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Study of the Endoparasites for the Common Carp (Cyprinus carpio) Fish from Mosul Dam Lake in Nineveh Governorate, Iraq

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ABSTRACT

The study highlights the importance of common carp in the Tigris River, especially in Mosul Dam, and the internal parasites that infect it. The study of 70 samples of common carp from Mosul Dam Lake, Nineveh governorate, aims to examine the prevalence of internal carp parasites in Mosul Dam Lake, Iraq. The study was conducted in 2023, and fish samples were collected between April and September. The fish were immediately transferred to the research laboratory within the Department of Biology, College of Science, University of Duhok. Each sample was carefully dissected to determine the presence of internal parasites in various internal organs, including the body cavity, urinary bladder, intestine, stomach, kidney, liver, and muscles. All collected parasite samples were carefully identified and fixed in 70% hot ethanol for further analysis. The infection rate in this study was 31% (22/70). Four types of internal parasites, a kind of protozoan, and three types of tapeworms were identified: *Balantidium polyvacuolum* (21%), *Schyzocotyle acheilognathi* (4.2%), *Khawia armeniaca* (5.7%), and *Khawia sinensis* (1.4%). The study emphasizes the critical importance of monitoring fish parasites, enhancing aquaculture efficiency and their care, and preventing the discharge of pollutants into the water, noting that parasitic infections did not show any noticeable pathological effects or changes in the infected fish.

Keywords: *Balantidium polyvacuolum*, carp fish, endoparasites, *Khawia armeniaca Schyzocotyle acheilognathi*, Mosul Dam Lake.

INTRODUCTION

The research highlights the importance of the common carp (*Cyprinus carpio L.*) as a prominently cultivated species of freshwater fish within aquaculture, with over 80% of its worldwide production originating from China and Indonesia (Kir and Selda, 2007). This study highlights the critical role of fish parasites in increasing the efficacy of aquaculture enterprises, improving the stocks of commercially important fish species, and clarifying the role of freshwater fish as intermediary hosts for human-infecting parasitic entities (Bilal and Abdullah, 2012). The academic studies additionally elucidate that a multitude of research initiatives have been executed in Iraq to investigate the parasitic organisms associated with freshwater fish populations, particularly within the aquatic habitats of rivers, lakes, and assorted water bodies located in the southern and central territories of Iraq, in addition to samples collected from the Tigris River in the urban area of Mosul in northern Iraq such as Cryptosporidium was recorded for the first time in Mosul city during the examination of intestinal contents and additional taxa of parasitic organisms including the trematode larval form *Diplostomum spathaceum*, the cestode larval phase of *Ligula intestinalis*, and the oocyst stage of *Eimeria* (Al-Taee, 2008) and recorded some parasites in Tigris river fish in Mosul city as *Ergasilus barbi*, and *E. mosulensis* (Rahemo, 1982). Moreover, numerous regions within Iraq (Babylon, Al-Diwaniyah, and Kurdistan) have experienced significant impacts from carp infections attributable to parasitic organisms (Obaid *et al.*, 2021). The most comprehensive inventory of parasites associated with carp enumerates 310 distinct species of parasites (Mhaisen and Abdul-Ameer, 2020). The prevalent parasites afflicting fish, which result in significant economic detriment, encompass the helminth parasites (Barcak *et al*., 2021). The parasitic infestation of fish can lead to elevated mortality rates, diminished weight, and decreased reproductive capacity. At the same time, protozoan organisms and various helminth species instigate severe pathologies in both aquaculture and natural fish populations (Shwani *et al.*, 2015). These parasitic assemblages impede the growth of fish and inhibit feeding behaviors. Particularly in aquatic environments that are tainted by industrial and urban contaminants, substandard water quality coupled with nutritional deficiencies contributes to the proliferation of parasitic diseases (Mansoor and Al-Shaikh, 2010). This research seeks to conduct a comprehensive survey and examination of the endoparasitic organisms afflicting the Common Carp species inhabiting the Mosul Dam Lake in the Nineveh governorate of Iraq.

