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Microbiological evaluation of the 'Only' Potable Water Source in Ishiala-Umudi Community, Nkwerre, Imo State, Nigeria

Effiong, Enobong[1*], Obazu Franklin[1], Omajene Aghogho[2] & Nwosu, Mmesoma[3]

[1]*Department of Biological Science, Edwin Clark University, Kiagbodo, Delta State, Nigeria.* [2]*Department of Physics, Edwin Clark University, Kiagbodo, Delta State, Nigeria.* [3]*Department of Microbiology, Hezekiah University, Umudi, Imo State, Nigeria.*
Corresponding (Effiong, Enobong) Email: enobong@edwinclarkuniversity.edu.ng[*]

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ABSTRACT

Access to healthy and wholesome drinking water sources in rural communities in Nigeria and around the world has become increasingly concerning. This study was designed to assess the microbiological qualities of drinking water sources in Umudi. Three samples were collected and transported to the laboratory at Hezekiah University, Umudi, Imo State. Measurements included total coliform count, heterotrophic bacterial count, fungal count, coliform counts, and Salmonella-Shigella count. Biochemical tests, as well as morphological and microscopic analyses, were employed to identify the bacterial and fungal isolates. The total coliform count was 10 and 30 MPN/100mL for B-sachet water and the university borehole, respectively. The total heterotrophic count ranged from 4.3 Log CFU/ml to 6.0 Log CFU/mL, while fungal counts ranged from 3.0 Log CFU/mL to 4.54 Log CFU/ml. The tentative identities of the isolates obtained were *E. coli*, *Pseudomonas* sp., *Proteus* sp., *Staphylococcus* sp., and *Shigella* sp., with *Staphylococcus* sp. and *E. coli* being the most frequently encountered. The fungi observed included *Candida* sp., *Aspergillus* sp., *Fusarium* sp., and *Penicillium* sp. There is an urgent need for university management to address this issue of drinking water pollution, as it may contribute to downtime experienced by staff and students; the university must inform sachet water producers of the importance of conducting source-tracking of water aquifer pollution, and government agencies should be encouraged to regulate activities of water packaging companies.

Keywords: Accessibility; *Potabilis*; Nkwerre; Microbiological evaluation; Government; Biochemical test; Potable water; Coliform; Ishiala-Umudi.

1. Introduction

Water is a crucial resource in the biosphere and occupies a critical niche to sustain life. Metabolic activities of biota depend on water to solubilise and absorb nutrients. The biosphere is composed of three-quarters sits on water. The impact of the population explosion and allochthonous influences has greatly impacted the availability of drinking water to both rural and urban settlements. Therefore, it has become imperative to source-track the quality of drinking water sources in rural and urban communities, because the poor health care facilities can plague the fatalities associated with disease outbreaks in rural settlements, scarcity of quality dispensaries, poor diagnostic and management facilities and the incidence of quack practices. The quality of drinking water in most rural communities has been impacted by both industrial and domestic pollution [1].

The availability of good-quality water is an indispensable feature for preventing diseases and improving the quality of life. Natural water contains different types of impurities that are introducedinto the aquatic system by different ways, such as weathering of rocks and leaching of soils, dissolution of aerosol particles from the atmosphere and from several human activities,including mining, processing and the use of metal-based materials [2]. The increased use of metal-based fertilizers in the agriculturalrevolution of the government could result in a continued rise in the concentration of metal pollution in freshwater reservoirs due to the water run-off. Also, faecal pollution of drinking water causes water-borne disease, which has led to the death of millions of people. [3].

People all over the globe are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil. These are related to animal and plants and finally affecting on it. Industrial development (Either new or existing industry expansion) results in the generation of industrial effluents,

and if untreated, results in water, sediment and soil pollution [4]. Having mainly excessive amounts of heavy metals such as Pb, Cr and Fe, as well as heavy metals from industrial processes, is of special concern because they produce water or chronic poisoning in aquatic animals. High levels of pollutants, mainly organic matter in river water, cause an increase in biological oxygen demand [5], chemical oxygen demand, total dissolved solids, total suspended solids and fecal coliform. They make water unsuitable for drinking, irrigation or any other use.

The quality of groundwater depends on various chemical constituents and their concentrations, which are mainly derived from the geological data of the region. Industrial waste and municipal solid waste have become some of the primary causes of pollution in surface and groundwater. In many parts of the country, available water is rendered non-potable due to the presence of heavy metals in excessive amounts. The situation worsens during the summer season due to water scarcity and rainwater runoff. Contamination of water resources used for household and drinking purposes with heavy elements, metal ions, and harmful microorganisms poses a serious health threat. Recent research in Haryana (India) concluded that the main causes of groundwater deterioration are high extraction rates without adequate recharge, improper disposal of solid and liquid waste, lack of strict law enforcement, and weak governance [6]. Most rivers in urban areas of developing countries are outlets for effluents discharged from industries. African and Asian countries experiencing rapid industrial growth face increasing difficulties in environmental conservation [7,8].

