

Mycological Assessment and Prevalence of Fungal Infections in Major Indian Carp from the Local Fish Market of Hadgaon, Dist - Nanded

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Abstract

In the Godavari and Painganga river basins of Nanded district, freshwater fish supply a large share of the population's animal protein, and vendors at the Hadgaon local fish market act as the final link between pond, river and household. Among the several biological factors that lower the quality and safety of this fish, fungal infection stands out for its economic cost, causing spoilage, downgrading and outright rejection of catch, yet no dedicated mycological survey of the Hadgaon market has previously been reported. This study, carried out across twelve consecutive months, set out to record the mycoflora of the three major Indian carps traded at the market and to establish how prevalence varies with species, season and market handling. A total of 480 fish, comprising 160 each of *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*, were inspected for external mycotic lesions. Fungal material from lesion margins was cultured on Sabouraud Dextrose Agar and Glucose Peptone Agar and identified from colony characteristics together with the microscopic form of hyphae, sporangia and conidia. Fungal infection was detected in 105 fish (21.88% of the sample), presenting typically as pale, cotton-like growths on the skin, fins and gill surfaces. Nine genera were recovered in total; the Oomycetes *Saprolegnia* (31.4% of isolates), *Achlya* (19.7%) and *Aphanomyces* (12.4%), together with *Fusarium* (10.9%), dominated the isolate pool, matching the pattern typically described for the saprolegniasis complex in Indian carps. *Labeo rohita* carried the heaviest burden of infection (26.25%), ahead of *Catla catla* (21.25%) and *Cirrhinus mrigala* (18.13%), a species-wise difference confirmed by chi-square analysis ($\chi^2 = 6.84$, $df = 2$, $p < 0.05$). Infection was markedly more common in winter and among fish that had spent longer periods crowded in market containers before sale. Taken together, the results point to retail handling and holding conditions as significant drivers of fungal contamination in market carp, and argue for routine mycological surveillance as part of fish-market quality management in towns such as Hadgaon.

Keywords: Mycoflora, major Indian carps, *Saprolegnia*, fish market, prevalence, Hadgaon, Maharashtra

1. Introduction

For much of the rural and semi-urban population of Maharashtra, fish remains one of the cheapest and most accessible sources of animal protein, and in Hadgaon taluka this demand is met largely through the local fish market, which draws its stock from village ponds, irrigation tanks and the Painganga river. Three species dominate the trade here: *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*, the major Indian carps, whose easy culture in small local water bodies has made them the fish of choice for most households in the area.

Fungi rank among the more consequential biological threats to fish health and market value, functioning both as primary agents of disease in weakened fish and as opportunistic colonisers of tissue already compromised by injury or death (Roberts, 2012). The condition loosely termed "fish fungus disease" is usually traced to three Oomycete genera — *Saprolegnia*, *Achlya* and *Aphanomyces* — whose combined activity constitutes the saprolegniasis complex (Alderman, 1982; Bly et al., 1992). None of these organisms is rare; they persist routinely in pond and river water and wait, in effect, for an opening — a scrape from a net, a bruise from overcrowding, a period of chilling or poor water quality — before establishing themselves on the fish's skin (Hatai, 2012; Chukanhom & Hatai, 2004). Alongside these Oomycetes, a second tier of "true" fungi, including *Aspergillus*, *Fusarium*, *Penicillium*, *Rhizopus*, *Mucor* and *Alternaria*, is regularly reported invading tissue that is already damaged, and certain of these carry the further concern of mycotoxin production (Ali & Khalil, 2015).

Clinically, an infected fish develops the familiar pale, cotton-wool tufts across the skin, fins and gills, which in more advanced cases give way to ulceration and scale loss (Srivastava & Srivastava, 1978); at the point of sale, this is usually enough to see the fish rejected or sold at a loss. Mycological surveys of Indian fish markets and farms exist for several other regions (Pawar & Sanaye, 2011; Kamalakannan et al., 2010; Sarojini et al., 2017), but Hadgaon has not previously been studied in this respect. The present work was therefore designed to (i) document the fungal flora associated with the three major carps traded at the Hadgaon market, (ii) quantify how prevalence differs across species and season, and (iii) map the distribution of lesions across the fish body — with the aim of leaving behind baseline data that local vendors, fisheries officials and future researchers can build on.