MATERIALS AND METHODS

Study area

The Mosul Dam Lake represents a pivotal strategic endeavor within Iraq's framework for the management of its aquatic resources. It holds the distinction of being the largest dam situated in Iraq Fig. (1A). The Tigris River, it is situated 60 kilometers to the northwest of Mosul city center of the governorship of Nineveh, upstream from the urban center of Mosul. The dam's primary functions encompass the generation of hydroelectric power as well as the provision of water for agricultural irrigation purposes downstream. The undertaking was executed along the banks of the Tigris River in northern Iraq, specifically 60 kilometers northwest of Mosul at latitude 36°37'44" N and longitude 42°49'23"E, Fig. (1B).

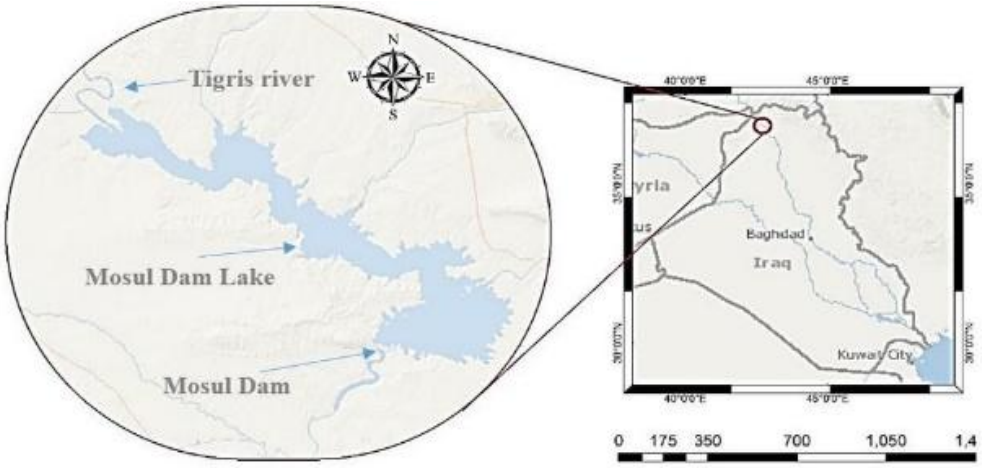

Fig. 1: (A) Mosul dam lake location. (B) The map of Iraq.
(Iraqi Ministry of Water Resources, 2012). Mosul Governorate Municipality Directorate)

Sampling collection

A collection of seventy specimens of common carp, *Cyprinus carpio*, was conducted from the population inhabiting Mosul Dam Lake, situated within the Nineveh governorate, from April to September of the year 2023. Monthly sampling involved the procurement of fifteen individuals of fish. The capture of the carp was accomplished through the utilization of nets, hooks, or bow nets by local commercial fishers (Coad, 2010). The specimens were subsequently placed in plastic tanks containing water sourced from the local lake and were promptly transferred to the research laboratory in the Department of Biology at the Science College of the University of Duhok. Following this, all fish specimens underwent dissection to identify the endoparasites in various internal organs, including the body cavity, bladder, intestine, stomach, kidneys, liver, and muscles, which were preserved in a physiological saline solution (0.7% NaCl) (Xi, *et. al.* 2016). The intestinal tract, along with its associated glands and resultant parasitic organisms, is subjected to anatomy through a longitudinal incision executed from the posterior to the anterior orientation (Scholz, 1991).

Samples examination

All specimens of fish underwent a comprehensive examination of their intestinal parasitic fauna. The helminths extracted from the intestines of the carp were subsequently rinsed in a saline solution. Each of the collected endoparasites underwent identification and was thereafter preserved in heated 70% ethanol. Specimens designated for whole-mount preparation were subjected to staining using Acetocarmine dye (Georgiev *et al.*, 1986). Photos were taken using a Dino−Eye Microscope Eye-piece universal camera model AM7023 series: 5 megapixels (Made in Taiwan). The parasites were scrutinized utilizing an Olympus ocular micrometer compound microscope, with magnifications ranging from (10x to 40x). The identified parasites were systematically categorized based on morphological characteristics through the application of established keys for parasite identification (Al-Niaeemi and Dawood, 2021).

