EVALUATING THE EFFICACY OF WATER GUARD AND AQUA TABS IN TREATING MICROBIALLY CONTAMINATED WATER FOR SAFE DRINKING PURPOSES

***Samuel Uchechukwu Ezenwosu[1]*., Philomena C. Chukwuemeka[1]*., Helen Ngozi Ebeh[2]*., Dialoke Christian Enyi [2*].**

[1] Department of Biology, Federal College of Education, Eha-Amufu, Enugu State Nigeria
[2] Departments of Integrated Science, Federal College of Education, Eha-Amufu, Enugu State Nigeria
Corresponding Author's Address: uchesam2002@yahoo.com

Abstract
This study was carried out to discover the efficacy of Water Guard and Aqua Tabs in treating microbially contaminated water for safe drinking purposes in remote areas. Uchu river located in Umuchu, Aguata local Government Area of Anambra State was used for the study. The main source of the river is located between Ugwuakwu and Osete communities. The water samples were collected randomly from the source of Uchu River on 22nd February 2021, at the peak of dry season to ensure that, the River was not contaminated by flood and run-off water during the season. The water samples were taken to Project Development Institution (PRODA) at Emene Industrial layout Enugu Nigeria within twenty four hours (24 hrs) to test the efficacy of the two disinfectants in treating microbially contaminated water for safe drinking purposes. The experimental water was divided into three groups; sample A, B and C. Sample A and B represent bacterial contaminated water treated with Water Guard and Aqua Tabs disinfectant while sample C represents control. Results of experiment A and B showed no presence of bacteria growth after treating the bacterial contaminated water with Water Guard and Aqua Tabs disinfectants. Water sample C which represents control experiment (untreated water) the following micro organisms were isolated; 6 Bacteria subtrillus, 62 Staphylococcus Aureus, 97 Chromobacterium violaceum, 12 Pseudomoni Spp, 22 Klebsiell species and 44 Enterococcus species respectively. The study discovered that Uchu River is loaded with micro organisms. Thus, the water from Uchu River can be used for other domestic activities but not safe for human drinking without proper treatment. Recommendations: Water Guard and Aqua Tabs substances are very good for water treatment for safety.
***Key words**: bacterial isolation, Uchu-River, Water Guard and Aqua Tabs Disinfectant*

Introduction

Water is a substance very vital for the functionality of human body and a source of life for both plants and animals. Access to good and safe drinking water is paramount to life and healthy living from generation to generation. Thus the settlement of man in any locality in the past was determined by availability of water. Since then, access to safe drinking water has been one of the millennium developmental goals. Water is a liquid that descends from the clouds in form of rain or ascends from the rocks in form of springs to form the rivers and seas.

It is used in different domestic purposes and constituent of all living matter within the ecosystem. Aquatic animals of vertebrate and invertebrate species cannot survive without water free from various kinds of contaminations. It is also known to serve as a unique means of transportation across various countries and continents of the world. It has also be proved as one of the major path-way for transmission of water borne diseases across the globe especially in less developing countries of African and Asia. Ichor *etal.*, (2015) descry water as one of the major assured route for transmission of diseases among less financial privilege household members in the urban, semi urban and rural areas when contaminated either by micro organisms or petro-chemical products.

Tilting towards the same direction, WHO in their research uphold that 80% of ill-health in developing countries especially among low income earners is water and sanitation related problems. They reported specifically that 61% of people inhabiting developing countries are estimated to have access to water supply were mainly rural people while 36% that have access to sanitation facilities were urban settlers (WHO, 2017). Cheesbrough, (2000) concords with the reports that mortality and morbidity associated with water-related diseases among low-income earners in developing countries is directly or indirectly linked up to water born diseases.

Wardlaw and Smith (2011) describe water as liquid that has no colour, taste or smell, that falls from clouds as rain, that form streams, lakes and seas and that is used for drinking, washing and other industrial purposes. It is also dependent of all plants' and animals' survival. Its quality is compromised by water borne pathogens and storage at house hold level.

