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Full Length Research Article

INCIDENCE OF MULTIDRUG RESISTANT BACTERIA IN SELECTED SACHET WATER SOLD IN MALETE, NIGERIA

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ABSTRACT
The proliferation of packaged water in rural communities has been exacerbated by the increasing demand for safe and potable water in areas where access to clean water sources remains a significant challenge. Unfortunately, non- compliance of some sachet water producers to adhere the standards regulations exposes the consumers to potential risks of waterborne diseases. Therefore, this study investigated the susceptibility profile of bacteria isolated from selected sachet water sold in Malete. Ten different brands of sachet water (B1- B10 NAFDAC registered) were randomly purchased from retailers in Moro LGA, Malete, Nigeria to assess their physicochemical, bacteriological quality and their susceptibility to antibiotics. Bacteriological analyses were carried out using membrane filtration technique. Identification of the isolates and susceptibility were done using standard methods. Physicochemical parameters measured included pH (7.01 - 7.50), electrical conductivity (12.3 - 199.3 µs/cm), alkalinity (42.67 - 73.04 mg/L), total dissolved solids (10.0 – 130.0 mg/L), turbidity (0.62 - 1.08 NTU), and hardness (54.36 - 84.22 mg/L).The total bacterial count in CFU/100mL of the sachet water sample ranged from 1.0 $x10^1$ - 4.7 $x10^1$, B4 and B1 have the lowest and the highest values respectively. The total coliform counts ranged from the lowest value of 0 CFU /100mL to the highest value of 12.0 $\times10^1$ CFU/100mL, no coliforms were detected in B2, B4 and B6 while B8 has the highest number of coliforms. Faecal coliforms were not detected in all the samples tested. Twenty two (22) bacterial isolates were identified phenotypically; *Staphylococcus aureus, Bacillus* spp., *Streptococcus* spp., *Micrococcus* spp. and *Enterobacter* spp. *Bacillus* spp. had the highest frequency of 7 (33 %) followed by *Micrococcus* sp. with a frequency of 6 and a percentage frequency of 29 %. *Staphylococcus aureus* also have a frequency of 4 and a percentage frequency of 19% while *Enterobacter* sp. and *Streptococcus* sp had 10 % and 9 % respectively. All the Gram positive bacteria obtained were resistant to amoxicillin and zinnacef and at least one other antibiotic while *Enterobacter sp*., the only Gram negative was resistant 4 different antibiotics; amoxicillin, augmentin and two others. This finding highlights the need for regular microbiological monitoring so as to ensure public health safety.

Keywords: Sachet water; Physicochemical parameters; Microbiological monitoring; Multidrug resistant bacteria; Malete

INTRODUCTION

Water is an important natural resource for sustenance of all living organisms, primarily utilized for consumption, domestic activities, agricultural and recreational purposes (Kumari and Jangra, 2023; Rahman, 2024). It is one of the most critical and considerable commodities of man occupying approximately 70% of the earth's surface (Mishra, 2023). Despite its importance in the sustenance of life and livelihood, the inability to access safe and potable water in Nigeria most especially rural communities has been identified as a major cause of morbidity and mortality (Abanyie *et al*., 2023). Access to safe drinking water is of critical public health importance due to the risk of water related diseases. Numerous outbreaks globally have identified contaminated water as a basic source of infection. The risk of contaminated water and scarcity of pipe borne water in rural areas and several other factors, sachet water packaged in polyethene container is widely consumed as an alternative source of drinking water (Odeyemi, 2015).