RESULTS AND DISCUSSION

The current study survey investigated a collection of 70 carp fish species from the Mosul Dam Lake in Iraq's Nineveh Governorate. The percentage of infection in this study was 31% (22/70), and there are four types of Endoparasites, including there are one species of protozoans in the class Ciliata: *Balantidium polyvacuolum* (21%), and three species of parasitic worms of Cestode *Schyzocotyle acheilognathi* (4.2%), *Khawia armeniaca* (5.7%), and *Khawia sinensis* (1.4%) (Table 1). These results, similar to the results in the Ahmad *et.al*. 2018 study, were infection rates with different types of helminth parasites (23.33%). And in a Karawan *et al.*, 2012 study where the percentage of infection of internal parasites was 36.34%. And in the study of Rahemo and Al-Naieemi 2001 the infection of male fish (42%) while that of female fish (41%). But it differs from another study by Tekin-Özan *et al.* (2008) which infection occurred (69.23%). The fish showed the ability to acclimatize to a diverse array of climatic and geographical conditions. various taxa of parasites have been identified in carp, as follows in (Table 1).

Table 1: The prevalence of endoparasites on body sites of *C. carpio* from Mosul dam lake fish of Nineveh governorate, Iraq.

Groups	Parasites	No. of parasites	No. of infected fish	Prevalence %	Site of infection
Protozoa	*Balantidium polyvacuolum*	33	14	21	Intestine
Cestode	*Schyzocotyle acheilognathi*	3	3	4.2	
	Khawia armeniaca	5	4	5.7	
	Khawia sinensis	1	1	1.4	

Protozoa

In the current investigation, one species of protozoa was identified:

Balantidium polyvacuolum

The intestine of *C. carpio* has been the ciliated protozoan with a prevalence of (21%) in the intestine of *Cyprinus carpio* from the Mosul Dam Lake in the Nineveh governorate (Table 1).

Morphological characteristics of *Balantidium polyvacuolum*

Ciliates belong to the phylum Ciliophora and are unicellular organisms distinguished by their motile cilia and nuclear dimorphism. The morphology of this genus is oval and exhibits a slight compression at the anterior region. Cilia are arranged in longitudinal rows, exhibiting a slight helical configuration towards the posterior extremity. Slit-like peristomes are located at the anterior aspect of the organism or in proximity to the ventral side, with the cytosol at the basal region leading into the cytopharynx. The trophozoite exhibits an oval shape Fig. (2). The cytopharynx and the cilia rows are in the anterior region. The cytoplasm encompasses both a macronucleus and a micronucleus. The macronucleus is elongate-ovoid in shape, with a length that varies from 12 to 40 µm and a width ranging from 7 to 15 µm. The micronucleus displays polymorphism in its spatial distribution, with a length ranging from 4 to 6 µm and a width of 2 µm or less (Al-Marjan and Abdullah, 2010). The incidence of infections caused by parasitic protozoa exceeds that of parasitic helminths, attributed to the heightened susceptibility of protozoa to host infection (Bu *et al*., 2023).

