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Assessment of sachet water quality in Ado-Ekiti and Environ

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Abstract

A comprehensive Laboratory assessment involving the physical and chemical analysis of nylon packed sachet water popularly known as pure water within the Ado-Ekiti metropolis in Ekiti state has been carried out. This is in view of the increasing number of the sachet water production factory due to growing population of the people within the metropolis and the need to generally investigate them to know the ones good and safe for domestic consumption. A total of fifteen (15) sachet water samples from different location within Ado-Ekiti, the area of study were collected and analyzed. The test was carried out using the pH comparator, turbidimeter, Lovibond comparator, and the caliform test for pH, turbidity, colour test respectively. The ionic concentration was also determined by adding some reagents and exposing it to the source of light. The result of the analysis shows that he sample has a pH value ranging from 5.11 − 7.52, Alkalinity 16− 160, Electrical conductivity 29 − 417ys/cm, Turbidity of the water sample ranges from 5.3 − 9.3, the total dissolve solid (TDS) ranges between 9.0 to 107mg/l/. The range of few ions like Iron (Fe), Sulphate ($S0_4^{2-}$), Chloride (Cl) and Nitrate (NO_3^-) analyzed in mg/l ranges between 0.1−1.0, 182−256, 14.58 − 29.15and 48 −71 respectively. The result of the analysis falls within the permissible limit and conforms with the standard recommended by NAFDAC, WHO and UNICEF.

Keywords: Water; Quality; Assessment; Sachet; Ado-Ekiti; Metropolis

1. Introduction

The population of Ado-Ekiti has increased tremendously in the last one decade. This is due to its new status of being the capital of Ekiti-State, carved out of the old Ondo State in 1996 [1]. The recent construction and rehabilitation of the major roads in the town embarked upon by the Ekiti State Government has brought about infrastructural, social and industrial development to the area thereby leading to the emergence of many Industries [2]. Hence, making the area witnessing an influx of people from far and near in the past few years. This situation has led to an increase in demand for portable and drinkable water by the people of the area especially for domestic consumption. In view of this, the number of sachet water factory within the state capital and metropolis has been on an increase. The situation is aggravated by the problem of water pollution and contamination. Consequently, environmental expert and professionals have make critical objective and scientific conclusion on what can be considered as risk for a given level of contamination present to an ecosystem [3]. The increasing environmental regulation and more exact standards for the quality of water, air, soil and food have led to a significant expansion of the environmental monitoring of industry and product throughout the world [4]. Also water intended for human consumption must be free from organism that are causative agents of disease, chemical substance at concentration hazardous to human health A comprehensive test including the chemical, physical, bacterial content and the metal concentration assessment of the this water sachet quality of Ado-Ekiti Southwestern Nigeria was performed with a view of identifying the sachet water that is up to the W.H.O and UNICEF requirement and standard.

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1.1. Location and geology of the study area

Ekiti State is located in the Southwestern part of Nigeria. It lies between the Longitude 3° and 6°E and Latuitude 8° and 10° N respectively. It covers an area of over 6,353 square kilometer (2,453 sq mi) and bounded by an international boundary with Benin Republic in the West in the North by Niger in the East by Kogi and to the South by Oyo, Ekiti and Osun.

The study area, Ado Ekiti, the state capital and headquarters of the Ekiti. It is also popularly called Ado has a population of 2,737,186 in 2004. It lies within latitudes 7° 15'N and 7° 16.8'N and longitudes 5° 19'E and 5° 23.2'E (Figure 1).Three major rivers - Osin, Ureje and Omisanjana - and other seasonal streams and springs, dominate the drainage system. The area also enjoys tropical climate with two distinct seasons. These are the rainy season (April–October) and the dry season (November–March). Temperature ranges between 21° and 28°C with high humidity. The south westerly wind and the northeast trade winds blow in the rainy and dry (Harmattan) seasons respectively. Tropical forest exists in the south, while savannah occupies the northern peripheries [5]

The study area lies within the geology underlain by the rocks of the older granite which is part of the Precambrian crystalline basement complex of Southwestern Nigeria [6, 7, 8, 9]. The Precambrian rocks forming part of the Western Nigerian Basement Complex predominantly composed of migmatite gneiss complex, slightly migmatised to unmigmatised paraschist and metaigneous rocks, Charnockitic rocks, older Granites, and unmetamorphosed dolerite dykes [10,11]. The main lithological units in the study area extending towards the south are Quartzite, Gneiss and dark colored Charnockite [12].