Sachet water refers to water in plastic sachet primarily used for consumption. This is practice is prevalent in developing countries as a means to curb limited supplies of safe and potable water while also generating source of income (Umoafia *et al*., 2023). Yet, studies have indicated that certain brands of sachet water may pose health risks as a result of pathogens such as *Escherichia coli, Salmonella typhi, Vibrio cholerae*, Hepatitis A virus etc. Contamination of water with these microbial pathogens deteriorates the quality of sachet water and can lead the transmission of diseases such as infectious hepatitis, cholera, diarrhea and typhoid. These diseases pose significant risks, most especially in children below five and elderly, resulting in severe dehydration, malnutrition and sometimes death. The deterioration in sachet water quality has been linked to non-compliance to the laid down protocols during production as well as poor handling after packaging and during the distribution processes (Takuissu *et al*., 2023).

For several years, antibiotic has been recognized as an effective antimicrobials used in the treatment of infectious diseases, greatly reducing morbidity and mortality rates (Chukwu *et al.,* 2020). Nonetheless, the abuse and excessive usage of these antibiotics has resulted in the emergence of antimicrobial resistance. Antibiotic resistance refers to ability of microorganisms to survive and tolerate the effects of antibiotics. Nearly all the major bacterial infections are acquiring resistance to commonly used antibiotics (Xu *et al.,* 2020). This circumstance has been recognized as one of the most pressing public health challenges world-wide. Currently, there is growing interest on antibiotic resistant bacteria in a range of environments and detection of these microorganisms in water assumed to be safe for drinking raises a great concern.

Several studies by the researchers in Nigeria have reported varying degrees of microbial contaminants beyond acceptable limits in packaged drinking water rendering the water unsafe for

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consumption (Mohammed *et al.,* 2020; Popoola *et al.,* 2024). The most frequently isolated microorganisms from the packaged water included *Salmonella, Escherichia coli*, faecal enterococci and spores of *Clostridium perfringens* (Mosi *et al.,* 2019). Though sachet water is an improved safe drinking water alternative, it is not totally devoid of microbial contaminations. This emphasizes the necessity for enhanced monitoring measures ensuring the safety of sachet water for human consumption thereby preventing sudden outbreak of waterborne diseases. Hence, this study aimed to assess the physicochemical features and bacterial contaminant in selected sachet water commonly sold and consumed in Malete, Moro LGA in Kwara State and the susceptibility of the bacterial contaminants to selected antibiotics.

MATERIALS AND METHODS

Study Area and Sample Collection

The research area is found within the Moro Local Government Area of Kwara State, spanning latitudes 8.6563°N to 8.8136°N and longitudes 4.2359°E to 4.5410°E. The site is situated at an elevation of 308 meters above the sea level. It is located in the Northern part of Ilorin, about 28 kilometers away from the capital of Kwara State. A total 10 different brands of sachet water commonly sold were gotten from the suppliers around Malete, Moro Local Government Area via random purchase and were labeled as B1–10. The samples were stored in ice- box and then taken to the Microbiology laboratory of the Kwara State University (KWASU), for further analyses.

