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A Survey of fungal contamination of some fish species from Tagwai Dam, Minna, Niger State

S.M. Tsadu,[†] R.O. Ojutiku[†] & A.V. Anyawale[‡]

[†]*Department of Water Resources, Aquaculture & Fisheries;* [‡]*Department of Biological Sciences, Federal University of Technology Minna.*

Abstract

A survey of fungal contamination of some species of fish from Tagwai Dam Minna was carried out from March to June, 2002. A total of 223 fish specimens were examined for fungal contamination. Fungi were isolated from the scale / skin, gills and fins. Twenty one (21) fungal species were identified from 18 species of fish. Contamination occurred among all the fish species examined. Most of the fungi encountered were of the mould group, predominantly *Aspergillus* species; the scale/skin were the most widely affected parts of the body. The following fungi were identified in order of their frequency of occurrence: *Aspergillus niger, Rhizopus* spp., *Mucor* spp., *Aspergilus flavus, Aspergillus parasiticus, Aspergillus fumigatus, Microsporum canis, Penicillum viridicalium* and *Fusarium* spp. respectively. *Aspergillus niger* occurred on all the species of fish sampled. Microbial load was measured by direct cell count using a Stuart colony counter. *Barrilius* spp. and *Chrysichthys auratus* had significantly higher mean fungal load on their fins and gills ($P<0.05$). There was no significant difference in the mean fungal load on parts of the body of all the other fish species ($P> 0.05$).

Key words: *Aspergillus*, Fish, fungal contamination, Tagwai Dam, mould, *Rhizopus*.

Introduction

Nigeria is blessed with inland water bodies covering about 12.5 million hectares and about 20 million hectares of swamps, lagoons and estuaries, which can be used for fish farming (Ita, *et al.*, 1985). Statistical surveys have shown that the demand for fish in the country exceeds supply and also the domestic production is still very low, considering the increasing human population. The annual fish consumption/demand in Nigeria has been estimated to be over 1.3 million metric tones, and the total domestic production is just about 450,000 metric tones per annum. Nigeria therefore imports about 800,000 metric tonnes annually to meet demand (Alamu *et al.*, 2004). Niger State has about 772,243.50 hectares of reservoirs and lakes including Kainji, Jebba, Shiroro, Tagwai, Tungan Kawo, Suleja and Kontagora dams (Ita *et al.*, 1985).

Tagwai Dam is located at 6° 39-44′ East and 9° 34-37′ North, to the South West of Minna, about 10 km from Minna town, off Minna-Suleja road. The reservoir was constructed by the impoundment of Tagwai River in 1978 for domestic water supply to Minna. It has an area of 45,000m^2 and a mean depth of 25m and a storage capacity of 28.8 million L^3 of water (Alkali, 1994). Inland water bodies flowing through towns and cities in Nigeria are often highly polluted due to domestic and industrial refuse and sewage that go into them. This turns them into a breeding ground for pathogenic microbes and parasites. Consequently, aquatic resources including fish in such waters are predisposed to microbial contamination including fungal contamination (Baldwin *et al.*, 1967). There is potential risk of human diseases occurring due to consumption of contaminated fish. Fungal contamination causes rapid post-harvest deterioration of fish. Fungi are also a source of food poisoning and many human gastrointestinal infections (Scott. 1964).

Awachie (1966) presented preliminary notes on the parasites of fish in the areas of the Kainji Reservoir and observed that 30% of *Sarotherodon niloticus* (syn. of *Oreochromis niloticus*) were infected by Acanthocephala while about 9% of *Clarias gariepinus* were infected by cestodes. Ukoli (1969) reported that 40% of *S. niloticus* (= *O. niloticus*) in River Niger area were infected by trematodes, while 15% were infected by Acanthocephala. He also reported cases of heavy cestode infections in Kainji reservoir. In eastern Nigeria, Ugwuzor (1987) carried out a survey on helminth parasites of fish from the Imo River and recorded a low level of infection (7.7%). Idiogede and Tsadu (2003) reported fungal contamination of some commercially important fishes sold in the market in Minna, Niger State. They noted that fungal contamination was one of the causes of fresh fish shortage in Niger State generally. Fungal contamination leads to rapid post harvest deterioration and loss of market value.

