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# BIOLOGICAL EVALUATION OF SOME BOTTLE WATER QUALITY SOLD WITHIN KANO METROPOLIS, NIGERIA

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***ABSTRACT***
***Water plays a vital role in daily metabolic life processes. However, promoting public health awareness as well as provision of safe and secured bottled drinking water by stakeholders cannot be over emphasized. The study is aimed at evaluating the biological quality of some bottled water sold within Kano Metropolis, Nigeria. Studies on physical and biological parametric standard method were conducted. A total of 40 samples comprising of 4 different brands was randomly selected using stratified sampling techniques from different sampling sites within Kano metropolis in Northern Nigeria. Physical observation of bottled water labeling characteristics was evaluated. Water sample was pressurized to deflate the bio films along the walls of the container.10-20ml of the sample was pipette into centrifuge bottles corresponding to the label of each sample brand .It was centrifuged at a rotor speed of 1,500 revolutions per minute (rpm) for 30 minutes for biological evaluation. Algal cells were identified and enumerated. Results showed that none of the samples met the physical full content labeling characteristic standard. 10 Species of algal cell/ml was detected in some bottled water brands with Flagillaria spp. being the abundance in brand A and Ankistrodesmus spp. being the least in brand B. However, none was detected in sample D. It is recommended that, effective implementation of WHO water safety guidelines from the catchment source to the consumer through campaign awareness can reduce level of exposure. Stake holders should be encouraged to protect and store bottle water against sunlight exposure, chemicals and cleaning reagents.***
***Keywords: Bottled water quality, Flagillaria spp., Ankistrodesmus spp Public Health***

## INTRODUCTION

Water plays a vital role in daily metabolic life processes. Therefore, promoting public health awareness as well as provision of safe and secured bottled drinking water by stakeholders cannot be over emphasized. Magda *et al.* (2008), World Health Organization (WHO, 2011) and Iliyasu *et al.* (2017), literally defined bottled water as any portable water that is treated and is of good sanitary quality which is intended for public consumption, bottled, distributed and offered for sale. They further maintained that, consumption of safe and secured bottle water can save about 1.8 million lives daily from incidence of water borne infections.

Biologically, D'Odorico and Rodriguez-Iturbe (2020), maintained that, water plays a crucial role in the origin of life. Water constitutes 80% of the protoplasmic constituent of life cells. Iliyasu *et al.* (2018) supported the view and reported that, water is a solvent that is vital for all forms of metabolic activities like excretion, digestion and transport of (Oxygen, vitamins, salts, amino acids). It also prevents constipation and certain diseases like colon cancer. They further attributed its enhancement to efficient and effective utilization of human, material and financial resources which at the long run would aid in the socio economic development of the nation at large.

Ashbolt *et al.* (2001) and WHO (2017) explained that, biological contaminants in drinking water hinders its aesthetic and acceptability qualities in terms of taste and odour. Thus some of the indicators include cyanobacteria toxins-Microcystin- LR. It has also been reported by Chorus and Bartram (1999), Kenku *et al.* (2006) that, some opportunistic microalgae species from raw water source, for example, *Microcystsis spp*. of Cyanobacteria could proliferate on transparent plastic water containers and eventually attach to the container inner sidewalls to form bio-film due to light exposure of the waters containers. Tarczynska

*et al.* (2000), Mankiewicz *et al.* (2002) remarked that, accidental or incidental ingestion of algal toxins in drinking water are capable of causing health effects in man. The cells produce gastrointestinal toxins. However, Kenku et al. (2006), Wagner *et al.* (2008) maintained that, the human health risks is diverse. It includes gastroenteritis, nausea, vomiting, fever, flu-like symptoms, sore throat, blister mouth, ear and nose irritation, rashes, visual disturbances, abdominal pains, kidney and liver damage. They further explained that, species such as *Microcystis, Aphanizomenon* and *Anabaena* as measured in mouse bioassays can produce potent poisons that can induce rapid and fatal liver damage at lower concentrations. Proliferation of the biological contaminants according to WHO (2017) is as a result of inefficient water treatment and maintenance practices. However, as argued by Keijola *et al.* (1988), Lepisto *et al.* (1994) ozonation has been found to be effective in completely destroying algal toxins.

In addition, Iliyasu *et al*. (2018) reported that, bottled water varies substantially among brands. It is influenced by time of production runs, water source, treatment technology, manufacturing operations, storage and distribution. They further attributed the attitude of bottle water retailers' of displaying bottle water under high temperature for longer periods to enhance market promotion strategies. Liee (2011) supported the view and reported that, the attitude of the retailers and shell life before use encourages the growth of algae more especially in the transparent packaged containers due to very low turbulence of water in the packaged containers. Empirically, despite limited literatures and awareness of algal species in bottled water by stakeholders, the objectives of the study is to collect some samples of bottled within Kano Metropolis ; evaluate its physical and biological qualities by identifying and enumerating some Algal cells in bottle water samples.