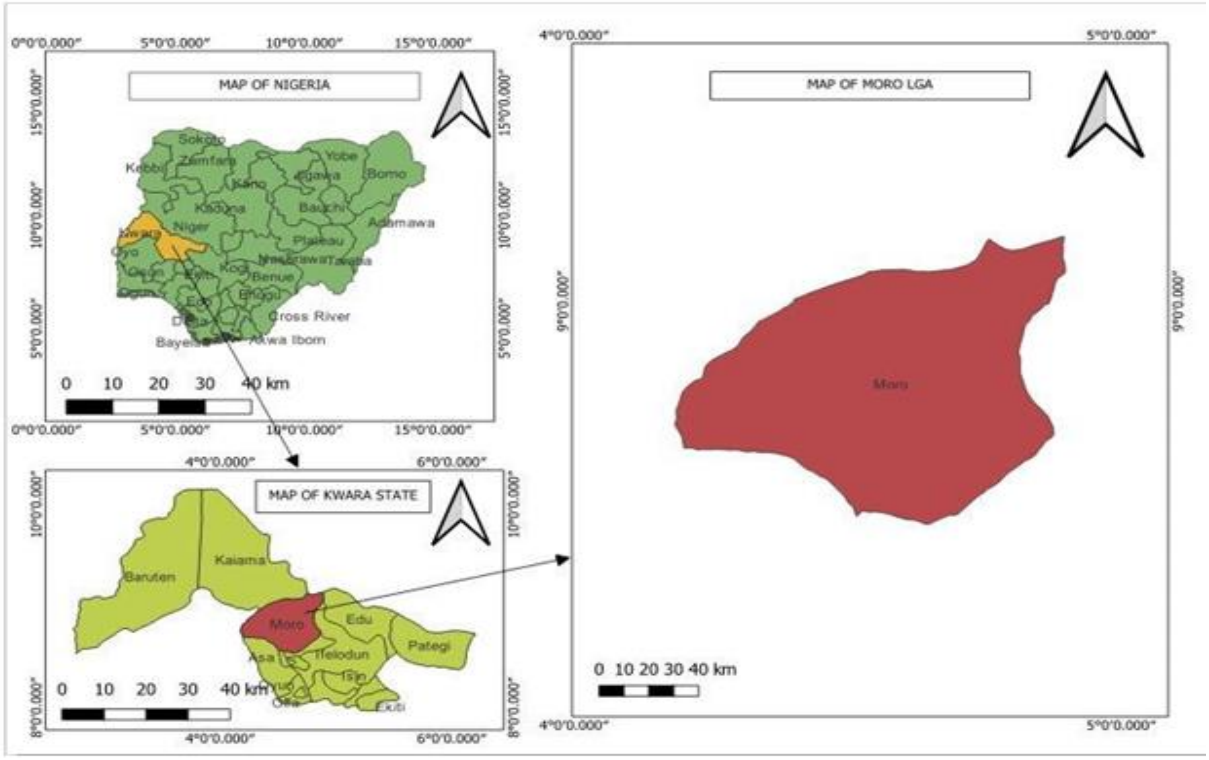

Figure 1: Map of Sample Collection Area (GIS software)

Physicochemical Analyses of Sachet Water

The physicochemical analyses of the sachet water samples collected were done based on the following parameters; The pH which was determined using a calibrated pH meter, temperature in degree Celsius was analyzed onsite using a mercury thermometer, turbidity expressed in Nephelometric turbidity unit was obtained using spectrophotometry while total dissolved solids and total suspended solids as well as total solids were analyzed by filtration techniques and expressed in mg/ L. Alkalinity and hardness were also analyzed using standard methods (Abdullahi *et al*., 2019; Gamawa and Okpanachi, 2023).

Isolation and Identification of the Isolates

The microbial content of the sachet water samples was evaluated using membrane filtration technique. A 100 milliliter of water sample was filtered through a 0.45 µm membrane filter to trap bacteria. The filter was then aseptically placed on already solidified agar plate of Nutrient agar, MacConkey agar and Eosine methylene blue agar and incubated at 37°C for 18–24 hours, this represents total bacterial count, total coliform count and faecal coliform count respectively and reflects the general hygiene condition of the samples. All the analyses were conducted in triplicates and averaged, this was then recorded as final results. Colonies counted were expressed as colony-forming units (CFU) per 100 mL of water. Pure cultures of the recovered bacterial isolates were characterized and identified using standard methods (Jimoh and Kolawole, 2021).

Antibiotic Sensitivity Test

This test was carried out to determine the susceptibility of the isolated bacteria to commercial antibiotics. This was done using disc impregnated antibiotics. The antibiotics disc used consisted of

