*PAT December, 2018; 14 (2): 58-67 ISSN: 0794-5213*

***Online copy available at*** *www.patnsukjournal.net/currentissue*

***Publication of Nasarawa State University, Keffi***

# Are Fungi Isolated from Water and Fish Samples in Lapai-Agaie Dam, Nigeria Pathogenic to Human Health?

**Adamu,K.M*[1], Adebola, M.O[2], Iloba, I.K,[3] Jonathan, D[1], Abdullahi, A.S.,[1] Onyemata, E.K,[4] and Ikomi, B.R.[3]**

*1- Department of Biological Sciences, Ibrahim Badamasi Babangida University, P.M.B. 11, Lapai, Niger State, Nigeria.*

*2- Department of Plant Biology, Federal University of Technology, Minna, Niger State, Nigeria*

*3- Department of Animal and Environmental Biology, Delta State University, Abraka.*

*4- Department of Biological Sciences, Nile University of Nigeria, Abuja*

**-Corresponding Author: kabrmoh@yahoo.com; +234(0)8035826075*

***Abstract***

*The need to identify pathogenic fungi isolates from the water and its' fishes, in Lapai-Agaie Dam that provides for both domestic and agricultural (irrigation and fisheries) activities in order to provide an understanding of the health implication of the isolates was the panacea for this study. Water samples were collected from four characterized sites while fish samples were obtained from the landing sites at the early hours (between 7000 and 8000hours). Standardized procedures for sample collections and fungi isolation and identification were adopted. Eight (8) and seven (7) species of freshwater fungi were isolated from the water and fish samples respectively. Seventeen (17) species of freshwater fishes were identified from the landing site. The most frequent isolates in water were Penicillium chrysogenum 11(26%) and Mucor varians 09(21%) while Aspergillus nidulans 1(2%) was the least in occurrence. P. chrysogenum, A. niger and A. fumigatus were the isolates common to both water and fish samples. The presences of these fungi in both media (water and fish) may pose health risk to the populace as the water is used for domestic activities; as some populace are in the habit of eating partially cooked fish called 'half done' as delicacy meal.*

***Keywords****: Tropical-Freshwater, Fishes, Mycoflora, Public Health*

## Introduction

Fungi are diverse group of organisms belonging to the Kingdom Eumycota (Schubler, *et al.,* 2001), where some are either pathogenic or parasitic that affects fishes as a result of stress or immune-compromise system due to unfavourable environmental condition, or secondary to bacterial or viral infections. They are cosmopolitan in nature due to their broad enzymatic capabilities; as they can actively degrade most complex natural substances thus exist in all strata of the aquatic ecosystem (APHA, 1989). They are known to cause zoosporic diseases (Lafevre *et al.,* 2012) that affects eggs, fingerlings and adult fishes (Eli and Abowei, 2011; Abolude *et al.,* 2013).

Fungal species diversity in aquatic environment varies by location and depth as Shearer *et al.* (2007) reported greater species diversity in the tropics, as most fungi isolated in the tropics and subtropics are anamorphic Basidomycetes and Ascomycetes (Sridhar, 2005). Harms *et al.* (2011) reported that they provide information on the biological and functional diversity of the environment. Studies of fungi diversity in aquatic environment has been conducted in water and sediment (Parveen *et al.,* 2011, Doi, *et al.,* 2018); on plants (Motlagh, 2010; Adamu *et al.,* 2017) and on fishes (Al-Niaeem *et al.,* 2015; Ali, 2015; Angahar, 2016; Atef *et al.,* 2016) as they have reported to cause serious diseases in freshwater fishes. Some fungi are disease-causing pathogens

responsible for mycoses and allergies. Walsh *et al.* (2004) reported that they are associated with disease affecting humans, plants, and animals. Studies of freshwater fishes in standing water has been conducted (Al-Niaeem, *et al.,* 2015; Angahar, 2016; Oso *et al*., 2017).

Dams are mainly used to conserve available water for use during need periods, or for irrigation, domestic uses and municipal water supply. The Lapai-Agaie dam was constructed by the Niger State Government in partnership with the Federal Government with the sole objective of providing portable water for the Lapai and Agaie populace. Therefore, this study isolated fungi in water column and fish samples from Lapai-Agaie Dam with the objectives of identifying species of fungi isolates on landing fishes, and in water column and identify the pathogenic isolates with potential human health implications.

