GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES VOL. 7, NO. 3, JUNE 2001:513-515

APPLICABILITY AND RELIABILITY OF WORLD HEALTH ORGANISATION SANITARY SURVEY (SS) METHOD IN BOREHOLE WATER QUALITY ANALYSIS IN UYO

B. B. ETANG

(Received 8 August 2000; Revision accepted 27 November 2000)

ABSTRACT

The quality of water obtained from boreholes in Uyo was determined using both the Standard bacteriological analysis (BA) and the WHO Sanitary Survey (SS) methods. A total of 58 boreholes were examined. Total heterotrophic microbial counts (TMC) of $2.3 \times 10^2 - 2.5 \times 10^5$ cfu/ml and coliform counts of 0-150 coliforms/100ml were obtained; while the SS analysis showed risk scores of 0-6 on a 13 point scale. No wells showed gross and dangerous pollution by both methods, and in most boreholes, the BA results agree with the SS scores except in a negligible number (5.2%) of cases. This high level of agreement between the two methods show that the SS method is highly reliable (94.8%) and with adequate care could be used as an alternative to the conventional BA method to determine water quality where facilities are lacking for bacteriological analysis.

Keywords: [*water pollution, bacteriological analysis, boreholes, surveillance, coliforms.*]

INTRODUCTION

Water that is safe and free of all forms of pollution is a vital and indispensable resource for every individual and community. Serious consideration is therefore to be given to the determination of water quality. This is best achieved through analysis of bacteriological and physicochemical parameters, using WHO guidelines (1985). These methods are standard methods which have been in use in the more advanced countries for over a century now; but have not yet been fully adopted in most developing countries, e.g. Nigeria, long after the end of the water decade in 1990.

A WHO study group (Lloyd and Helmer, 1990), after several trials, successfully applied the surveillance method (WHO 1976) for use in small communities water supplies in Peru, Thailand and Indonesia (Lloyd and Suyati, 1989; Lloyd and Bartram, 1991).

Surveillance is defined as the continuous and vigilant public health assessment and overseeing of the safety and acceptability of drinking water supplies (Lloyd and Helmer, 1990). This method attempts the identification of possible sources of contamination depending on the water supply facility. To ensure safety of water supply facility there must be continuous inspection of the installation and environment where the water facility is located. This method was used along with the standard bacteriological method to test its suitability for use in our local situation.

No attempt has previously been made to compare the standard bacteriological method with the sanitary survey, in order to establish the suitability or reliability of the latter method, for possible application in rural areas where there are no facilities for standard analysis, this study is thus the first such attempt in Nigeria.

MATERIALS AND METHODS

Collection of Samples

Borehole water samples were collected at various locations in Uyo Metropolis directly from hand pumps into sterile 500ml conical flasks stoppered with cotton wool plugs and wrapped into aluminium foil. The pump was allowed to run for 2-3min before water sample collection. The flask was filled to the 250ml mark, the stopper replaced and transported to the laboratory for analysis within one hour of collection. Each borehole was sampled on three different occasions and analysed using standard procedures (Okafor, 1985; Opara, 1993; Itah et al, 1996). A total of 58 boreholes were surveyed and water samples from them analysed within the study period of 3 months (January – March, 1997).

Microbial Determinations

Total (Heterotrrophic) microbial count (TMC) and the coliform count were estimated using the standard plate count and the multiple tube techniques for coliform enumeration respectively. (APHA, 1985).

The Sanitary Survey Method

The sanitary survey (SS) method

B. B. ETANG, Department of Botany and Microbiology, University of Uyo, Uyo, Nigeria

assesses the overall risk of contamination of water sources by examining the facilities using a sanitary survey form (Lloyd and Helmer, 1990).

The form is in 3 parts. Part one contains general information on type of water facility, location, date of sample as well as the coliform grade. Part 2 consists of specific diagnostic information for assessment, example: location of possible contamination sources such as laterine, rubbish or stagnant pool within 10m of the hand pump. The condition of hand pump, whether loose on the point of attachment, or whether there are cracks on the cement floor around the hand pump. The results are scored on the 13 point scale.