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two types, one type is specific for Gram-positive bacteria and the other one for Gram-negative bacteria. Various antibiotics and their corresponding concentration impregnated in the Gram-positive and the Gram-negative disc is as follows:
Gram-positive disc: Ciprofloxacin (10 µg), Norfloxacin (10 µg), Gentamycin (10 µg), Amoxicillin (20µg), Rifampicin (20µg), Streptomycin (30µg), Erythromycin (30µg), Ampiclox (20 µg), Chloramphenicol (30 µg) and Levofloxacin (20µg). Gram-negative disc: Augmentin (30µg), Tarivid (10µg), Reflacine (10µg), Ciprofloxacin (10µg), Gentamycin (10µg), Ciporex (10µg), Streptomycin (30µg), Nalidixic acid (30µg), Ampicillin (30µg), Septrin (10 µg). A 24 hour old culture was prepared for each isolate of bacteria by adjusting the turbidity to 0.5 McFarland standard and the inoculum was spread on already solidified sterile Mueller–Hinton agar plate. The antibiotic discs were placed aseptically on each agar plate and the plates were incubated at 37 °C for 24 hours. The zones of inhibition (ZOI) were measured in millimeter (mm), and the susceptibility of the isolates were classified as resistant, sensitive or intermediate according to the tables and guidelines of the Clinical Laboratory Standards (CLSI) (Sule *et al.,* 2023).

The results of the physicochemical parameters of the sachet water samples sold in Malete are presented in Table 1. The pH obtained from the ten samples obtained from the sachet water ranged between 7.01 and 7.50 with the lowest value obtained in B9. The electrical conductivity of the sachet water was between 12.3 and 199.3µs/cm for B5 and B1 respectively. Alkalinity in mg/L, B6 has the lowest value of 42.67 while B2 has the highest value of 73. 04. Total Dissolved Solid of the samples ranged from 10 – 130 mg/L with the highest value obtained from B1. The turbidity obtained from water samples ranged from 0.62 to 1.08 NTU while hardness of the samples ranged between the lowest value of 54.36 mg/L in B3 and the highest value of 84.22 mg/L in B6. Analyses of Total Bacterial Count, Total Coliform Count and Faecal Coliform Count in CFU/100mL oscillated from 1.0 x 10^1 - 4.7 x10^1, 0.0 – 12.0 x 10^1 while faecal coliforms were not detected. Four Gram positive bacteria were detected while *Enterobacter* sp. was the only Gram negative bacteria obtained in this study. Bacterial species with the highest frequency of occurrence were *Bacillus* spp. All the isolated bacteria from the sachet water samples were resistant to multiple antibiotics.

RESULTS

Table 1: The Physicochemical Parameters of the Sachet Water Samples

Sample	pH	Electrical Conductivity (µs/cm)	Alkalinity (mg/L)	Total Dissolved Solid (mg/L)	Turbidity (NTU)	Hardness (mg/L)
B1	7.34	199.3	60.04	130.0	0.69	84.04
B2	7.50	165.3	73.04	110.0	0.76	82.16
B3	7.03	21.8	43.28	10.0	0.70	54.36
B4	7.27	121.0	67.39	80.0	1.06	72.04
B5	7.29	12.3	50.37	10.0	0.75	59.47
B6	7.50	164.1	42.67	90.0	1.08	84.22
B7	7.26	93.2	50.48	90.0	0.68	71.73
B8	7.33	169.3	60.07	52.0	0.72	83.10
B9	7.01	49.9	67.42	70.0	0.80	56.94
B10	7.41	170.1	48.04	100.0	0.62	65.76
WHO Standard	6.5-8.5	< 400	200	< 300	< 5	< 100

Key: B1 –B10 = Brands of Sachet Water; WHO = World Health Organization

Table 2: Bacteriological Quality of Sachet Water Samples Sold in Malete

Sample	Total Bacterial Count (x10^1 CFU/100mL)	Total Coliform Count (x10^1 CFU /100mL)	Total Fecal Coliform Count (CFU /100mL)
B1	4.7	10.0	0.0
B2	2.3	0.0	0.0
B3	2.9	3.0	0.0
B4	1.0	0.0	0.0
B5	3.4	2.0	0.0
B6	2.8	0.0	0.0
B7	2.3	11.0	0.0
B8	3.7	12.0	0.0
B9	1.6	9.0	0.0
B10	2.1	6.0	0.0
WHO Standard	≤100 CFU/mL	0	0.0

