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Low-Cost *Moringa* Seeds and *Terminalia* Kernels Water Purifier: A Water Management Technology

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ABSTRACT

The study aimed to develop a low cost water purifier in treating ground water utilizing indigenous plant materials such as the seeds of the *Moringa Oleifera* Lam as the main flocculant and the kernels of the *Terminalia catappa* Linn. which is the activated carbon adhering to the principles and practices of green technology. Ground water samples from three local communities in Zamboanga City, namely, Talisayan in the west cost, Bungiao in the east cost and San Roque in the city proper were gathered conforming to the standard procedures of the Department of Science and Technology (DOST). Some water parameters were tested using the gadget and these were compared with the standard values set by the Philippine National Standard for Drinking Water (PNSDW). A survey questionnaire of four point Likert scale was employed in determining the acceptability of the gadget among sixty four respondents from the three communities. The weighted mean was use in treating the data. The findings revealed that the gadget which is made of a four layer stainless steel containing the de fatted *moringa* press cake (MPC), the *terminalia* granulated activated carbon (TGAC), the sand and the pebbles has the capacity to improve the quality of ground water based from the result of the laboratory tests conducted by the Depratment of Science and Rechnology

in Zamboanga City as against the standard values of the Philippine National Standard for Drinking Water on the following parameters, pH total dissolved solids (TDS), hardness and total coliform count (TCC0 and odor. The gadget is accepted by the sixty four respondents in terms of its functionality, effectiveness and portability. The study recommends that the gadget may use different type of materials with surface pores smaller than that of the particles of the press cake and activated carbon.

Keywords **—** Water Management Technology, water purifier, *Moringa Oleifera* Lam, experimental design, Philippines

INTRODUCTION

Water, coming straight from the ground contains bacteria and unwanted sediments, which makes it unfit for human consumption. This may cause several water-borne diseases among the locals such as diarrhoea,cholera, intestinal helminths and other related diseases, specially the young and the old.

In rural areas particularly in developing countries like the Philippines, especially in Zamboanga City, underground wells still used in procuring water, for drinking, washing, bathing, cooking a. This is done either by drawing water straight from the well using a bucket or through the use of water pumps.

Procuring water this way, puts the health of the people at great risk. This is the present concern of the World Health Organization (WHO)- to provide clean and potable water people who do not have access to it.

For many communities in developing countries, however, the use of coagulation, flocculation and sedimentation is low due to high cost and limited availability of chemical coagulants such as alum and iron salts. These substances aside from being expensive pose a threat on the people's health as these are inorganic. For water to be considered safe and potable it has to undergo treatment prior to drinking or cooking.

One alternative could be the use of *moringa* oleifara seeds. The seeds can be used to purify water Corpuz (2009).

Moringa Oleifera Lam. more popularly known as malunggay in thePhilippines is called "The Miracle Tree". As the term implies, from its leaves down to its roots, almost every part of the *moringa* tree can be utilized, as food, medicine, fertilizer, dye among others. Studies have shown that the *Moringa* seeds not only diminish water pollution, but that they also remove harmful bacteria, making it fit for

consumption. The filtering method is simple and effective. The *Moringa* seed powder is added, joins with the solids in the water and sinks at the bottom. The result is clear and clean water. The crushed seeds are to a bucket of water and let the bucket is allowed to sit undisturbed for about an hour or until the impurities have sunk to the bottom. The process can be done at home.

Since, using chemicals in treating ground water proved to be expensive and at times possed a threat to peoples' health, the need to utilize organic substances that are cheap and readily available proved to be the best solution to the current issues and problems on water sanitation and hygiene.

It is for these reasons that this study was conceived, it aid to develop a low cost and handy water purifier using defatted seeds from *Moringa Oleifera* Lam or malunggay as the main flocculent and the kernels of the talisay tree as the activated carbon for underground water adhering to green technology principles and practices and utilizing indigenous plant materials.

According to the World Health Organization WHO (2004), Water, Sanitation and Health Program there are 1.8 million people die every year from diarrhoeal diseases (including cholera); 90% are children under 5, mostly in developing countries.

Eigthy- eight percent, (88%) of diarrhoeal disease is attributed to unsafe water supply, inadequate sanitation and hygiene and improvements in drinking-water quality through household water treatment, such as chlorination at point of use, can lead to a reduction of diarrhoea episodes by between 35% and 39%.

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OBJECTIVE OF THE STUDY

The main objective of this study is to develop a low cost water purifier using *Moringa Oleifera* (malungay) seeds as its main flocculent and the kernels of *Terminalia catappa* (talisay) as the source of activated carbon to treat underg round water.

