ORIGINAL ARTICLE

Bacteriological Analysis of Protected Springs in Jimma Zone, Southwestern Ethiopia.

Worku Legesse, MSc[1] and Kebede Faris, MSc[1]

ABSTRACT: ***Sixteen springs in Jimma zone, Southwestern Ethiopia were studied to investigate their bacteriological safety for drinking water. Four protected springs in Agaro, three in Jimma and two in Asendabo towns were found to be unacceptable. All protected springs in Shebe were classified as bacteriological acceptable. Failure of achieving a safe water supply appears largely attributed to the lack of post-construction disinfection and a lack of effective mechanisms for follow-up and maintenance after construction has been completed. Open sewage systems in bigger towns such as in Agaro were found to percolate adjacent to some springs and appear to be the major sources of contamination in these poorly maintained water supply systems. In smaller towns, absence of diversion ditches, and poor drainage systems around the protection box were implicated as contributing factors to water quality deterioration. These findings highlight the fact that contamination of drinking water at the source, coupled with its further deterioration at home due to poor storage practice, may lead to increased potential risk of morbidity to consumers. Subsequently, efforts to increase safe water supply coverage and the resultant reduction of the hazard of contracting waterborne disease in the zone will not move forward, and in the worst scenario even may be reversed. Therefore, this study calls for periodic surveys of all protected springs in the zone so that the health benefits may be substantial.***

INTRODUCTION

Because of the essential role water plays in supporting human life, it has if contaminated, great potential for transmitting a wide variety of diseases and illnesses (1). Microorganisms like bacteria, protozoa and viruses are transmitted by fecal-oral routes and so largely arise either directly or indirectly by contamination of water resources by sewage or on occasions, by animal waste (2). Although this would be due to provision of efficient water supply and waste disposal system, about 80% of all illnesses in developing countries such as Ethiopia are water-related (3). This frightening extent of morbidity in the later has been recognized by WHO as a major health issue for which the General Assembly of the United Nations formally declared 1981-1990 as the International Drinking Water Supply and Sanitation Decade (IDWSSD) (4). Evaluation since 1990 shows that the 38 countries in Africa for which information on water supply was available, only 7 water sources are used periodic sanitary surveys of the raw water. The survey should include countries had a coverage level of

[1]*School of Environmental Health, Jimma Institute of Health Sciences, P.O. Box 378, Jimma , Ethiopia.*

75% while 14 countries had less than 50% coverage (5) indicating that the decade's efforts did not even come close to the goal. Ethiopia has one of the worst health status in the world due to poor socioeconomic development resulting in a low standard of living, poor environmental conditions and inadequate health services (6). Similarly, the number of population having access to a safe water supply is 47% and 28% for urban and rural areas respectively, which is among the lowest even in the continent (7). If the trend remains unchanged, it has been predicted that by the year 2000 some 755 million people will remain without a safe drinking water supply and nearly 86% of these people will be in rural parts of Africa (5). Therefore, in the face of this poor background of socioeconomic conditions and rapid population growth unprecedented level of effort is needed by developing countries, such as Ethiopia, to make real progress towards universal access to a safe and adequate drinking water supply.

Efforts in drinking water protection and increasing coverage have been witnessed in Ethiopia. On the other hand, follow-up records on their bacteriological safety are virtually non-existent. Jimma zone is one of the beneficiaries of a scheme of providing a safe water supply by governmental and non-governmental organizations. Among the governmental institutions, Jimma Institute of Health Sciences plays a great role in supplying clean water through spring protection as part of the community based training program. Although a number of springs have been protected in the zone, the bacteriological safety of the springs has not been documented.

It has been suggested that for large water supply systems, it should be a routine activity to sample water daily at each stage of treatment. In situations where untreated an on-site inspection and evaluation of the water supply system, and a bacteriological analysis of the water.

The purpose of this study is therefore directed towards evaluating the bacteriological quality of protected springs in Jimma zone using bacteriological analysis methods in the environmental health laboratory.

MATERIALS AND METHODS

Sixteen protected springs located in Jimma, Agaro, Shebe and Asendabo were studied from April 1 to May 1, 1997. A protected spring in this study is defined as one in which the water is collected where it rises by enclosing the 'eye' of the spring in a covered chamber with an outlet near the bottom to allow free flow from the original site. All the springs sampled were located in areas most accessible for sampling. Springs that were not protected were excluded from the study even though they were accessible. The population served by the springs ranges from about 4000 in Asendabo to 88,000 in Jimma. These springs are the major sources of water supply to the communities in Agaro, Shebe and Asendabo, where as, the springs in Jimma serve as a supplement to the main water treatment plant.