Table 3a: Morphological Features of the Bacterial Isolated from Selected Sachet Water Sold in Malete

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Isolates	Gram shape and reaction	Margin	Elevation	Colony	Shape	Size	Colony	Texture
1	+ve cocci	Entire	Convex	Yellow	Circular	Small	Yellow	Dry
2	+ve rod	Entire	Raised	Creamy	Circular	Medium	Creamy	Dry
3	+ve rod	Entire	Flat	White	Circular	Medium	White	Dry
4	+ve rod	Entire	Raised	White	Circular	Medium	White	Dry
5	+ve cocci	Undulate	Raised	Yellow	Circular	Small	Yellow	Buttery
6	+ve rod	Entire	Raised	Creamy	Circular	Medium	Creamy	Dry
7	+ve cocci	Entire	Flat	White	Circular	Small	White	Smooth
8	+ve cocci	Lobate	Convex	Yellow	Circular	Small	Yellow	Buttery
9	+ve rod	Entire	Raised	White	Round	Large	White	Dry
10	+ve cocci	Smooth	Convex	Yellow	Round	Small	Yellow	Buttery
11	+ve cocci	Smooth	Convex	Yellow	Round	Large	Yellow	Buttery
12	+ve rod	Entire	Flat	Cream	Circular	Medium	Cream	Dry
13	+ve cocci	Lobate	Convex	Yellow	Circular	Small	Yellow	Opaque
14	+ve cocci	Lobate	Convex	Yellow	Circular	Small	Yellow	Smooth
15	+ve cocci	Entire	Raised	Yellow	Circular	Medium	Yellow	Buttery
16	+ve cocci	Lobate	Convex	Yellow	Circular	Small	Yellow	Smooth
17	+ve cocci	Lobate	Convex	Yellow	Circular	Small	Yellow	Smooth
18	+ve cocci	Entire	Convex	White	Circular	Medium	White	Smooth
19	+ve rod	Entire	Raised	Creamy	Circular	Medium	Creamy	Dry
20	+ve rod	Entire	Convex	Green	Circular	large	Green	Smooth
21	-ve rod	Entire	Convex	Dark blue	Round	Large	Dark blue	Smooth
22	+ve rod	Irregular	Convex	Dark blue	Round	Medium	Dark blue	Glittery

Key: +ve = Positive; -ve = Negative

Table 3b: Biochemical Characterization of the Bacterial Isolates

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Isolates	Catalase	Indole	Citrate	Methyl Red	Voges Proskauer	Oxidase	Probable organism
1	+	-	+	+	+	-	*Staphylococcus aureus*
2	+	-	+	-	+	+	*Bacillus* species
3	+	-	+	-	+	+	*Bacillus* species
4	+	-	+	-	+	+	*Bacillus* species
5	+	-	+	+	+	-	*S. aureus*
6	+	-	+	-	+	+	*Bacillus* species
7	-	-	-	-	+	-	*Streptococcus* species
8	+	-	-	+	-	+	*Micrococcus* species
9	+	-	+	-	+	+	*Bacillus* species
10	+	-	-	+	-	+	*Micrococcus* species
11	+	-	+	+	+	-	*Staphylococcus aureus*
12	+	-	+	-	+	+	*Bacillus* species
13	+	-	-	+	-	+	*Micrococcus* species
14	+	-	-	+	-	+	*Micrococcus* species
15	+	-	+	+	+	-	*Staphylococcus aureus*
16	+	-	-	+	-	+	*Micrococcus* species
17	+	-	-	+	-	+	*Micrococcus* species
18	-	-	-	-	+	-	*Streptococcus* species
19	+	-	+	-	+	+	*Bacillus* species
20	+	+	-	+	-	-	*Bacillus* species
21	+	-	-	-	+	-	*Enterobacter* species
22	+	-	-	-	+	-	*Enterobacter* species