## Materials and Methods

### Sampling Site

The sampling was conducted in Lapai-Agiae Dam, located close to Bakajeba village at latitude $9^{O}13^{1}$N and Longitude $6^{O}35^{1}$E (Plate 1) in Lapai Local Government Area of Niger State, Nigeria where sampling was conducted biweekly during the months of June and July, 2017.

### Sample Collection

Surface water sample was aseptically collected from one meters from the bank for fungi isolation during the 0700 and 0800 hours. The water pH and temperature were monitored using Hanna, pH meter and mercury glass thermometer respectively before sampling.

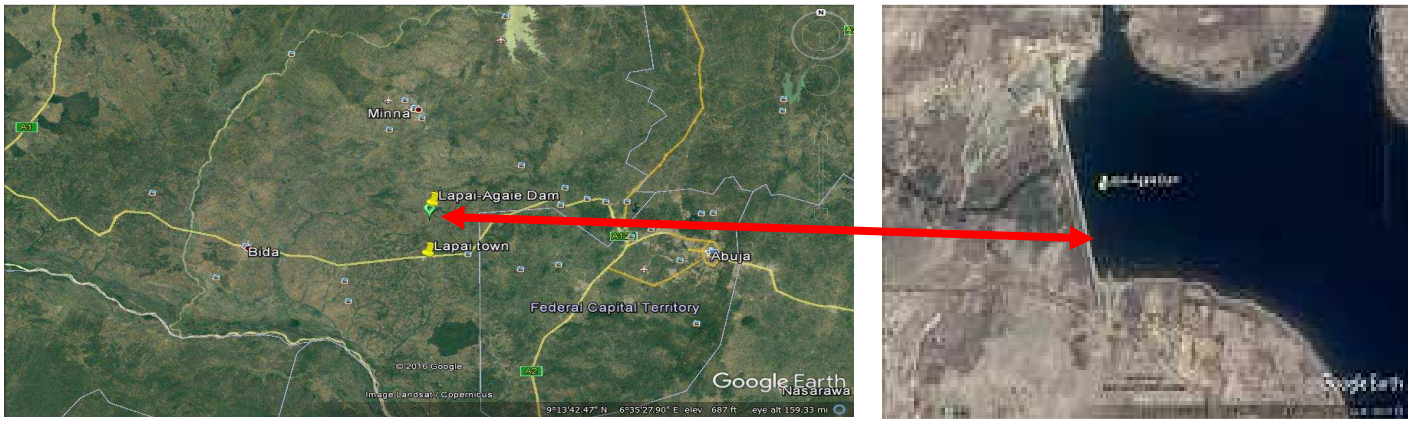


Plate 1: Pictorial representation of Lapai-Agaie Dam source: Google Earth

The samples were collected from four identified site labeled A-D into sterilized sample bottles (Okuda *et al.,* 2000). The following distinctions were noted for the sites; Site A (rocky with aquatic plants); Site B (domestic activities such as washing and bathing), Site C (landing site/fishing activities) and Site D (clayey and calm water without aquatic plants). The identified fish samples were obtained from the landing site, swabbed with a sterile swab stick and placed in a normal saline for analyses.

### Isolation and Identification of Fungi

The laboratory activities were conducted within 2-4 hours of the swab were collected. Potato Dextrose Agar (PDA) was used and prepared in accordance to the Manufacturer's instruction (Accumix®- Tulip Diagnostics (P) Ltd). The samples were serially diluted and dilution factors $10^{-2}$ and $10^{-3}$ were used as stock solution. One ml of each dilution was aseptically taken from the suspension and transferred into sterile Petri dishes. Then Potatoes Dextrose Agar (PDA) was

poured into the Petri dishes containing the suspension and 1ml of chloramphenicol. The plates were swirled gently to allow even distribution of the sample in the medium and were incubated at room temperatures (28 ± 2°C) for 24 hours. From the culture obtained, sub-culturing was made to get the pure culture of each fungus isolated. Fungi isolated were identified using Fungi Families of the world mycological monographs by Samson *et al.* (2004) and Amadi and Adebola (2008). Isolates were studied macroscopically by colony shape, size, colour and growth pattern. Slides were prepared from each colony and stained with 0.05% Trypan blue in lacto phenol. The slides were observed under microscope. The existing septate wall, sexual organ structure, size and arrangement of spores were also examined and recorded. The fungi species were identified with the help of available fungi identification keys and literature (Willoughby, 1994). The data obtained were presented in tables and charts, the mean fungal load were compared using one-way analysis of variance (ANOVA), followed by the student's t-test for comparison test. Analyses were aided with Microsoft Excel, 2007 version where level of significance was placed at 5% probability.