This study was therefore conducted to identify fungal species occurring among fishes from Tagwai Dam which is one of the important sources of fish in Minna, and to evaluate the rate of contamination on different parts of the fish body.

Materials and Methods

Fresh fish specimens were randomly selected and purchased from fishermen at the dam site three times in a month for a period of four months (March to June, 2002). They were transported to the laboratory for analysis in sterile polythene bags and kept cold using ice blocks beside the polythene bags. Potato Dextrose Agar (PDA) was prepared using peeled and sliced Irish potato, glucose, Agar-agar, chloramphenicol and distilled H_2O. The medium was prepared according to the method described by Alabi (1967). Fungal smears from the fish were taken using the method described by Ojala (1968). The scales/skin, gills and fins were carefully rubbed with cotton wool swab impregnated with distilled water and kept in test tubes as described by Ojala (1968). The mouths of the test tubes were covered with cotton wool plugs which allowed air into the medium but prevented the entry of contaminating microbes. Swabs from each part of the body were cultured in various media concentrations in 3 replicates using 3×4×3 factorial experimental design. Fungal growth was observed for 24-72 hours and colony count was carried out by direct count of cell colony or coliform forming unit per gram (CFU/g) using a Stuart colony counter. Fungi were identified by observation of their morphological features and comparing them with other known taxa using the fungal identification guide by Ogbuile *et al.* (1998). The fungal counts from the three parts of the body were analyzed by one-way analysis of variance.

Results

Twenty one fungal species were identified from 18 species of fish examined. Table 1 shows the fish species and the mean fungal counts (CFU/g) on skin/scales, gills and fins. All the parts of the fish body examined were contaminated with fungi. *Auchenoglanis biscutatus, Chrysichthys furcatus, Barrilus* spp., and *Chrysichthys nigrodigitatus* had significantly higher fungal count on their skin/scale than on their fins and gills ($P<0.05$). *Hemichromis bimaculatus* had significantly higher fungal count on the gills than on their scales and fins ($p<0.05$). The mean fungal counts on the remaining fish species were not significantly different on all the three body parts ($p> 0.05$).

Table 2 shows the fungal species and their morphological characteristics for identification.

Fish contaminated with fungi had white patches on the affected areas of the body surface. *Aspergillus niger* occurred on all the 18 species sampled. *Rhizopus* sp. occurred on 16 species. *Aspergillus flavus* and *Aspergillus fumigatus* occurred in 14 of the 18 species. *Aspergillus* species therefore had the highest cases of occurrence in the fishes of the dam.

Table 3 shows the frequency and site specificity of fungi isolated from fish. It shows that the skin/scale of all the species had the highest number of isolates (204), followed by the gills (198 isolates) and the least were the fins (188 isolates). The differences were however not significant ($P> 0.05$). *Barillus* sp. had the highest number of fungal isolates (80) followed by *Tilapia zilli* (74) and *Allestes nurse* (66) (Table 3). The least contaminated fish species were *Chrysichthys furcatus* and *Tylochromis jentiki* with only 6 isolates each.

Discussion

The study revealed that different parts of the fish body could harbour different types of fungi which can affect fish quality. This agrees with the report of Eyo and Balogun (1992), that fungal contamination is a major limitation to good quality fish processing especially in areas where the relative humidity is always high. Alkali (1994) reported that relative humidity around Tagwai Dam is always high (about 70%) during rainy season. The fungal isolates obtained from this study compared favourably with those reported by John (1991) from smoke-dried fish from Rivers State in Nigeria and Burges (1967) from the author's work on fish handling and processing in India. Both authors concluded that mould growth was a major problem of processed fish especially where relative humidity is above 70%.

Most of the fungi isolated were members of the genus *Aspergillus,* which as observed by Olufemi (1984), are able to grow under the environmental conditions of their host. Thus they are environmental conformers. The occurrence of *Aspergillus* species is of significant public health concern since *A. niger* and *A. flavus* are known to be common agents of food spoilage especially in the tropics, where their spores are easily distributed widely. Certain species of these fungi are known to secrete toxins known as aflatoxins which cause food poisoning and are carcinogenetic to humans and animals (Wales, 1970). When ingested, aflatoxins affect the liver and an effective therapeutic treatment is yet to be found (Rubin, 1990). *Aspergillus* spp. cause aspergillosis (Idiogede, 2001). Many human and animal diseases such as mycotic abortion,

