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An Assessment on Drinking Water Quality and Management in Kakamega Municipality

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Abstract: **Drinking water must be free from components which may adversely affect the human health. Such components include minerals, organic substances and disease causing microorganisms. A large portion of the population in urban areas in developing countries suffers from health problems associated with either lack of drinking water or due to the presence of microbiological contamination in water. This research was conducted in Kakamega municipality with a broad objective to conduct assessment of water quality and management in Kakamega municipality. The Specific objective was to determine the chemical water quality parameters in water and to evaluate the management practices on water in Kakamega municipality. Four water quality parameters; two physical and two chemical were tested from the samples collected for this research work. Sampling technique was purposive where water samples from water sources and distribution points in densely populated areas of Kakamega municipality were taken. Data collection instruments that were used included sterilized bottles to collect water, delivery to the laboratory within six (6) hours of collection for reliable results and data quality control was achieved through immediate entry in the pre-designed data form. According to the results pH values at all the sources and house connections are well within the WHO desirable limit of 6.50-8.0. The sample from Sichirai had a pH of 7.8 that was the highest as compared to an Isiukhu river that had 6.6 pH. The samples from Isiukhu river, Savona Island River, fishpond at bridge and Shikhambi spring showed more than 5 NTU. The researchers recommended for water surveillance in Kakamega municipality in order to ensure consumers have safe water free from agricultural and industrial chemical pollution.**

Keywords: **quality, parameters, contamination, human health, water.**

I. INTRODUCTION

Water is necessary for most of life on earth. Humans can survive for several weeks without food, but for only a few days without water. The exact amount of water a human need is highly individual, as it depends on the condition of the subject, the amount of physical exercise, and on the environmental temperature and humidity [1]. Parameters for drinking water quality typically fall under two categories: chemical/physical and microbiological. Chemical/physical parameters include heavy metals, trace organic compounds, total suspended solids (TSS), and turbidity . Drinking water must be free from components which may adversely affect the human health. Such components include minerals, organic substances and disease causing microorganisms [2]. Chemical parameters tend to pose more of a chronic health risk through build-up of heavy metals although some components like nitrates/nitrites and arsenic may have a more immediate impact. Physical parameters affect the aesthetics and taste of the drinking water and may complicate the removal of microbial pathogens [3]. Poor water quality is responsible for the death of an estimated five (5) million children in the developing countries [4]. The problem is further aggravated by rapidly increasing population which results in poor water-quality management

So far, few urban communities in Africa are able to improve their water supplies. The technical means for improving access to water are relatively simple, but the social arrangements are not. Improved water access promises significant progress in the life of many. Unsafe and insufficient water means sick children, unhealthy food, infrequent clothes washing, and little milk from cows, few vegetables in gardens and sparse fruit on trees. It also means hours and hours spent climbing up and down hills carrying heavy loads. The brunt of this burden of poor health and heavy labor is borne by women Jessica [5].

2. METHODS

Four water quality parameters; two physical and two chemical were tested from the samples collected.

Physical parameters tests were pH and turbidity. pH is one of the most important operational water quality parameters. Chemical parameters were hardness and total dissolved solids (TDS).

The values were compared with World Health Organization (WHO) guidelines for drinking water.

Water samples were collected from water sources in the catchment area and water distribution or collection points in densely populated areas of Kakamega municipality. Water samples from stand-pipes was collected by opening the tap to run for a while then the sample collection bottle was swiftly elevated to collect the sample. Samples from the streams were collected by the use of a rod and a string that was tied to the neck of the collection bottle. The bottle was gently lowered in the middle of the stream and the sample was collected and labelled with an identification number so assigned to the water point.

Sterilized bottles were used to collect water samples in order to minimize interference with the state of the sample. The water samples were promptly delivered to the laboratory for analysis to ensure credible and reliable results. Data quality control was achieved through immediate entry of readings in a pre-designed data form. The data was collated and compared with the World Health Organization (WHO) guidelines on safe drinking water. The deductions were made based on the WHO guidelines.