Poor sanitation in developing countries has been one of the causes of water borne diseases such as cholera, typhoid, dysentery and diarrhea. For instance, diarrhea diseases which are frequently transmitted by contaminated water continue to be leading causes of morbidity and mortality among children under 5 years of age in developing

countries like India and Africa (Chabba, 2013). Estimates of annual total mortality from diarrhea diseases range from 2.5 – 3.5 million.

WHO (2013) estimates that more than 25,000 people throughout the world die every year, nearly 1.5 billion people mostly children between the age of five suffer from preventable water borne diseases such as cholera, typhoid fever, amoebic dysentery, bacterial gastroenteritis and viral diseases such as hepatitis. Similarly, diarrhea diseases kill an estimated 1.8 million people each year, and accounts for 17% of deaths of children under the age of five in developing countries (Clasen *et al.*, 2007). Ninety-four percent of the diseases troubling man is contracted through contaminated water, lack of sanitation and unhygienic practices in food preparation (Clasen *et al*, 2008). Ministry of Health (2005) reports that, diarrhea as water related disease causing death; it leads to loss of family income, loss of productive time and malnutrition. A research in Malawi indicates that dehydration caused by severe diarrhea is a major cause of mobility and mortality among young children (National Statistic Office Zomba Malawi, 2005). Although water emerges to be the most plentiful liquid substance on earth with no replaceable alternative, so it appears like there is no safe drinking water for man and for domestic uses without treatment. Umuchu in Aguta local government area of Anambra state is densely populated area without portable safe drinking pipe born water. Thus, this challenge has compelled majority of the house hold to source water from borehole, underground storage tank and Uchu River as means of water supply. Therefore, the available water sources in the area are not safe from pathogenic microorganisms without using water treatment or purification substances. Presently, few water bore hole sank by the government/ individuals some were not functional. The functional once are not enough for the communities at large for domestic purposes.

There is a doubt that without water treatment / purifications the quality of those waters in the area cannot be used directly without boiling to avoid water born diseases. WHO (2017) reports that water must be of high quality and should present no risk to the users by its physical, chemical and biological quality for it to be safe for drinking and other domestic uses. In other words, these factors call for an alternative solution which can be affordable by many, easily utilized and effectively means of water treatment to obtain safe drinking water. The application of disinfecting chemical is essential in order to prevent water borne diseases whose transmission route is by oral ingestion (Ichor *et al*., 2015). In a quest to solve human problem of poor quality water supply, sodium hypochlorite with a name Water Guard has been identified as an effective water treatment for domestic water uses (Mmbando 2004).Many communities around the world depend on Water Guard and Aqua Tabs for their domestic uses. .

Water Guard is chlorine based product used for treating drinking water at household level across the globe. It was introduced by Population Service International (PSI) in November 2002 (Ichor *etal.*, (2015)). It is a bottled solution of liquid sodium hypochlorite which when properly mixed, makes most water safe for drinking. The product is in liquid form to ensure dosing flexibility and is sold in 200ml bottle (Ichor *etal.*, (2015)). One cap of Water Guard can be used for treatment of 25 liters of water but when the water is dirty two caps is recommended. Sodium hypochlorite is safe for consumption over long period of time even if injected undiluted. It could cause no dangerous effects (Tersagh *etal.*, 2015). WHO (2017) reports that consistence use of water guard has proved to be effective like chlorine has been used worldwide to treat water every two years and is still strongly trusted by the world health organization.

Confirmation of Water Guard efficacy, Alekial (2005) explains that Water Guard usage reduces the objectionable taste and odour of various waters immediately after treatment making it acceptable for drinking. Likewise, consistence use of Water Guard has proved to be effective in controlling some types of water borne diseases like cholera, dysentery and typhoid (Yohanna, and Mashauri, 2008) Therefore, people should be encouraged to treat their water accordingly and not to under-treat, to avoid being contaminated.

Aqua Tabs is another effective water treatment reagent. WHO (2013) reports that aqua-tabs are the world number one water purification tablets. They are vibrant tablets which kill micro-organism in water to prevent cholera, typhoid, dysentery and other water born diseases.