Table 1. Fish species from Tagwai Dam and mean fungal count (CFU/g) on three parts of the body

S/N°	Fish species	Mean fungal counts (CFU/g)			± SEM
		Scale/Skin	Fins	Gills	
1	*Barilius* spp.	1.41×10^{3a}	0.84×10^{3b}	1.06×10^{3b}	0.19
2	*Hemichromis fasciatus*	1.03×10^{3a}	0.77×10^{3a}	0.61×10^{3b}	0.12
3	*Chrysichthys auratus*	1.07×10^{3a}	0.99×10^{3a}	0.84×10^{3a}	0.12
4	*Tilapia zilli*	1.01×10^{3a}	0.85×10^{3a}	0.69×10^{3b}	0.13
5	*Auchenoglanis occidentalis*	1.03×10^{3a}	0.71×10^{3a}	0.98×10^{3a}	0.14
6	*Alestes nurse*	1.02×10^{3a}	1.04×10^{3a}	0.74×10^{3a}	0.13
7	*Hemichromis bimaculatus*	0.53×10^{3b}	0.52×10^{3b}	0.85×10^{3a}	0.00
8	*Barilius senegalensis*	1.12×10^{3a}	0.89×10^{3a}	0.75×10^{3a}	0.17
9	*Tilapia tourneri* (Daget)	0.60×10^{3a}	0.43×10^{3a}	0.49×10^{3a}	0.00
10	*Sarotherodon galileaus*	0.91×10^{3a}	0.83×10^{3a}	0.69×10^{3a}	0.11
11	*Pelmatochromis guentheri*	0.74×10^{3a}	0.78×10^{3a}	0.54×10^{3b}	0.00
12	*Clarias anguilaris*	1.07×10^{3a}	0.89×10^{3a}	0.81×10^{3a}	0.19
13	*Tylochromis jentinki*	0.74×10^{3a}	0.92×10^{3a}	0.83×10^{3a}	0.18
14	*Mormyrus hasselquisti*	1.08×10^{3a}	0.82×10^{3a}	0.69×10^{3a}	0.16
15	*Hemichromis nostar*	0.65×10^{3a}	0.64×10^{3a}	0.75×10^{3a}	0.00
16	*Chrysichthys furcatus*	1.26×10^{3a}	1.04×10^{3a}	0.62×10^{3b}	0.00
17	*Chrysichthys nigrodigitatus*	1.17×10^{3a}	0.66×10^{3b}	0.79×10^{3b}	0.09
18	*Auchenoglanis biscutatus*	1.16×10^{3a}	0.78×10^{3a}	0.93×10^{3a}	0.16

Values with the same superscript in the same row are not significantly different (P>0.05); **CFU/g** = Coliform forming unit per gram

Table 3. Frequency and site specificity of fungi isolates from some important fish species from Tagwai Dam Minna, Niger State

S/N°	Fish species	N° of Isolates			Total No. isolates
		Scale/Skin	Gills	Fins	
1	*Barillius* sp.	26	29	25	80
2	*Hemichromis fasciatus*	17	16	14	47
3	*Alestes nurse*	24	21	21	66
4	*Tilapia zilli*	23	26	25	74
5	*Barilius senegalensis*	10	10	09	29
6	*Sarotherodon galileaus*	19	19	16	54
7	*Pelmatochromis guentheri*	02	02	03	07
8	*Hemichromis nostar*	03	03	03	09
9	*Tylochromis jentinki*	02	02	02	06
10	*Clarias anguillaris*	15	15	13	43
11	*Auchenoglanis occidentalis*	20	19	18	57
12	*Chrysichthys auratus*	18	13	15	46
13	*Mormyrus hassequilsti*	11	08	09	28
14	*Hemichromis bimaculatus*	02	03	04	09
15	*Auchenoglanis biscutatus*	03	04	03	10
16	*Chrysichthys nigrodigitatus*	04	04	04	12
17	*Tilapia tournieri* (Daget)	03	02	02	07
18	*Chrysichthys furcatus*	02	02	02	06
	Total N° of Isolates	**204**	**198**	**188**	**590**

Table 2. Morphological characteristics and identification of the fungi isolated from some fish from Tagwai Dam Minna, Niger State