## Results and Discussion

### Water Samples

The water temperature and pH are presented in Table 1. Water at Site B recorded the highest water temperature and pH of 27.00±0.32 $^{o}$C and 6.90±0.01 respectively. There was significant difference ($p<0.05$) in the monitored pH values.

**Table 1: Mean and Standard Error of Temperature and pH of sampled water sites of Lapai-Agaie Dam**

| Parameters | Sampling Sites | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Temperature ($^{o}$C) | 25.00±0.04 | 27.00±0.32 | 26.20±0.45 | 26.00±0.02 |
| pH | 5.30±0.41* | 6.90±0.01 | 6.40±0.37 | 6.40±0.23 |

*$p<0.05$

The macroscopic and microscopic characterizations of fungi isolated from the four sampling sites are presented in Table 2. The different fungi isolated from the sampling sites are presented in Table 3. Eight (8) fungi isolates where identified from the water sample. *A. nidulans* was only recorded in Site C. Site B recorded the least (7) frequency of isolates while the highest (14) was recorded in Site A. The highest cumulative average fungi load on the identified fishes was recorded in *Petrocephalus soudanensis* as $13.50x10^{5}$cfu/ml. The least values of $6.00x10^{5}$cfu/ml was recorded in *Melapterururs electricus* as presented in Table 4. The total numbers of seven (7) fungal isolates were identified on the fishes as presented in Table 5 based on their morphological examination. In Table 6 revealing the different isolate per fish showed that *Aspergillus niger* was the most frequent isolate whilst *Pelvicachromis taeniatus* recorded the highest number of fungal isolates on the skin. Four (4) isolates: *Rhizopus* sp, *Geotrichum candidum*, *Candida* sp and *Trichoderma viridae* were not isolated from water sample but on the fish.

**Table 2: Morphological Characterizations of Fungi Isolates in Water samples from Lapai-Agaie Dam**

| Morphological Characterization | | Probable Fungi |
|---|---|---|
| **Macroscopic** | **Microscopic** | |
| Light yellow greenish colony. Ovoid in shape colonies. | Conidial head are radicate. Conidiophores was thick walled, hyaline and slightly roughened, erect, long, aseptate with a vesicle at the top with phialides and short conidial chains. | *Aspergillus flavus* |
| Widely spread black colonies with smooth white edges and spongy surface that is densely packed with the formation of hyphae | Hyphae are septate, hyaline and conidiophores are long and globase at the tip, blackish conidial head. | *A. niger* |
| Has a dark cress green surface, its reverse side were pale to bright yellow to deep brown. | It had branched septate, dome shaped and blue to green conidial head. The conidial surface is smooth slightly rough. | *A. nidulans* |
| Widely spread colony, dark green with smooth white edges and spongy surface. | Long conidiophores with narrow base and broad near the vesicle, smooth walled hyaline. Grayish conidial head. | *A. fumigatus* |
| Fast growing colonies, resembles white-to-grey cotton candy that darkened with time. While the reverse is light-coloured to white. | Wide hyphae, branched septate with long sporangiophores, septate and round sporangia. | *Mucor varians* |
| The colony was grayish-green to dark green, while reverse was creamy-yellow. | It has subglobose conidia shape that is smooth finely roughed. Septate hyphae. | *Penicillium chrysogenum* |
| The colony was pink with white patch on surface. Round shaped colony. | Light and dark violet, salmon-coloured, purplish brown, all with cottony mycelium, without exudates | *Fusarium oxysporum* |
| The colony was pink with white patch on surface. Round shaped colony. | The mycelium is orange brown with light brown exudates. In appearance it is light yellow and moist. | *F. solani* |