Clasen and Edmondson (2006) explain that Aqua Tabs are one of the most inventions in water treatments. The tablets are very active in extermination of bacteria in water from difference sources like stream, lakes and rivers. The authors also added that Aqua Tabs has been extensively used over the decades in household water treatments, commercial laundry bleaches, scouring powders and industrial and recreational water disinfection. NADCC has reported recently that is now used in sanitizing medical instrument, cleaning of baby bottles and contact lenses Therefore this study aims to: Determine the level of microbial contamination of Uchu River water available for domestic uses, secondly to determine the efficacy of 'Water Guard and Aqua Tabs in treatment of micro organisms contaminated water. The result obtained in this study will help the populace to determine the hygienic quality of

Uchu River water available in community for use and a scientific justification of the efficacy of Water Guard and Aqua Tabs water treatment.

Area of the study

The Uchu River is located in Umuchu town in Aguata Local Government area of Anambra State, Nigeria. Umuchu lies near the state border between Anambra and Imo state. It is connected by road to Umunze in the east and Igbo-Ukwu in the northwest. It is home to the Igbo people and Umuchu is also the name of the local dialect of the Igbo language. It is bounded on the South by Arondiizuiogu, Umualaoma and Akokwa in Ideato South local Government area of Imo State in the North, and Northeast by Achina and Enugwu-Umuonyia. In the West by Uga and Amesi, in the East by Umuomaku, Umunze and Aghommili River.

It is about 8.5 kilometers from Uga at the junction between Awka-Orlu-Okigwe-Onitsha roads. The town is located in a table land at a height of 180 meters above sea level, which shelves down a valley eastwards where Umuomaku and Umunze are situated. The town has an estimated land area of 48.6 square kilometers with an estimated population of 310,400 making her one of the most thickly populated communities in Aguata Local Government of Anambra state.

Sample Collection

Water samples were collected on 22nd February, 2021, at the pick of dry season to ensure that the water was not contaminated by flood and run-off water during the season. The water was collected using sterilized 1 liter plastic container at about 6am in the morning. This container was transported within 24hrs to Projects Development Institute (PRODA) at Emene Industrial Layout, Enugu State of Nigeria for analysis. Two water samples were collected randomly from two different points at source of Uchu River located between Ugwuakwu and Osete village. The two samples, one was used for physicochemical and the other was used for bacteriological test respectively.

Experimentation

Water samples were collected to check the efficacy of Water Guard and Aqua Tabs disinfectant in treatment of micro organisms contaminated water for provision of safe drinking water. The bacterial loads of the Uchu River was determined by pour plate methods using selective media to determine the enteric bacterial present in the water sampled for the study. Normal dose of the Water Guard and Aqua Tabs disinfectant was used to treat the water. The water treated with the two disinfectants was allowed to settle for 30 minutes to one hour before examining the efficacy of the two disinfectants used. After the normal time of the treatment was over, digital microscope and culture methods of dictating bacteria were used. The experimental samples were grouped into sample A, sample B and sample C. This sample A was treated with Aqua Tab, sample be was treated with Water Guard and sample C stands for control experiment.

Results

In table 1(one) the experiment showed water sample A treated with Aqua-tab. In sample A being treated with Aqua Tabs, the following were examined Nutrient, Cled and Sabourand Agar. The experiments were divided into three isolate A, B and C to determine the bacteria isolates in each. See table one below

Table 1: The Result of the Experimental Water Sample A treated with Aqua Tabs.

Sample	Sample A	Characteristics of isolate	Name of bacteria isolate
Total count of bacteria isolate	0	Nill	Nill
Total count of individual isolate	0	Nill	Nill
Isolate A	0	Nill	Nill
Isolate B	0	Nill	Nill
Isolate C	0	Nill	Nill

On the above table one (1) it was discovered that there was no significant bacteria growth see after 48 hours of incubation. From the observation, it indicates that the water is safe for human consumption. It has the capacity of eliminating micro-organisms and bacterial contaminant in water when treated at required dose.

In table 2(two) the experiment showed water sample B, treated with Water Guard, the following were examined, Nutrient, Cled and Sabourand Agar. The experiment was divided into three isolate A, B and C to determine the bacteria isolate. See table two below.