One of the major challenges faced by decision-makers in most developing countries like Nigeria is providing sufficient water to meet the increasing population's water demand. A key reason is the inability of existing water supply systems to supply clean water to the populace [9]. According to these researchers [10,11], when comparing the population growth rate with the current public water supply, especially in rural and semi-urban areas, it is generally inadequate and unreliable. Furthermore, almost all urban areas in Nigeria experience water shortages relative to demand. According to Lawal and Basorun [12], the public water supply is irregular, intermittently unreliable, and sometimes inaccessible, resulting in a high dependency on alternative sources. Additionally, about half of the water in drinking water distribution systems in developing countries is lost due to leakage, vandalism, and illegal connections [13,14]. This study aims to determine the quality standards of the only drinking water source in Hezekiah University, Umudi, Imo State.

1.1. Objectives of the Study

(1) Collection and transportation of the water samples obtained from Umudi, Imo state. (2) Coliform analysis of the water samples obtained during the study. (3) Microbiological population analysis of the potable water samples. (4) Biochemical identification of microbial flora associated with the potable water samples. (5) Determination of the frequency of occurrence of the microbial flora.

2. Materials and Methods

2.1. Sample collection

The two most consumed sachet water were first sought by sampling the opinion of the people residing in Umudi, Nkwerre, Imo State. The sachet water samples were bought within the Ishiala Umudi and placed in a cold container and transported to the Microbiology laboratory, Hezekiah University, Umudi, Imo State. The University borehole

samples were collected from the tap in the classroom section of the university. The samples were collected using sterile plastic bottles, by first using the water to rinse the containers before the samples were fetched and transported to the laboratory.

2.2. Media and Reagents

Analytical grade reagents were purchased and transported by Joechem Services Limited, Choba, Rivers State, Nigeria. The media used for the study was prepared using the manufacturer's instructions.

2.3. Microbiological analysis

2.3.1. Determination of Total Heterotrophic Bacteria Count

Total heterotrophic bacterial counts for the different water samples were determined using the spread plate method on nutrient agar. The water samples were made to go through a 10-fold serial dilution by using 1ml of well-mixed water and 9ml diluent. Then, 0.1ml aliquots of diluent samples were plated on plate count agar in triplicate. The plates were incubated for a period of 24 hours in the incubator at 37^{o}C; characteristic colonies, with counts between 30-300 then these values were then expressed as CFU/ml [15].

2.3.2. Determination of the coliform count, Salmonella-Shigella and Staphylococcal count

Nutrient Agar, MacConkey agar, Mannitol salt and *Salmonella-Shigella* agar were used to enumerate total heterotrophic bacteria, *Enterobacteriaceae* bacteria and Salmonella-Shigella counts. The water samples were serially diluted, and the pour plate method previously described by Pepper and Gerba [16] and Benson [17] was employed to determine the bacterial population. Approximately 1.0ml of the diluted water samples was aseptically plated in the different media and incubated at 37ºC for 24- 48 hours. Then, after, the colonies that grew on the different agar plates were counted and expressed as colony-forming units per millilitre of the water samples. The different colonies were isolated into nutrient agar plates for identification.

2.3.3. Determination of Total Fungal Count

Total fungal count for the different rainwater samples was determined using the spread plate approach on Potatoes Dextrose Agar (PDA). Aliquot of about 0.1ml was placed and spread on the prepared agar medium.

2.3.4. Determination of Total Coliform Count

The Most Probable Number (MPN) test was used to ascertain both fecal and total coliforms respectively. The method described by Harley and Prescott [18] was employed in this analysis. The 3-test tube technique as detailed by Effiong and Asionye (2024) using Mac Conkey broth in single and double strengths. The presence of gas and fermentation was used to ascertain the responses.

2.3.5. Determination of Culturable Total coliform Count

The total culturable coliform count was determined using the Eosine methyleneblue agar as described by enumeration of responses [20].

2.3.6. Determination of Total *Salmonella–Shigella* Counts

The *Salmonella–Shigella* counts present in the water samples were determined using the spread plate method on Salmonella-Shigella agar (Oxoid, Basingstoke, United Kingdom). About 0.1ml aliquots of appropriate dilutions was spread on selenite-f broth /*Salmonella–Shigella* Agar. The petri dishes carrying the already spread inoculum from the enrichment were incubated at 37^{o}C for two days.

2.4. Biochemical identification of bacterial isolates

2.4.1. Gram Stain

This test was employed to differentiate the bacterial isolates into 2 main categories based on their ability to retain dyes of different classes. Morphology and physiology of the cells are harnessed; hence, the first with huge layers and that retains the primary dyes is said to be positive, while the other is regarded as negative. The smear of the test bacterial culture was prepared and heat-fixed on the grease-free slide. The slide was flooded with the primary dyes for half a minute and re-flooded with clean water, then drained. Gram's iodine was applied for a similar time duration as the former. 75% alcohol is used to wash stains for 30 seconds. The slide was washed with tap water and air-dried. Then, 0.25% safranin was used to counterstain the slide for 30 seconds. The slide was washed, drained, dried and examined under an oil-immersion microscope(x100). A purple colour indicated a Gram-positive organism because of the retention of the primary stain (crystal violet) while a pink colouration, arising from the colour of the counterstain (safranin) because of the inability to retain the primary stain indicated a Gram-negative organism [21].