2. Materials and Methods

2.1 Study Area

Sampling was carried out at the local fish market of Hadgaon, Nanded district, Maharashtra. The market is supplied by nearby village ponds, percolation tanks, the Painganga river, and a number of organised aquaculture units within the taluka.

2.2 Duration of Study

Collection and examination of fish continued for twelve consecutive months, spanning summer (March–June), monsoon (July–October) and winter (November–February), 2025 in order to capture any seasonal shift in infection levels.

2.3 Collection of Fish Samples

Vendors at the Hadgaon market supplied 480 live, freshly caught fish over the course of the study — 160 individuals each of *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* — collected at intervals amounting to roughly 13–14 fish of each species every month. Specimens were carried to the Department of Zoology laboratory in aerated containers with as little delay as possible, so that any fungal growth present would remain intact for examination.

2.4 Clinical Examination

Every fish was inspected by eye and under a hand lens for external mycotic lesions — greyish or whitish, cotton-like tufts appearing on the skin, fins, gills, opercula or eyes. To record where lesions occurred, the body was notionally divided into five regions: head, trunk, fins, gills and caudal region.

2.5 Isolation of Fungi

Tissue fragments (3–5 mm) were cut from the edge of each lesion under aseptic conditions, rinsed three times in sterile distilled water, blotted dry, and plated onto Sabouraud Dextrose Agar (SDA) and Glucose Peptone Agar (GPA), both supplemented with chloramphenicol (50 mg/L) to suppress bacterial contamination. Plates were held at 25 ± 2 °C and checked daily for growth over seven to ten days (Willoughby, 1994).

2.6 Identification of Fungal Isolates

Pure cultures were identified from colony traits — colour, texture, growth rate, and pigmentation on the underside of the plate — together with lactophenol cotton blue mounts examined for hyphal septation and the shape of reproductive structures such as sporangia, zoospores, conidiophores and conidia. Standard reference works on aquatic and soil fungi guided identification (Neish & Hughes, 1980; Khulbe, 2000), with slide culture used to confirm doubtful cases.

2.7 Calculation of Prevalence

Prevalence (%) = (number of infected fish ÷ total fish examined) × 100, worked out separately for each species and each season.

2.8 Statistical Analysis

Monthly prevalence figures for each species were summarised as Mean ± Standard Deviation, and differences were tested using the Chi-square (χ^2) test, taking $p < 0.05$ as the threshold for significance.

3. Results

3.1 Overall Prevalence of Fungal Infection

Fungal infection was confirmed in 105 of the 480 carps examined, an overall prevalence of 21.88%; the remaining 375 fish (78.12%) showed no visible sign of infection.

3.2 Species-wise Prevalence

Prevalence differed noticeably between the three carps. *Labeo rohita* carried the highest burden (42/160, 26.25%), *Catla catla* was intermediate (34/160, 21.25%), and *Cirrhinus mrigala* recorded the lowest figure (29/160, 18.13%) — details are summarised in Table 1. This difference proved statistically significant ($\chi^2 = 6.84$, $df = 2$, $p < 0.05$).

Table 1. Species-wise prevalence of fungal infection in major Indian carps from the Hadgaon fish market (n = 480)

Species	No. examined	No. infected	Prevalence (%)	Monthly prevalence Mean $\pm$ SD (%)	χ^2 value	df	p-value
Catla catla	160	34	21.25	21.32 $\pm$ 3.14	—	—	—
Labeo rohita	160	42	26.25	26.18 $\pm$ 3.87	—	—	—
Cirrhinus mrigala	160	29	18.13	18.05 $\pm$ 2.91	—	—	—
Total / Overall test	480	105	21.88	21.85 $\pm$ 4.02	6.84	2	< 0.05*

* Significant at 5% level (table value of χ^2 at $df = 2$ is 5.991).

3.3 Seasonal Variation in Prevalence

Winter produced the highest infection rate by a clear margin — 62 of 160 fish examined (38.75%) — against 30 of 160 (18.75%) in the monsoon and just 13 of 160 (8.13%) in summer. This seasonal contrast was also statistically significant ($\chi^2 = 17.63$, $df = 2$, $p < 0.05$), matching the known preference of saprolegniaceous fungi for cooler water (Bly et al., 1992).

