ASSESSMENT OF POTABLE WATER QUALITY CONTROL CHECKS IN THE GAMBIA

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ABSTRACT

This study looked at potable water quality control checks, specifically with regards to locally produced bottled water in The Gambia. Questionnaires were distributed to the Food Safety and Quality Authority and seven out of eight existing bottled water producers in The Gambia. The surveyed companies used four different methods of disinfection. All the companies used boreholes as their source of water. The Food Safety and Quality Authority carries out a satisfactory level of inspection of the surveyed companies, which in turn generally comply with the standards. There is need for a comprehensive pesticide analysis in potable water in The Gambia. *[African Journal of Chemical Education—AJCE 14(3), July 2024]*

INTRODUCTION

Potable water is water that is fit for human consumption; this also implies that it has undergone certain processes that would remove pollutants, viruses, bacteria, etc. This definition is according to the Water Education Foundation, 2023[1]. Potable water meets standards set by regulatory authorities. These standards pertain to safety and quality related matters. In The Gambia, the regulatory authority in charge of this is the Food Safety and Quality Authority of The Gambia (FSQA). In a study by Mbenga *et al*, 2023 in The Gambia, four different bacteria species was found in four out of a total of twenty differently branded bottled water samples [2]. This was a baseline study that involved testing only one sample of each brand of bottled water, and this current study is to supplement the findings from that study.

In The Gambia, there are regulations pertaining to water quality parameters for potable water. There are two bodies responsible for this regulation: Food Safety and Quality Authority and the Public Utilities Regulatory Authority. The latter uses standards that are developed by The Gambia Standards Bureau. All-in-all, the standards are mandatory and enforceable. This study is a follow-up study. A concern for this study is the effectiveness of FSQA regulatory/enforcement measures to ensure the relevant standards and/or regulations are adhered to.

The bacteria species detected by Mbenga *et al* (2023) were *Micrococcus luteu*s, *Micrococcus terreus*, *Herbaspirillum huttiense*, and *Ralstonia pickettii* [2]. The water samples were coded, (according to ethical standards) to keep the identity of the water companies confidential. Further to the study, only nine out of the twenty different samples were found to be within the acceptable pH range, set by the World Health Organization, WHO [2]. However, in the national standard for portable drinking water, the pH range is 6.5 to 8.5. Furthermore, 15% of the samples showed growth after 24 hours. This increased after 48 hours with 20% showing growth. According to WHO (2003), standard drinking water must not contain pathogenic bacteria.

Statement of the Problem

In the research carried out by Mbenga *et al* in 2023, microbes were detected in all twenty brands of bottled water sold in The Gambia [2]. The results are quite worrisome because of consumers. The presence of microorganisms in the afore-mentioned study is an indication of potential loopholes in bottled water quality control checks in the country. It also puts into question the effectiveness of the said control checks. How safe is the bottled water sold in The Gambia?

Not much is known about the quality of potable water particularly bottled water in The Gambia as not much research has been done in this area. This research seeks to investigate the quality control

checks carried out at local bottled water production companies by FSQA in the country, and to relate this to the results in the study carried out by Mbenga *et al* (2023) [2].

Aims and Objectives of the Study

This is to ascertain the kinds of potable water quality control checks implemented at bottled water companies and the effectiveness of enforcement actions by the FSQA in The Gambia.

Significance of the Study

This study is being conducted to assess the quality control checks implemented by bottled water companies and the effectiveness of regulatory measures done by FSQA on bottled water manufacturing companies and to determine whether they meet internationally accepted standards as well as locally set standards. The results will provide much-needed information on how water is treated and what water quality parameters such as pH, bacteria, taste, and odor are tested.

Research Questions

This study seeks to answer the following research questions: -

1. Do businesses that deal with potable water in The Gambia carry out quality control checks on the water they sell?
2. What potable water quality control checks are carried out by companies that produce potable water in The Gambia?

3. Does the Food Safety and Quality Authority of The Gambia inspect establishments that produce and/or sell bottled (potable) drinking water in The Gambia?

Scope and Delimitation of the Study

This study deals with potable water in plastic bottles sold in The Gambia. These are of different brands; locally produced and imported. Potable water in sachets (plastic bags) is no longer available in The Gambia. This is because ex-president Yahya A.J.J. Jammeh banned the use of plastic bags across The Gambia in 2015 and this banned is still enforced by the National Environment Agency.

The researchers in this study looked at the quality control checks carried out by FSQA inspectors and the bottled water manufacturers themselves, and the availability of equipment and materials for the testing of water quality parameters. The study, however, will not consider imported bottled water brands. This research took place in the urban areas of The Gambia where most of the population resides. There are no bottled water companies in the rural areas of The Gambia registered with FSQA.