**Table 3: Frequency of Fungi Isolates in Water samples from Lapai-Agaie Dam**

| Fungi Isolates | Sampling Site/Sampling Period (Biweekly) | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | | | B | | | C | | | D | | | |
| | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | |
| *Aspergillus niger* | + | + | - | - | - | - | + | + | - | + | + | - | 06 |
| *A. nidulans* | - | - | - | - | - | - | + | - | - | - | - | - | 01 |
| *A. fumigates* | + | - | + | + | - | - | + | - | + | - | - | - | 05 |
| *A. flavus* | - | - | + | - | - | + | + | - | - | - | - | + | 04 |
| *Fusarium oxysporum* | - | + | - | - | - | - | - | + | - | - | + | - | 03 |
| *F. solani* | - | + | + | - | - | - | - | - | - | - | + | + | 04 |
| *Mucor varians* | + | + | + | + | + | + | + | + | + | - | - | - | 09 |
| *Penicillium chrysogenum* | + | + | + | - | + | + | + | + | + | + | + | + | 11 |
| Sub-Total | 04 | 05 | 05 | 02 | 02 | 03 | 06 | 04 | 03 | 02 | 04 | 03 | |
| Total | | 14 | | | 07 | | | 13 | | | 09 | | 43 |

+ = Present, - = Absent

**Table 4: Fungal load on the skin of sampled fishes from Lapai-Agaie Dam, Lapai**

| Fish sample | Sampling Periods (Biweekly)/Fungi population in Cfu/ml x$10^5$ | | | Cumulative Average Cfu/ml x $10^5$ |
|---|---|---|---|---|
| | 1 | 2 | 3 | |
| *Barboides gracilis* | 7.00 | - | 9.00 | 8.00 |
| *Tylochromis sudanencis* | 12.00 | 5.00 | 7.00 | 8.00 |
| *Ctenopoma petherici* | 9.00 | - | - | 9.00 |
| *Brycinus nurse* | - | 11.00 | - | 11.00 |
| *Labeo senegalensis* | - | 8.00 | 5.00 | 6.50 |
| *Pelvicachromis taeniatus* | 7.00 | 10.00 | 8.00 | 8.33 |
| *Tilapia dageti* | 13.00 | - | 10.00 | 11.50 |
| *T. zilli* | - | 9.00 | 9.00 | 9.00 |
| *Petrocephalus soudanensis* | - | 13.00 | - | 13.00 |
| *Badysynodontis batensoda* | - | 7.00 | - | 7.00 |
| *Marcusenius mento* | - | 8.00 | 11.00 | 9.50 |
| *Marcusenius abadii* | 8.00 | 12.00 | - | 10.00 |
| *Bryconaethiops quinquesquamae* | 11.00 | - | - | 11.00 |
| *Clarias gariepinus* | 10.00 | - | 6.00 | 8.00 |
| *C. anguillaris* | 15.00 | 6.00 | 12.00 | 11.00 |
| *Petrocephalus bovei* | - | - | 8.00 | 8.00 |
| *Melapterurus electricus* | 6.00 | - | - | 6.00 |

-=not sampled

**Table 5: Morphological Characterizations of Fungi Isolates on the skin of sampled fishes from Lapai-Agaie Dam**

| Morphological Characterization | | Probable Fungi |
|---|---|---|
| **Macroscopic** | **Microscopic** | |
| Surface- texture deeply cottony white becoming gray brown on surface. Reverse; pale white | Hyphae broad, not or scarcely septate, rhizoids and stolon present. Sporangiophores brown. | *Rhizopus* sp |
| Widely spread black colonies with smooth white edges and spongy surface that is densely packed with the formation of hyphae | Hyphae are septate, hyaline and conidiophores are long and globase at the tip, blackish conidial head. | *Aspergillus niger* |
| Surface- off-white to cream colored colonies with butyrous texture with a velvety, suede-like or ground glass/matt appearance. | Clear hyaline, septate hyphae. Produce chains of arthroconidia. | *Geotrichum candidum* |
| Surface- fluffy white tufts, green tufts may develop within the colony. Reverse; typical light tan to yellow or pale orange. | Septate hyaline hyphae, conidiophores are short and branching irregularly. Phialides are flask shaped. Conidia are globose. | *Trichoderma viridae* |
| Greenish to black, white mycelia at the margin, white droplet, yellow golden in the media | It has subglobose conidia shape that is smooth finely roughed. Septate hyphae. | *Penicillium* sp |
| Widely spread colony, dark green with smooth white edges and spongy surface. | Long conidiophores with narrow base and broad near the vesicle, smooth walled hyaline. Grayish conidial head. | *Aspergillus fumigates* |
| Creamy to white colonies on surface. | Septate hyphae, conidiophores are short and inflated with black and thick wall conidia. | *Candida* sp |