The samples were collected in glass bottles sterilized in an autoclave at 120^{0}C for one hour. The glasses were fitted with a stopper and wrapped with sterilized paper to avoid any contamination until sampling. Samples were then taken aseptically and brought to the laboratory where they were incubated within 6 hours of collection. A portion of the sample collected (100 ml) was aseptically transferred into replicate test tubes containing laurel sulfate lactose broth that supported growth of coliform organisms. The samples were then incubated at 44 ^{0}C for 48 hours to isolate fecal (thermotolerant coliforms) as it is

possible to confirm colonies directly by demonstrating gas production without performing the test at lower temperature. Based on the results the Most Probable Number (MPN) were determined. Samples were taken twice following guidelines for unchlorinated water supplies (4)

RESULTS

As depicted in table 1, the bacteriological analysis of sixteen springs in Agaro, Jimma, Shebe and Asendabo are as follows. Of the four springs considered in Agaro town for this study, bacteriological analysis has shown Agaro Suse to be safe for drinking and classified as excellent (A). One the other hand, Agro municipality and Aba Galan springs were categorized as unacceptable (C), while Agaro Tusae was categorized as grossly polluted (D). Bacteriological qualities of protected springs in Jimma were categorized in unacceptable quality classes (C) except Wellege, which is categorized as acceptable (B). Out of the four springs in Asendabo area Doyo spring is in the excellent quality class (A), where as, Seyo and Bisso Gelan springs being were considered acceptable (B). Nada spring was of inferior quality and grouped in the unacceptable category (C). All protected springs in Shebe, namely; Melka Sheke, Red Cross, Digo and Bomba were classified as acceptable (B) (Table 1).

Table 1. Bacteriological analysis results of springs in Jimma Zone, May 1-30, 1997.

Site of spring	Coliform count/100ml	Category*	Quality Remark
1. Shebe			
Melka Sheke	7	B	Acceptable
Red Cross	7	B	Acceptable
Digo	4	B	Acceptable
Bomba	9	B	Acceptable
2. Agaro			
Agaro suse	0	A	Excellent
Municipality	34	C	Unacceptable
Aba Galan	16	C	Unacceptable
Agaro Tisae	54	D	Grossly polluted
3. Asendabo			
Seyo	4	B	Acceptable
Bisso Gelan	1	B	Acceptable
Nada	18	C	Unacceptable
Doyo	0	A	Excellent
4. Jimma			
Saredo	19	C	Unacceptable
Wellege	4	B	Acceptable
Geruke Jimmatte	15	C	Unacceptable
Merewa	11	C	Unacceptable

* Cheesbrough, M. (1984), Medical Laboratory manual

DISCUSSION

The study was planned only for protected springs with the assumption that unprotected springs with runoff flowing in them freely, domestic and other animals contaminating it with urine and dung and people washing or bathing in or near such a source will prove to be contaminated even if tested.

The bacteriological analysis results of the protected clearly indicated that springs that are found in Jimma and Agaro were of inferior water quality compared to springs in Shebe and Asendabo (table 1). This observation was in agreement with the sanitary chemical analysis reported by Tesfaye and Worku (8). The marked difference in quality class may partly be attributed to possibilities of contamination by open sewerage systems which are characteristic features of Jimma and Agaro. The size of the population served by the springs also appears to contribute to increased risk of contamination, as springs located in Jimma and Agaro are likely to serve many more people compared to springs in Shebe and Asendabo. Survey of each spring for potential contamination has shown almost all springs sampled lack proper diversion ditches and drainage systems. Spent water from delivery pipes and wash basins create a pool adjacent to the protection box, which may be contaminated by human and animal activities on the site. This in turn contaminates the spring after infiltration rendering the idea of spring protection useless. Other factors such as poor site selection, lack of proper construction and inadequate follow up may also contribute to the overall deterioration of water quality. The presence of faecal colifrom organisms as found in many of the samples in this study is in excess of the recommended limit (4). What is very alarming is that this level of contamination at the source, coupled with further deterioration of water quality during fetching, transport and storage, represents a substantial risk of morbidity and mortality to the consumers (9). In conclusion, a periodic survey of any public water supply and more so protected springs for their bacteriological safety, is required to maximize the health benefits of the consumers. This study suggests that in addition to the efforts of constructing new springs, proper measures should be instituted to maintain, rehabilitate and protect already existing ones that fail to meet the safety criteria.

ACKNOWLEDGMENT

We are grateful to the Research and Publications Office of Jimma Institute of Health Sciences for financial support of this study.

REFERENCES

1. Tebbutt THY. Principles of wate quality control, 4th edition, Pergamo press, Oxford. 1992.
2. Gray NF. Drinking water quality problems and solutions. John Wiley & Sons Ltd. West Susex, England, 1994.
3. Panchdhari AC. Water supply an sanitary installations, desig construction and maintenance, Wile Eastern Limited, New Delhi. 1995.
4. Cheesbrough M. 1984. Medic laboratory manual for tropic countries, Vol. II. Microbiolog Butterworth-Heinmann Ltd. Oxfor 1984
5. WHO. Water supply and sanitatic sector monitoring report, Genev 1995.
6. Federal Democratic Republic Ethiopia, Ministry of Health. Heal and health indicators, Addis Abat 1995

7. Van der Leeden F, Troise FL, Todd DK. The water Encyclopedia, Second edition, section D-public water supply of the world. pp 328-331. 1990.
8. Tesfaye G, Wroku L. Sanitary chemical analysis of protected springs in Jimma zone, Southwestern Ethiopia, Ethiopian Journal of Health Development 1999;48:
9. Dranget JO, Lundquist J. Household water and health: issue of quality, quantity, handling costs: In: Environmental Health: water supply and sanitation status in Ethiopia, Issues and constraints, Gebre Emanuel Teka, Department of Community Health, Addis Ababa. 1991.