Specifically, the study determined the: 1. Design and construct a low cost water purifier using *moringa* seeds as its main flocculent and terminalia kernels as its activated carbon that is environment friendly, which involve the materials, processes and procedures to be used in the gadget; 2. Evaluate the effectiveness of the gadget based on the laboratory test results on the different parameters of the water samples before and after treatment; 3. The shelf life of the processed and packed *moringa* presscake; and, 4. Evaluate the acceptability of the gadget in terms of its functionality, effectiveness and portability.

METHODOLOGY

The mixed research was used in this study which is a combination of qualitative and quantitative research. Quantitative research, in which the information gathered is quantitative, meaning , numeric information from some type of formal measurement and is analyzed with statistical procedures. Whereas, qualitative research focuses on gaining insights on and an understanding of an individual's perception of events. It is concerned with in-depth descriptions of people or events and their interpretation of circumstances. Methods used in this type of research are questionnaires and unstructured interviews collectively used in a survey. Cristobal and Cristobal (2013)

The first phase of the study made use of the true experimental design after the development of the gadget, in which it made use of the independent and dependent variables as well as the moderating / experimental variable or the causal effect design and the latter phase made use of qualitative approach which involved the survey method in the collection or gathering of data.

The study was composed of six stages; **Stage 1** was the gadget design; **Stage 2** was the construction of the gadget. The **third stage** wass the processing and packing of the *moringa* press cake and the *terminalia* activated carbon. The **fourth stage** was the gathering of water samples. **Stage 5** was the testing of the effectiveness of the water purifier against standard conditions. The **last stage** was the evaluation of the gadget among ground water users**. All** stages were illustrated using the input-throughput-output approach employing biostatics. Biostatistics (or biometry) is the application of statistics to a wide range of topics in biology. The science of biostatistics encompasses the design of biological experiments, especially in medicine, pharmacy, agriculture and fishery; the collection, summarization, and analysis of data from those experiments; and the interpretation of, and inference from, the results.

The study is a technical development research in which the gadget or the stainless steel water purifier was designed, constructed and developed. In objective number two, evaluating the effectiveness of the gadget, the true experimental design was employed, this type of design is primarily concerned with cause and effect relationships in which all experimental studies involve manipulation or control of the independent variables (causes) and measurement of the dependent variables (effects). This design utilizes the principle of research known as the method of difference. This means that the effect of a single variable applied to the situation can be assessed, and the difference likewise be determined (Mill as cited in Cristobal and Cristobal (2013). The time series design was used for research objective number three, where the formula, O1-O2-O3 x O4-O5-O6 was used ,where: O1, O2,O3 stand for pretest (multiple observations) and O4,O5,O6 stand for postest (multiple observations) and X stand for intervention/treatment while the survey method was employed for research objective four.

RESULTS AND DISCUSSION

The laboratory tests, specifically the physical or aesthetic parameters were done in the Chemistry Laboratory of the Zamboanga City State Polytechnic College, Zamboanga City and the chemical and microbiological aspects were performed by the chemists of the Department of Science and Technology, (DOST) at Pettit Barracks, this City. The results were used to evaluate the effectiveness of the gadget in treating underground water.

Open underground water was collected from three barangays in the east and west coasts and in the city proper using the purposive sampling. In determining the barangay where the water sample will come from, the fish bowl method was used.

In the west coast, barangay A was identified, the source of ground water was an open deep well, which was the same type of source with barangay B in the city proper. While a dug-out-hole was for barangay C in the east coast.

Water samples were drawn and collected from the respective sources using sterile containers with a lid and following the standard procedures from the DOST on the gathering of water samples from open water source. These were brought to the DOST for the laboratory tests and analyses. There were two sets of water samples, one set were the samples gathered from the three different sources which were untreated with the gadget while the second set were the samples which were treated with the gadget containing the defatted *moringa*

seeds or the *moringa*press cake (MPC) and the other was the kernels of terminalia granulated activated carbon (TGAC) all of which were processed and packed in a four layered stainless steel, which is the water purifier. The materials, processes and procedures all conform to the principles of greentechnology. Which are all environment friendly and organic.

The results were used in evaluating the effectiveness of the gadget against standard values of the Philippine National Standard for Drinking Water (PNSDW) of 1993, under PD 856 -The Sanitation Code of the Philippines of 1975.

The time series design was used in evaluating the shelf life of the *moringa*press cake. While the survey-questionnaire was the main instrument used in evaluating the acceptability of the gadget among the sixty-four respondents from the three barangays. The weighted mean was use in the treatment of data.