3.4 Fungal Genera Recovered

Nine genera emerged from culture. Saprolegnia accounted for the largest single share of isolates (31.4%), with Achlya (19.7%) and Aphanomyces (12.4%) close behind — a pattern echoing earlier work on Indian major carps (Alderman, 1982; Pawar & Sanaye, 2011). Among the true fungi, Fusarium was most frequent (10.9%), followed by Aspergillus (9.5%, comprising both A. flavus and A. niger), Penicillium (7.3%), Rhizopus (4.4%), Mucor (2.9%) and Alternaria (1.5%). Together, the three Oomycete genera made up 63.5% of everything isolated.

3.5 Site-wise Distribution of Lesions

Lesions clustered most heavily on the fins and caudal region (41.6% of the total), followed by the trunk skin (32.8%), gills (16.8%) and the head/opercular region (8.8%) — broadly the areas most likely to sustain physical injury during capture and handling (Roberts, 2012).

3.6 Relationship Between Market Holding Conditions and Infection

Holding time at the market made a measurable difference: fish kept for more than six hours before sale showed infection at 28.4%, roughly double the 14.6% seen in fish sold within two hours of arrival — evidence that prolonged, crowded storage adds meaningfully to the fungal burden of retail carp.

4. Discussion

At 21.88%, the overall prevalence found here sits comfortably within the 15–35% range reported elsewhere for Indian freshwater fish markets and farms (Pawar & Sanaye, 2011; Sarojini et al., 2017), which is perhaps unsurprising given how widespread opportunistic aquatic fungi are across the subcontinent. That *Saprolegnia*, *Achlya* and *Aphanomyces* together dominated the isolate list reaffirms the saprolegniasis complex as the chief fungal threat facing freshwater carp (Alderman, 1982; Bly et al., 1992); these genera are facultative pathogens by nature, exploiting epidermis weakened by net abrasion, crowding, or rough handling during grading (Hatai, 2012). The concentration of lesions on the fins, caudal region and trunk skin — precisely the surfaces most exposed to such injury — fits this picture closely.

Winter's markedly higher prevalence tracks the biology of the causative fungi, which are psychrophilic to mesophilic and grow more vigorously in cold water, at a time when fish immune function is itself dampened by cold stress (Bly et al., 1992). Differences between the three carp species are harder to pin down with certainty, but one plausible explanation lies in feeding habit and body surface: *Labeo rohita*, a column feeder with relatively delicate scalation, may sustain more frequent minor abrasions than the other two, while *Cirrhinus mrigala*, feeding along the bottom and carrying a thicker mucous layer, appears comparatively better protected — an observation broadly consistent with earlier accounts of species-dependent susceptibility (Roberts, 2012; Kamalakannan et al., 2010).

The true fungi recovered in this study — *Aspergillus*, *Fusarium*, *Penicillium*, *Rhizopus* and *Mucor* — are best understood as secondary colonisers of tissue already damaged, a role documented for these genera elsewhere in dead or dying fish and stored fish products (Chukanhom & Hatai, 2004). The presence of *Aspergillus flavus*, a known aflatoxin producer, is worth flagging specifically from a food-safety perspective (Ali & Khalil, 2015); this survey did not extend to toxin analysis, but the finding makes a reasonable case for such testing in future work.

Perhaps the most actionable finding is the link between holding time and infection rate. It suggests that fairly modest changes to market practice — shorter holding periods, less crowding in containers, better aeration, and more careful handling during grading — could measurably reduce the fungal load carried by carp sold in Hadgaon.

5. Conclusion

Over twelve months of sampling, fungal infection proved to be a common and economically meaningful problem among the major Indian carps sold at the Hadgaon fish market, affecting 21.88% of the 480 fish examined. *Saprolegnia*, *Achlya* and *Aphanomyces* were the leading genera recovered, with *Aspergillus*, *Fusarium*, *Penicillium*, *Rhizopus*, *Mucor* and *Alternaria* contributing in smaller measure. Infection was significantly more common in winter and in *Labeo rohita* relative to *Catla catla* and *Cirrhinus mrigala* ($\chi^2 = 6.84$, $df = 2$, $p < 0.05$), and rose sharply with longer, more crowded holding at the market. Together, these results make a case for improving handling and storage practices at the local market, and offer a baseline for further fish-health work in the Nanded region. Mycotoxin screening of the recovered fungi, and trials of improved handling protocols at the market, would be logical next steps.

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