By and large, it is against this back - ground that, the study aimed at the biological evaluation of some bottle water quality sold within Kano Metropolis, Nigeria, through survey design and laboratory experimental method. The result would be compared with the national and international guidelines of safe drinking water. (WHO, 2011; National Agency for Food, Drugs and Administration Control, NAFDAC, 2004; 2018)

## MATERIALS AND METHODS

### Study Area

Kano State according to Iliyasu et al*.* (2017) is in the North West geopolitical region in Nigeria. It is located along the equator of Kano State. It covers an area extending between Latitudes 10 º 3'N and 12º 4'N of Equator and Longitude 7º 4'E and 9 º 3'E of the Prime Meridian. They further, maintained that, it is climatically classified (Aw) Koppen's classification. It is characterized by tropical wet and dry savanna. It is pronounced with driest month with a mean temperature and precipitation of 26.4$^0$C and 332mm respectively.

### Research Design

The research design involves survey design through collection and physical examination of the bottled water samples (NAFDAC, 2004; 2018) and laboratory experiment for biological evaluation.

### Sample and Sampling Technique

A Total sample of forty (40) bottled water samples from four different brands were collected fortnightly for six months at about 8.00 am. It was collected from retailed outlets, shops super markets, traffic light junctions etc. from the stratified sampling sites of the Kano metropolis.

### Sample Preparation and Processing

The collected samples were placed in cooler containing ice blocks and transported to the laboratory. All the samples collected were processed and analyzed as described by WHO (2011) and American Public Health Association, (APHA, 2012) within six hours of collection for biological analysis.

### Physical Examination of Bottled water Samples

The physical labeling characteristics of the bottled water samples was observed and recorded as per meeting registration requirement as described by (Ndinwa, et al., 2012; NAFDAC, 2018).

### Biological Evaluation of Bottled water for Identification and Enumeration of Algal cells in Water Samples

Algal cells were identified and enumerated according to the method described by Liee (2011). The water sample was pressurized to deflate the bio films along the walls of the container.10-20ml of the sample were pipette into centrifuge bottles corresponding to the label of each sample brand. It was centrifuged at a rotor speed of 1,500 revolutions per minute (rpm) for 30 minutes. The algal species were observed and enumerated with a binocular compound electrical microscope Wetzlar H600 Model. The algal species were further identified with the identification reference guide of

(Palmer, 2006; Bellinger and Sigee, 2010; APHA, 2012). A computerized camera Amscope MD900E model was attached to the eye piece for capturing pictures of some identified algal cells. The result was expressed as cell per ml of water sample.

## RESULTS

### Physical Observation of labeling Characteristics of Bottled Water Samples

The result of the physical examination of bottled water samples as shown in (Table 1) showed that, none of the sample brand displayed an informative labeling content order as stipulated by the regulatory agency NAFDAC (2004; 2018) and United States Food and Drug Administration the USFDA (2018). Batch number was found to be absent in brand A

**Table 1: Physical Observation of the labeling Characteristics of Surveyed Bottled Water Samples.**

| Brands | NAFDAC Reg. no. | Best before date | Manufac. Date | Batch no. | Net vol. in milliliters | Producers name | Contact Address | Content label |
|---|---|---|---|---|---|---|---|---|
| A | + | + | + | _ | 550 | + | + | _ |
| B | + | + | + | + | 750 | + | + | _ |
| C | + | + | + | + | 750 | + | + | _ |
| D | + | + | + | + | 550 | + | + | _ |

Table of labeling characteristics of bottle water sample; Key; (+) =Present ;(_) = absent

### Algal Species

The result of enumerated algal cells as shown in (Table 2) indicates that, brand. A has the highest number of algal species belonging to the families; (Cyanophyceae, Bacillariophyceae, Euglenophyceae and Chlorophyceae ), followed by brand C (Cyptophyceae ; Bacillarophyceae and Chlorophyceae).and (Bacillariophyceae in Brand B). No algal cell was detected in brand D. Some of the identified species include: *Anacystis* (*Microcystis spp.*), *Fragellaria spp.*, *Oocystis spp.*, *Ankistrodesmus spp.*, *Trachelomonas spp.* , *Ulothtrix spp.*, *Cosmarium spp.*, *Cryptomonsa spp.*, *Tabellaria spp.* , *Synedra spp*, .

