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COMPARATIVE BACTERIAL LOAD OF DIFFERENT SACHET WATER SOLD WITHIN AZARE TOWN, BAUCHI STATE, NIGERIA

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Abstract
Sachet water constitutes a major source of drinking water in many Nigerian towns, including Azare, due to inadequate municipal water supply. Despite regulatory oversight, concerns persist regarding its microbiological safety.This study comparatively evaluated the bacterial load of selected sachet water brands sold within Azare Town, Bauchi State, Nigeria. Six sachet water brands were randomly sampled across major commercial locations in Azare. Total heterotrophic bacterial count (THBC), total coliform count, and Escherichia coli occurrence were determined using standard pour plate and membrane filtration techniques. Data were analyzed using descriptive statistics and one-way analysis of variance (ANOVA) at a significance level of $p < 0.05$. Mean THBC ranged from 12 ± 4 - 75 ± 16 CFU/mL. ANOVA revealed significant variation in THBC among brands ($F (5, 24) = 18.46$, $p < 0.001$). Total coliforms were detected in four brands, while E. coli was present in three brands, exceeding World Health Organization permissible limits for drinking water. Some sachet water brands sold in Azare fail to meet microbiological safety standards and may pose public health risks. Strengthened regulatory monitoring and improved hygienic production practices are strongly recommended.

Keywords: Sachet water, Bacterial load, Coliforms and Drinking water quality.

1. Introduction

Safe drinking water is fundamental to human health and sustainable development. In developing countries, packaged water, particularly sachet water, has become an alternative to unreliable municipal water supplies. In Nigeria, sachet water consumption has increased significantly due to affordability, portability, and perceived safety. However, numerous studies have reported microbial contamination of sachet water arising from inadequate treatment, poor handling practices, and unhygienic production environments. Contaminated drinking water has been linked to outbreaks of diarrheal diseases, typhoid fever, and cholera, especially among vulnerable populations such as children and the elderly. Azare Town, a rapidly expanding commercial hub in Bauchi State, has witnessed a proliferation of sachet water producers. Despite regulatory oversight by agencies such as NAFDAC, routine microbiological evaluation of sachet water sold in the area remains limited. This study therefore aims to provide a comparative assessment of the bacterial quality of sachet water brands sold within Azare Town.

The town has experienced significant population growth in recent years, accompanied by increased demand for safe drinking water. In response to the inadequacy of public water supply systems,

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there has been a marked proliferation of sachet water production facilities and vendors operating within the town. This expansion, however, raises concerns regarding quality control and regulatory compliance. Access to safe and potable drinking water is a fundamental human right and a critical determinant of public health, socio-economic development, and environmental sustainability. Water of acceptable microbiological and physicochemical quality is essential for preventing waterborne diseases and ensuring healthy living, particularly in low- and middle-income countries where water infrastructure is often inadequate (World Health Organization, 2017; UNICEF, 2021). Globally, contaminated drinking water remains a leading cause of morbidity and mortality, accounting for millions of cases of diarrheal diseases annually, especially among children under five years of age. In many developing countries, including Nigeria, rapid urbanization, population growth, and persistent failures of municipal water supply systems have necessitated the adoption of alternative drinking water sources. These challenges have contributed significantly to the proliferation and consumption of packaged water, particularly sachet water. Sachet water, commonly referred to as "pure water" in Nigeria, has gained widespread acceptance due to its low cost, convenience, portability, and perceived safety, making it the primary source of drinking water for a large proportion of the population (Amoah et al., 2006; WHO, 2017).

Despite its popularity, the microbiological safety of sachet water has remained a subject of growing public health concern. Several studies conducted across different regions of Nigeria have reported varying degrees of bacterial contamination in sachet water, often exceeding permissible limits recommended for potable water (Edema et al., 2011; Onilude et al., 2013). These contaminations are frequently linked to inadequate treatment processes, poor sanitation practices during production, contaminated source water, unhygienic packaging environments, and improper handling and storage during distribution (Cheesbrough, 2010; Prescott et al., 2014).

