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Diplostomidae infections in Indian freshwater fishes: A mini review

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Abstract
Fisheries are an important occupations for the Indian population, making a significant contribution to country's economy. Fish serve as potent second intermediate host for helminth parasites of the class Trematoda, affecting the fisheries sector. Among digenean trematode, the family Diplostomidae, species of the genus *Diplostomum* and *Tylodelphys* are responsible for causing eye diseases in fish, leading to visual impairment, cataracts, behavioral changes, and mortality. Another condition, 'Black spot disease, caused by the genus *Posthodiplostomum*, results in black spots on the skin, tissues and vital organs of infected host. These parasites impacts the fisheries sector by reducing fish growth, lowering their nutritional value, and making them unpalatable. The present review emphasizes on documenting available public domain works on Diplostomidae infection in fish hosts in India over the last fifteen years. Only thirteen reports are freely available in public domain on digenetic trematode of the family Diplostomidae represented by genera *Neascus*, *Posthodiplostomum*, *Diplostomum* and *Tylodelphys* -infecting fish hosts of the families Ailiidae, Anabantidae, Bagridae, Belonidae**,** Channidae, Cyprinidae, Osphronemidae and Siluridae, respectively. These parasites were found infecting different sites of the host, including eyes, brain, muscle, liver and gills. Although the family Diplostomidae comprises a large number of species, the limited data and research restricted to the states of Andhra Pradesh, Uttar Pradesh, and Manipur render the current documentation incomplete and lacking information from all parts of the country. Therefore, this present analysis highlights the urgent need for more exhaustive studies on Diplostomidae infection in edible fishes to understand various parameters—such as their types, prevalence, pathogenesis, and biology—across every state and section of our country.

Keywords: Eye diseases, trematode, diplostomidae, fish, India

Introduction

Freshwater fisheries represent a significant place in India's economy, providing employment, food security, women empowerment and livelihood to many in the rural areas. However, changing in environmental parameters and indigenous practices has increase the risk of parasitic infection in them. Among the helminth parasite, digenetic trematode has complex life cycle with two intermediate hosts and fish serve as the potent second intermediate host harbouring infective metacercarial larval forms encysting in various parts of their organ. These infection cause devastating problems in fisheries affecting host's growth, making them unpalatable, mortality and risk of transmitting zoonotic infections if any to human health (Bullard and Overstreet 2008).

Digeneans trematodes belong to family Diplostomidae are widely distributed infecting various fish eating birds as their definitive host. They have complex life cycle with snails as first intermediate host, fish as second intermediate host harbouring the metacercarial larval stages and various mammals and piscivorous birds serving as definitive host. Their infestation in fish's host cause diplostomiasis affecting eye, skin, gills, visceral organs resulting devastating effect in fish health even dead due to heavy infection (Choudhary *et al*. 2017). In family Diplostomidae, important groups of the genus *Diplostomum* and *Tylodelphys* are responsible for causing Ocular Diplostomiasis and genus *Posthodiplostomum* caused 'white spot' diseases in the fish host. These diseases occur due to their metacercarial larval form encysting in eye, muscle or in different parts of the body. In ocular diplostomiasis, metacercarial stages of *Diplostomum* spp. and *Tylodelphys* spp. frequently found infecting different parts of eyes and brain affecting their vision, cataract formation, and change in behaviour, decreasing forage, reduced growth leading to decrease in nutritive value or unpalatable form.

Another disturbing disease 'Black spot disease' decreases economic value and making the fish unpalatable due to encystation of metacercarial stage of genus *Posthodiplostomum* (Karimian *et al*. 2013). It is also known as 'White grub' due to encystation in the muscles and viscera in some case (Lane and Morris 2000; Boone *et al*. 2018). Heavy infection affects the growth, metabolism, damaging visceral parts; even decrease the immune system thus causing mortality (Lane and Morris 2010). Notable species include *P. minimum* and *P. cuticola*.

Fish population are constantly declining or decreasing their nutritive value due to parasitic infection leading mass morbidity and mortality. So, the aim of the present review will bring out information available on the status of eye diseases and digenetic trematode parasites of family Diplostomidae from different parts of India. Thus, a comprehensive data will be generated in Indian context and with this, research gaps will be clearly visible and addressed, attracting helminthology community to give more importance and focus in this area.

Methods

Literature survey was carried out using an electronic search engine from the Google scholar database using the combination of terms as 'commonly edible fish+ diplostomidae+India' respectively. Searching was limited from the year 2010 to 2025 [21], respectively. Only those studies were included which involved the characterization

and reports of Diplostomidae infection through morphological and molecular methods and are available freely in the public domain. A table is prepared to list and arranged the information collected from each article including the Diplostomidae parasites reported, fish host, infection site, geographical location and a reference section (Table 1).