Table 2: The Result of the Experimental Water Sample B Treated with Water Guard.

Sample	Sample B	Characteristics of isolate	Name of bacteria isolate
Total count of bacteria	0	Nill	Nill
Total count of individual isolate	0	Nill	Nill
Isolate A	0	Nill	Nill
Isolate B	0	Nill	Nill
Isolate c	0	Nill	Nill

On the above table two (2) it was discovered also that there was no significant bacteria growth seen after 48 hours of incubation. This entails that the water guard disinfectant is safe for human consumption. It has the capacity of eliminating micro-organisms and bacterial contaminant in water when treated at required dose.

Table (3) three of the experiment represented water sample C which stands for control (untreated water from Uchu River). Under sample C, the following were examined Nutrient and Cled Agar. The experiment were divided into three isolates A, B and C respectively to determine the bacteria load of the experimental water (Uchu river). A total of 165 bacterial isolates were identified in the water, comprising 6 isolates of *Bacillus* sp. (Isolate A), 62 isolates of *Staphylococcus aureus* (Isolate B), and 97 isolates of *Chromobacteriumviolaceum* (Isolate C). See table three below.

Table 3: The Result of the Experimental Water Sample C untreated Water from Uchu River.

Sample	Sample C	Characteristics of isolate	Name of bacteria isolate
Total bacteria count of isolate	165	_	Bacteria sublillus, Staphylococcus aureus and Chromobacterium violaceum
Count of individual isolate			
Isolate A	6	Large, Circular and creamy colonies with Rhizoid appearance	Bacteria subtillus
Isolate B	62	Moderate in size creamy isolate with possitive gram reaction	Staphylococcus aureus
Isolate C	97	Small and raised isolate with distinctive smooth low convex colonics which appear dark violet meltalic shown colour Gram negative	Chromobacterium violaceum

From the above table three (3) it was discovered that bacteria is heavily loaded in the water sample from Uchu River. Thus, the water is not good for human consumption without treatment. Therefore the community member who drinks this water does so because they are ignorance of the level of bacteria present in the water.

Table four (4) experiments was also divided into three isolate A, B and C to determine the bacteria load of the experimental water (uchu river). Table four (4) experiments were to determine Cled Agar. It was discovered that 78 isolate representing isolate A 12 Pseudomoni ssp,isolate B 22 Klebbella and isolate C 44 Enterococcus. See table four (4) below.

Table 4: The Result of the Experimental Water Sample C untreated Water from Uchu River to determine Cled Agar.

Sample	Sample C	Characteristics of isolate	Name of bacteria isolate
Total bacteria count	78	-	-
Count of individual isolate	12		
Isolate A	22	Big circular and raised colonies with green colour	Pseudomoni Spp
Isolate B	44	Moderate in size which appear whitish blue on Cled Agar	Klebblia
Isolate C		Small and raised yellow colonies which is about 0.5mm in diameter	Enterococcus

From the above table which tested Cled agar, pseudomoni Spp, Klebblia and enteracoccus were discovered. The presence of these pathogenic bacteria in the water sample makes it unsafe for human consumption and domestic use due to its high level of microbial contamination.

Discussion

The result of the experiment in table one (1), it was discovered that there was no significant bacteria growth seen after 48 hours of incubation. From the observation, it indicates that the water is safe for human consumption after treated with aqua-tab disinfectants. This implies that aqua-tab as a water disinfectant kills microorganisms when applied in contaminated water. The finding is in accordance with Clasen and Edomondson (2006) which reported that the use of household water treatment methods such as aqua-tab reduces the burden of diarrhea in community. Likewise Roma *et al.*, (2014) state that aqua-tab is essential for safe and easy storage and handling, as well as the capacity to dissolve quickly with no evidence of objectionable odour or taste as well as ability to reduce total and faecal coliforms in water. Therefore, it is proven that the purpose of disinfecting water is to destroy pathogenic organism and thereby eliminate and prevent water borne diseases like typhoid, diarrhea, cholera and amoebic dysentery. Moreover, it is also necessary that water should be treated with adequate recommendation. 25 liters should be treated with one (1) or two tablet(s) to make the water safe for human consumption. The study has proven that it is safe for water treatment.