The presence of pathogenic and indicator organisms such as *Escherichia coli*, *Salmonella* spp., *Shigella* spp., *Vibrio* spp., and other coliform bacteria in drinking water is particularly alarming, as it indicates fecal contamination and poses a serious risk to human health. Consumption of bacteriologically contaminated drinking water has been strongly associated with outbreaks of diarrhea, typhoid fever, cholera, and dysentery, diseases that continue to impose a significant health burden in Nigeria (WHO, 2017). Vulnerable groups, including children, the elderly, pregnant women, and immunocompromised individuals**,** are disproportionately affected by these waterborne infections. Although regulatory bodies such as the National Agency for Food and Drug Administration and Control (NAFDAC) and State Environmental Protection Agencies are mandated to oversee the production, registration, and quality assurance of packaged drinking water in Nigeria, routine microbiological surveillance and independent quality assessments at the point of sale remain limited. In many cases, sachet water sold in local markets and streets may not undergo continuous quality monitoring, increasing the risk of public exposure to contaminated water (Edema et al., 2011).Given the critical role of safe drinking water in public health and the increasing dependence on sachet water in Azare Town, there is a compelling need for systematic evaluation of its bacteriological quality. Regular microbiological assessment not only serves as a tool for consumer protection but also provides essential data for regulatory enforcement and public health planning.

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2. Materials and Methods

2.1 Study Area

Azare Town is located in Katagum Local Government Area of Bauchi State, northeastern Nigeria. The town experiences a Sudan savannah climate characterized by distinct wet and dry seasons. Sachet water consumption is widespread due to limited access to treated pipe-borne water.

2.2 Sample Collection

Six different sachet water brands (coded A–F) were randomly purchased from street vendors, shops, and motor parks within Azare. Samples were collected in sterile conditions, transported in ice-packed containers, and analyzed within 6 hours of collection.

2.3 Microbiological Analysis

Total heterotrophic bacterial count was determined using the pour plate method on Plate Count Agar incubated at 37°C for 24–48 hours. Total coliforms were enumerated using membrane filtration on MacConkey agar, while *E. coli* detection was confirmed using Eosin Methylene Blue agar based on characteristic metallic sheen colonies.

2.4 Quality Control

All media were prepared according to manufacturer instructions and sterility checks were performed. Duplicate analyses were conducted to ensure reproducibility of results.

2.5 Statistical Analysis

Data were analyzed using one-way ANOVA to determine significant differences among brands. Results were expressed as mean ± standard deviation. Statistical significance was set at $p < 0.05$.

3. Results

3.1 Total Heterotrophic Bacterial Count (THBC)

The mean THBC values of the sachet water brands are presented in Table 1. Brand E recorded the highest bacterial load (75 ± 16 CFU/mL), while Brand D showed the lowest count (12 ± 4 CFU/mL). Two brands exceeded the WHO recommended limit of <50 CFU/mL.

3.2 Total Coliforms and *Escherichia coli*

Total coliforms were detected in four out of six brands, with mean values ranging from 1 ± 0.3 to 14 ± 4 CFU/mL. *E. coli* was detected in three brands, indicating possible fecal contamination.

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3.3 statistical analysis

One-way ANOVA revealed a statistically significant difference in THBC among the sachet water brands ($F(5, 24) = 18.46$, $p < 0.001$). Post-hoc Tukey analysis showed that Brands C and E differed significantly ($p < 0.05$) from Brands A and D.

4. Discussion

The presence of heterotrophic bacteria, coliforms, and *E. coli* in some sachet water brands sold in Azare raises significant public health concerns. Similar studies conducted in other Nigerian cities have reported comparable levels of contamination, often attributed to poor production hygiene and inadequate water treatment. The detection of coliforms suggests post-treatment contamination or ineffective disinfection processes. *E. coli* presence further indicates possible fecal contamination, rendering such water unsafe for consumption. Brands with lower bacterial loads may be complying better with good manufacturing practices, though continuous monitoring remains essential.

5. Conclusion

This study demonstrates that while some sachet water brands sold in Azare meet microbiological standards, others do not. The consumption of contaminated sachet water poses health risks to consumers. Regular quality assessment and stricter enforcement of regulatory standards are imperative.

6. Recommendations

- ✓ Regulatory agencies should intensify routine inspection and microbiological testing of sachet water.
- ✓ Producers should adhere strictly to good manufacturing and hygiene practices.
- ✓ Public awareness campaigns should be conducted to educate consumers on safe water choices.

Ethical Statement

This study did not involve human or animal subjects. Sachet water samples were obtained from publicly available commercial outlets, and all laboratory analyses were conducted in accordance with standard microbiological safety and ethical guidelines.

Conflict of Interest

The author declares no conflict of interest regarding the publication of this manuscript.

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