Contamination risk score of 9-13 = very high; 6-8 = high; 3-5 = intermediate; 0-2 = low. The number of risk points was totalled to give the sanitary inspection risk score. Part 3 – Results and recommendations. When risk score was calculated, it was then used in grading the sample and then compared with the coliform count in order to assess whether water quality and risks identified by inspection are related. A total of 58 boreholes were sampled. The water samples analysed gave coliform counts between 0-150 coliforms/100ml. The coliform counts were used to classify the water into grades according to WHO guidelines (WHO, 1985) shown in Table 1.

Table 1: Classification of Water into grades based on Bacteriological and SS methods (WHO,1985)

Grade	Count/100ml (SS)	Risk
A	0(0)	No risk
B	1-10 (1-2)	Low risk
C	11-100 (3-5)	Intermediate to high risk
D	101-1000 (6-8)	Gross pollution, high risk
E	> 1000 (9-13)	Gross pollution, very high risk

RESULTS

The 58 boreholes were categorized according to depth, and the type of pump used. Deep wells with submersible pumps (DS); deep wells with hand pumps (DH), shallow wells with hand pumps (SH) and wells with no information on depth (NH).

Table 2 shows the bacterial counts and coliform counts for the different wells. The coliform counts for different wells showed that most of the wells had between 0-25, showing no risk/intermediate - high risk, with only few wells (22) having low risk/intermediate – high risk or gross pollution. There were no wells within category E by both methods.

Table 3 shows the relative results of the bacteriological method and sanitary survey method by comparing coliform counts with risk scores. The counts in well type A (20 wells analysed) showed intermediate risk both by coliform and SS methods. While well types C and D showed low to high risk by both methods.

Table 4 indicates that both bacteriological and sanitary survey methods did not show any sample or well with gross pollution with very high risk i.e. >1000 Coliforrms/100ml or SS 9-13 respectively. All samples were within no risk and very high risk in both cases.

Table 2: Bacterial Counts and Coliform Counts for the Different Wells

Well Type (No)	TMC. Cfu/ml	MPN Coliforms/ 100ml	Grade
DS (20)	$1.2 \times 10^2 - 2.4 \times 10^3$	0-23	A, B & C
DH (16)	$2.3 \times 10^2 - 3.5 \times 10^4$	0-25	A, B & C
SH (10)	$2.5 \times 10^3 - 2.3 \times 10^5$	4-150	B, C & D
NH (12)	$2.4 \times 10^3 - 3.1 \times 10^3$	25-123	C & D

Table 3: Comparison of Coliform Counts and Sanitary Risk Scores

Well Type (No)	Coliform/100ml	Risk Scores
DS (20)	0-23	0-6
DH (16)	0-25	2-6
SH (10)	4-150	2-6
NH (12)	25-123	3-6

Table 4: Combined Risk Score for Bacteriological Analysis and Sanitary Inspection of 58 Boreholes

Well Type (No. analysed)	No Risk No. (%)	Low Risk No. (%)	Intermediate to High Risk No. (%)	Very High Risk No. (%)
DS (20)	2 (10.0)	4 (20.0)	10 (50.0)	4 (20.0)
DH (16)	0 (0.0)	3 (18.75)	9 (56.3)	4 (25.0)
SH (10)	0 (0.0)	3 (30.0)	4 (40.0)	4 (40.0)
NH (12)	0 (0.0)	2 (16.6)	5 (41.7)	5 (41.7)
Total = 58	2(3.4)	12(20.7)	28(48.3)	17(29.3)

DISCUSSION

Drinking water quality can best be assessed by the bacteriological and physicochemical methods according to WHO (1985) recommendations. This study indicates that most wells in Uyo from which most households have their water supply are moderately contaminated considering the results of both bacteriological (BA) and sanitary survey (SS) analyses. Only a small number of wells 3.4% and 8.6% were free from contamination. No wells (0%) showed gross and dangerous pollution by both methods.