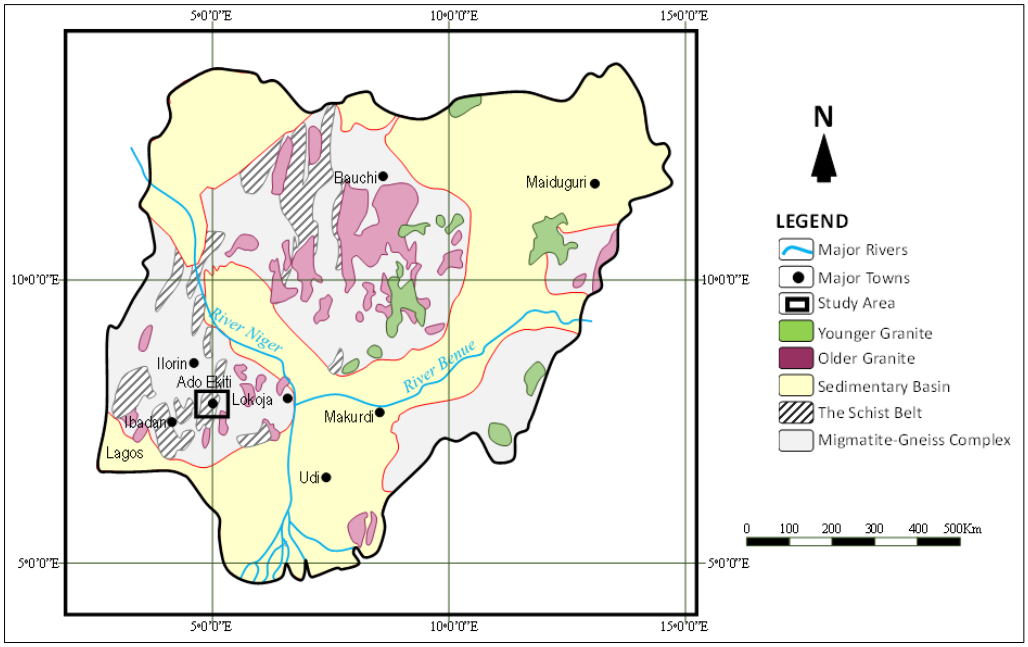

Figure 1 Geological Map of Nigeria showing the location of the Study area

2. Methodology

A total of fifteen (15) sachet water samples packed in transparent nylon bags of different factory products were bought at different places and location in the Ado-ekiti metropolis. The water samples were subjected to different physical and chemical test. Table 1.0 shows the result of the physical tests which includes turbidity, colour, odour and the taste. The different samples collected were later chemically analyzed at the Federal Polytechnic Ado-Ekiti Central Research Laboratory. The chemical analysis were conducted using standard laboratory techniques involving wet analysis to determine both anion and cation concentrations. Parameters determined included hydrogen ion concentration (pH), specific conductance of the water, hardness, total dissolved solids (TDS), secondary and minor elements such as Iron (Fe), Zinc (Zn), and Nickel (Ni). Others are alkali-ions: potassium (K) and sodium (Na), the alkaline earth metals: calcium (Ca) and manganese (Mn), sulfate (SO_4^{2-}), chloride (Cl^-) and nitrate (NO3-) constituents.

Table 1 Laboratory Result of Samples Physical Test

Sample	Turbidity	Appearance	Colour (H.V)	Odour	Taste	Temperature (℃)	Total Dissolve salt(ppm)	Turbidity	Electrical Conductivity (us/cm)
1	0.25	Clear	5.0	Odourless	Tasteless	26.5	59	8.2	231
2	4.23	Clear	5.0	Odourless	Tasteless	26.5	22	5.2	86
3	3.21	Clear	5.0	Faint Odour	Tasteless	26.5	32	6.9	125
4	0.58	Clear	5.0	Odourless	Tasteless	27.2	90	5.1	82
5	0.69	Clear	5.0-10	Odourless	Tasteless	26.4	47	7.1	184
6	0.65	Clear	5.0	Odourless	Tasteless	26.5	91	8.5	361
7	2.56	Clear	5.0	Odourless	Tasteless	26.5	62	8.3	277
8	2.64	Clear	5.0-10	Odourless	Tasteless	26.4	107	9.3	417
9	2.96	Clear	5.0	Odourless	Tasteless	26.5	82	8.4	323
10	3.0	Clear	5.0-10	Odourless	Tasteless	26.0	82	4.8	29
11	5.68	Clear	5.0-10	Odourless	Tasteless	26.4	79	5.1	39
12	1.25	Clear	5.0	Odourless	Tasteless	25.5	110	9.0	341
13	2.0	Clear	5.0-10	Faint Odour	Tasteless	26.0	70	8.1	220
14	2.8	Clear	5.0	Odourless	Tasteless	26.4			
15	2.3	Clear	5.0	Odourless	Tasteless	26.5			