2.4.2. Indole test

This test was carried out to test the ability of bacterial isolates to break down tryptophan by using the enzyme tryptophanase and producing indole using Kovac's reagent. The test was carried out as described by [22]. The test after incubation, 0.5ml (about 5 drops) of Kovac's reagent was poured into the test tube and observed after agitation for a minute. The presence of a brick-red layer over the top of the media suggests a positive reaction, while the alternate colours suggest a negative result [23].

2.4.3. Methyl Red (MR) test

This was carried out to evaluate the capacity of the isolate to use the media. Most of the isolates first decrease their pH from 7.5 to about 4.4 or below. Five (5) drops of methyl red solution were then added to one portion of MR-VP broth. Fermentation of a red colour indicates high acid production and a decrease in the pH of the culture medium to 4.4 is interpreted as a positive result, while yellow colour formation indicates a slightly acidic environment with a pH above 6.0 is regarded as a negative result [22,20].

2.4.4. Voges Proskauer test

This test was carried out to test the ability of bacteria to produce acetyl methyl carboinol, a product of fermentation. After incubation, 0.6 ml (about 12 drops) of 5% (w/v in ethanol) alpha-Naphthol and 0.2ml (about 4 drops) of 40% (w/v in distilled water) KOH solution were added to the test tube, which was vigorously shaken and kept aside in a slanted position to allow for maximum exposure to oxygen for about an hour. Brick red production indicated a positive result, whereas yellow colour is regarded as a negative result [22,20].

2.4.5. Motility test

This test was done to identify motile organisms. A semi-solid medium was prepared by dissolving 14g of nutrient agar in one 1 litre of distilled water. 10ml of the semi-solid nutrient agar was dispensed into each test tube and allowed to pre-heat, sterilise and cool. A sterile inoculating needle was then aseptically used to pick the test organisms and stabbed into the semi-solid agar, and incubated for 48 hours at 37 ^{o}C and observed for growth that deviated from the original needle stab. A deviation indicates that the organism is motile, whereas a straight-line growth indicates non-motile organisms [22]

2.4.6. Oxidase test

This test was carried out to test the ability of the isolates to produce the oxidase enzyme. The dry filter paper method as described by MacFaddin [20], was employed. A piece of filter paper was soaked with the reagent solution, allowed to dry and further smeared with a colony of the test organism and observed for the formation of purple colour. The purple colour within 2 minutes indicated a positive result, while isolates with no purple colour within 2 minutes were adjudged negative.

2.4.7. Starch hydrolysis test

This test was carried out to identify the capacity of microorganisms to hydrolyse starch with the enzyme, alpha-amylase or oligo-1,6-glucosidase activity [24,20]. The test organism was spotted on a sterile starch agar plate; the plate was inverted and incubated aerobically at 35 ^{o}C for 48 hours. After incubation, the plate was brought out, covered with iodine and immediately examined for the presence of a halo around the growth. The presence of a halo around the growth, not on the growth, indicated a positive result, while the absence of a halo zone indicated a negative result.

2.4.8. Sugar Fermentation

The isolates were also screened for their ability to ferment certain sugar molecules. The carbohydrates that were used for the test were lactose and glucose. During sugar fermentation, the isolates were introduced into sugar-rich peptone water tubes, with each isolate being inoculated into 5 tubes of peptone water containing 5 different sugar types and labelled accordingly. The culture was then incubated for 24-48 hours at 37°C, and a bright golden yellow indicates positive.

2.4.9. Triple sugar iron (TSI) test

This test was aimed at the differentiation of microorganisms based on sugars utilised, gas and precipitation of sulphides. When sugars are utilised, the colour of the media changes to yellow as stated above. Iron mordants are the hydrogen sulphide (H_2S) indicator. Sodium Chloride maintains the osmotic balance of the medium [23]. The agar slant method was used. TSI agar was prepared according to the manufacturer's instructions, and the medium was sterilised by autoclaving at 121 ^{o}C for 15 minutes at 15 psi. The sterile molten medium was slanted, allowed to cool and inoculated with a 24-hour culture of the test organism. The medium was incubated at 37 ^{o}C for 24 hours. After incubation, the result was interpreted by noting the following observations [23].

3. Results

3.1. Coliform composition of the drinking water sources in Umudi

The results presented in Table 3.1 show the total coliform composition of the drinking water sources in Umudi, Nkwerre Local Government Area, Imo State. The first sample, termed A-Sachet 1, was observed not to have any coliform detected in the water sample. The samples denoted as B-sachet were identified to have a 12 CFU/mL while the ones from Hezekiah University, Umudi, Imo State borehole had 20 CFU/mL. The positive presumptive tubes were identified as 1-2-1 and 2-1-1 for B-Sachet 2 and the HezUni Borehole sample. The result presented below clearly shows that the water sample was contaminated with coliforms.

3.2. Microbial population proxies

The results presented in Figure 3.1 show the distribution and titre of microbes in the water samples examined during the study. The total heterotrophic bacterial count of samples obtained from the University borehole and the sachet water samples was 6.0 Log CFU/mL and 4.3 Log CFU/mL, respectively. The total fungal count for the samples was 3.0 Log CFU/mL and 4.54 Log CFU/mL. The coliform count observed for the HezUni borehole was 4.92 and 3.0 Log CFU/mL.

