29th WEDC International Conference Abuja, Nigeria, 2003

TOWARDS THE MILLENNIUM DEVELOPMENT GOALS

Quality of sealed polythene water in Kaduna and Lagos

O.O. Oni Okanlawon and F. Olayeni (Miss), Nigeria

THE SEALED POLYTHENE packaged water otherwise called "Pure water" began over ten years ago in order to provide safe drinking water to the public. This was due to the lack of access to potable water by a good majority of the public and the inability to afford the price of bottle drinking water. Packaged `Pure water' is usually regarded as a cottage industry that meet the needs of the low income group mostly peri-and urban dwelling.

The proliferation of such outfits has necessitated the regulation and control by the National Agency for Food and Drugs Administration and Control, (NAFDAC) in order to make them comply with potable water requirement for drinking by the general public. Registration numbers are now issued for approved producers. Prior to the Government regulation and enforcement procedures, the industry has become an all comers affairs who are only interested in the commercial gains without due regard to the health of the people. The demand for 'pure water' is very high from travelers at motor parks and train stations because of high human traffic. Also in some towns the quality of the water supplied from the public water stand pipes by the Water Board are turbid making the consumers not to trust the wholesomeness of the water. The very little attention paid to the aesthetics quality of water has encouraged people to have more confidence in 'Pure water' and bottled water.

This study is a preliminary study to first of all establish a working basis for assessment of water quality. It involves an evaluation of randomly selected sample of twenty brands from different producers at three(3) interval of time within the sampling months (i.e the three samples constitute a batch No. for that producer). Summarized results of the 3 samples for each producer were presented as a batch in the table I and II. Key parameters for physico-chemical analysis and bacteriological examination of the 'Pure water' samples were determined to find out the wholesomeness of the water. During the course of the study, visits were made to two of the producers to see their outfit production process and recognise potential pitfalls that might contaminate the 'Pure water' products.

Materials and methods

Sampling and collection of samples

Random samples for 500mls sealed sachet of packaged pure water were collected for analysis.

In both Lagos and Kano metropolis, samples of different brands were purchased at diverse locations of motor parks, toll gates and markets with codes allocated for each brand and location of purchase. The study was conducted over the months of December to April, the critical months of the dry season when the need for cold drinking water is in high demand due to the dry season environment.

The result of analysis for bacteriological and physico-chemical examination is influenced by sample collection, storage and method of assessment. Collected samples were collected and refrigerated overnight and analysed within 48 hours maximum.

Analysis of water samples

The pH was measured with pH meter (Endress + hauser, PM 8) and the turbidity was measured by the Turbiditimeter (HACH Turbiditimeter 2100 P). The conductivity was measured by the Conductivity meter (Endress + Hauser, LM 8) HACH. Digital spectrophotometer (DR 2010) was used to determine sulphate while hardness alkalinity and chloride were determined by titration method.

In the Bacteriological assessment, 100 mls of the water sample were filtered through a membrane filter of 0.45 :m.

The filter retaining the micro-organisms is then placed on a selective medium containing lactose which has been sterilised. It was placed out the nutrient absorption pads. Duplicates of each sample were made, one sample was incubated at 37^{o}c for total coliform count and the other incubated at 44^{o}c for faecal coliforms using M Endo and MFC broth respectively for a period of 24 hours (WHO, 1984). Preparation and selection of the media were based on established method of APHA (1971) Colony counter was used to count the colony shown on the plate. The organism count is rated per100ml of sample.

Results

Physico-chemical parameters results of pure water for selected samples in Lagos and Kaduna.

The results for Batch of samples 1 - 10 are from Lagos while Batch of samples 11 - 20 are from Kaduna. The taste and odour were generally acceptable. The guide line value for colour is 5 Hazen units. 2 samples from Lagos (Nos 1 and 10 as well as No. 17 in Kaduna) exceeded the lower limit (i.e 15, 16 and 10). However they still lag behind the maximum 50 Hazen Units (WHO, 1984). The observed pH ranges from 6.8 - 7.40 which is within the guideline value of 6.5 - 8.5.

Turbidity measure ranged from 0.86 - 5.52 NTU which conforms with the 5.0 NTU guideline value. Except for

sample 10, all other samples were below 3.5 NTU. Total dissolved solids ranged from 32 - 109 mg/l which is far below the guideline value of 1000 mg/l.

Total Hardness ranged from 16 - 140mg/l but still within the guideline value of 500mg/l . Sulphate ranged from 0.00 - 9mg/l as against the guideline value of 200mg/l. The Chloride ranged from 58 - 360mg/l. All the values except sample 14 were all below the guideline value of 200mg/l, however the maximum permissible limit is 600mg/l for chloride.

The obtained alkalinity level of 8 - 32mg/l were observed to be acceptable. The Nitrate concentration ranged from 0.00 - 0.6mg/l as against the guideline value of 45mg/l. Overall the water samples met reasonable and acceptable physico-chemical requirements for drinking water, but will need to meet the microbiological requirement before it can be regarded as potable.

Bacteriological results

From Lagos: The ten batchs observed had 7 or 70% with faecal coliform present. One batch has coliform above the limit without faecal coliform, this is unacceptable. Only one batch of sample had just one total coliform and no faecal coliform. 80% of the batch of samples did not meet the required drinking water quality.

From Kaduna: The ten batch of samples observed had 5 or 50% with faecal coliform present and 5 or 50% without faecal coliform and even four had zero total coliform. 50% of the batch of samples did not meet the drinking water quality requirement.