METHODOLOGY

Survey and questionnaires were used to gather data for this study. The local bottled water manufacturers of the locally produced bottled water tested by Mbenga *et al*, 2023 were targeted in this survey. A total of 7 local bottled water manufacturers participated in this survey and questionnaires were given to laboratory experts at the said companies to investigate the efficiency of the quality control checks, if any, that they carry out. A noteworthy point is this: the contact person at each laboratory might not be very conversant with the process controls; a production/operations manager would. A questionnaire was also given to an FSQA inspector to provide insight into the frequency and the way the inspections are carried out.

The Design of the Survey

Questions on the source of the water used and availability of instruments to check water quality parameters were included. The fundamental questions about water quality control aimed to obtain information about the extent to which these bottled water manufacturers go to ensure their products meet water quality standards in Table 1.2.

The questionnaire taken to FSQA included questions on the frequency of their visits and inspections to potable water producers and the methods used to test for contaminated water. The

responses obtained from this questionnaire were compared to the responses given by laboratory experts and managers of the bottled water companies.

A sanitary site inspection was conducted for each company visited.

Samples of both questionnaires are displayed below.

PORTABLE WATER QUALITY CONTROL CHECKS IN THE GAMBIA
QUESTIONNAIRE FOR FOOD SAFETY QUALITY AUTHORITY, FSQA

This research pertains to potable water quality checks carried out by the FSQA with regard to bottled water sold in The Gambia. ***All responses to this questionnaire will be kept confidential.***

1. Do you have materials/instruments required to check potable water quality parameters?

   ☐ Yes

   ☐ No

2. Do you as an Agency routinely visit potable water producers?

   ☐ Yes

   ☐ No

3. If yes, how often?

   ……..

4. Does your inspection involve testing for potable water quality parameters?

   ☐ Yes

   ☐ No

5. Do you check if the water is contaminated?

   ☐ Yes

   ☐ No

6. If yes, how do you check?

   ……
   ……
   ……
   ……..

7. If no, why?
   ……
   ……

8. Have you ever had to stop the sale of a batch of water because the batch did not meet the water quality standards?

   ☐ Yes

   ☐ No

PORTABLE WATER QUALITY CONTROL CHECKS IN THE GAMBIA
QUESTIONNAIRE FOR BOTTLED WATER COMPANIES IN THE GAMBIA

All responses to this questionnaire will be kept confidential.

1. What is the source of the water you use?

   ……..

2. Do you carry out water quality control checks?

   ☐ Yes

   ☐ No

3. If no, why?
   ……
   ……
   ……

4. If yes, list the water quality parameters that you check before selling the bottled water to the public.
   ……
   ……

5. Do you have materials/instruments to carry out all the water quality parameters you have listed?

   ☐ Yes

   ☐ No

6. Do you check for pesticide residues in your water?

   ☐ Yes
   ☐ No

7. If yes, what pesticides have you been able to detect?

   ……
   ……
   ……

8. If no, why?

   ……
   ……

9. Do you store data on water quality control checks?

   ☐ Yes
   ☐ No

10. Does the Food Safety and Quality Authority, FSQA visit your premises?

    ☐ Yes

    ☐ No

11. If yes, how often?

    ……..

12. When was the last time an FSQA official visited your company?

    ……

13. Do you disinfect the water you sell?

☐ Yes

☐ No

14. If yes, how do you do it?

……
……

15. If no, why?

……
……

16. Have you ever had to stop the sale of a batch of water because of not meeting water quality standards?

☐ Yes

☐ No

17. If yes, what was done to the batch?

……
……

Sampling

The Gambia is a very small country, and the number of local bottled water companies are few. Mbenga *et al* sampled 20 branded bottled waters; 12 were imported and 8 were locals. Seven bottled water companies took part in this survey; meaning that only one did not. The only one that did not, could not be reached. This study intended to survey all bottled water companies sampled by Mbenga *et al*, 2023. The researchers in this study are of the considered opinion that seven companies surveyed out of eight existing companies are a good representation of the existing bottled water companies in The Gambia.

RESULTS AND DISCUSSION

After closely observing the production site of each company, it was found that the hygienic conditions were on average satisfactory. At the time this study took place, it was rainy season in The Gambia. There were a significant number of puddles and mud just outside the entrance of some of the companies. The water production sites and the laboratories, however, were free of mud and dirt. The workers wore full shoes and hair nets. The production sites were well-lit and ventilated. The laboratories were equipped with the necessary chemicals and laboratory equipment. One

laboratory was well-organized with batches of bottled water samples and calibrated beakers neatly arranged on a bench.

All seven companies reported that boreholes are their source.

