First record of *Thelohanellus wuhanensis* Xiao & Chen, 1993 (Myxozoa: Myxosporea) in Iraq on the gills of *Carassius auratus* (Linnaeus, 1758)

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Abstract. In the current study, the myxobolid, *Thelohanellus wuhanensis* Xiao & Chen, 1993 was recorded for the first time in Iraq from the gills of *Carassius auratus* (Linnaeus, 1758) that was caught from Tigris river near Al-Shawwaka location in Baghdad city during the period from May to October 2020. With this registration, *T. wuhanensis* become the fourth species of the genus *Thelohanellus* so far recorded from the Iraqi fish. The description and measurements of this external parasite as well as its illustrations are given.

Keywords. *Thelohanellus wuhanensis*, *Carassius auratus*, Myxozoa, Tigris river, Iraq.

1. Introduction

Myxozoans are microscopic metazoan parasites of marine and freshwater fishes from natural and aquaculture resource, this group is important from an economic point as it causes losses of production and makes fishes unfit for human consumption [1]. The phylum Myxozoa includes over 2,180 species belonging to 60 genera of Class Myxosporea of the Phylum [2]. *Thelohanellus* (Kudo, 1933) the sixth most species genus with 108 nominal species reported worldwide [3], 52 nominal species of this genus infected freshwater fishes in India up to 2015 [4]. Species of *Thelohanellus* are mostly histozoic, bivalvular myxosporeans, tear-shaped or pyriform to broadly ellipsoidal in valvular view, more slender in sutural view, and have a single polar capsule either pyriform or tear-shaped with a single coil of polar filament [2]. These myxozoan parasites are mainly plasmodia-forming parasites of freshwater fish with a great diversity of sites of infection such as gills, fins, scales, skin, muscles, gallbladder, kidneys [3, 4]. *Thelohanellus* species have strict tissue specificity and shown inclined to the epithelium, connective tissue, cartilage, or vascular tissue that usually occurs within the gill apparatus [5]. The plasmodia of this genus are classified according to their location in the gill filament, the interfilamentous vascular type which occupying the tip, and intralamellar vascular type which occupying the side [6]. The present paper documents the first record in Iraq of *T. wuhanensis* Xiao & Chen, 1993 from gills of *Carassius auratus* (Linnaeus, 1758) from Tigris river near Al-Shawwaka location in Baghdad city.
2. Materials and Methods

In this study, nine live specimens of *Carassius auratus* (Linnaeus, 1758) were caught from Tigris river near Al-Shawwaka location in Baghdad city between May to October 2020. The lives fishes were brought to the laboratory and classified according to an account on freshwater fishes of Iraq [7], then investigated for myxozoan infection. To detect the plasmodia, fresh smears the external parts such as the skin, fins, gills, and operculum and all internal organs such as kidneys, spleen, liver, the wall of the intestine, urinary bladder, gall-bladder, eyes, heart, muscles, testes and ovaries of fishes were examined under a dissecting microscope. A smear using fresh spores were made from the external parts and internal organs of the fish and examined with a compound microscope. Spores were freshly photographed by a digital camera. The spore was drawn using a Camera Lucida. For permanent specimens, the spores were fixed in absolute methanol for two to eight minutes and then stained with Giemsa solution for about 25-30 minutes, then washed in tap water and dried [8]. Myxosporian spores were measured and described according to the guidelines [9]. The scientific name of the parasite was checked with lists [3]. All measurements are presented (in $\mu$m) as minimum-maximum followed by mean values. The information on the previous records of myxozoans of fishes of Iraq was obtained from the index-catalogue of parasites and disease agents of fishes of Iraq [10].