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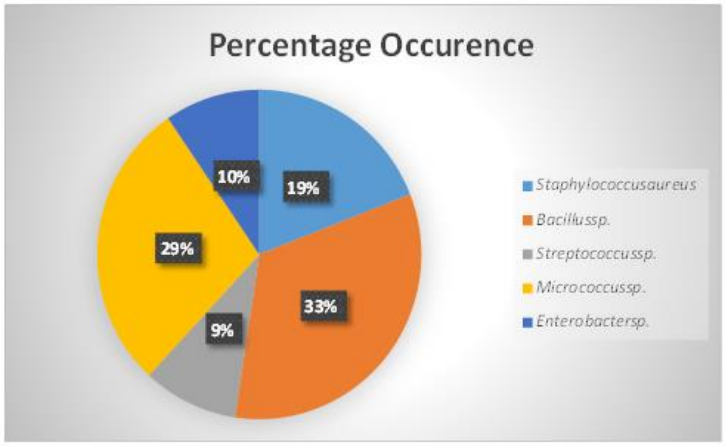

Figure 2: Percentage Frequency of Occurrence of the Identified Bacteria

Table 4: Antibiotic Susceptibility of Bacteria Isolated from the Sachet Water Samples

Probable Organism (Gram Positive)	Z (30ug)	AM (30ug)	R (30ug)	CPX (30ug)	AZ (30ug)	LEV (30ug)	E (30ug)	PEF (30ug)	GN (10ug)	APX (30ug)
Staphylococcus Aureus	0(R)	0(R)	21.5(S)	28.0(S)	20.5(S)	22.5(S)	21.0(S)	22.5(S)	18.5(I)	0(R)
Bacillus sp.	0(R)	0(R)	22.5(S)	22.5(S)	22.5(S)	22.5(S)	25(S)	22.5(S)	16.0(I)	0(R)
Streptococcus sp.	0(R)	0(R)	17.5(I)	22.5(S)	21.0(S)	20.0(S)	19.0(I)	20.0(S)	14.0(I)	0(R)
Micrococcus sp.	0(R)	0(R)	0(R)	0(R)	18.5(I)	22.5(S)	21.0 (S)	21.5(S)	21.5(S)	0(R)
Probable Organism (Gram negative)	SP (30ug)	CPX (30ug)	AM (10ug)	GN (10ug)	AU (30ug)	OFX (30ug)	S (30ug)	PEF (30ug)	SH (30ug)	CH (30ug)
Enterobacter sp.	11.5(I)	22.0(S)	0(R)	17.5(I)	0(R)	21.5(S)	0(R)	19.0(I)	0(R)	0(R)

Keys: R=Resistance (0 ≤ 10.0mm), I=Intermediate (11.0 ≤ 19.0 mm), S=Susceptible (≥20.0 mm) SP= Septrin, CH= Chloranphenicol, SH= Sparfloxacin, AU= Augmentin, Z=Zinnacef, PEF= Perfloxacin, OFL= Ofloxacin, S=Streptomycin, R=Rocephin, CPX=Ciprofloxacin, AZ= Azithromycin, LEV= Levofloxacine, E= Erythromycin, GN= Gentamycin, AM= Amoxicilin, APX =Ampiclox