Manufacturing plant visit observations

Two manufacturing plants were visited in order to see how the companies are complying with the NAFDAC requirement and the implication for the production quality observations/short comings were noted.

i. Adequate space was not provided according to NAFDAC design specification to control contamination and overcrowding workers.
ii. The handling by the staff was deficient in neatness, hygiene and industrial care usually demonstrated by the use of white face mask and white coat.
iii. No schedule of NAFDAC Inspectors visit to monitor the water quality after registration and/or check the compliance by the producers on regular basis.
iv. The filter change schedule seems to be compromised as it is allowed to clog before it is removed.

Discussion of results

The physico-chemical result showed the water met the specified guideline requirement of NAFDAC and WHO. They also met the general aesthetics quality requirement. Mendie, (1992) reported that even when the chemical components have been maintained within acceptable limits, the microbiological quality of drinking water is of paramount importance.

In both the NAFDAC (2001) and WHO (1984) guideline, drinking water will not always be absolutely pure but it must not contain pathogenic contaminants particularly those linked to faecal contamination. Out of the Lagos samples, 90% were contaminated with E. Coli and in Kaduna 50% were similarly contaminated. The independent 't' test of significance was performed on the two sets of data. The analysis for all the 20 samples were all considered in a single stretch since the number of analysis do differ when a particular set of observation was considered.

Table 1. Result of bacteriological analysis by membrane filter technique of ramdom samples from Lagos

S/N	BATCH CODE	AVERAGE NO OF COLIFORM PER 100 ml	AVERAGE NO. FAECAL COLIFORM PER 100 ml	CONFIRMATION GUIDELINE LIMIT FOR WATER STANDARD T.C 10/100 ml E. COLI 0/100 ml	COMMENT
1.	BEC	3	1	Not acceptable	E. Coli present
2.	W.A.S	5	3	Not acceptable	E. Coli present
3.	TYH	20	0	Not acceptable	Coliform above 10
4.	DSG	1	0	Acceptable	Good water
5.	SNW	2	1	Not acceptable	E. Coli present
6.	ZPL	4	2	Not acceptable	E. Coli present
7.	FMS	3	1	Not acceptable	E. Coli present
8.	SLS	0	0	Acceptable	Good water
9.	PVC	4	2	Not acceptable	E. Coli present
10	KMT	8	5	Not acceptable	E. Coli present

Table 2. Result of bacteriological analysis by membrane filter technique of random samples from Kaduna

S/N	BATCH CODE	AVERAGE NO. OF COLIFORM PER 100 ml	AVERAGE NO. FAECAL COLIFORM PER 100ml	CONFIRMATION GUIDELINE LIMIT FOR WATER STANDARD T.C 10/100 ml E. COLI 0/100 ml	COMMENT
11.	CRT	5	0	Acceptable Within the range	Good water
12.	OLN	0	0	Acceptable	Good water
13.	APX	0	0	Acceptable	Good water
14.	KLN	2	1	Not acceptable	E. Coli present
15.	TP	5	2	Not acceptable	E. Coli present
16.	BST	10	7	Not acceptable	Polluted water
17.	RBO	4	2	Not acceptable	E. Coli present
18.	MRK	0	0	Acceptable	Good water
19.	LFN	14	1	Not acceptable	Polluted water
20	LNG	0	0	Acceptable	Good water

The t test statistical analysis show that at 95% level of significance, the caculated Z value for Lagos and Kaduna are 1.865 and 1.742 respectively at 18 degrees of freedom. This shows that there exist a significant difference between the samples analysed and confirm departure from the accepted stnadard.

Conclusion

The report of confirmation contamination observed shows comparable result to that of Mendie(2002), which found contamination of 5-200 coliforms/100ml from 10 producers studied. He concluded that "the most significant factor responsible for contamination is non adherence of manufacturer to Good Manufacturing Practice (GMP). GMP is defined as part of quality assurance which ensures that products are consistently produced and controlled to the quality standards appropriate to their intended use and as required by product specifications (NAFDAC, 2001). GMP guidelines are used to eliminate or demolish the risks inherent in any production that cannot be prevented completely through the testing of final products. Under GMP, quality is built into a product and not just tested for in the finished product (NAFDAC). Other factors include poor state of the manufacturing environment, dirty filling equipment, contaminated packaging materials, unhygienic handling of the products and lack of microbiological in -house controls. The failure of the various tiers of government to provide clean, clear and portable water for the populace has led to the commercial pure water producer to fill the vacuum. The above study establishes that a significant proportion of water being sold are not potable.

Pure water production needs supervision, control and regulation. Quality control is imperative to avoid backyard and one room producers holding sway at the expense of public health. The insuiance of NAFDAC registration number for a product should only be a first step towards compliance, other factors such as periodic change of filters, quality control, sanitation and hygiene, qualified personnel, documentation and clean operating equipment must be ensured by NAFDAC inspectors for appropriate corrective action. Monitoring efforts should also be focussed on storage/shelf life determination as well as the leaching test on PVC packaging materials.

References

Mendie, V. (2002) " Cyclical growths of contaminants in drinking water packaged in polythene bags", Nigerian Journal of Pharmacy vol. 33, Abuja, Nigeria.

National Agency for Food and Drug and Administration and Control, (NAFDAC 2001) NAFDAC Consumer Safety Bulletin, Abuja, Nigeria.

World Health Organisation (WHO, 1984) Guide lines for Drinking Water Quality Recommendations, Vol.I (WHO) Geneva.

Okanlawon O.O. Oni is of Water and Environmental Science, National Water Resources Institute, Kaduna.

Olayeni F. (Miss) is a collaborator on the study.

OKANLAWON O.O. ONI and OLAYENI F. (MISS)
(okanlawononi@hotmail.com)
Department of Water and Environmental Science, National Water Resources Institute, Kaduna.