**Table 6: The different fungal isolates, identified from the skin of freshwater fishes sampled from Lapai-Agaie Dam**.

| Fish sample | *Pennicilium* sp | *Rhizopous* sp | *Aspergillus niger* | *Aspergillus fumigatus* | *Geotrichum candidum* | *Trichoderma viridae* | *Candida sp* |
|---|---|---|---|---|---|---|---|
| *Barboides gracilis* | + | + | + | | + | | |
| *Tylochromis sudanencis* | + | + | + | | | | + |
| *Ctenopoma petherici* | + | | + | | + | | |
| *Pelvicachromis taeniatus* | + | ++ | + | + | + | | + |
| *Tilapia dageti* | + | + | + | | + | | |
| *Marcusenius abadii* | | ++ | + | | + | + | + |
| *Bryconaethiops quinquesquamae* | + | + | + | | | | + |
| *Clarias gariepinus* | + | + | | | + | | |
| *C. anguillaris* | + | + | | + | + | | |
| *Melapterurus electricus* | | | + | | + | | + |
| *Brycinus nurse* | | | | + | + | + | |
| *Labeo senegalensis* | | | + | | | + | + |
| *Tilapia zilli* | | ++ | + | + | | | |
| *Petrocephalus soudanensis* | | + | + | + | | | |
| *Marcusenius mento* | | | + | | + | + | |
| *Petrocephalus bovei* | | | + | | | | |
| *Brachysynodontis batensoda* | | + | | | | + | + |

++= high presence, +=present, -=absent

The highest frequency of fungi was recorded in Site A. This may be attributed to the substrata nature of the site (rocky) which could enable fungi to firmly attach to the bottom and the acidic nature of the water which may be due to the metabolites released by the isolates. However, the least frequency of isolates in Site B may be attributed to the high rate of domestic activities in the area. The fishing activities in Site C, may have been responsible for another higher fungi frequency as the presence of biotic components such as faecal matter, scales and death remains of fishes may have been the factor that is responsible for the high frequency of fungal isolates recorded in the area; in spite of having less hard substratum. The less frequency of isolates in Site D, may be attributed to the substratum (sandy clayey) and least biotic components observed thus reduced

availability of nutrient. The low rate of water flow and temperature variation in standing waters like the Lapai-Agaie Dam have been attributed to increase pathogenic fungal isolates (Bodnarska *et al.,* 2009 and Bichi and Bawaki, 2010). The absence of *A. niger* and *F. oxysporum* in site B, may be attributed to the Human activities in the area. However, the presence of *A. nidulans* in only site C, may be related to the presence of decomposing matter (bacteria) (Adamu *et al.,* 2017). Thereof, they may be opportunistic parasites that are able to take advantage of damaged or stressed fishes. The high quantum of fungal pathogen recorded in this study may be an indication of high bacteria or other pathogens present on the surface of the identified sampled fishes (Fayioye *et al.,* 2008; Junaid *et al.,* 2010; Shahbazain *et al.,* 2010). The source of these fungal pathogens may be associated with anthropogenic activities that occur around the water as well as the presence of bacterial isolates not overlooking the ubiquitous nature of these microscopic prolific giants. Contamination of fish by pathogens may occur prior to harvest (Venugopal, 2002) as pathogen in water and other aquatic biota are likely to infest the fish. According to Kirby *et al.* (2003) water could be a vehicle for the transmission of many micro-organisms.

Pathogenic Fungi isolates such as *Aspergillus spp* (Refai *et al.,* 2010) was isolated in this study which are higher than that reported by Ali, (2015). Reports have revealed that the fungi are mostly frequent in fishes (Ali, 2015, Doi *et al.,* 2018). De Hong and Horré (2002) had described *Aspergillus* spp in water as causative agents of kidney, liver disorder, allergy, burns, otitis media and increase risk of invasive infections. It causes a disease known as Aspergillomycosis in fishes (Fayioye *et al.,* 2008). Studies have reported the isolation of this fungus in fishes (Momeni Shahraki, *et al.,* 2014, Al-Niaeem *et al.,* 2015, Atef, *et al.,* 2016). *A. niger* is a common allergen and may cause opportunistic invasive respiratory infection in hospitalized immunized patients (De Hoog *et al.,* 2000). *A. flavus, A. fumigates* and *A. niger* are known to produce aflatoxins, and ochratoxins which are carcinogenic and are capable of causing kidney and liver disorders, invasive and non-invasive aspergillosis, allergic and sinusitis (Samson *et al.,* 2004; Thliza *et al.,* 2015). The effects of aflatoxins on animal health vary from species to species (Gourama and Bullerman, 1995).