DISCUSSION

The physicochemical parameters of the sachet water samples in Table 1 revealed that all the pH range of 7.01 and 7.50 of sachet water samples analyzed fall within the acceptable pH range (6.5-8.5) recommended by the World Health Organization (WHO), indicating that the water is neither too acidic nor too basic. Electrical conductivity measures the water's ability to conduct electricity due to dissolved salts and ions (Bamidele and Ajibade, 2024). The values obtained were below the WHO threshold of 400 µs/m in all samples, with B5 showing the minimum value of 12.3 µs/cm, indicating lower ion contents while the maximum value was observed in B1. The alkalinity reflects the water's capacity to neutralize acids, with most of the results obtained aligning within the WHO guidelines of 200 mg/L. Marginally higher value of 73.04 mg/L in B2. Total Dissolved Solids (TDS) for all samples were comfortably within the WHO limit of 300 mg/L for good drinking water quality. TDS indicates the amount of solids in dissolved form in water and this has a strong relationship with electrical conductivity and the level of bacterial contaminants that maybe present in water. B3 and B5 have the lowest TDS of 10.0 mg/L, suggesting minimal dissolved salts and solids, while the highest value of 130.0 mg/L was obtained in B1. Turbidity is indicative of the water clarity and it is very low across all analyzed samples (0.62 – 1.08 NTU), meeting the WHO standard of less than 5 mg/L, implying that the water is visually clear and free from particulate matter. Finally, hardness which measures the concentration of calcium and magnesium ions was significantly below the maximum permissible limit of 100 mg/L, with all samples indicating relatively soft water. Hardness of all the sachet water in mg/L ranged between 54.36 and 84.22 with the lowest and highest values recorded in B3 and B6 respectively. These results are consistent with other studies on the quality of sachet water, with general reports of compliance with WHO standards in terms of physical and chemical properties, contributing to the acceptability of such water

for consumption. However, variations among the samples could be due to different water sources, treatment methods used by the producers as well as varying distribution outlets, as reported by Agunbiade *et al*. (2020).

The bacteriological quality of sachet water samples, as shown in Table 2, revealed variable bacterial contamination across different samples. The total bacterial counts ranged in this study ranged from 1.0×10^1 to 4.7×10^1 CFU/100 mL. All samples complied with the World Health Organization (WHO) standard for total bacterial count (≤100 CFU/mL). Total coliform counts in seven out of the ten samples exceeded acceptable limits (0.0 CFU/mL), the highest being 12.0×10^1 CFU/100 mL in B8. The presence of coliforms in those samples the brands not suitable for human consumption. No coliform was detected in B2, B4 and B6. Presence of coliforms in drinking water is an indication of pathogenic microorganisms' presence in water and this could be due to sanitary conditions during and after production. This finding conforms to the studies of Opafola *et al*. (2020), Oyedeji *et al*. (2022) and Balogun *et al*. (2024) who reported coliform contamination in sachet water samples, attributing it to poor handling and environmental exposure during the distribution process. Also, no faecal coliforms were detected in any of the analyzed sachet water samples, indicating the absence of direct faecal contamination. The absence of faecal coliforms might be attributed to effective initial water treatment processes that eliminate faecal contamination but fail to address subsequent non-fecal bacterial contamination during handling, storage or distribution.

The bacterial analyses of sachet water samples from Malete revealed the presence of a variety of bacterial species which are opportunistic pathogens, indicating potential contamination risks. The organisms identified include *Staphylococcus aureus*, *Bacillus* species, *Streptococcus* species, *Micrococcus* species and *Enterobacter* species. Their nutrient requirements vary and can thrive even in limited nutrient availability. The majority of these organisms are indigenous to aquatic environments.

Previous studies on sachet water quality by Adewoye *et al*. (2013) and Oludairo and Aiyedun (2015) similarly reported the presence of *Staphylococcus aureus* and *Streptococcus* species in sachet water, highlighting ongoing public health concerns related to bacterial contamination. Additionally, the detection of *Enterobacter* species is consistent with work of Abiola and Olatunde (2022). *Enterobacter* species isolated from sachet water is a type of non-faecal coliform and can also be obtained from the environmental samples. It can act as a pathway for pathogens to enter the water and potential for waterborne diseases due to faecal contamination (Onajobi *et al.,* 2015a). The occurrence of *Streptococcus* and *Micrococcus* species also reflects observations from a study by Adeniyi *et al*. (2023), further emphasizing the presence of opportunistic pathogens in sachet water.