S/N°	Fungal species	Aerial hyphae colour	Substrate hyphae colour	Hyphal nature	Shape & kind of asexual spore	Presence of special structure	Appearance of sporangiophore /conidiophore	Sporehead characteristics
1.	*Aspergillus niger*	White yellow	Black	Non-septate	Spherical vesicle	Footcell present	Long, erect & non-septate Conidia	Chains of brown rough wall
2.	*Rhizopus* sp.	Grey black	Black	Non-septate	Oval	Footcell absent	Long erect	Smooth round
3.	*Aspergillus flavus*	Yellow	Brown	Septate & Multinucleate	Oval greenish conidia	Footcell present	Long erect & non-septate conidia	Multinucleated, Vesicle eliptical
4.	*Mucor* sp	Grey	Brown	Non-septate	Oval black dots	Footcell absent	Long erect non-septate conidia	Multinucleated, vesicle eliptical
5.	*Penicillium viricatum*	Clear green	Deep red -purple	Non-septate	Oval	Footcell absent	Long & erect	Multicellular
6.	*Aspergillus parasiticus*	Green	Deep green	Septate	Oval	Footcell absent	Long erect	Spindle shaped
7.	*Microsporium canis*	Lemon yellow	Deep brownish yellow	Septate	Large spindle shape	Footcell absent	Short erect, septate	Multinucleate
8.	*Aspergillus fumingatus*	Bluish	Brown	Septate	Oval greenish conidia	Footcell absent	Long erect non septate	Globose vesicle
9.	*Fusarium* sp.	Pink	Dark brown	Non-septate	Green concave shape	Footcell absent	Single celled microconidia	Sickle shaped
10.	*Aspergillus nidulans*	Dark green	Purplish red	Septate	Brown global	Footcell absent	Long erect	Short columnar
11.	*Aspergillus versicolor*	Orange yellow	Tan to yellowish green	Septate	Oval deep red conidia	Footcell absent	Long erect	Semi elliptical
12.	*Syncephalastrum* sp.	Black	Dark brown	Non-septate	Curved	Footcell absent	Fingerlike projection	Round sacked
13.	*Aspergillus glaucus*	Greenish yellow	Orange yellow	Septate	Flask shape	Footcell absent	Long erect	Dome like
14.	*Cladosporium* sp.	Black	Dark grey/green	Septate	Grey& yeastlike	Footcell absent	Long erect	Sporehead yeast-like
15.	*Trichophynton gallinae*	Light pink	Deep pink	Septate	Oval pear shaped	Footcell absent	Long erect	Multicellular
16.	*Aspergillus clavatus*	Blue green	Green	Septate	Elongate	Footcell absent	Elongate	Chains
17.	*Trichophyton verrucosum*	Grey white	Brownish	Septate	Oval pear shaped	Footcell absent	Long erect	Multicellular
18.	*Gliocladium* sp.	Dark green	White salmon	Septate	Chains	Footcell absent	Long erect	Multicellular
19.	*Curiularia* sp.	Bkack	Black brown	Septate	Curved	Footcell absent	Long erect	Spindle shape
20.	*Absidin* sp.	Coarse grey	Brown	Non-septate	Pear shaped	Footcell absent	Long erect rhizoid	Round
21.	*Aspergillus terreus*	Brown	Orange brown	Septate	Hemispherical	Footcell absent	Long erect	Dome like

aflatoxin poisoning, allergic reaction, systemic infections are attributed to mould and fungal ingestion (Zottola, 1986). Mycosis is an important cause of morbidity and mortality in humans especially individuals that are immuno-suppressed as a result of conditions such as AIDS, organ transplant, radiation and even age (Zottola, 1986). Species of *Penicillium* and *Fusarium* are also capable of secreting toxins like ichra toxins and penicillic acid that are dangerous to human health (Rubin, 1990). Various lung diseases in farmers are associated with moulds and grain dust (Zottola and Smith 1990).

Fungal contaminations mostly by moulds occur on fish species in Tagwai Dam. This finding has shown that *Aspergillus* spp. and other moulds can attack fish as does *Saprolegnia*. This work confirms that fungal contamination occurs among aquatic animals including fish, just as they occur in terrestrial animals. Fish processors and consumers should be aware of the possibility of fungal diseases and mycotoxins from poorly processed fish.

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