Similarly, *Penicillium chrysogenum* was referred to as pathogenic isolate (Iqbal and Saleemi, 2013). Studies have revealed that the isolate are disease causing agents (Nazim *et al.,* 2008; Gunhild *et al.,* 2009) such as allergy, asthma and other respiratory problems (Houbraken *et al.,* 2010; Memon, 2012). The fungal is most associated with fish as supported by the study conducted by Moneni Shahraki *et al.,* (2014) that it caused 22% mortality of fish eggs and fishes (Refai *et al.,* 2010 and Shahbazain *et al.,* 2010); thereby may be affecting the population of fish in the Dam. Therefore, the presence of this terrestrial mould in aquatic habitat is an indication of contamination that may be attributed to sewage disposal in the study area. According to Hassan *et al.,* (2011), *Candida spp* (a yeast species) are one of the fungal species infesting *Tilapia* spp (Atef, *et al.,* 2016). *Candida sp* is peculiarly associated with spoilage of food (Obayamiji *et al.,* 2008). *Candida* sp may cause be any opportunistic fungus that may affect the health of human as Madhavan *et al.* (2011) reported that *Candida albicans* causes mycosis where oral candidiasis is common amongst AIDS patients, poorly nourished patients and immune-suppressed patients. Mbata *et al.* (2008) reported the presences of these fungi in Jordan River, Israel to be significant ($p<0.05$).

Studies have revealed that *Mucor* sp and *Rhizopus* sp causes invasive diseases (Jimoh *et al.,* 2014; Al-Niaeem *et al.,* 2015; Atef *et al.,* 2016). *Trichoderma viridae* is very useful in industry as biocontrol agent (Samuel, 2006). The fungus is reported to produce trichothecenes, alamethicins, emodin, trichotoxin and suzukacillin and have been reported to cause mycosis and allergy in humans (Samson *et al.,* 2004). The presence of *T. viridae* in this study medium (PDA) had proved

its efficancy in fungi isolation (Iqbal *et al.,* 2017). The fungal community described herein represents the diversity found in this standing water during the study period. Many of the fungus species found are pathogenic and may be useful due to their ability to produce specific enzymes applicable in the biotechnological and pharmaceutical industries.

**References**

Abolude, D.S, Opabunmi, O.O and Davies, O.A (2013). Fresh water fungi associated with eggs and broodstock of African Catfish (*Clarias gariepinus,* Burchell 1822) in fish hatchery farms, Zaria, Kaduna State, Nigeria, *Journal of Research in Environmental Science and Toxicology*, 2(27): 131 – 135

Adamu, K.M., Aliyu-Paiko, M., Ikomi, R.B., Suleiman, S.A., Ahmed, I.B., Mamman, R and Mohammed, S.S.D., (2017). Evaluating the associate microbial organisms, fish feed utilization potential and feedstock in biogas production of water hyacinth, *FUTA Journal of Research in Sciences*, 13(1): 24 – 38

Ali, H.H (2015). Isolation and Identification of Pathogenic Fungi from Carp fish in Suliamania Province, *Global Journal of Bio-Science and Biotechnology*, 4(4): 356 – 363

Al-Niaeem, K. S., Ameen, F., Hatamleh, A., and Bakri, M. (2015). Isolation and Identification of pathogenic fungi on *Oreochromis aureus* (Steindachner, 1864) in the University of Basrah Fish pond. *Indian Journal of Geo-Marine Science,* 44 (8): 1213-1216.

Amadi, J.E. and Adebola, M.O (2008). Effect of moisture content and storage conditions on the storability of garri. *African Journal of Biotechnology*, 7(24): 4591-4594.

Angahar, L. T. (2016). Prevalence of Saprolegniasis in Fish Farms in Gboko, Nigeria. *American Journal of Animal and Veterinary Research ,* 1: 1-8.

APHA, (1989). Stndard methods for the examination of water and waster water, 20th Edition, Washington DC, American Public Health Association.

Atef, H. A., El Shafei, H. M., Mansour, M. K., Snosy, S. A., and Abo-Zaid, K. F. (2016). Effect of Microbiological contamination and Pollution of water on the Health status of fish. *European Journal of Academic Essays,* 3 (5): 178-192.

