Vol. 4, Issue 2:
Issues in Engineering & Environmental Studies
ISSN: 2714-3643; September, 2025

RUGIPO Research & Technical Journal
https://elearning.rugipo.edu.ng/Rugipo_Tetfund_Journal_Research_Portal/
TETFund/DESS/POLY/OWO/ARJ/05

Study on Microbial and Fungal Load Concentrations from Various Water Sources

Ulaka, George A.
Department of Fisheries Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria
E-mail: georgeayo00@gmail.com

Abstract
The microbial with fungal load concentrations from four water sources (Borehole, Stream, earthen pond and concrete pond waters) within Rufus Giwa Polytechnic, Owo main campus were investigated and compared. The earthen pond has the least microbial and fungal load concentration (0.0333 Cfu/ml x 10^3 and 0.0133 Sfu/ml x 10^3) among the selected water sources under assessment stream water has the highest microbial load and fungal load concentration (0.1633 Cfu/ml x 10^3 and 0.0433 Sfu/ml x 10^3). The total microbial load range between 0.0333 Cfu/ml x 10^3 to 0.1633 Sfu/ml x $10^{3,}$ while fungal load concentration range between 0.0133 Sfu/ml x 10^3 to 0.0433 Sfu/ml x 10^3. The statistical relationship showed that microbial load of earthen pond is significantly varied ($P < 0.05$) in comparison to that of Concrete (0.1400 Cfu/ml x 10^3), Borehole (0.1300 Cfu/ml x 10^3) and Stream water (0.1633 Cfu/ml x 10^3). The fungal load concentration also ranges between (0.0133 Sfu/ml x 10^3, 0.0233 Sfu/ml x 10^3, 0.0233 Sfu/ml x 10^3 and 0.0433 Sfu/ml x 10^3) for earthen pond water, concrete pond water, borehole water and stream water, respectively.

***Keywords**: Microbial load, fungal load, concentration, water sources.*

How to Cite: Ulaka, G. A. (2025). Study on Microbial and Fungal Load Concentrations from Various Water Sources. *RUGIPO Research and Technical Journal in Engineering and Environmental Studies*, 4(2): 47–52. https://elearning.rugipo.edu.ng/Rugipo_Tetfund_Journal_Research_Portal/.

1.0 Introduction

Water dominates approximately 71% of the Earth's surface, with continents and islands accounting for the remaining 29% (Agu et al., 2014; Agu et al., 2017; Agu et al., 2021; Agu et al., 2023). Most of our water supplies are from surface water, which includes: rivers, streams, lakes, oceans and seas, water bodies are likely to be polluted with domestic and industrial wastes as well as agricultural waste. Although there are no official definitions for the general term river as related to geographic features, in some countries or communities, a river is defined by its size (Agu et al., 2017).

Microorganisms have a very important function within aquatic organisms because they participate in nutrient conversion, and these may affect the disease control of various water quality parameters such as pH, dissolved oxygen and ammonia. The bacteriological quality of water plays a vital role in the diseases in farmed fish, a fact that must be well known by the fish farmers who should understand the importance of maintaining a proper bacteriological water quality of the pond. In aquaculture, bacterial pathogen is an important cause of fish infections and mortalities (Ademoroti, 1996). More so, the fish bacterial flora is the main source of occupational diseases affecting the fish handlers and some bacteria from the fish ponds, such as *Enterobacteriaceae*, are directly related to factors like suspended matter, dissolved oxygen, organic detritus and nutrient salt. (Basudha et al., 2019). There is a need to determine the extent of current knowledge regarding which fungal species have been reliably identified as present in treated drinking water and its distribution systems, their ecology and the extent to which they are a hazard to human health.

Generally, most bacteria (gram-negative) are commonly found in fresh water, some of which include: *Pseudomonas*, *Archaebacter* and *Vibrio*. While some Gram-positive bacteria which are found in water include: *Micrococcus*, *Archaebacteria* and *Actinomycetes* (Cabral, 2010). Water is a potential carrier of pathogenic organisms that can endanger human and animal life especially fish. Most drinking water sources are often contaminated with different pollutants like faeces, animal and plant wastes, making such water unfit for drinking if not treated (Umeh et al., 2015). The pollution of water with pathogenic organisms and other pollutants can only be detected by carrying out a microbiological assessment of such water. Most human diseases such as typhoid, Paratyphoid, Cholera, Amobiasis, Trichinosis, Gastroenteritis, Salmonella, Shigellosis, Diphtheria, Giardia, Dracunculus, etc., are known to be waterborne diseases (Park et al., 2018; Tchobanoglous et al., 1995). The increase in drinking water from different sources, especially in Ondo State, has made it necessary to investigate the microbial content of water. This study aims to evaluate the microbial and fungal load concentrations from four water sources and compare their characteristics.