3. Results and Discussion

3.1. *Thelohanellus wuhanensis* Xiao & Chen, 1993

This parasite found in the skin and gills of two out of nine of *Carassius auratus*. The infection of these fishes was not severe, the plasmodia were not found during the examination. Groups of spores distributed in the tissues examined were obtained, so the identification has been based on the characters of spores. Description and measurements (in $\mu$m) based on five fresh spores are listed below and shown in Figures 1 and 2. Spores large-sized, oval elongated slightly tapering anteriorly in frontal view, lemon-shaped in lateral view with the straight sutural line, the anterior end slightly narrow, a pit near on the anterior end, asymmetric valves, length of spore 22.6-24.2 (22.9) and width 12.3-12.6 (12.45), thickness 10.8-11.4 (11.1). One subspherical polar capsule with triangle protrusion at the upper end near the anterior end of the spore and occupies almost half the size of the spore, measuring 11.1-11.9 (11.5) long and 7.9-8.3 (8.1) wide. Sporoplasm occupying most of the extracapsular space behind the polar capsules with the small dark granules.

![Image A](image1.png)

![Image B](image2.png)
Figure 1. *Thelohanellus wuhanensis* in frontal view. A - Diagrammatic drawing (Scale bar = 11.5 μm), A: Photomicrograph (400 x). The arrows appear in the pit on the anterior end of the spore.

Figure 2. *Thelohanellus wuhanensis*, Lemon-shaped in lateral. A- Diagrammatic drawing (Scale bar = 11.5 μm), B- Photomicrograph (400 x).

The descriptions and measurements of *T. wuhanensis* in this study are corresponded with those of the holotype of the parasite from on the skin of silver crucian carp *Carassius gibelio* (Bloch, 1782) (= *Carassius auratus gibelio*) in Wuhan City and Jingshan County of Hubei Province, China [3]. This is the first record of *T. wuhanensis* in Iraq, as it has not been recorded in any studies of the parasites of Iraqi freshwater fish [10]. *T. wuhanensis* Xiao & Chen, 1993 was first identified on the skin of allogynogenetic silver crucian carp in Wuhan City and Jingshan County of Hubei Province, China. Subsequently, this parasite was described and supplements its ultrastructural and histological characteristics from the same fish host from a pond in Honghu City, Hubei Province, China [11]. Although many species of the genus *Thelohanellus* showed less pathogenicity to their hosts, *T. wuhanensis*, caused the mortality of infected fish [3], for being leads to the formation of obvious swellings on the skin of infected fishes, and severe epidemic thelohanelliosis and mortality of the heavily infected fish [12]. In Iraq, three *Thelohanellus* species have been described from freshwater fishes from different water bodies. The first species, *T. catlae* (Chakrawarty and Basu, 1958) was registered from the gills of *Cyprinion macrostomum* for the first time in Iraq from the Tigris river within the limits of Baiji city [13]. Then, three other host fish species are so far known as hosts for this parasite: *Planiliza abu* (= *Liza abu*) [14], *Carasobarbus luteus* [15] and *Carassius auratus* [16]. The second one, *T. dogieli* (Akhmerov, 1955) was reported for the first time from Iraq in gills of *Cyprinus carpio* from Tigris river near Al-Zaafaraniya region at Baghdad province [16]. The third one, *T. misgurni* (Kudo, 1919) registered for the first time in Iraq from the gills of *Garra rufa* from the Tigris river within the city limits of Al-Ataifiya [17]. Accordingly, *T. wuhanensis* is the fourth species of the genus *Thelohanellus* so far recorded from the Iraqi fish.

4. Conclusion

The Myxozoan parasite *Thelohanellus wuhanensis* Xiao & Chen, 1993 was recorded from gills of *Carassius auratus* (Linnaeus, 1758) for the first time in Iraq and becomes the fourth species of the genus *Thelohanellus* so far recorded from the Iraqi fish.