The result of the experiment showed in table two (2), it was discovered also that there was no significant bacteria growth seen after 48 hours of incubation. This entails that the water is safe for human consumption. Therefore water guard is a chlorine based product used for treating water. This is in agreement with the research carried out by Ogunyoku (2011) in Kwara state. The research discovered that the water guard has proven to be effective in controlling some water borne diseases like cholera, dysentery and typhoid. Likewise Mwambete and Manyanga

(2007) use water guard to disinfect well water, streams and tap water in dares salaam so as to determine their effectiveness against pathogens. It was also discovered that water guard reduces the level of microbial contamination in water. Therefore it is advised that people should treat their water using water guard. PSI/Tanzania (2007) adds that because of the effectiveness of water guard in water treatment, it has been used worldwide to treat water over 100 years now and it is still strongly trusted by WHO for capability.

The result of the experiment on table three (3) and four (4) stand for control experiment (untreated water from Uchu river, it was discovered from the result of the study that the water was heavily loaded with bacteria. In water sample C, total of 5(five) pathogenic bacteria were isolated name: bacillus Spp, Staphylococcus Spp, Pseudomoni Spp, klebsila Spp and entervococcus spp. Their bacteria counts are as follow: 6, 62, 12, 22 and 44 respectively with staphylococcus showing the highest bacteria load, followed by entrovococcus. The presence of these pathogenic bacteria in water sample C is a great concern which makes it not good for consumption because it is highly microbial contaminated. One (1) non pathogenic bacterium was also isolated from water sample C and it is called chromobacterium violaceum. Meanwhile, water may be clean in surface but yet had a lot water contaminants or a lot of pathogens such as Uchu River which is very clean by mere looking. This is in line with Kuroda *et al.,* (2014) that say in order to improve water quality or water safe level, the varieties of treatment methods aqua-tab, water guard etc should be put into consideration because this substance prevent water borne diseases. This is in line with Cheebroiugh (2000) who reports that most of the mortality and morbidity associated with water-related diseases in urban and rural areas is due directly or indirectly intake or consumption of untreated water. Likewise, it has been proven that various water sources from different communities used for drinking and domestic purposes are directly or indirectly a habitat of microorganisms which makes such water unsafe without proper treatment. Thus it is apparent from the present study that drinking water used in urban and rural areas should be treated before use in order to combat several diseases caused by pathogenic microorganisms that inhabit waters.

Conclusion

Although Uchu River has been used for ages for different purpose, the present study discovered that the condition of the river when it comes to safe drinking water is not free from disease cursing bacteria. It was also discovered that about five decade ago, runoff water, animal and human excreta and other anthropogenic activities that occur now in the river was not allowed then to take place. Thus, the human anthropogenic activities that go on in the river now may be one of the major contributing factors that led to numerous bacteria discovered from the river that makes it unsafe for human consumption. At this juncture, the users of Uchu River are advised to treat the water with Aqua Tabs, or Water Guard before using it for domestic purposes due to the efficacy of Aqua Tabs and Water Guard in treating contaminant in water.

Recommendations

1. The state Government should remember Umuchu town when it comes to construction of water treatment plants for provision of safe drinking water free from contaminants.
2. Numbers of individual dependency on Uchu-River for domestic purposes can be reduced through provision of bore holes in the area by Philanthropists and well to do individuals.
3. Maintenance of the river periodically by the community can help in controlling the effects of anthropogenic activities of man around the river.
4. Channeling of gutters and industrial waste into water runoff ways that leads to the river should be prohibited and monitored through security agencies.

References

© 2015 Academic Journals Inc.
Alekial, P.Y. (2005). Appropriate water Treatment for Nyanza province of Kenya (Thesis) Massachusetts Institution of Technology.