2.0 Materials and Methods

2.1 Experimental Site and Sample Collection

The experiment was carried out in the Fisheries and Aquaculture Teaching and Research Farm Laboratory in the Department of Fisheries and Aquaculture Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria. Two (2) litres each of borehole, stream, earthen pond and concrete pond waters were collected within the Rufus Giwa Polytechnic, Owo main campus into a transparent plastic container and conveyed to Fisheries and Aquaculture Teaching and Research Laboratory for further microbial and fungal load analysis.

2.2 Determination of Fungal and Microbial Load in Different Water Sources

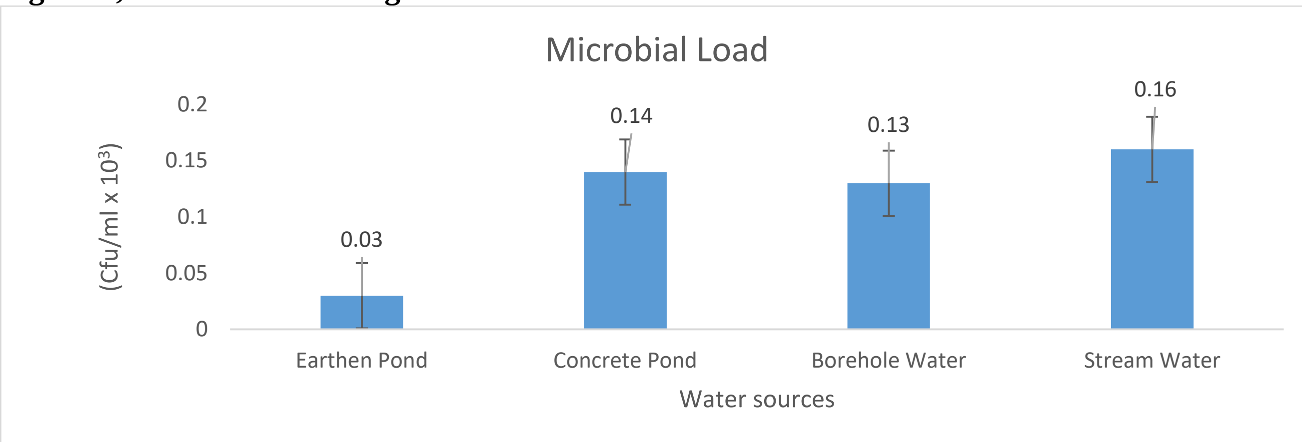
Three (3) different samples of water from each experimental sample were taken quickly, McCartney bottle cap was removed and it bottom was inserted into the water body, sweeping it back and front to avoid surface dirt, and the bottle was plunge into the water to fill it just about half-full, the cap was replaced and they were labeled appropriately. The samples were shaken gently, and 0.1ml was transferred into a sterile plate and another 1ml into another plate, this also labelled appropriately. The 0.1ml of each sample was added to 9.9ml sterile water and mixed properly to give a 10^{-2} dilution, while 1ml of the sample (10^{-2} dilutions) was added to a sterile petri dish and labelled appropriately, following methods by Cappuccino and Sherman (2014) *Microbiology Laboratory Manual*. Thereafter, the molten nutrient agars were poured into plates containing the water samples. All the plates were incubated at 37^{0}C for 48 hours, and the colonies were counted with the aid of hand lens and related to the dilution factor. The bacterial count in 3 replicated samples was related, and the average was recorded.

3.0 Statistical Analysis

The results were subjected to statistical comparison using a one-way analysis of variance (ANOVA). The significant treatment means were calculated using LSD at 5%.