FSQA confirmed that, during full audit inspections, the monitoring records of the companies' inquisition are reviewed, and when necessary, samples are collected for testing (based on relevant safety and quality parameters). Chlorination was proven to be the most common method for disinfecting water with 4 out of the 7 companies (57.1%) claiming it as their method of disinfection. Only 3 companies mentioned different means of disinfection. An additional noteworthy piece of information is that fact that the personnel who provided this information might not be very conversant with the processes that take place at the companies. The important thing here is the fact that the water sold to the public is disinfected. Company D uses both ozone and ultraviolet radiation, and Company B uses both ozone and osmosis to disinfect their bottled water Figure 1. Chlorine has been banned in some countries, as a means of disinfecting potable water due to formation of toxic byproducts when it reacts with organic matter in water.

FSQA stated that the frequency of their inspections is dependent on the risk ranking of the establishment type and the compliance history of the company in question. All the companies confirmed the frequent and regular inspections of FSQA inspectors. This is commendable.

According to companies B, E and F, FSQA inspections occur every 2 months while companies A and D claimed they occur every 3 months. Company C, however, placed the frequency of these inspections at every 4 months.

Regarding the disposal of batches of water that do not meet the set water quality standards, Companies B and D mentioned that the records are consulted to locate the buyers or distributors and the bottles are recalled and replaced with requirement-meeting batches of bottled water. The other companies described similar approaches while Company A claimed to have never had to deal with stopping the sale of a batch of water due to subpar water quality. According to the FSQA Act, 2011, "food business operators shall have documented traceability and recall system to facilitate the recall of non-compliance products''. The data on disposal of batches of water that do not satisfy the set water quality standards is in full compliance with the FSQA Act. This is laudable.

All seven bottled water manufacturers claimed they routinely check for water quality parameters and for pesticides but were, however, unable to identify pesticides they had detected. The limit of pesticides in The Gambia is 0.1mg/L. There are a lot of pesticides in use and present in water. It is almost impossible for one to begin to catalogue all of them with their respective limits; hence, the use of a single standard in The Gambia: 0.1mg/L. One wonders if there is need for some form of pesticide analysis of bottled water sold in The Gambia. The researchers in this study would

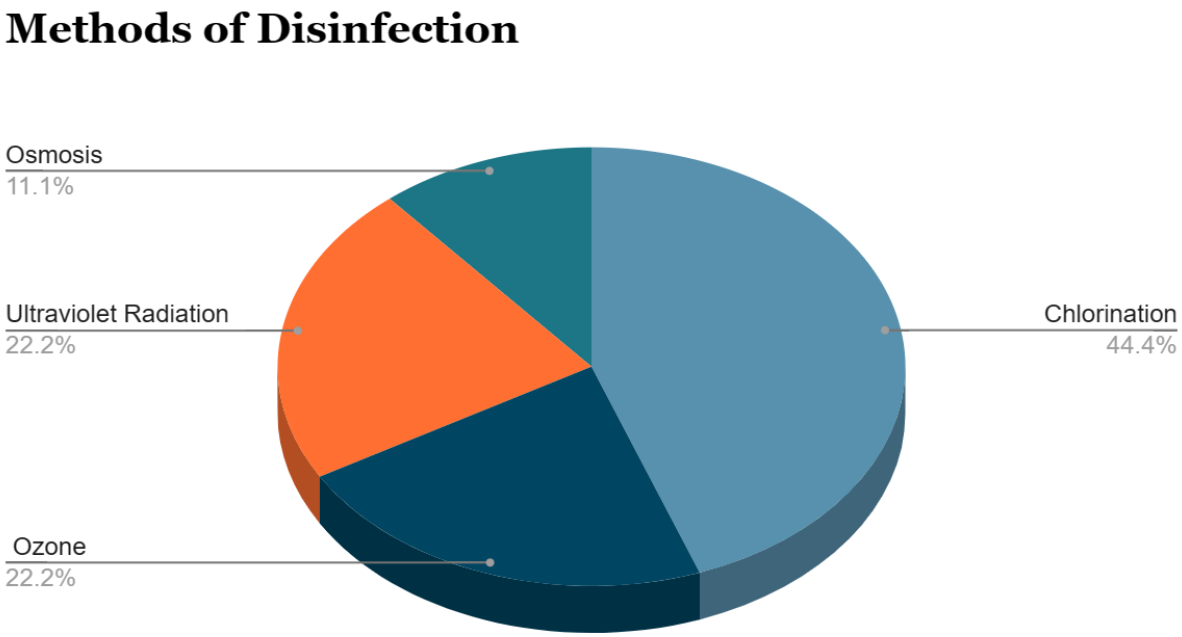
advise that pesticide analysis of the most commonly used pesticides in The Gambia could be carried out. A study in Dakar, Senegal confirmed the existence of pesticides in water. According to Isselmou *et al*, 2012, maneb and propanil were found in surface and ground-water samples in Dakar, Senegal [3]. They had percolated through the soil. Senegal and The Gambia co-exist in the same region, the Senegambia Region. Everything that can be found in Senegal potentially also exists in The Gambia. One could speculate that the two pesticides also exist in The Gambia. This speculation was partly verified by the Registrar of Hazardous Chemicals and Pesticides, when it was confirmed that maneb exists in The Gambia.