Present state of Diplostomidae infection in freshwater fishes of India

From the analysis, it depicts the limited studies available in the public domain with respect to the diplostomid infection in edible fishes in India, represented by only thirteen references (Table 1). An overview and status of Diplostomidae reported from commonly edible fish host during the present analysis are presented below.

***Neascus* spp.**

The metacercarial larval stage of *Neascus* spp, encysting on skin, fins or muscles of fish host caused Black Spot disease. The infected fish appears raised black nodules due to melanin pigment produced and deposition around the cyst by the host as defence mechanism against the infection. In India, only three works are available in the public domain during the last fifteen years (Choudhary *et al*., 2017; Vankara *et al*., 2011; 2025) [7, 22, 23]. These works restricted only in the states of Andhra Pradesh, Uttar Pradesh. They have reported five species namely *Neascus hepatica, Neascus* Type-I, *N. hanumanthai*, *N. gussevi* and *N. xenentodon* found infecting Liver and Gills of fish host- *Belone cancila, Anabas* sp *Channa punctata, Trichogaster fasciata* and *Xenentodon cancila* respectively. Vankara *et al*., 2011; 2025 [22, 23] utilized morphological characterization for the recovered metacercariae incorporating with histopathological analysis. Choudhary *et al*., 2017 [7] utilized molecular PCR techniques amplifying the partial regions of 28S, ITS1 and mt cox1 gene markers to characterize the metacercaria recovered during the study.

***Posthodiplostomum* spp.**

Species of the genus *Posthodiplostomum* are digenetic trematodes, it's metacercarial larval stages are found encysting in the muscle of fish intermediate host causing 'white grub disease' in them and the adult form parasitized intestine of piscivorous birds (Niewiadomska, 2002). Some of its species caused black-spot disease giving black spot appearance on the site of infection due to melanocyte deposition around the metacercaria causing liver damage, digestion dysfunction, weight loss, growth retardation and mortality (Lane and Morris, 2000) [15]. In India, four studies reporting the genus *Posthodiplostomum* are available in public domain during last fifteen year; three from Uttar Pradesh and one from Manipur, Northeast India. These data showed metacercarial form found infecting muscle tissue of *Channa punctata*, *Labeo catla*, *Pethia conchoniu* (Athokpam and Tandon, 2014 [1]; Baitha *et al*., 2021 [2]; Raju *et al*., 2021) and in the liver of *Xenentodon cancila* (Chaudhary *et al*., 2023) [12]. Athokpam and Tandon (2014) [1] and Chaudhary *et al.* (2023) [12] have utilized morphological characterization using light microscopy and morphometric analysis supplemented with molecular PCR amplification of ribosomal DNA: partial 18S, internal transcribed spacers (ITS1, ITS2) and 28S, respectively.

***Diplostomum* spp.**

Diplostomum spp. (family Diplostomidae), represents species rich genus infecting wide variety of fish-eating birds and mammals as definitive host. Their infective metacercarial form found infecting eyes of fish intermediate host causing eye disease (Niewiadomska, 2002). Although the genus represents the most number of species, only two works are available reporting *Diplostomum cerebralis* and *Diplostomum* sp. in *Channa punctata*, *Labeo bata*; *Wallago attu* limited to Uttar Pradesh only (Table 1). Chaudhary et al., 2017a, 2024 [10] utilized both morphological and molecular technique to characterize the species accurately.

***Tylodelphys* spp**

Genus *Tylodelphys* are widely distributed and found infecting wide range of fish host. They infect the second intermediate freshwater fish host by encysting in brain cranial cavity and eyes. The metacercarial larval stage is the commonly encountered stage from host (Otachi *et al*., 2015 [19], Blasco-Costa et al., 2016). Heavy infection in brain and eye leads to disruption in normal activities, eye cataracts, leading to the death of the fish (McCloughlin, 2016). In India, limited studies are available represented by only four, from Uttar Pradesh (Table 1). Metacercarial larval form was found infecting eyes and brains of *Channa gachua*, *Puntius sophore*, *Ailia coila*, Hybrids of *Cirrhinus mrigala*, *Labeo rohita and Mystus tengara*. They were characterized through morphological light microscopy corroborated by molecular techniques overcoming the difficulty faced during accurate identification (Chaudhary *et al*., 2017b, c, 2021; Singh *et al*., 2025) [11, 21].

In India, informations on Diplostomidae infection in fish host are represented by only thirteen works, with most works confine to Uttar Pradesh and one each from Manipur and Andhra Pradesh. The data available in public domain are comparatively very less considering wide diversity of species within Diplostomidae. From the analysis, it was observed that *Neascus* spp. infect the visceral organs; *Posthodiplostomum* sp. metacercaria encyst in muscle; *Diplostomum* sp. and *Tylodelphys* spp. in the eye and brain causing ocular diplostomiasis in fish host (Table 1).