Bichi, A. H., and Bawaki, S. S. (2010). A survey of ectoparasites on the gill, skin and fins of *Oreochromis niloticus* at Bagauda Fish Farm, Kano, Nigeria. *Bayero Journal of Pure and Applied Sciences ,* 3(1): 83-86.

Bodnarska, M., Bednarski, M., Soltysiaki, Z., and Polechonski, R. (2009). Invasion of Lernaea cyprinacea in Rainbow trout (*Oncorynchus mykiss*). *ACTA Scientiarum Polonorum Medicina Veterinaria ,* 8(4): 27-32.

De Hoog, G.S, Guarro, J, Gene, J and Figueras, M.J (2000). *Atlas of Clinical Fungi.* Centrealbureau voor schimmeclutures, Utretcht, The Netherlands.

Doi, S.A, Pinto, A.B, Canali, C.C, Polezel, D.R, Chinellato, R.A.M, and de Oliveira, A.J.F.C (2018). density and diversity of filamentous fungi in the water and sediment of Araçá bay in São Sebastião, São Paulo, Brazil, *Biota Neotropica* 18(1): e20170416, 1-9

Eli, A.C and Abowei, J.F (2011). A review of some fungi infection in African fish *Saprolegniasis,* Dermal mycoses; Branchiomyces-infections, systemic mycoses and Dermocystidium. *Asian J. Med. Sci.,* 3(5): 198 -205

Fadaeifrad, F, Raissay, M, Bahrami, E, and Najafipoor, A (2011). Freshwater fungi isolated from eggs and brood stocks with an emphasis on *Saprolegnia* in rainbow trout farms in west Iran. *African Journal of Microbiology Research,* 4: 3647 -3651

Fayioye, O.O, Fagbohun, T.R and Olubanjo, O.O (2008). Fungal infestation and nutrient quality of traditionally smoke-dried freshwater fish. *Turkish Journal of Fisheries & Aquatic Science*, 8: 7-13.

Gourama, H and Bullerman, L.B (1995). *Aspergillus flavus* and *Aspergillus parasiticus*: Aflaxigenic fungi of concern in foods and feeds: A Review, *Journal of Food Protection,* 58(12): 1395-1404

Harms, H, Scholosser, D and Wick, L.Y (2011). Untapped potential: exploiting fungi in bioremediation of harzardous chemicals. Nature Reviews Microbiology, London, 9:177-192

Hassan, A.A, Manal, A,H, Howayda, M, E, Rasha, M.H.S.E and Abd El-Dayem, R.H (2011). Detection of aflatoxigenic moulds isolated from fish and their products and its public health significance. *Nature and Science,* 9(9), 106-114

Houbraken, J.A.M.P, Frisvad, J.C and Samson, R.A (2010). Taxonomy of *Penicillium citrinum* and related species. *Fungal diversity* 44:117-133

Iqbal, Z and Saleemi, S.C (2013). Isolation of pathogenic fungi from a freshwater commercial fish *Catla catla* (Hamilton). *Sci. Int* (Lahore), 25: 851-85.

Iqbal, S, Ashfaq, M, Malik, A.H, Inam, Ul-haq, Khan, K.S and Mathews, P (2017). Isolation, preservation and revival of *Trichoderma viride* in culture media. *Journal of Entomology and Zoology Studies,* 5(3): 1640 -1646.

Jimoh, W.A, Ayeloya, A.A., Oladele_Bukola, M.O, Adebayo, M.D, Azeez, A,F. and Salami, S.R (2014). Isolation of fungi infesting smoved African catfish from markets in Ibadan, Nigeria, *Nigerian Journal of fisheries and Aquaculture.* 2(2):13-17

Junaid, S.A, Olarubofin, F and Olabode, A.O (2010). Mycotic contamination of stockfish sold in Jos, Nigeria. *Journal of Yeast and Fungal Res.* 1: 136-141

Kirby, R.M., Bartram, B and Carr, R.(2003). Water in food production and processing-Quality and quality conceus. *Food centre.*14: 283-299

Madhavan, P, Jamal, F and Chong, P.P (2011). Laboratory isolation and identification of *Candida* species. *Journal of Applied Sciences,* 11(16): 2870-2877.

Memon, N.A (2012). Isolation of fungi in the Drinking water distribution system of Hyderabud (Pakistan). Quaid.E.Awam University *Research Journal of Engineering, Science and Technology,* 11(1) 6-9

Mbata, T.I, Ogiehor, S.I and Obeleagu, M.N (2008). Isolation of filamentous fungi from Yardenit-Beptismal site on the Jordan River. *SJPH,* 3(4): 173-175.