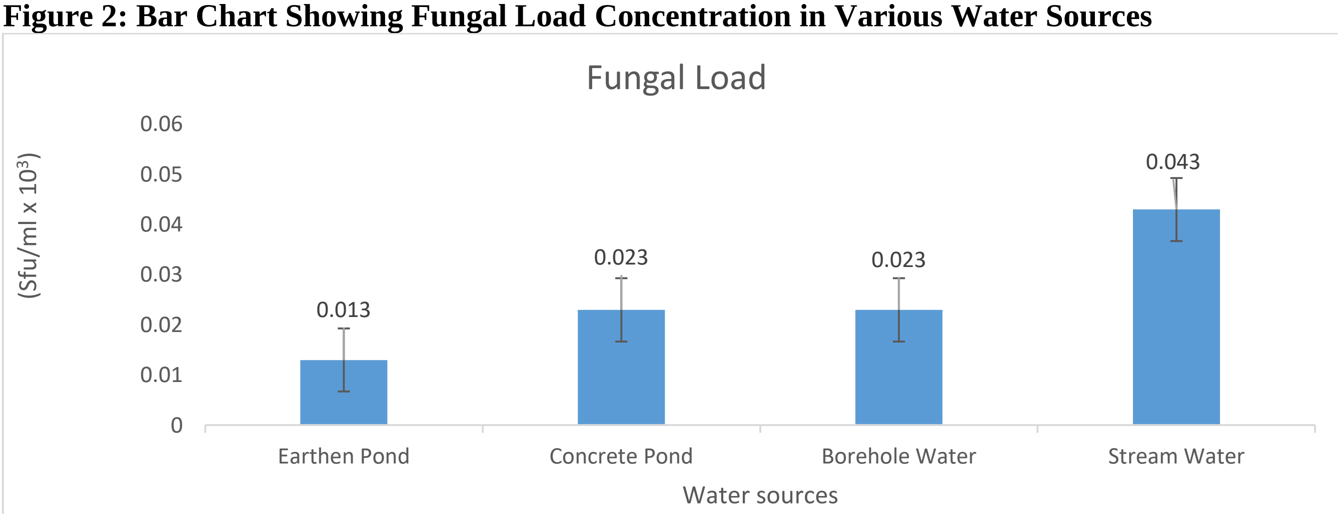
4.0 Results

Figure 1; Bar Chart Showing Microbial Load concentration in Various Water sources



The bar chart in figure 1 above shows the microbial load concentration (cfu/ml×10^3) across different water sources, earthen pond, concrete pond, borehole, and stream water. From the study, stream water recorded the highest microbial load value (0.163×10^3cfu/ml), followed closely by concrete pond water (0.140×10^3cfu/ml) and borehole water (0.130×10^3cfu/ml) while the lowest microbial load was observed in earthen pond water with the value (0.033×10^3cfu/ml). This trend suggests that surface waters are more prone to microbial contamination compared to groundwater sources (boreholes), which are often filtered naturally through soil layers (Odonkor & Ampofo, 2013). High microbial presence in streams could be linked to agricultural runoff, open defecation, or surface contact with organic matter as reported by (WHO, 2017). The relatively low microbial load in earthen pond water may be due to natural sedimentation and predatory control of microbes by other aquatic organisms (Akinbile & Yusoff, 2011).

Figure 2: Bar Chart Showing Fungal Load Concentration in Various Water Sources



The fungal load concentrations (sfu/ml×10^3) also reveal that, stream water again had the highest fungal load value (0.043×10^3sfu/ml), and the concrete pond with borehole water both recorded similar fungal loads concentration (0.023×10^3sfu/ml). Earthen pond water had the lowest fungal concentration (0.013×10^3sfu/ml). The dominance of fungi in surface water (streams) can be explained by the presence of decaying organic matter, leaves, and nutrient enrichment, which provide substrates for fungal growth as reported by (Pitt & Hocking, 2009). Boreholes and concrete ponds, though showing lower values, but still had measurable fungal loads concentration which may reflect contamination during handling, storage, or seepage (Edberg et al., 2002). The minimal fungal presence in earthen pond water could be attributed to better microbial balance within the pond ecosystem and natural competitive inhibition between bacteria and fungi (Igbinosa et al., 2012).

