the secondary lamella to thicken and become irregular in shape. Cells epithelium discovered in the secondary lamellae of the gills might be an adaptive strategy to the presence of parasites.

Histopathologically the process of gill defense from the attachment of parasites using anchors can cause bleeding. Defensive reactions in the lamellae stimulate the rapid growth of epithelial cells of the gill lamellae (hyperplasia) and an increase in mucus secretion by mucus cells [15]. Lamella hyperplasia is not only caused by the growth of epithelial cells but can also synergize with mucus cell proliferation and fusion of secondary lamellae (fused gill lamellae). Proliferation is a condition in which secondary lamellae epithelial cells grow excessively due to ectoparasite injuries, causing increased mucus production and resulting in excess secondary epithelial cells [16]. The proliferation of lamellae cells that occurs is a response to a long or rapid infection. *Dactylogyrus* sp. was known as the parasites that attaches to the surface of the gill lamella by using an opistaptor, a suction device that circulates with blood circulation [17]. Several researchers inform that gills infected with the parasite, including *Dactylogyrus* sp., are characterized by hyperplasia and swelling [18].

## 4 Conclusion

Macro pathology of gills, skin, and fins of ectoparasites-infected snakehead fish indicates changes in skin color and excessive mucus production. Histopathology of the gills of ectoparasites-infected snakehead fish pointed to the presence of hyperplasia, a disorder that triggers the appearance of cells between the secondary lamellae. These cells can prompt the secondary lamella to thicken and become irregular in shape.

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