3.3. Morphological description of bacterial isolates

The result presented in Table 3.2 shows the morphological descriptions of the bacterial isolates obtained from the drinking water sources. Five distinct colonies were obtained from A-Sachet water, while 8 isolates were obtained from the University borehole. Isolate A1 had a flat elevation, regular edge, smooth texture, creamy pigment and punctiform size description. Isolate C8 had a flat elevation, regular edge, smooth texture, creamy pigment and punctiform size description.

3.4. Biochemical identification of the bacterial isolates

The results of the biochemical characterisation of the bacterial isolates were presented in Table 3.3 below. The Gram reactions showed that the isolates 90% of the isolates were Gram-negative rods, while 10% were Gram-positive cocci. The tentative identity of the isolates obtained from the study was *E. coli, Pseudomonas* sp., *Proteus* sp., *Staphylococcus* sp. and *Shigella* sp.

3.5. Frequency of isolation of bacterial isolates obtained during the study

The frequency of occurrence of the isolates obtained from the study was presented in Figure 3.2. The study identified that *Staphylococcus* sp. and *E. coli* were the most frequently occurring flora, with 31.82% and 27.27%, respectively. *Pseudomonas* sp. and *Shigella* sp. accounted for 13.64% and 9.01%, respectively.

3.6. Tentative identification of Fungal isolates obtained during the study

Table 3.4 shows that the fungal isolate NW1 had a raised colony with a milky pigmentation, with an opaque and regular edge, with budding outgrowths and was identified as *Candida* sp., while NW2 had a mass of dull green mycelium, it has an aseptate mycelium, with its conidia well aligned on the columella and was identified as *Aspergillus* sp.

3.7. Frequency of occurrence of Fungal Isolates obtained during the study

The result presented in Figure 3.3 shows that *Candida* sp. was the most frequently isolated fungi with a frequency of occurrence of 50%. While *Fusarium* sp. and *Penicillium* sp. were the least occurring fungi, with a frequency of 12.5%

Table 3.1. Total coliform composition of the drinking water sources in Umudi, Nkwerre

Samples	DS 10.0 mL	SS 1.0 mL	SS 0.1mL	Confirmatory Test	Completed Test	CFU/100mL
A-Sachet 1	0	0	0	Negative	Negative	0
B-Sachet 2	1	2	1	Positive	Positive	12
C-HezUni, Borehole	2	1	1	Positive	Positive	20

Positive= Presence of a green metallic sheen, Utilisation of Lactose with evolution of gas= Positive, DS= Double Strength; SS= Single Strength.

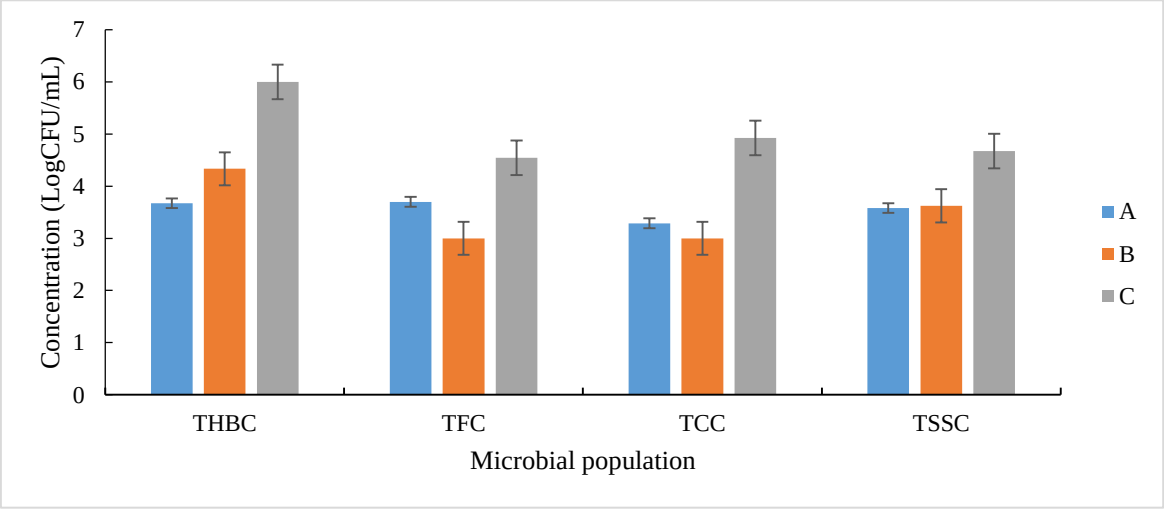

Figure 3.1. Microbial population of drinking water sources in Umudi, Nkwerre, Imo State Key: THBC= Total heterotrophic Bacterial count; TFC= Total Fungal Count; TCC= Total Coliform Count; TSSC= Total *Salmonella-Shigella* Count

Table 3.2. Colonial Morphology of bacterial isolates obtained from the study

Sample	Elevation	Edge	Texture	Pigment	Size
SA1	Raised	Irregular	Dry	Milky	Moderate
SA2	Flat	Irregular	Mucoid	Creamy	Punctiform
SA3	Raised	Irregular	Smooth	Milky	Large
SA4	Flat	Irregular	mucoid	Milky	Large
SB1	Concave	Regular	Dry	Creamy	Punctiform
BB2	Flat	Regular	Mucoid	Green	Moderate
SB3	Raised	Irregular	Smooth	Milky	Large
HB1	Raised	Irregular	Dry	Creamy	Moderate
HB2	Raised	Regular	Dry	Creamy	Moderate
HB3	Concave	Regular	Mucoid	Milky	Large
HB4	Flat	Irregular	Dry	Creamy	Moderate

SA= Sachet- Water A, SA= Sachet Water B and HA-HezUni Borehole.