3. RESULTS AND DISCUSSION

3.1pH:

The pH values at all the sources and house connections were well within the WHO desirable limit of 6.50-8.0. No health base guidelines are proposed by WHO for the pH of drinking water. However, it is one of the most important operational water quality parameters. pH values higher than 8 are not suitable for effective disinfection while values less than 6.5 are too acidic to likely enhance corrosion in water mains and household plumbing system. Chemical parameters tend to pose more of a chronic health risk through buildup of heavy metals although some components like nitrates/nitrites and arsenic may have a more immediate impact to the human health if the water is consumed without treatment to reduce the metals to acceptable levels [3].

3.2 Turbidity:

No health based guidelines are proposed for turbidity by WHO. Nevertheless, a value of 0.5 NTU is recommended for effective disinfection. It is evident that at all the drinking sources , the turbidity in water was less than the desirable limit of 0.5 NTU while it is more than 0.5 NTU from Isiukhu river, Savona island river, Fishpond at bridge and Shikhambi spring. On the other hand a value upto 5 NTU is considered acceptable to the consumers. It is evident that values of turbidity of water samples collected at Sichirai, MMUST MCU and MMUST MEA and stand pipes at household connections were well below 5 NTU. Values of turbidity rose in water samples obtained from rivers. This difference was, however, very marginal. No apparent reason could be ascribed to this phenomenon on the basis of this study and further research is recommended to find out the facts. The main impact of turbidity is esthetic, nobody likes the look of dirty water. But also, it is essential to eliminate the turbidity of water in order to effectively disinfect it for drinking purposes either at the household level or at the treatment site. This adds some extra cost to the treatment of surface water supplies [6]

3.3 Hardness:

The research shows that hardness in water at all the sources were less than 80 mg/L as $CaCO_3$. Hardness for sources varied from 13 to 75 mg/L as $CaCO_3$. Shikhambi spring indicated a high 75 mg/ml as $CaCO_3$. The hardness at all the river sources and stand pipe connections were less than the WHO guideline value of 500 mg/L as $CaCO_3$. As a matter of fact, this guideline value is not proposed on the basis of health. Consumers can tolerate water hardness in excess of 500 mg/L. Water hardness above 500 mg/L needs excess use of soap to achieve cleaning. Hardness decreased from river Isiukhu and Savona Island River. This may be due to the dilution effect of the river. If the hardness values at river sources and stand pipe connections are compared then it is revealed that the hardness at house connections sometimes increased or decreased as compared to the hardness at river source.

No reason could be ascribed for this effect on the basis of present research work. Further probe and investigations is needed on this issue as presence of Fluoride slowly dissolves from the granite rocks underneath and slowly poisons the population, particularly evident in the bone deformations of children thus altering human health [7].

3.4 Total Dissolved Solids (TDS):

There was high TDS at both MMUST stand pipes samples. Isiukhu river sample showed the lowest TDS of 27.8 mg/l. No health based guideline is proposed by WHO for TDS. Since TDS higher than 1000 mg/L impart taste to the water. The desirable TDS value of 1000 mg/L is proposed by WHO. A value higher than 1000 mg/L results in excessive scales in water pipes, heaters, boilers and household appliances. It can further be pointed out that TDS in the collected samples from MMUST stand pipes and river indicated a high of 65mg/L. Elevated total dissolved solids can result in water having a bitter or salty taste; result in incrustations, films, or precipitates on fixtures; corrosion of fixtures, and reduced efficiency of water filtration [3].

4. CONCLUSION

The researchers recommended for water surveillance in Kakamega municipality in order to ensure consumers have safe water free from agricultural and industrial chemical pollution. Hard drinking water may have moderate health benefits, but can pose serious problems in boilers, cooling towers, and other equipment that handle water. In domestic settings, hard water is often indicated by a lack of suds formation when soap is agitated in water, and by the formation of lime-scale in kettles and water heaters. Wherever water hardness is a concern, water softening is commonly used to reduce hard water's adverse effects and this is an expensive activity that cannot be achieved by the water service provider for Kakamega.

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