Perspective

The works available in the public domain related to Diplostomidae infection in fish host restrict to Andhra Pradesh, Uttar Pradesh and Manipur, there is high probability that many new undiscovered and unidentified diplostomid species harboured various piscine intermediate host body from different parts of the country. North east regions due to its unique geographical location and diverse environmental condition, varieties of piscine host may harbour many cryptic new digenetic trematode species phylogenetically distinct from the mainland. The information's available mainly focussed on identification of species through light microscopy, morphometric and molecular techniques, but data is lacking on many aspects like their biology, life cycle, pathogenesis, etc. So, there is urgent need to survey various fish infection with digenetic trematode to understand their geographical distribution, infection status and prevalence in different regions, types, and severity of infections, their pathogenesis effect, biology and life cycle by finding possible intermediate hosts and avian definitive host, an important measure to conserve our biodiversity.

Table 1: Fish borne Diplostomidae in India. ND: Not determine, LM: Light microscopy, PCR: Polymerase Chain reaction, HSP: Histopathology, SEM: Scanning Electron Microscopy

Sl. No.	Parasite (Developmental Stage)	Fish species	Methods	Infected organ	Lake/ Rivers/ Area study	References
1	*Neascus hepatica*, *Neascus* Type-I	*Belone cancila*, *Anabas* sp.	LM	Liver, Gills	River Godavari, Rajahmundry, Andhra Pradesh	Vankara et al., 2011
	N. hanumanthai, *N. gussevi* and *N. xenentodon* : metacercaria	*Channa punctata*, *Trichogaster fasciata* and *Xenentodon cancila*	PCR of 28S, ITS1and mitochondrial cox1 gene markers	ND	Uttar Pradesh	Choudhary et al., 2017
	N. hepatica: Metacercaria	*Xenentodon cancila*	HSP	Liver	India	Vankara et al., 2025
2	*Posthodiplostomum sp.: Metacercaria*	*Channa punctata*	LM, PCR of 18S, ITS2 and 28S regions and mitochondrial CO1 gene	Muscle	Manipur, North east India	Athokpam and Tandon, 2014
	Posthodiplostomum sp.	*Labeo catla; Pethia conchonius*	LM, HSP	Muscle	Ganga River, West Bengal	Baitha et al., 2021
	Posthodiplostomum sp.; Metacercaria	*Labeo catla* and *Pethia conchonius*	LM, HSP	Musculocutaneous tissues	Ganga River	Raju et al., 2021
	Posthodiplostomum sp.: Metacercaria	*Xenentodon cancila*	LM, PCR of partial 18S, internal transcribed spacers (ITS1–5.8S–ITS2), and 28S of nuclear ribosomal DNA	Liver	Ganga River, Uttar Pradesh	Chaudhary et al., 2023
3	*Diplostomum cerebralis*; Metacercaria	*Channa punctata*	PCR of internal transcribed spacers (ITS1-5.8S-ITS2 rRNA gene	Eye, Brain	Meerut, Uttar Pradesh	Chaudhary et al., 2017
	Diplostomum sp.	*Labeo bata*; *Wallago attu*	LM, PCR of rRNA and mitochondrial *cox*1 gene	ND	Ganga River, Uttar Pradesh	Chaudhary et al., 2024
4	*Tylodelphys* spp	*Channa gachua* and *Puntius sophore*	LM, PCR	Eye	Uttar Pradesh	Chaudhary et al., 2017a
	Tylodelphys sp.: metacercariae	*Ailia coila*	LM, PCR of RNA ITS1–5.8S–ITS2 and mitochondrial cytochrome *c* oxidase subunit 1 (COX1)	ND	India	Singh et al., 2025
	Tylodelphys spp	Hybrids of *Cirrhinus mrigala* and *Labeo rohita*	LM, SEM	Eye	Meerut, Uttar Pradesh	Chaudhary et al., 2021
	Tylodelphys sp.: Metacercaria	*Mystus tengara*	LM, PCR	Eyes, Brains	Meerut, Uttar Pradesh	Chaudhary et al., 2017b

Conclusion

Present analysis revealed that in India, the reports of digenetic parasite of the family Diplostomidea infecting fish intermediate host are very limited restricting in the states of Andhra Pradesh, Uttar Pradesh and Manipur, Northeast India. Our country has diverse geographical and environmental conditions that have contributed to rich biodiversity including piscine host. But the works available on the review aspects are very limited. So, intensive research needs to carried out surveying as many piscine host as possible from different states for finding any parasitic parasite, their types, prevalence, pathogenesis, biology, life cycle, effect of environmental parameters on them, etc. The diseases caused by this group of digenetic trematode directly impacted the life of the farmers and ours country economy, thus necessitates helminthologist to focus and work on these aspects.

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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