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Sachet Water Quality Evaluation Vended In Gashua Northeastern Nigeria

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ABSTRACT

This study evaluated the quality of sachet water vended in Gashua, Bade Local Government Area of Yobe State, Nigeria. Sachet water samples were collected from five different factories identified as V, W, X, Y, and Z. Heavy metal concentrations were determined using Atomic Absorption Spectrophotometry (AAS), while standard analytical methods were employed to assess the physicochemical properties of the samples. The findings revealed that the concentrations of lead (0.12 ± 0.01 , 0.12 ± 0.01 , 0.18 ± 0.01 , 0.05 ± 0.01 , and 0.13 ± 0.01), cadmium (0.01 ± 0.01 , 0.02 ± 0.01 , 0.02 ± 0.01 , 0.03 ± 0.01 , and 0.03 ± 0.01), and arsenic (0.11 ± 0.00 , 0.14 ± 0.01 , 0.22 ± 0.00 , 0.09 ± 0.01 , and 0.13 ± 0.01) in samples V, W, X, Y, and Z respectively, exceeded the permissible limits recommended by the World Health Organization (WHO), which are 0.02 ± 0.00 , 0.003 ± 0.00 , and 0.01 ± 0.00 respectively. Zinc was not detected in any of the analysed samples. However, iron concentrations recorded in samples V, W, X, Y, and Z (0.002 ± 0.00 , 0.03 ± 0.01 , 0.05 ± 0.01 , 0.03 ± 0.00 , and 0.03 ± 0.00 respectively) were considerably lower than the WHO permissible limit of 3.00 ± 0.00 . Chromium concentrations were above the recommended limit in samples V, X, and Z, whereas samples W and Y were within the acceptable WHO standard of 0.05 ± 0.00 . Furthermore, conductivity, total dissolved solids (TDS), and sulphate concentrations in all the analysed samples were below the WHO permissible limits. In contrast, turbidity and total suspended solids (TSS) exceeded the recommended standards. Overall, the study indicates that several brands of sachet water marketed in the study area failed to comply with WHO guidelines due to elevated levels of certain heavy metals and physicochemical parameters beyond acceptable limits.

Keywords: Water quality, Evaluation, vended, Physicochemical, permissible, Concentration, lead.

INTRODUCTION

Sachet water is any commercially treated water, manufactured, packaged and distributed for sale in sealed food grade containers and is intended for human consumption. The production of sachet water in Nigeria started in the late 90s and today the advancement in scientific technology has made sachet water production one of the fastest growing industries in the country (Labbo et al, 2021). The Millenium Development Goal (MDG 7) on drinking-water met globally in 2010. The target was to halve the proportion of the world's population without sustainable access to safe water. About 48 least developed countries did not meet the target, but much progress was made with 42 percent of the current population in these countries gaining access to improved drinking-water sources since 1990. The demand for sachet water in most urban cities in Nigeria has been on increase due to limited public water supplies and high level of confidence of the masses on safety of sachet water (Stoler, 2017). This has boosted the production of packaged drinking water by private companies (Thliza et al.,2015). However, contamination of this

sachet water is well established from physical, chemical and microbiological factors that influence the production procedures including packaging, storing, and distribution. Evaluation of water quality based on physicochemical parameters and heavy metals at any well-known and involves various methods and techniques adapted by researchers. These physical parameters are identified as taste, odor, electrical conductivity, major ions (Na, K and Fe) turbidity, temperature, and dissolved and suspended solids (Odiongenyi et al., 2015).

The packaging of sachet water popularly called “pure water”, has become a flourishing business in Nigeria. In the sight of the Nigerian government, whose concern is poverty purge, the sachet water industry is perceived as a poverty alleviation industry in Nigeria (Orish et al., 2006). Sachet water wrapping materials contributed to the leaching of some undesirable heavy metals into the water sources which when in high concentration can be lethal and can cause severe or chronic health effect.

Pollution of water bodies normally is caused by chemical and microbial contaminants which leads to water borne infections and diseases (United State Environmental Protection Agency, 2001). While improper dispersal of industrial effluents which is most common in most African countries has leads to heavy contamination of water sources reducing the volume of safe agriculture, domestic, irrigation and drinking water (Ezeh et al., 2019). Yashim and Abdullahi, 2023, opined that determination of heavy metals impacts greatly on human health, while Adepoju and Alabi,2005, reported that heavy metals can cause severe health effect depending on the nature and quantity of the metal swallowed. The growing prevalence of renal failure and other organs damage was in alarming rate at Gashua as such there is a need for proper investigation and possible solutions to this menace.

MATERIALS AND METHODS

Study Area

Gashua is the capital city of Bade local government in Yobe state Northeastern Nigeria. Its approximate coordinates are 12.87°N latitude and 11.04°E longitude, with average elevation of about 299–339 m above sea level and a population of 125,000 according to 2006 census. The Month of March and April are the hottest in the year in the area with temperature ranges between 38 to 42°C. The temperature falls during the rainy season in the month of June to September getting to about 23 – 28°C with rainfall of 500 to 1000mm.

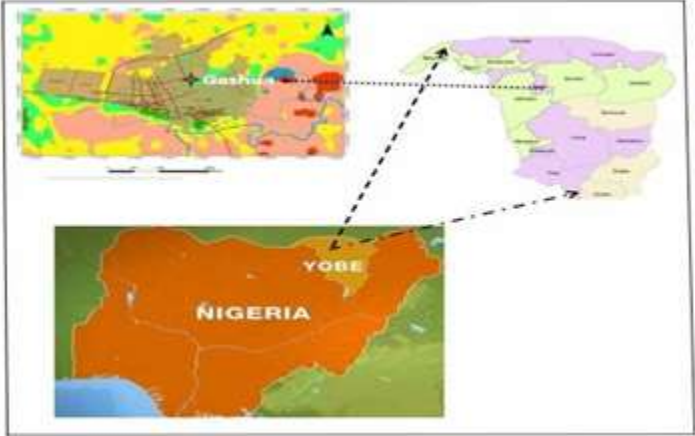


Fig 1: Map of Nigeria showing Gashua Study Area.