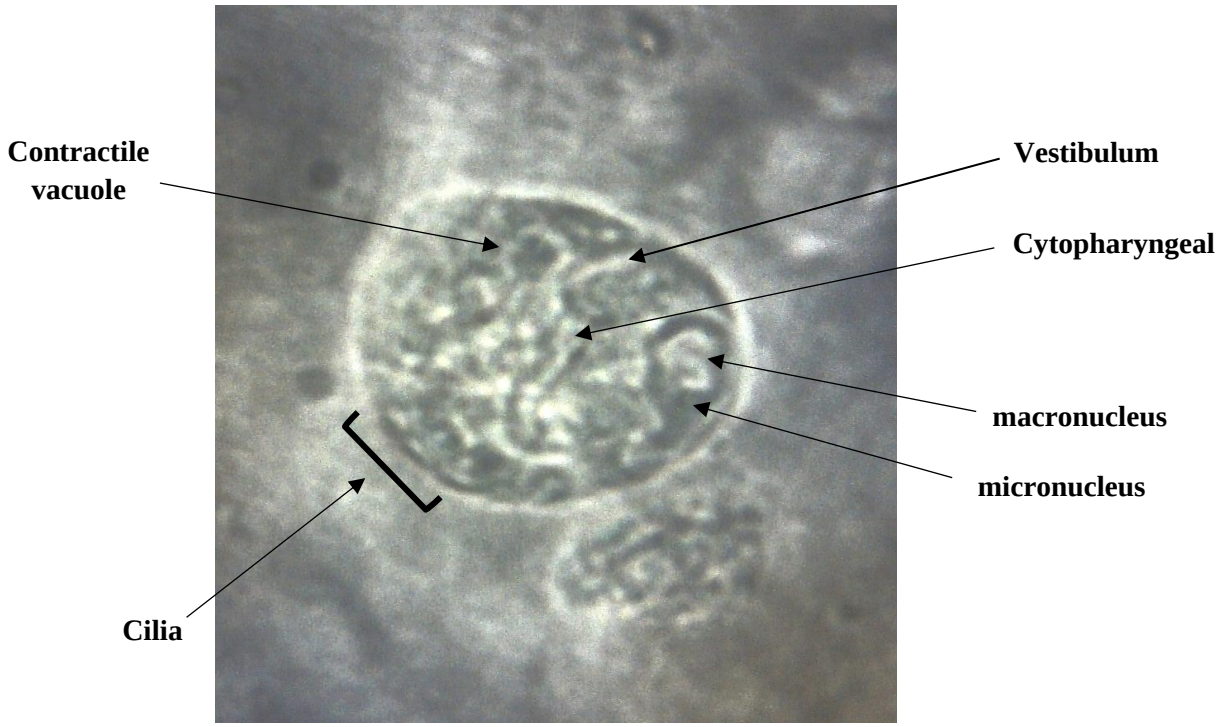

Fig. (2): *Balantidium polyvacuolum* in light microscope (100x).

The helminthes

1- *Schyzocotyle acheilognathi*

In this study, the infection of three *Schyzocotyle acheilognathi* worms was (4.2%), found in the intestine of a *C. carpio* from (Table 1). *Schyzocotyle acheilognathi* was recorded for the first time in Iraq by Ali *et al.,* (1987) in *C. carpio* from Habbaniya Lake. The Asian fish tapeworm (AFT) is an intestinal cestode parasite of fish indigenous to East Asia and the coastal regions of Australia; Yamaguti (1934) initially classified the species as *Schyzocotyle acheilognathi*, derived from a singular small cyprinid fish located in Lake Ogura, Japan (Salgado-Maldonado *et al.,* 2015).

Morphological characteristics of *Schyzocotyle acheilognathi*

Mature cestodes were systematically classified as (Alsaady and Chekhyor, 2020) *S. acheilognathi* based on the following morphological characteristics: (I) a scolex exhibiting a pyramidal shape, characterized by flattening, which was devoid of hooks and suckers but possessed two elongated bothria; (II) a segmented strobila; (III) the absence of a distinct neck (i.e., the non-segmented region situated posterior to the scolex and anterior to the first discernible segment); and (IV) a posterior section of the scolex that exhibited a greater width than the anterior segmented strobila, as illustrated in Fig. (3A). The anterior segment of the intestine served as the attachment site for *S. acheilognathi* to the intestinal walls, while their bodies extended along the full length of the intestine around 40cm. with three worms (Table 1), Fig. (3B). Infected fish revealed pronounced, distended abdominal regions, within which the worms were often visible to the translucent walls of the alimentary canal (Choudhury *et al.,* 2013). Some fish exhibiting signs of infection also presented with hemorrhagic lesions within the intestinal wall, leading to obstruction of the gastrointestinal tract, destruction of the intestinal mucosa, intestinal rupture, abdominal distension, weight reduction, protein deficiency, intestinal inflammation, anemia, impaired swimming capability, and ultimately, mortality; the infection caused by *S. acheilognathi* may result in bothriocephalosis in the affected host (Salgado-Maldonado and Pineda-L´opez, 2003). The proglottids exhibited rounded edges and lacked a distinct neck. In the mature proglottids, the initial proglottids were situated directly posterior to the scolex, with the presence of ovaries and genital pores (Boonthai *et al.,* 2017). The classification of *S. acheilognathi* has exhibited having been assigned multiple distinct synonyms (e.g., *B. acheilognathi* and *B. gowkongensis*). These

different names are differentiated primarily by variations in scolex morphology and proglottid dimensions. *Schyzocotyle acheilognathi* demonstrates a remarkable capacity for environmental adaptation, as evidenced by its extensive distribution (Rahemo and Al-Kallak, 1998).