Bruno Mmbando (2004) Effectiveness *of Water Guard as a Disinfectant in Water Treatment*. *MSc. Thesis, University of Dar es salaam, Dar es salaam.*

Chabba, B. (2013). Thyroid Disrupting Activities in waste water and surface. A review of their vitro Analysis. *Journal of Environmental Protection 10 (09)11 -31.*

Cheesbrough, M. (2000). District Laboratory Practices n Tropical Countries. 2nd Edn. Cambridge University Press New Delhi, India.

Clasen T. Cairncross S. (2004) Household water management: Refining the dominant paradigm. *Trop. Med. Int. Health.* 918 –191

Clasen T., Mclaughlin C., Nayaan N., Bolsson S., Gupta R., Desal D., and Nimish S. (2008) Microbiological effectiveness cost of disinfecting water by boiling in semi-urban India. *American Journal of Tropical medicine and Hygiene 79(3) 407-413.*

Clesen T. Schmidt. W.P.Rabie T., Roberts I and Cairncross S. (2007). Interventions to improve water quality for preventing diarrhea. Systematic \Review and Metal Analysis. *(Clinical Researched). 334 (7597) 391 - 419.*

Clesen T., and Edmondon P. (2006). Sodium Dichloro Scocyanurante (NADDC) Tablets as in Alternative to Sodium Hypochlorite for theroutine treatment of drinking water at the household level. *International Journal of Hygiene and Environment Health. 10 (209) 173-181.*

Hussein Mohamed; Joe Brown; Robert M. Njee; Thomas Clasen; Hamisi M. Malebo; Steven Mbuligwe (2015) Point-of-use chlorination of turbid water: results from a field study in Tanzania Journal of Water Health (2015) 13 (2): 544–552.

Ichor, T. S., Nevkaa, D. And Onaji, J. P (2015) Efficacy of water guard disinfectant as a domestic stored water treatment method in Makurdi metropolis. Research of Journal and Environmental Sciences. 9 (8): 364-369.

Kuroda, K.; Hayashi, T.; Nga, T.T.V.; Oguma, K and Takwizawa, S.;. (2014). Household Survey of Installation and Treatment efficiency of point-of-use Water treatment systems in Hanoni, Vietinan. Journal of water supply Research and Technology AQUA63 (2), 154-161

Ministry of Health (2005). Hand book for health providers on the essential Health Package (EHP) in Malawi, Lilongwe. Malawi

Mohamed, H., et al, (2015) Point-of-use chlorination of turbid water: results from a field study in Tanzania, Journal of Water and Health, 13 (2): 544-552.

Mwambete, K. D. and Manyanga, V. (2007) quality of drinking water in Dar es Salaam and use of Waterguard® as disinfectant. Tanzania Medical Journal; 21(1) 345-352.

National Statistical Office Zomba Malawi (2005) *Demographic and Health Survey 2004, Malawi*. ORC Macro Calverton, Maryland, USA .

Ogunyudu, T.A Nover, D.M Mcknize, E.R. Joshi, G and Fleenor F. (2011). Point of use drinking water treatment in developing world community acceptance project monitoring and revision. *International journal for services learning in Engineering (1) 14 – 32.*

Roma E., Bond T. and Jeffey P. (2014) factors involved in sustained use of point of use water disinfection methods. A field study from Flores Island Indonesia. *Journal of Water and Health 12 (3) 573 -583.*

Tersagh, I, et al., (2015). Efficacy of Water Guard Disinfectant as a Domestic Stored Water Treatment Method in Makurdi Metropolis. Research Journal of Environmental Sciences, 9: 364-369.

Wardlaw G. M and Smith. A. M. (2011) Contemporary Nutrition: New York. McGraw- Hill Companies.

World Health Organization (WHO) (2013) Cholera 2012. *The Weekly Epidemiological Record*, 88, 321-336.

World Health Organization (WHO).(2017) *Guidelines for Drinking-Water Quality*, 4th ed.; Incorporating the 1st Addendum; World Health Organization: Geneva, Switzerland.

Yohanna, L., and Mashauri, D., (2008) Potential Use of Water Guard as a disinfectant for domestic water use Tanzania Journal of Engineering and Technology 31(2): 62-69.