FINDINGS

The following findings were deduced

1. On the effectiveness of the gadget
    1. Physical Parameters
        1.1 Odor- there was no objection on the odor state on the three water samples before and after treatment using the gadget.
        1.2 Color- the three water sample gave a clear color state before treatment with the gadget. After treatment, however, all three sample were found to be slightly cloudy. The main reason for this maybe the holes of each cover materials which were “big” enough to allow the passage of the minute particles of the *moringa*presscake (MPC) and the terminalia granulated activated carbon (TGAC) rendering the state of cloudiness to the water.
    2. Chemical Parameters
        2.1 pH- all pH values after treatment using the gadget rendered the three water samples slightly alkaline. Before treatment , the pH values for all samples was slightly acidic. The water after treatment using the gadget became alkaline which is an indication that there was improvement in the pH of all water samples.
        2.2 Hardness- this is one property of water that measures the minerals present in the form of calcium carbonate (CaCO3). All water samples before treatment using the gadget have hardness values

that were acceptable by the PNSDW. After treatment using the water purifier, the values for hardness has decreased by 11 to 27 percent. This shows that there was an improvement in the quality of all water samples in terms of hardness when using the gadget.

2.3 Turbidity- Values for turbidity before treatment using the gadget for the two water samples in Barangays A and C had shown to be higher than the standard. Except for the water sample from barangay B which met the standard value for turbidity. However, after treatment using the gadget. Turbidity values had increased. This shows that there were solid particles that were suspended in the water rendering the water cloudy or turbid. The reason for this maybe the materials used as covering for the MPC and TGAC. The minute particles of these two substances were able to pass through the holes of the three cover materials which were, the filter paper, muslin cloth and sterile gauze.

2.4 Total Dissolved Solids (TDS) – The accepted standard value for TDS is 500mg/L. All water samples have values exceeding the accepted value except for water sample coming from Barangay B. After treatment, all TDS values had decreased from 55 to 72 percent. This means that there was improvement in the quality of the water samples in terms of total dissolved solids.

3. Microbiological Parameter

3.1 Total Coliform Count (TCC)-This is the number of coliform found in water. Standard value for this is zero per 100ml sample. But the permissible limit is 10. All water samples gave a very high number of TCC before treatment. After treatment however, the number of bacteria decreased by 63 to 66 percent. This shows that the gadget containing the MPC and TGAC has the ability to kill bacteria present in water.

2. On the Shelf Life of the *Moringa* Press cake (MPC)

2. 1. Before Use, under normal room temperature, the average shelf life of the MPC is 19 days and kept refrigerated is 30 to 31 days

2. 2. After use, under normal room temperature, the average shelf life of the MPC is 3 to 4 days and kept inside the refrigerator about a week or 7 days.

3. On the acceptability of the Gadget in terms of its:
    3.1 Functionality- the overall mean for this parameter was 3.34. This value was found to be in the range of 3.26-4.00 with the descriptive equivalent of Very Acceptable.
    3.2 Effectiveness – Parameter number two, which was the effectiveness on the acceptability of the gadget among the sixty-four respondents had an overall mean of 3.25 and with a "Acceptable" descriptive equivalent.
    3.3 Portability- the overall mean for this parameter was 3.15 and with a descriptive equivalent of Acceptable.

The grand mean on the acceptability of the gadget among the respondents from the three barangay was 3.25 with an Acceptable descriptive rate.

CONCLUSION

On the basis of the findings the following are derived

1. The gadget, which is a stainless steel water purifier containing the processed and packed *moringa*press cake (MPC) andterminalia granulated activated carbon (TGAC) can treat and improve the quality of underground water on some parameters on the basis of the ratio used of the MPC and TGAC per liter of underground water and the kind of materials used as cover.
2. The gadget is acceptable in terms of its functionality, effectiveness and portability.
3. The average shelf life of the MPC is about a month kept refrigerated while unrefrigerated is 19 days prior to use. After use, the average shelf life is about a week kept inside the refrigerator and only 3-4 days under room temperature.

It is best to keep the MPC inside the refrigerator for a longer shelf life.

RECOMMENDATIONS

On the basis of the conclusions, the following are recommended: 1) Other materials maybe use as cover so as not to allow the passage of minute particles such as the *moringa* press cake and terminalia activated carbon in order to obtain clear state of water; 2) Increase the amount of the *moringa*press cake and terminalia activated carbon per liter of water to be purified to yield better purification and

improvement of the quality of water; 3) It is best to keep the MPC inside the refrigerator for a longer shelf life; 4) For the gadget to be strongly acceptable among underground water users, an awareness campaign maybe conducted on water sanitation and hygiene; and 5) A follow up study similar to the present one maybe conducted to improve the gadget.

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