**Table 2: Total Identified Algal Cells from Bottled Water Samples**

| Bottled water Brand | Algal specie detected | Number of cell/ml | Examples |
|---|---|---|---|
| A | Cyanophyceae | | |
| | Filter clogging | 2 | *Microcystis spp.* |
| | Bacillariophyceae | | |
| | Pinnate diatom | 6 | *Flagillaria spp.* |
| | Euglenophyceae | | |
| | Centric diatom | 2 | *Trachelomonas spp.* |
| | Chlorophyceae | | |
| | Filter clogging | 2 | *Oocystis spp.* , *Ulothrix spp.* |
| B | Bacillariophyceae | | |
| | Taste and odour | 1 | *Ankistrodesmus spp.* |
| C | Cryptophyceae | | |
| | Filter clogging | 3 | *Cryptomonsa spp.* |
| | Bacillariophyceae | | |
| | Odour and taste | 2 | *Tabellaria spp.* , *Synedra spp* |
| | Chlorophyceae | | |
| | Filter clogging | 1 | *Cosmarium spp.* |
| D | Not Detected | Not Detected | No Specie detected |

**DISCUSSION**

From the result obtained it has shown that, some bottled water sold in Kano Metropolis exhibit some variables characteristics in terms of physical and biological parameters . The absence of the informative full labeling content order (water source, treatment method and some parametric as stipulated by the regulating agency was a violation of the standard. procedure. The absence of batch number on sample A can lead to difficulty in tracing faulty product for effective quality control.

In addition, (n=2)5% of the bottled water sample was found to exceed the expiry date but yet circulating around the channels of distribution of goods and services. However, it was observed that, the single serving of 500-750ml volume content affordable by the middle class man is packed with transparent plastic materials for market promotion strategies. This is to say that, it is not protected from sunlight penetration right from the manufacturing company. Good packaging in cartons can serve as a protection against direct sunlight penetration. Similar studies conducted by Magda *et al.* (2008) in Egypt and. Ndinwa *et al.* (2012) in Warri ,Nigeria also recorded lapses in content labeling and storage irregularities .

Moreover, the presence of algae in bottled drinking was due to poor and inefficient treatment. Others might be attributed to failure to use ozonation , poor storage and unhygienic handling processes. Algal growth is encouraged when bottled water is exposed to high temperature and warmth. It can also be due to calm and low turbulence of the water in an enclosed system of packaged bottles. Species of *Trachelomonas* and *Ankistrodesmus* according to Huynh and Serediale (2006) are clean water indicators as studies have shown that they tend to disappear in polluted waters. On the other hand, Bellinger and Sigee, (2010) describe *Fragilaria* spp. as pinnate diatom found in oligotrophic water and tends to be broader in girdle view. They give a more rectangular cells closely linked along their axes touching along entire length.

Furthermore, opportunistic *Microsystis* as explained by Huynh and Serediale (2006), Belliger and Sigee (2010) are known to be persistent in water due to their morphological structure of 2.5-6µm in diameter and possession of gas vesicles that allows their buoyancy in water supplies. They further maintained that, they clog filtration system in treatment water works and bottle water industries. They produce toxins such as mirocystins and lipopolysaccharides in water.

These identified species of algae are known to be problematic and cost effective in the treatability of drinking water industry. However, regular maintenance of water filters as emphasized by WHO (2004); NAFDAC (2018) avoid the clogging of water filters. It in turn enhances the acceptability of water on the part of consumers in terms of odour and taste. The findings of the research was in line with the study of Liee (2011) in South Africa who found that certain species of algae growing in the bottled water could be attributed to prolonged storage condition under elevated temperature

**CONCLUSION**

It was observed at the end of the study that, some bottled water sold in Kano metropolis contained variable characteristics in terms of physical and biological qualities. An inefficient and poor labeling content characteristic is a violation of the standard. Presence of biological contaminants of *Flagillaria spp.* and *Ankistrodesmus* hinders its aesthetic and acceptability qualities in terms of odour and taste .

**RECOMMENDATIONS**

The following recommendation if properly managed will improve the quality of some bottled waters

a) Algal load can be controlled by effective implementation of WHO water safety guide lines from the catchment source to the consumer. For example water treatment method such as ozonation before bottling as well as creating public enlightenment to retailers to avoid poor and longer storage of bottled water under elevated sunlight.
b) Further research should include the raw water source, as the number of the bottled water manufacturing companies is increasing most especially during the hot season. This is in order to determine the actual point of contamination of the water, so as to compare and contrast the point source of contamination between the raw water source before and after bottling

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