Table 2 Laboratory Result of Samples Chemical Test Analysis

Sample	pH	Acidity (mg/l)	Alkalinity (mg/l)	Chloride (mg/l)	Sulphate (mg/l)	Iron (mg/l)	Nitrate (mg/l)	Total Dissolve Salt (ppm)	Calcium Hardness ppmg/l
1	6.71	0.00	24	29.15	224	0.8	61	0.00	156
2	6.89	0.10	24	21.87	208	0.3	52	0.00	110
3	6.71	0.20	72	14.58	212	0.3	58	0.00	190
4	6.88	0.05	24	29.15	183	0.1	53	0.00	120
5	6.32	0.12	16	14.58	218	0.1	60	0.00	152
6	6.73	0.18	80	21.87	249	0.9	69	0.00	100
7	7.24	0.08	80	21.87	218	0.2	63	0.00	160
8	7.24	0.10	160	21.87	253	0.1	71	0.00	120
9	7.52	0.10	140	14.58	232	0.1	68	0.00	125
10	5.11	1.19	16	21.87	182	0.1	48	0.00	122
11	6.81	0.09	16	14.58	205	0.2	51	0.00	200
12	7.13	0.10	32	14.58	256	0.9	69	0.00	120
13	7.04	0.10	80	14.58	228	0.2	61	0.00	130

Table 2 shows the result of the different chemical test performed on the samples including acidity, alkalinity, sulphate, iron, hardness for calcium and total dissolved

The water sample test results are shown in Table 3 and 4 for the chemical and metal concentration respectively.

Table 2 shows the comprehensive details of the hardness, pH and the Alkalinity value of the water samples. According to the World health organization (WHO) standard regulation, the total hardness must not be too soft or hard and the pH value of any water must not be greater than 300mg/l and 7.0 respectively. Any water sample with value greater than this is considered to be too basic or hard and dangerous for human consumption and usage.

Table 3 WHO Recommended Concentration Values for Quality water

TEST	**Range of WHO Recommended Concentration in mg/l**
Total Dissolve Salt (TDS)	1000
pH	6.5-8.5
Taste	Tasteless
Odour	Odourless
Iron (Fe)	0.3
Copper (Cu)	1-2
Zinc (Zn)	1-3
Manganese (Mn)	0.5
Magnesium (Mg)	10.42-17.05
Potassium (K)	0-12
Sodium (Na)	200
Calcium (Ca)	0-0.50
Chloride (Cl-)	200 – 600
Sulphate	250 – 400
Nitrate	50 – 100

3. Results and discussion

All the Water samples were carefully observed and analyses physically in which it was observed to be tasteless, odorless, clean and clear without any trait of strange particles.
Although from table 1 the turbidity result for each sample were found to have meet up to a moderately acceptable standard, the water samples were still considered to contained a small quantity of solid particles. The result of the colour of each water samples is also considered to have meet the minimum acceptable standard for human consumption. According to the World Health Organization (WHO) guidelines, the cause for water rejection for colour is 25 while the minimum limit colour value is 5 [13]. In view of the complexity of factors used in determining water quality and contents, different variables and parameters have been considered. The average value of the samples from each test conducted were determined and compared with the parameter and recommendation limit for unity of the World health organization (1993) standard for water quality shown in table 3.0.

4. Conclusion

The results obtained using complexity of factors, different variables and parameters to determine the water quality of each sample and compared with the parameter recommended World health organization standard indicated that sachet water produced and sold in Ado-Ekiti and its environ were of good quality and safe for consumption. However, there is

need for regulatory and statutory agencies (NAFDAC and SON) to monitor all operation processes and enforce laws that will further encourage healthy water production.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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