5.0 Discussion

The results from this study show that stream water had the highest microbial load (0.163×10^3cfu/ml), followed by concrete pond water (0.140×10^3cfu/ml) and borehole water (0.130×10^3cfu/ml), while the lowest microbial load was recorded in earthen pond water (0.033×10^3cfu/ml). This suggests that surface waters are more prone to microbial contamination than groundwater sources. According to Odonkor and Ampofo (2013), surface waters are usually more contaminated with bacteria due to agricultural runoff, indiscriminate waste disposal, and direct human or animal contact, which may explain the higher values in the stream and concrete pond waters. The relatively lower microbial concentration in borehole water may be attributed to the natural filtration capacity of soil and aquifers, which reduce microbial passage (Edberg et al., 2002). Interestingly, the earthen pond water showed the lowest microbial concentration, which could be due to natural sedimentation and microbial predation within the pond ecosystem. Akinbile and Yusoff (2011) observed that earthen ponds often develop microbial equilibrium because organic matter is broken down and stabilized by resident microbial communities.

A similar trend was observed for fungal load, where stream water recorded the highest concentration (0.030×10^3sfu/ml) and concrete pond water and borehole water showed moderate but equal concentrations (0.023×10^3sfu/ml) and (0.023×10^3sfu/ml) respectively. The lowest fungal concentration was found in earthen pond water (0.013×10^3sfu/ml). High fungal presence in stream water can be linked to nutrient enrichment from decaying plant matter and organic pollutants, which provide favorable substrates for fungal growth. Pitt and Hocking (2009) noted that aquatic fungi thrive in environments rich in organic debris, leaves, and decaying vegetation, which explains the higher fungal load in surface waters. Similarly, Eze and Madumere (2020) reported that untreated Nigerian surface waters frequently harbor significant fungal populations, some of which may include pathogenic species of *Aspergillus* and *Candida*. The lower fungal counts in borehole and pond waters may be explained by reduced exposure to external contamination. However, the detection of fungi in borehole water indicates possible secondary contamination during collection, storage, or through seepage from surrounding soils. Igbinosa et al. (2012) stressed that even groundwater sources can become vulnerable to microbial and fungal infiltration where sanitation and borehole protection measures are inadequate. The results from both figures confirm that stream water consistently harbors the highest microbial and fungal loads, making it the least suitable for direct consumption or aquaculture use without treatment. Boreholes and earthen pond water showed lower loads, but still not negligible, indicating the need for water quality monitoring and treatment. This agrees with findings by Eze and Madumere (2020), who reported that untreated surface water sources in Nigeria often contain high microbial and fungal populations, posing risks for fish culture and human health.

Similarly, WHO (2017) emphasizes that high microbial loads in natural waters are critical indicators of pollution and potential pathogenic contamination.

6.0 Conclusion and Recommendation

The present study revealed that for human health to be improved, a healthy diet must certainly be worked upon. Aquatic animals are essential part of the human diet as well as water itself hence, knowing the health status of water and its components should be considered necessary to man. Microorganisms constitute a lot to water health conditions, which has a lasting effect on the edible species in the aquatic ecosystem. The findings from this study consistently demonstrate that stream water is the most contaminated source, both bacteriologically and mycologically, whereas earthen pond water appears to be the least contaminated. This outcome aligns with the World Health Organization (WHO, 2017), which emphasizes that high microbial loads in surface waters are critical indicators of poor sanitation and potential pathogenic risk. From an aquaculture perspective, high microbial and fungal contamination may compromise fish health and reduce productivity, while for human use, such water is unsuitable without adequate treatment. however, further research is needed to investigate the species of the available micro-organisms reviewed (bacteria and fungi), to be sure if they are harmful or beneficial species.

References

Ademoroti, C. M. A. (1996). Environmental Chemistry and Toxicology. Folulex *Press Limited*, Ibadan, 44 -47.

Agu, K. C., Nmecha, C.O., Nwaiwu, M.O., Ikedinma, J.C., Awah, N.S., Eneite, H.C., Victor-Aduloju A.T., Umeoduagu N., and Onwuatuegwu, J.T.C. (2017). Isolation and Characterization of Halotolerant Bacteria from Ezzu River Amansea, Awka, Anambra State. *Bioengineering and Bioscience*, 5 (4): 86-90. DOI:10.13189/bb.2017.050303

Agu, K.C. and Chidozie, C.P. (2021). An Improved Slide Culture Technique for the Microscopic Identification of Fungal Species. *International Journal of Trend in Scientific Research and Development*, 6 **(**1): 243-254, URL: www.ijtsrd.com/papers/ijtsrd45058.pdf.