Table 3.3. Biochemical identification of bacterial isolates drinking water sources in Umudi, Nkwerre, Imo State

Biochemical	HUB1/PW2	HUB2	HUB3	PW1/HUB5	PW2/HUB4
Gram Reaction	-/Rod	-/Rod	-/Rod	+/cocci	-/Rod
Oxidase	-	+	+	+	+
Catalase	-	+	+	+	+
TSI	A	A	A	A	A
Slant					
Butt	A	A	K	A	A
Gas	+	-	-	-	-
H_2S	+	+	+	-	-
MR	+	-	-	-	-
VP	-	-	+	-	+
Indole	+	-	+	-	+
Citrate	-	+	-	-	-
Motility	-	+	+	-	+
Glucose	A/-	A/G	A/G	A/G	A/G
Lactose	A/G	A/-	A/-	K/-	A/+
Mannitol	A/G	A/G	A/G	A/G	A/+
Sucrose	A/G	A/G	K/-	A/G	A/-
Tentative Identity	*E. coli*	*Klebsiella* sp.	*Proteus* sp.	*Staphylococcus* sp.	*Salmonella* sp.

Key: A= Acid; K=Alkaline; - = Negative; += Positive, G= Gas, H_2S= Hydrogen sulphide.

Table 3.4. Morphological and microscopic description of fungal isolates obtained from drinking water sources in Umudi, Nkwerre, Imo State

Isolate ID	Phenotypic and microscopic characteristics	Tentative
HUB1A	Mucoid and concave morphology, budding under the microscope	*Saccharomyces* sp.
HUB2A	Sueded brown columella and sporangia with a non-septate	*Rhizopus* sp.
SA1/SB2	Ciliated green dense growth with It has a septate hypha with a	*Penicillium* sp.
SA1/SB1	Whitish and sueded mass with a brown reverse side of the plate. Septate arthrospores with an aseptate hyphae.	*Mucor* sp.

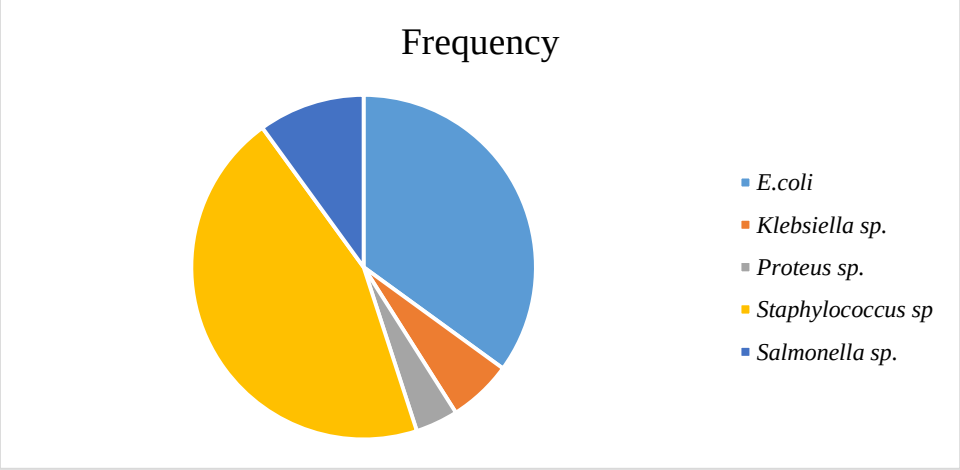

Figure 3.2. Frequency of occurrence of bacterial isolates obtained from Umudi, Nkwerre, Imo State, Nigeria

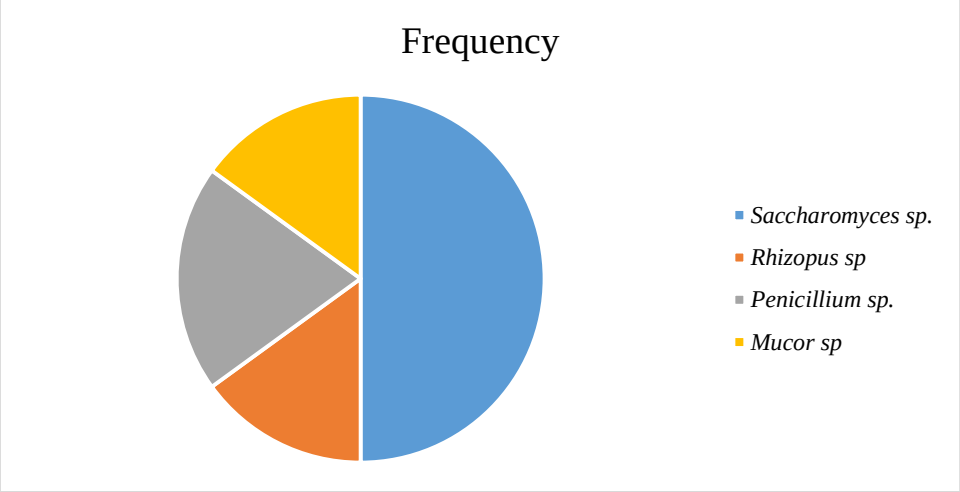

Figure 3.3. Frequency of occurrence of fungal isolates obtained from Umudi, Nkwerre, Imo State, Nigeria