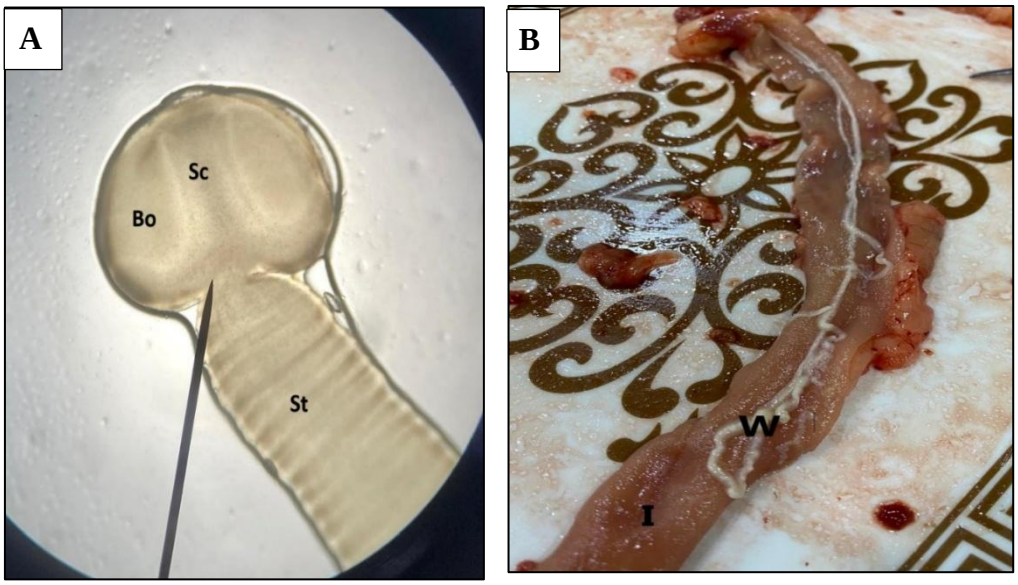

Fig. 3: *Schyzocotyle acheilognathi* in the light microscope (40x).
A- The anterior end of the worm Sc= Scolex Bo= Bothria St= Strobila (Segments).
B- The worm attachment to the intestine I= Intestine W=Worm.

Khawia spp.

The tapeworms exhibit morphological traits that are characteristic of the genus *Khawia*, which encompasses monozoic cestodes classified under *Khawia* (Caryophyllidea: Lytocestidae), and serve as parasites of cyprinid fish across Europe, Asia, Africa, and North America (Rahemo and Al-Kallak, 1998).

2- *Khawia armeniaca*

Five parasitic worms were found in the intestine of *C. carpio*, and their infection rate was (5.7%) from the Mosul Dam Lake in the Nineveh governorate (Table 1). *Khawia armeniaca* was initially classified as *Caryophyllaeus armeniacus* by Cholodkovsky in 1915, and it is situated within the family Caryophyllaeidae, originating from Lake Sevan in Armenia. This particular cestode has predominantly been documented in association with barbel fish across various Middle Asian nations, including Armenia, Azerbaijan, Georgia, Iran, and Iraq (Rahemo and Al-Naieemi, 2001).

Morphological characteristics of *Khawia armeniaca*

The total length of the organism is measured at 30-40 mm, exhibiting a tapering configuration toward the posterior extremity (Scholz *et al.*, 2011). The scolex is characterized as exhibiting a semi-bulbous morphology with a boundary, while the neck maintains a width of 0.74-1.21 mm in Fig (4A). The genital pores are observable on the external surface yet remain distinct, positioned nearby. The testes are classified as medullary, displaying an almost oval to spherical shape, with dimensions ranging from (95.76-247.38) µm × (99.75-247.38) µm. The testicular field extends nearly to the anterior edge of the cirrus sac, constituting 47.51%-61.87% of the total body length. The ovary is described as follicular and adopts a butterfly-like configuration with broad and short arms, measuring 0.76-1.80 µm Fig (4B), The genital pores, while separate, are situated near one another (Jepkorir *et al.*, 2021).