In a similar study on bacteriological analysis of water supplies in Calabar by Itah et al. (1996), similar results were obtained, with some wells showing very high bacterial counts and a few Nil coliform counts, which agree with the result of this study. However, this result differs slightly from the studies carried out by Adesiyun et al (1983), Alabi and Adesiyun (1986) and Agbu et al (1986) who reported gross bacterial contamination of private and public well supplies in Katsina, Zaria and Samaru all in Northern Nigeria. The latter studies were however carried out on open wells, which could be responsible for the poor quality observed.

By examining the faecal grading together with the sanitary inspection risk scores for a number of facilities, it was possible to assess the reliability of the latter method. Results obtained show an agreement between the two methods.

The SS method is not complete without the recommendations of what remedial actions should be taken depending on the level of risk, thus a no risk score requires no action while low risk requires low priority and intermediate to high risk requires higher priority for improvement of facilities. But the very high risk requiring highest priority for urgent action were not found among the samples. This result agrees with previous studies in Java by Lloyd and Bartram (1991).

The SS scores agree with the BA scores except in 5.2% of the cases, thus showing a high agreement between the two methods. This high level of reliability means that the SS method could be a good alternative where facilities for bacteriological analysis are lacking, in rural areas and even in urban areas like Uyo where private owners operate boreholes on commercial basis. This method is cheaper, easier and simpler to carry out. However, the bacteriological testing may not be discarded since the SS cannot detect remote pollution from underground sources but rather the introduction of the SS method for use in Nigerian situation will serve as a good alternative for testing water quality from time to time after initial bacteriological testing.

There may however be need for enlightenment and mobilization of potential beneficiaries by the relevant government agencies, departments and organizations, for the successful application of this method.

REFERENCES

Adesiyun, A. A.; Adekeye, J.O.; Umoh, J.U. and Nadarajah, M., 1983. Studies on Well Water and Possible Health Risks in Katsina, Nigeria. Journal of Hygiens 90: 199-201.

Agbu, A.A.; Alaribe, H.C.; Singh, K. and Adesinyun, A.A.,1988. Bacteriological Studies and Chemical Analysis of public well water in Samaru and Zaria City in Northern Nigeria Nigeria Journal of Microbiology 8 (1-2): 88-98.

Alabi, D.A. and Adesuyin, A.A., 1986. Studies on the Microbiological quality of filtered water in house-holds of a University Community. Journal of Hygiene 96 239-248.

American Public Health Association. 1985. Standard methods for the examination of water and waste water (14th Ed.) American Public Health Association Washington.

Itah, A. Y; Etukudo, S.M and Akpan, E.J., 1996. Bacteriological and Chemical analysis of some rural water supplies in Calabar, Nigeria. West African Journal of Biological and Applied Chemistry 41: 1-10.

Lloyd, B. and Helmer, R., 1990. Surveillance of drinking water quality in rural areas. Longmans. London.

Lloyd, B. and Bartram, J. 1991. Surveillance solutions to microbiological problems in water Quality Control in developing countries. Water Science and Technology 24 (2): 61-75.

Lloyd, B. and Suyati, S. 1989. A pilot rural water Surveillance project in Indonesia. Waterlines 7(3): 10-13.

Okafor, N. 1985. Aquatic and Waste Microbiology Fourth Dimension Publishing Co. Ltd. Enugu, Nigeria, p.107.

Opara, A.A. 1993. Assessing anaerobic enteric bacteria as indicators of faecal pollution in tropical waters. Tropical Freshwater Biology 3:309-318.

WHO 1976. Survelliance of drinking water quality. WHO Monograph No.63. Geneva.

WHO 1985. Guidelines for Drinking Water Quality Control in small communities. Vol.3 World Health Organisation, Geneva.