Table 1 Responses from Bottled Water Companies in The Gambia

Company Codes	**Source of Water**	**Parameters Tested**	**Method of Disinfection**
A	Borehole	pH, TDS, EC	Chlorination
B	Borehole	pH, turbidity, taste and odour, colour, TDS, nitrate ions, chloride ions	Ozone, osmosis
C	Borehole	TSS, TDS, pH, taste and odour, iron	Chlorination
D	Borehole	pH, EC, TDS, odour and taste, iron, nitrate ions, temperature	Ozone, Ultraviolet radiation
E	Borehole	pH, colour, taste and odour, TDS, iron	Ultraviolet radiation
F	Borehole located at Kotu	pH, EC, microbes, TDS, TSS, Iron	Chlorination
G	Borehole	pH, colour, taste, TDS, iron	Chlorination

TDS – Total dissolved solids, TSS – Total suspended solids, EC – Electrical conductivity

Figure 1



Effectiveness of Water Quality Control Checks

Companies F and D claimed to conduct pest controls at least once a week. All the companies claimed to conduct water quality control checks regularly. This can be considered consistent with the findings of Mbenga *et al*, 2023 who, after conducting microbial and physicochemical tests on 20 bottled water samples, found that a large proportion of the samples (80%) were free of microorganisms.

The regularity of FSQA inspections is dependent on the compliance history of the respective companies suggesting that companies with less frequent visitations, such as Company C, have a good record of meeting water quality standards. This is also commendable and consoling for The Gambia public to know.

Water Quality Control Checks *vis-a-vis* Physiochemical Parameters

According to Mbenga (2023), 11 out of 20 water samples had pH well below 6.5, which is the lowest permissible pH for drinking water (WHO, 2022) [2]. All seven water companies that participated in this survey claimed to test the pH of their water on a regular basis, see table 1.

All seven companies claimed to regularly test for TDS. This is consistent with the findings of Mbenga (2023) who discovered that 95% of the samples were well below the TDS standard limit of 1000 mg/L provided by WHO. The Gambia national standard for TDS is 500mg/L. While four

companies failed to mention EC as a water quality parameter that is considered during production, all seven companies claimed to regularly test for TDS.

CONCLUSION

After physically visiting the bottled water production sites, it can be concluded that a good number of companies have suitable equipment to produce safe drinking water. Staff were well-dressed in hair nets and gloves, and the laboratories visited were organized and clean.

This, of course, does not take away from the fact that some bottled water brands were contaminated with microorganisms, according to Mbenga *et al*, 2023 [2].

RECOMMENDATIONS

1. There is a need for FSQA to enhance pesticide analysis of bottled water sold in The Gambia.
2. It is necessary for water quality control checks to be carried out on imported brands. It is not acceptable to assume that they meet the required standards, even if they are known and respected brand names.

IMPLICATIONS FOR CHEMICAL EDUCATION

1. Water quality parameters should be included in undergraduate chemistry curriculum, with special emphasis on potable water because it relates directly to health.
2. There is need for farmers to be educated on the best way to use pesticides and to be made aware of the fact that pesticides can pollute water. Furthermore, farmers need to be sensitized about the environmental damage that pesticides inflict.

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ETHICAL ISSUE

Authors are aware of, and comply with, best practice in publication ethics. Authors adhere to publication requirements that submitted work is original and has not been published elsewhere in any language.

Authors' contribution

All authors of this study have a complete contribution for data collection, data analyses and manuscript writing.

REFERENCES

1. Portable water (2023). Water Education Foundation. Retrieved from: http://www.watereducation.org/aquapedia-background/potable-water
2. Mbenga, I. (2023). Microbial quality of bottled water sold in The Gambia. [BSc Published Thesis, University of The Gambia]
3. Isselmou, O.H., Diop, C., Sarr, D., Mbaye, M., Cisse, L., Mbaye, A., Gaye-Seye, M.D., Coly, A., Delattre, F., Oyelakin, O., Tine, A. (2012) Environmental aspects of the photodegradation of Maneb and Propanil in various media *International Journal of Chemistry*, 4, 7, https://doi.org/10.5539/ijc.v4n1p50