Momeni Shahraki, M., Asgari, M. R., Khamesipour, F., and Raissy, M. (2014). Prevalence of *Argulus foliaceus* and Fungal infections in some Ornamental fishes [Discus (*Symphysodon discus*), Dwarf Gourami (*Trichogaster lalius*) and Guppy (*Poecilia reticulata*)] in Isfahan City of Iran. *Kafkas Univ Vet Fak Derg ,* 5, 817-820.

Motlagh, M.R.S (2010): isolation and characterization of some important fungi from *Echinochloa spp* the potential agents to control rice weeds. *Austrialian Journal of Crop Science.* 4(6):457-460

Nazim, S., Dawar, S, Tariq, M and Zaki, M.J. (2008). Quantitative Estimation of Mycoflora in Drinking Water and Fruit Juices Of Karachi. *Pak. J. Bot.*, 40(3): 1263-126.

Okuda T, Klich MA, and Seifert K.A (2000). Media and Incubation Effect on Morphological Characteristics of *Penicillium a*nd *Aspergillus*. In: Integration of Modern Taxonomic Methods For *Penicillium a*nd *Aspergillus* Classification (Samson RA, Pitt JI, Eds). Harwood Academic Publishers, Amsterdam: 83–99.

Parveen, S, Lanjewar, S, Sharma, K and Kutti U. (2011). Isolation of fungi from the surface water of river. *Journal of Experimental Sciences,* 2(10): 58-59.

Refai, M, Attia, S, Salem, R.M and El-Dahsham, E.M (2004). Studies on the pathology of *Aspergillus fumigatus, A. flavus* and *A. niger* isolated from chicken and their environment. *Egypt J Comp. Path Clinic Pathol.,* 17: 193-205

Samuel, J.G (2006). *Trichoderma*: Systematics, the sexual state and Ecology, *Phytopathology,* 96(2): 195-206.

Samson, A.R, Hoekstra, S.E and Prisvad, C.J (2004). Introduction to food and Airborne fungi. 7th edition. Published by the Centraal Bureau Voor Schimmelcultures Utrecht pp. 12-124.

Schubler, A, Schwarzott, D and Walker, C (2001). A new fungal phylum, the Glomeromycota: Phylogeny and Evolution. *Mycological Research,* 105: 1413-1412

Shahbazain, N, Ebrahimzadeh, M, Soltani, M, Khosravi, A.R, Mirzagai, S and Sharifpour, I (2010). Fungal contamination in rainbow trout eggs in Kermanshah Province propagation with emphasis on Saprolegniaceae. *Iranian Journal of Fish Science,* 9, 151-160

Shearer, C, Descals, E, Kohlmeyer, B, Kohlmeyer, J, Marvanova, L, Padgett, D, Porter, D, Raja, H.A, Schmit, J.P, Thorton, H.A and Voglymayr, H (2007). Fungal biodiversity in aquatic habitats. *Biodiversity and Conservation*, 16:49-67

Silva, D.C.V, Tiago, V.P, Matos, J.L.S, Paiva, L.M and Souza-Motta, C.M (2011). Isolamento e seleção de fungos filamentosos de solo de sistemas agroflorestais do municipio de Bom Jardim (PE) com base na capacidade de produção de enzimas hidroliticas. *Revista Brasil. Botânica* 34(4): 607-610

Sridhar, K.R (2005). Diversity of fungi in mangrove ecosystems. In: Satyanarayana, T, Johri, B.N (ed). Microbial diversity: Current perspectives and potential applications. I.K. International Publishing House Pvt. Ltd. p.129-148

Thliza, I.A, Khan, A.U and Dangora, D.B (2015). Fungi contamination of some selected brands of sachet water marketed in Ahmadu Bello University, Zaria, Nigeria. *Journal of Microbiological Research,* 5(1): 23-30.

Venugopal, V.(2002). Bio sensor in fish production and quality centre. *Biosensors and Bioelectronics* 17:147-157.

Walsh, T.J, Groll, A, Hiemenz, J, Fleming, R, Roilides, E and Anaissie, E (2004). Infections due to emerging and uncommon medically important fungal pathogens. *Clinical Microbiology and Infection*, 10(1): 48-66

Willoughby, L.G (1994). Fungi and Fish Disease Pisces. Press Stirl. UK. pp 57