4. Discussion and Conclusion

The quality of potable water available to rural dwellers in Imo State is quite worrisome and grossly inadequate. The problem caused by insecurity and the insensitivity of both government and non-governmental agencies has further worsened the water shortage for the teeming population [8,25,26].The term' Potabilis' is a root word for potable water, suggesting purity and wholesomeness for consumption and broad use. The global potable water deficit is estimated at 2 billion people, according to WHO [26], with those affected sourcing water from open streams, ponds, and lakes. This study examined the microbial quality of drinking water sources available to Hezekiah University and the Ishiala-Umudi community, where the total coliform count was observed to be 10 and 30 MPN/100mL, respectively. The topology and geophysical features of the soil may influence the percolation of contaminants. These contaminants, whether chemical, physical, or biological, have been traced to several life-threatening diseases, especially in children and neonates [27,28]. Coliforms, either total or faecal, are lactose-utilising microbes capable of producing gas during metabolism, indicating the presence of microorganisms of gastrointestinal origin from anthropogenic sources [26,29]. Potable water must be free from coliforms or any microbes; their presence makes water objectionable [30]. Furthermore, Megchún-García et al. [31] identified coliforms as primary agents in diseases in South America, originating from seepages and septic tanks. Agricultural, industrial, and environmental activities can greatly influence the safety and quality of potable water. The total heterotrophic bacterial count for the Hezekiah University borehole was found to be 6.0 Log CFU/mL, while for B-Sachet water, it was 4.3 Log CFU/ml. These findings align with the earlier report by Effiong and Asionye [36], who documented a microbial count of around 5.0 Log CFU/mL, corroborating the present results.

The presence of domestic and industrial pollutants has been identified to be laden with these priority pollutants. Soil profile and structure have been implicated in the ease of water pollution, while the sharp practices in the drilling of community borehole water. The bacterial isolates observed during the study have been implicated in several degrees of gastroenteritis; some of the bacterial flora observed were *E. coli*, *Pseudomonas sp.*, *Proteus sp.*, *Staphylococcus sp.* and *Shigella sp.* The fungal flora was as follows: *Candida sp., Aspergillus sp., Penicillium sp., and Fusarium sp.* Previous studies have accounted for the presence of *E. coli*, *Pseudomonas* sp., *Proteus* sp.,

Staphylococcus sp. and *Shigella* sp. Asionye et al. [8] Microbes associated with the potable water samples were *Bacillus* sp., *Escherichia* sp., *Staphylococcus* sp., *Streptococcus* sp., *Shigella* sp., *Proteus* sp., *Pseudomonas* sp., *Klebsiella* sp., *Vibrio* sp. and *Micrococcus* sp. *Escherichia coli* is an indicator of faecal pollution. These bacterial isolates have been associated with several degrees of gastroenteritis; this aligns with the previous studies of Asionye and Effiong [29] whose study identified the presence of *Escherichia* sp., *Enterobacter* sp., *Alcaligenes* sp, *Klebsiella* sp. and *Staphylococcus* sp, Eboh et al. [32] reported the following organisms *Escherichia* sp., *Enterobacter* sp., *Alcaligenes* sp, *Klebsiella* sp., *Staphylococcus* sp, *Bacillus* sp., *Proteus* sp., *Micrococcus* sp., *Serratia* sp., *Acinetobacter* sp., *Alcaligenes* sp. and *Pseudomonas* sp. from ground water at Ukwuani LGA in Delta State, while Onyango et al. [33] reported isolates such as *Clostridium* species along with enteric organisms from his study on ground water supplies in Kenya. Enteric organisms such as *Shigella* and *Salmonella* are the cause of Shigellosis and Salmonellosis, two potentially fatal illnesses. Alimontaziba et al. [37] found that groundwater samples taken close to swine lagoons included more than 17 different genera or species of bacteria. In their groundwater samples, they found more *Staphylococcus* and *Enterococcus* species in addition to the same bacteria that were found close to the pits. 15% of the groundwater samples that were examined contained *Salmonella* sp. According to Aksu and Vurala [34], one explanation is that the water was tainted by many sources, including livestock, wastewater, and septic tanks. If utilised, this might lead to several ailments in both humans and animals. Similarly, Demir et al. [35] reported that water from water sources they inspected should not be used since they detected *Salmonella* sp. in 11.7% of them. *Pseudomonas* and *Bacillus* species were the most common bacteria in the field blanks [37]. Six samples, or 15% of the groundwater samples, contained *P. aeruginosa*. An immunocompromised population may experience issues if opportunistic Pseudomonads are present in the water. *Pseudomonas* and *Bacillus* species, which are found in both soil and faeces and may not be a sign of animal dung, were frequently found in shallow groundwater samples.