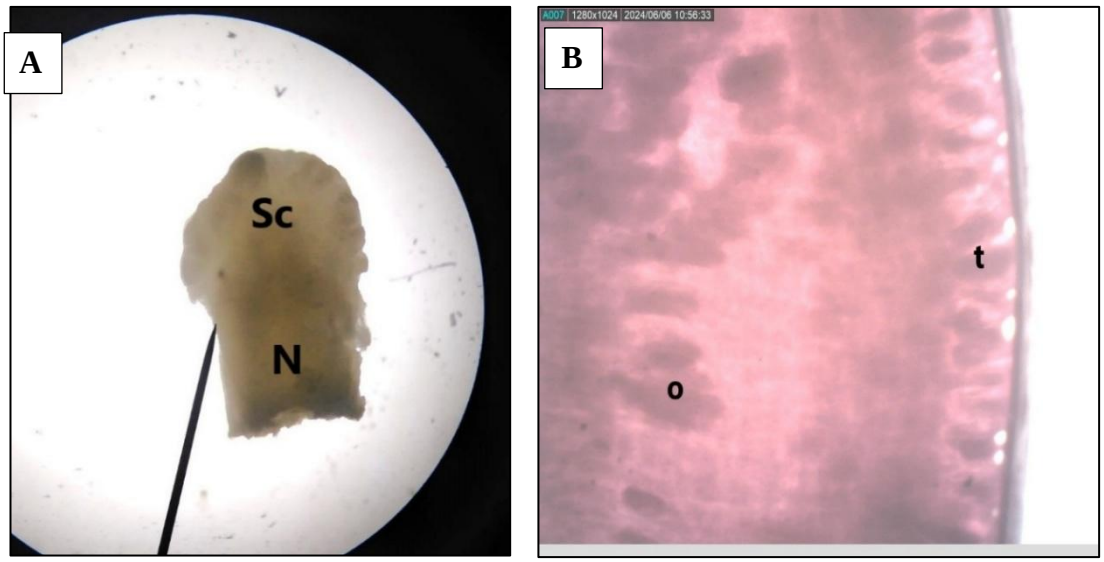

Fig. 4: *Khawia armeniaca* worm in the light microscope (40x).
A- The anterior end of the worm Sc= Scolex N= Neck.
B- Mature proglottids of worm showing testicular field (t), ovary (o).

3- *Khawia sinensis*

One worm was found in the intestine of *C. carpio*, and its infection rate was 1.4% (Table 1). *K. sinensis* was first recorded in Central Europe as a significant parasitic organism affecting carp in numerous European nations, as well as in the region surrounding Beijing, China (Oros *et al.*, 2009).

Morphological characteristics o*f Khawia sinensis*

The scolex presents a festoon-like appearance characterized by pronounced folds that can reach lengths of up to 0.6mm, located on the anterior margin and exhibiting a width of 2.0 to 2.4mm, surpassing that of the neck. The neck measures between 0.7 and 1.1mm in width Fig. (5A). This worm exhibits a substantial body size, measuring between 41 and 112mm long, with a maximum width ranging from 1.3 to 2.3mm, stained with Acetocarmine dye Fig. (5B). At the same time, the vagina is merging with the uterus to establish a uterovaginal canal that subsequently opens into the genital atrium (Abdullah, 2005).