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6. References

[1] Singh R and Kaur H 2012 Thelohanellus (Myxozoa: Myxosporea: Bivalvulida) infections in major carp fish from Punjab wetlands (India) Protistology 7 178.
[2] Lom J and Dykova´ I 2006 Myxozoan genera: definition and notes on taxonomy, life-cycle terminology and pathogenic species Folia Parasitologica 53 1.
[3] Zhang JY, Gu ZM, Chaganti K, Eiras J, Liu Y, Guo QY and Molnár K 2013 Synopsis of the species of Thelohanellus Kudo, 1933 (Myxozoa: Myxosporea: Bivalvulida) Syst. Parasitol. 86 235.
[4] Kaur H, Singh R, Katoch A, Attri R, Dar SA and Gupta A 2017 Species diversity of the genus Thelohanellus Kudo, 1933 (Myxozoa: Bivalvulida) parasitizing fishes in Indian subcontinent J. Parasit. Dis. 41 305.
[5] Molnár K 2002 Site preference of fish myxosporeans in the gill Dis Aquat Org. 48 197.
[6] Kaur H and Katoch A 2014 Gill disease caused by Thelohanellus bifurcata basu and haldar, 1999 a pathogenic myxozoan parasite in cultured Indian carp, Labeo rohita (Hamilton, 1822) in Punjab India J. Anim. Health Prod. 2 19.
[7] Coad BW 2010 Freshwater fishes of Iraq Pensoft Publ., Sofia: 274 pp.+16 pls. www.briancoad.com.
[8] Saha M and Bandyopadhyay PK 2017 Parasitological and histological analysis of a new species of the genus Thalohanellus and description of a myxozoan parasite (Myxosporea: Bivalvulida) from cultured ornamental goldfish, Carassius auratus L. Aquac. Rep. 8 8.
[9] Lom J and Arthur JR 1989 A guideline for the preparation of species descriptions in Myxosporea J. Fish Dis. 12 151.
[10] Mhaisen FT 2020 Index-catalogue of parasites and disease agents of fishes of Iraq (Unpublished: mhaissenf@yahoo.co.uk).
[11] Liu Y, Yuan J, Jia L, Huang M, Zhou Z and Gua Z 2014 Supplemental description of Thelohanellus wuhanensis Xiao & Chen, 1993 (Myxozoa: Myxosporea) infecting the skin of Carassius auratus gibelio (Bloch): Ultrastructural and histological data. Parasitol. Int. 63 489.
[12] Wang G T, Yao W J, Wang JG and Lu YS 2001 Occurrence of thelohanellosis caused by Thelohanellus wuhanensis (Myxosporea) in juvenile allogynogenetic silver crucian carp, Carassius auratus gibelio (Bloch), with an observation on the efficacy of fumagillin as a therapeutant J. Fish Dis. 4 57.
[13] Abdul-Ameer KN 1989 Study of the parasites of freshwater fishes from Tigris River in Salah Al-Dien province, Iraq. MSc. Thesis, Coll. Sci., Univ. Baghdad 98. (In Arabic).
[14] Balasem AN, Mhaisen FT, Adday TK, Al-Jawda JM ans Asmar KR 2003 A second survey of parasitic infections in freshwater fishes from Al-Qadisiya Dam Lake, Euphrates River, Iraq Mar. Mesopot. 18 123. (In Arabic).
[15] Mohammed HJ 2017 Parasitic fauna of some fish species from Diyala River in Diyala province. MSc. Thesis, College of Education Pure Sci., Ibn Al-Haitham, Univ. Baghdad 122. (In Arabic).
[16] Bdair AT 2018 Diagnosis of ectoparasitic infestation in some fishes in the Tigris river at Al-Zaafaraniya region from Baghdad city MSc. Thesis, Coll. Vet. Med., Univ. Baghdad: 118 (In Arabic).
[17] Abbas JA and Abdul-Ameer KN 2020 Thelohanellus misgurni (Kudo, 1919) (Myxozoa: Myxobolidae) in gills of the cyprinid fish Garra rufa: first record in Iraq Biochem. Cell. Arch. 20 3281.