Today, the most well-recognised sources of drinking water come from groundwater. Nigerian regulatory bodies have been continuously checking the drinking water quality for compliance, particularly after the introduction of contaminants like microplastics. While using the Hezekiah University borehole, which is widely used by teaming students and faculty due to its perceived purity and cleanliness, this attempted to raise concerns about the wholesomeness status of the drinking water sources in Umudi. The University borehole water exhibited a total coliform composition of 20 CFU/mL, whereas the sachet water had 4.3 CFU/mL, and the total heterotrophic bacterial count was 6.0 Log CFU/mL. As a result, the school administration must perform an emergency cleaning of the storage tanks and treat the water regularly. Additionally, the administration should be urged to notify the sachet water suppliers to consider treating their water before packaging it for human consumption. Furthermore, encouraging the public to boil their food before drinking it will help stop the spread of illnesses linked to contaminated water among university employees and students.

5. Conclusion

Potable water is an essential need of man and Nkwerre in Imo State, Nigeria. The quality of water for drinking and domestic purposes has remained a major challenge to the populace residing in the community. Microbiological studies revealed that the water is tainted with coliforms, suggesting it may remain unfit for consumption. The

microorganism obtained from the study, excluding the coliforms present, also indicates that the water may be source-tracked to Staphylococcal diseases. There is a need for critical stakeholders to improve the situation of the water quality and availability in rural communities in Nigeria.

6. Gaps for Further Research

1) There is a need for further research in the exploitation of metagenomic profiling of the microorganisms.

2) Assessment of microbiological safety of other potable water resources in nearby communities within Nkwerre, LGA, Imo State needs to be prioritised.

3) The microbial load of potable water needs to be assessed.

4) The frequency of microorganisms with multi-drug resistance in Nkwerre that is associated with the groundwater in Nkwerre, Imo State.

5) Ascertain the risk model and water quality indices associated with the potable water consumed in Nkwerre L.G.A, Imo State, Nigeria.

Declarations

Source of Funding

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Competing Interests Statement

The authors declare that they have no competing interests related to this work.

Consent for publication

The authors declare that they consented to the publication of this study.

Authors' contributions

All the authors took part in literature review, analysis, and manuscript writing equally.

Availability of data and materials

Supplementary information is available from the authors upon reasonable request.

Institutional Review Board Statement

Not applicable for this study.

Informed Consent

Not applicable for this study.

References

[1] Basavaraja, T., Gangaprasad, S., & Dhusyantha Kumar, B.M. (2011). Correlation and path analysis of yield and yield attributes in local rice cultivars (*Oryza sativa* L.). Electronic Journal of Plant Breeding, 2(4): 523–526.

[2] Ofoezie, I.E., & Asaolu, S.O. (1997). Water level regulation and control of schistosomiasis transmission: a case study in Oyan Reservoir, Ogun State, Nigeria. Bulletin of the World Health Organisation, 75(5): 435.

[3] Adefemi, S.O., & Awokunmi, E.E. (2010). Determination of physico-chemical parameters and heavy metals in water samples from Itaogbolu area of Ondo State, Nigeria. African Journal of Environmental Science and Technology, 4(3).

[4] Fakayode, S., & Onianwa, P. (2002). Heavy metal contamination of soil, and bioaccumulation in Guinea grass (*Panicum maximum*) around Ikeja Industrial Estate, Lagos, Nigeria. Environmental geology, 43: 145–150.

[5] Kulkarni, S.R., Djorgovski, S.G., Ramaprakash, A.N., Goodrich, R., Bloom, J.S., Adelberger, K.L., & Newman, J. (1998). Identification of a host galaxy at redshift z= 3.42 for the γ-ray burst of 14 December 1997. Nature, 393(6680): 35–39.

[6] Gupta, V.K. (2009). Application of low-cost adsorbents for dye removal–a review. Journal of Environmental Management, 90(8): 2313–2342.

[7] Agarwal, S. (2011). The state of urban health in India: comparing the poorest quartile to the rest of the urban population in selected states and cities. Environment and Urbanisation, 23(1): 13–28.

[8] Asionye, E.I., Bariweni, A.P., Idome, J.E., & Onyena, A.P. (2023). Assessment of physicochemical and microbiological qualities of potable water sources in Okorenkoko, Delta State, Nigeria. Journal of Life and Bio Sciences Research, 4(01): 31–39.

[9] Shittu, I., Meseko, C.A., Gado, D.A., Olawuyi, A.K., Chinyere, C.N., Anefu, E., & Joannis, T.M. (2017). Highly pathogenic avian influenza (H5N1) in Nigeria in 2015: evidence of widespread circulation of WA2 clade 2.3. 2.1 c. Archives of Virology, 162: 841–847.

[10] Coster, A.S., & Otufale, G.A. (2014). Households' water-use demand and willingness to pay for improved water services in Ijebu Ode local government area, Ogun State, Nigeria.

[11] Jideonwo, J.A. (2014). Ensuring sustainable water supply in Lagos, Nigeria. Doctoral Dissertation, University of Pennsylvania.