Sample Collections

Sachet water was obtained directly from the factories in Gashua metropolis

At about 25⁰C and taken to laboratory for further analysis. The factories were designated as V, W, X, Y, and Z to avoid legal implication. This study provides the overview of sachet water quality at the time of sampling.

Analysis of Physicochemical parameters of the sample

The analytical test of the water samples collected were conducted and. Sulphate the pH was determine using Test-2pH meter while the temperature, Total Dissolved Solid (TDS), and conductivity were estimated using electrical conductivity TDS/Temperature (HM-Digital COM-100). Sulphate, nitrate, phosphate and turbidity of each samples was measured using spectrophotometer (HACH-DR-2000). Using deionized water as blank at a wavelength of 420nm the turbidity was determined. Total Suspended Solid (TSS), Dissolved Oxygen (DO) Total Organic Carbon (TOC). Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were determine using American Public Health Association). The Alkalinity was determined using titrimetric techniques.

Analysis of Heavy Metals

Flame Atomic Absorption Spectrophotometer PerkinElmer Analyst 400 AA Spectrometer was used to examine all the heavy metals concentrations.

RESULT AND DISCUSSION

The result of physicochemical parameters and heavy metals were evaluated and presented in table 1 and 2 below

Table:1 Physicochemical Parameters Analysis of Sachet Water Samples

Parameters	WHO	NSD	V	W	X	Y	Z	P- Value
Temperature 0C	30-32	20-30	27.50±0.34	27.50±	27.27±0.35	27.23±0.30	27.40±0.20	0.438
Conductivity(us ^{cm³})	500		2.31±0.11	2.00±0.10	2.81±0.04	1.89±0.04	2.44±0.05	<0.0001
pH	6.5-8.50		7.51±0.21	7.53±0.15	7.69±0.10	7.45±0.23	7.72±0.20	0.3494
TDS(mg/L)	259		1.14±0.02	1.05±0.05	1.33±0.12	0.97 ±0.26	1.23±0.14	0.0027
Turbidity(NTU)	5.00		10.71±1.23	7.56±0.30	8.71±0.39	9.33±0.6	10.34±0.73	
TSS(mg/L)	50.00		52.26±0.95	52.39±1.13	52.68±0.38	50.80±0.53	50.73±0.83	0.0034
Total Alkalinity (mg/L)	20.200		50.00±0.00	75.00±0.00	25.00±0.00	80.00±0.00b	40.00±0.00	0.0005
BOD(mg/L)	50.00		50.25±0.13	48.45±0.10	50.10±0.10	49.50±0.10	50.25±0.10	<0.0001
COD(mg/L)	50.00		50.20±0.10	50.50±0.10	50.10±0.10	50.40±0.10	50.23±0.20	<0.0001
DO(mg/L)	7.50		2.15±0.10	2.10±0.18	2.50±0.20	2.20±0.20	2.10±0.10	0.022
TOC(%)	2.00		2.15±0.10	2.10±0.18	2.50±0.20	2.20±0.20	2.10±0.10	0.0221
Sulphate (mg/L)	200		184.50±1.73	180.30±3.36	190.50±0.25	190.20±4.90	190.20±0.20	<0.0001
Nitrate (mg/L)	45.00		43.30±0.2	45.30±4.0	40.10±0.10	42.40±2.1	45.10±0.10b	0.0340
Phosphate(mg/L)	5.00		4.30±0.5	4.50±0.10	5.30±0.27	5.30±0.82b	5.55±1.5	0.3553

Table 2: Heavy Metals analysis

Sample	Pb(mg/L)	Zn(mg/L)	Fe(mg/L)	Cr(mg/L)	Cd(mg/L)	Ar(mg/L)
WHO	0.02	5.00	3.00	0.05	0.003	0.01
V	0.12	NP	0.002	0.1	0.01	0.11
W	0.12	NP	0.03	0.04	0.02	0.14
X	0.18	NP	0.03	0.13	0.02	0.22
Y	0.05	NP	0.03	0.09	0.03	0.09
Z	0.13	NP	0.03	0.11	0.03	0.13

DISCUSSION

The study tried to evaluate the physicochemical parameters and presence of some heavy metals in sachet water vended in Gashua metropolis. These heavy metals are lethal to the human body if taken in food or water at a higher concentration. This study shows that the concentration of lead, cadmium, and arsenic in sample V, W, X, Y and Z was seen to be above the WHO tolerable limit. This indicate that it is contrary with the findings of Sufyan et al., 2022; Orish et al.,2016), but agrees with that of (Odiongenyi et al.,2016).

The concentration of iron in the sample shows that its lower than the WHO standard, but zinc was not present in all the samples. Total dissolved solids (TDS), conductivity and sulphate were seen to be lower than WHO permissible limits in all the samples which is in agreement with that of Sawere & Uwagwue, 2016; Halilu et al., 2011; Ezeh et al.,2019).Turbidity shows higher value than the WHO standard which is in agreement with the findings of (Raji et al., 2010) but contradicts that of (Halilu et al., 2011; Ezeh et al.,2019).The Total suspended solid (TSS) was found to be above WHO standard in the samples V, W, and X while Y and Z were seen to fall within tolerable limit The biochemical Oxygen demand (BOD) and chemical oxygen demand(COD) were within the required standard of WHO in sample V, X, and Y.

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