Agu, K.C., Orji, M.U., Onuorah, S.C., Egurefa, S.O., Anaukwu, C.G., Okafor, U.C., Awah, N.S., Okafor, O.I., Mbachu, A.E. and Anyaegbunam, B.C. (2014). Influence of Solid Waste Dumps Leachate on Bacteriological and Heavy Metals Contamination of Ground Water in Awka. *American Journal of Life Science Researches*, 2 (4): 450-457.

Agu, K.C., Umeoduagu, N.D., Egurefa, S.O., Awari, V.G., Uwanta L.I., Ikenwa, B.O., Udenweze, E., Nwiyi, I.U., Chidubem-Nwachinemere, N.O., Ozoh, C.N., Ohanazoeze, C.F. and Nwosu, J.C. (2023). Comparative Study of the Microbiota of Fish Ponds in Awka, Anambra, Nigeria. *Global Scientific Journal*, *11*(6): 16251646.

Agu, K. C. and Odibo, F. J. C. (2021). Biodegradation Potentials of *Aspergillus Flavipes* Isolated from Uburu and Okposi Salt Lakes. *International Journal of Trend in Scientific Research and Development*, 5(5): 11601170. URL: www.ijtsrd.com/papers/ijtsrd44949.pdf

Akinbile, C. O., and Yusoff, M. S. (2011). Environmental impact of fish pond effluent on water quality and physicochemical properties of soil. *Journal of Environmental Protection*, *2*(7), 711–716.

Basudha, U. K., Panigrahi, P. and Sarangi, A. (2019). Multiple water use protocols in integrated farming system for enhancing productivity. *Water Resources Management*, 26: 2605-2623.

Cabral, J. P. S. (2010). Water Microbiology: Bacterial Pathogens and Water. *International Journal of Environmental Research and Public Health*. 7:3657–3703

Edberg, S. C., Rice, E. W., Karlin, R. J., and Allen, M. J. (2002). Escherichia coli: The best biological drinking water indicator for public health protection. *Journal of Applied Microbiology*, *88*(S1), 106S–116S.

Edzwald J. K. (2010). *Water Quality and Treatment: A Handbook on Drinking Water*. New York Publication: McGraw-Hill.

Eze, V. C., and Madumere, I. C. (2020). Bacteriological and mycological quality assessment of different water sources in Owerri, Nigeria. *African Journal of Environmental Science and Technology, 14*(9), 253–261.

Igbinosa, I. H., Igbinosa, E. O., and Okoh, A. I. (2012). Impact of discharge wastewater effluents on the physico-chemical qualities of a receiving watershed in a typical rural community. *International Journal of Environmental Science and Technology*, *9*(2), 353–362.

Odonkor, S. T., and Ampofo, J. K. (2013). Escherichia coli as an indicator of bacteriological quality of water: An overview. *Microbiology Research*, *4*(1), e2.

Park, J., Kim, J.S., Kim, S., Shin, E., Oh, K.H., Kim, Y. and Kim, J. (2018). A Waterborne Outbreak of Multiple Diarrhoeagenic Escherichia coli infections Associated with Drinking Water at a School Camp. *International Journal of Infectious Diseases,* 66: 45–50.

Pitt, J. I., and Hocking, A. D. (2009). Fungi and Food Spoilage (3rd ed.) *Macmillian* and Springer. pp.210

Tchobanoglous, G, Peavy H. S, and Rowe D. R. (1995) Environmental Engineering. *New York*: McGraw-Hill Interamericana. Pg 78-80

Umeh, C.N., Okorie, O.I. and Emesiani, G.A. (2015). Towards the Provision of Safe Drinking Water: The Bacteriological Quality and Safety of Sachet Water in Awka, Anambra State. In The Book of Abstracts of the 29th *Annual Conference* and General Meeting on Microbes as Agents of Sustainable Development Organized by Nigerian Society for Microbiology (NSM). University of Agriculture, Abeokuta, 14–17.

World Health Organization (WHO). (2017). *Guidelines for Drinking-water Quality* (4th ed.). Geneva: WHO