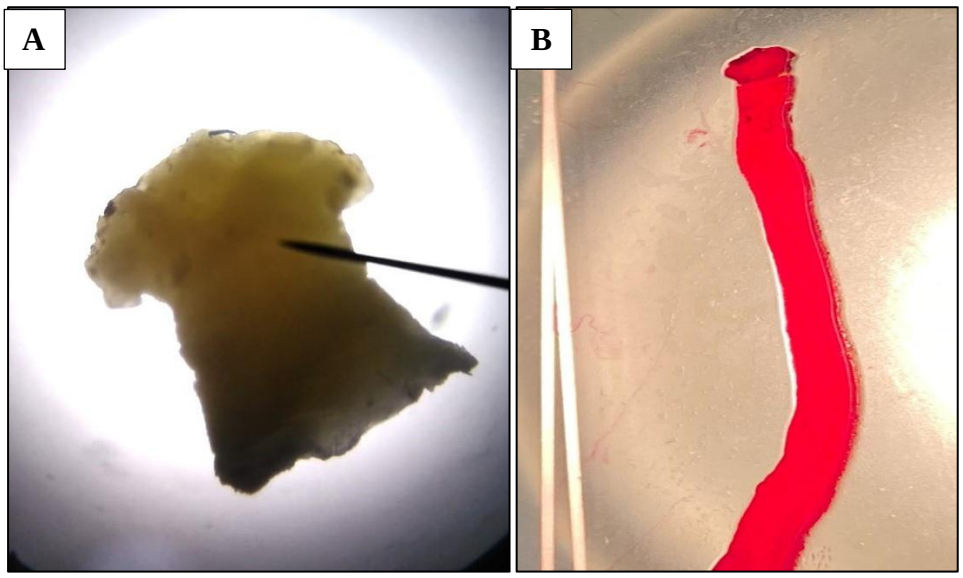

Fig. 5: *Khawia sinensis* Cestoda.
A- The scolex of the worm in the light microscope (40x).
B- The body of the worm.

The common carp is valued for its culinary applications; consequently, aquaculture production fulfills culinary demands while simultaneously providing populations released into natural aquatic environments for angling purposes. The incidence of the affliction is significantly elevated within aquaculture fish cohorts, which can be ascribed to variables including excessive stocking densities and inadequate water quality parameters (Dhole *et al.*, 2010).

CONCLUSIONS

In the present research, parasitic infections exhibited a mild degree of intensity. Based on the in-situ observations, neither pathological alterations were detected at tapeworm infestation sites, nor were any adverse physiological conditions. The study deduces that the incidence of endoparasites in *Cyprinus carpio* from the Mosul Dam Lake in Iraq was observed to be 31% (22/70), with four distinct taxa of endoparasites identified: One protozoan species, *Balantidium polyvacuolum* (n=33) (21%), alongside three cestode species, *Schyzocotyle acheilognathi* (n=3) (4.2%), *Khawia armeniaca* (n=5) (5.7%), and *Khawia sinensis* (n=1) (1.4%). The research underscores the critical necessity of surveilling fish parasites to enhance aquaculture productivity and ensure optimal fish health.

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دراسة الطفيليات الداخلية لأسماك الكارب الشائع في بحيرة سد الموصل في محافظة نينوى، العراق

محمد عدنان البدراني

قسم علوم الحياة/ كلية العلوم/ جامعة دهوك/ كردستان/ العراق

الملخص

يسلط البحث الضوء على اهمية سمك الكارب الشائع في نهر دجلة وخاصة في سد الموصل والطفيليات الداخلية التي تصيبه، الدراسة تشمل فحص 70 عينة من سمك الكارب الشائع من بحيرة سد الموصل الواقعة في محافظة نينوى، تهدف إلى فحص انتشار الطفيليات الداخلية لأسماك الكارب في بحيرة سد الموصل، العراق. حيث أجريت الدراسة في عام 2023 وجمعت عينات الاسماك بين أبريل وسبتمبر، تم نقل الاسماك على الفور إلى مختبر البحوث داخل قسم الأحياء بكلية العلوم، جامعة دهوك. تم تشريح كل عينة بدقة لتحديد وجود الطفيليات الداخلية في الأعضاء الداخلية المختلفة، بما في ذلك تجويف الجسم، المثانة البولية، الأمعاء، المعدة، الكلى، الكبد، والعضلات. تم تحديد جميع العينات الطفيلية التي تم جمعها بدقة وثبتت في الإيثانول الساخن بنسبة 70% لمزيد من التحليل. نسبة الإصابة في هذه الدراسة كانت 31% (70/22). تم تحديد أربعة أنواع من الطفيليات الداخلية، نوع واحد من الهدبيات الأولية، وثلاثة انواع من الديدان الشريطية *Balantidium polyvacuolum* (21%)، *Schyzocotyle acheilognathi* (4.2%)، *Khawia armeniaca* (5.7%)، *Khawia sinensis* (1.4%) تؤكد الدراسة على الأهمية الحاسمة لمراقبة طفيليات الاسماك وتعزيز كفاءة تربية الأحياء المائية ورعايتها ومنع تلويث المياه، مشيرة إلى أن الإصابات الطفيلية لم تظهر تأثير او أي تغييرات مرضية ملحوظة في الأسماك المصابة.

الكلمات الدالة: الهدبيات الأولية، سمك الكارب، الطفيليات الداخلية، الدودة الشريطية، بحيرة سد الموصل.