Figure 2 illustrates the percentage frequency of bacterial occurrence in sachet water samples sold in Malete. The chart shows that *Bacillus* sp. had highest percentage frequency of 33 %, followed by *Micrococcus* sp. and *Staphylococcus aureus*. *Streptococcus* sp. and *Enterobacter* spp. have lower occurrences. This pattern is in line with other studies that highlight *Bacillus* sp. as a dominant contaminant in water samples which is often due to its spore-forming ability and resilience in various environmental conditions (El – Gayar, 2017). The notably high frequency of *Micrococcus* sp. can be linked to its ubiquitous nature, as observed in research by Adetunji *et al*. (2021), who also recorded its presence in water sources exposed to environmental contaminations. Presence of *Staphylococcus aureus* and *Micrococcus* sp. could also reflect contamination resulting from human and environmental sources. The relatively lower occurrence of *Streptococcus* sp. and *Enterobacter* sp might reflect better sanitary conditions during packaging, as these organisms are more commonly associated with faecal contamination. These findings align with previous studies on the microbiological quality of sachet water in Nigeria, where *Enterobacter* spp. and *Staphylococcus aureus* were also frequently detected (Adesomoye *et al.,* 2024). This is attributable to the contamination through human contact from handling to packaging processes.

All the bacterial species obtained in this study were multidrug resistant, exhibiting resistance to at least two out of all the antibiotics used (Table 4). All the Gram positive organisms obtained in this study have similar resistance to three of the antibiotics used; Zinnacef, Amoxicillin and Ampiclox. This might be due to misuse and abuse of these selected antibiotics used in this study. *Staphylococcus aureus* exhibited resistance to three out of the ten antibiotics (30% resistance): Zinnacef, Amoxicillin and Ampicillin but was susceptible to Ciprofloxacin, Azithromycin, Levofloxacin and others. *Bacillus* sp. and *Streptococcus* sp. showed similar susceptibility patterns but with intermediate resistance to some antibiotics like Gentamycin and Rocephin. Interestingly, it was observed that one of the Gram positive bacteria, *Micrococcus* sp. and the only Gram negative bacterial specie *Enterobacter* sp. demonstrated the highest resistance to multiple antibiotics (50 %). *Enterobacter* sp. showed intermediate susceptibility to Septrin, Gentamycin and Perfloxacin but was resistant to Amoxicillin, Augmentin, Streptomycin, Chloranphenicol and Sparfloxacin, with susceptibility to Ciprofloxacin and Ofloxacin. These findings are consistent with other studies that report widespread resistance among bacteria isolated from drinking water sources, likely due to antibiotic overuse and environmental contamination Adeleke *et al*. (2021) also observed similar resistance pattern in *Staphylococcus aureus* and *Enterobacter* sp. to Amoxicillin. The resistance observed may be attributed to the proliferation of resistant strains in the environment, horizontal gene transfer and the selective pressure exerted by antibiotic residues in water sources.

Conclusion and Recommendations

The study evaluated physicochemical quality, bacterial population and antibiotic resistance profiles of ten sachet water samples sold in Malete. Based on the physicochemical parameters, the pH, EC, turbidity, total dissolved solids as well as alkalinity in all the investigated water samples were all found to be within the optimal ranges and complied with the World Health Organization (WHO) acceptable guidelines. However, these findings indicated a degree of contamination, evidenced by the presence of total coliforms and a notable occurrence multidrug resistant bacteria in sampled water raises concerns for human health due to the potential for horizontal gene transfer and public health risks most especially due to heavy reliance of this rural community on the analyzed samples for consumption. To mitigate the risk of post - production contamination, it is essential to implement proper treatment, handling and storage practices for sachet water. The study hereby recommend that sanitary measures be taken during water packaging and handling to reduce bacterial contamination and judicious use of antibiotics is encouraged to prevent the development and spread of antibiotic resistant bacteria.

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