[12] Lawal, O.L., & Basorun, J.O. (2015). Access to safe water in Akure: a paradox in Nigerian urbanised regions. International Journal of Emerging Knowledge, 3(3): 39–45.

[13] Un-Habitat (2008). State of the World's Cities 2008/9: harmonious cities. Earthscan.

[14] Hall, P. (2014). Cities of tomorrow: An intellectual history of urban planning and design since 1880. John Wiley & Sons.

[15] Nwachukwu, M.A., Feng, H., & Alinnor, J. (2010). Assessment of heavy metal pollution in soil and its implications within and around mechanic villages. International Journal of Environmental Science & Technology, 7: 347–358.

[16] Pepper, I., Gerba, C.P., Gentry, T., & Maier, R.M. (Eds.) (2011). Environmental microbiology. Academic Press.

[17] Benson, H.P. (2002). Using concave envelopes to globally solve the nonlinear sum of ratios problem. Journal of Global Optimisation, 22(1): 343–364.

[18] Prescott, L.M., & Harley, J.P. (2002). Microbiology.

[19] Uzoigwe, C.I., & Agwa, O.K. (2012). Microbiological quality of water collected from boreholes sited near refuse dumpsites in Port Harcourt, Nigeria. African Journal of Biotechnology, 11(13): 3135–3139.

[20] Madigan, M.T., Martinko, J.M., Dunlap, P.V., & Clark, D.P. (2006). Brock biology of microorganisms. Englewood Cliffs: Prentice Hall.

[21] Beveridge, T.J. (2001). Use of the Gram stain in microbiology. Biotechnic & Histochemistry, 76(3): 111–118.

[22] Cheesebrough (2000). District laboratory practice in tropical Africa. 2nd Press Syndicate of the University of Cambridge, Pages 62–70.

[23] MacFaddin, J.F. (2003). Pruebas bioquímicas para la identificación de bacterias de importancia clínica. Ed. Médica Panamericana.

[24] Smibert, R.M., & Krieg, N.R. (1994). Phenotypic characterisation. In P.Gerhardt, R.G.E. Murray, W.A. Wood, & N.R. Krieg (Eds.), Methods for general and molecular bacteriology, Pages 607–654, American Society for Microbiology, Washington, D.C.

[25] Moyo, S. (2004). The land and agrarian question in Zimbabwe. In the first annual colloquium (30 September 2004) at the University of Fort Hare.

[26] World Health Organization (2011). World report on disability. In World Report on disability, Pages 24–24.

[27] Mintz, E.D., & Guerrant, R.L. (2009). A lion in our village—the unconscionable tragedy of cholera in Africa. New England Journal of Medicine, 360(11): 1060–1063.

[28] World Health Organization (Ed.) (2008). World Health Statistics 2008. World Health Organisation.

[29] Effiong, E.C., & Asionye, E.I. (2025). Microbiological and Physicochemical Evaluation of Roof-Harvested Rainwater obtained from Hezekiah University, Umudi, Imo State, Nigeria. Middle East Journal of Applied Science and Technology, 8(1): 01–11

[30] Ashbolt, N.J., Grabow, W.O., & Snozzi, M. (2001). Indicators of microbial water quality. Water quality: Guidelines, Standards and Health, 30: 289–316.

[31] Megchún-García, J.V., Chávez, M.D.R.C., Rodríguez-Lagunes, D.A., Adame-García, J., Murguía-González, J., Lango-Reynoso, F., & Leyva-Ovalle, O.R. (2018). Use of thiamethoxam, associated with insect populations in papaya (*Carica papaya* Linnaeus) cultivation. Int. J. Res. Granthaalayah, 6: 428–439.

[32] Eboh, D.E.O., Ogbeide, O.U., & Ivwighren, T. (2017). Radiographic anthropometric study of the frontal sinus for sex determination in Benin City, South-South Nigeria. Journal of Forensic Dental Sciences, 9(1): 31–35.

[33] Onyango, A.E., Okoth, M.W., Kunyanga, C.N., & Aliwa, B.O. (2018). Microbiological quality and contamination level of water sources in Isiolo County in Kenya. Journal of Environmental and Public Health, 2018(1): 2139867.

[34] Aksu, M.İ., & Kaya, M. (2005). The effect of α-tocopherol and butylated hydroxyanisole on the colour properties and lipid oxidation of kavurma, a cooked meat product. Meat Science, 71(2): 277–283.

[35] Demir, E., Sarica, Ş., Özcan, M.A., & Sui Mez, M. (2003). The use of natural feed additives as alternatives for an antibiotic growth promoter in broiler diets. British Poultry Science, 44(s1): 44–45.

[36] Effiong, E.C., & Asionye, E.I. (2025). Evaluation of Quality proxies of roof-harvested rainwater obtained from tertiary institutions in Orlu Zone, Imo State. Middle East Journal of Applied Science and Technology, 8(1): 13–25.

[37] Alimontaziba, A., Asionye, E.I., & Effiong, E. (2025). Ecological Proxies to the Bioremediation of Crude Oil Polluted Mangrove Soil Obtained from Okerenkoko, Delta State, Nigeria.