A THREE-STAGE WATER PURIFIER UTILIZING OYSTER SHELLS AND *Moringa oleifera* (MALUNGGAY) SEEDS AS MAIN COMPONENT

A Research Paper Presented to the
Faculty and Staff of
Philippine Science High School

In partial fulfillment of the requirements in
Technology Research II

Researchers :
Juphel Ace Jiao Guerra
Celman Elden Dequilla Sudaria

APPROVAL SHEET

This research paper entitled "A THREE STAGE WATER PURIFIER UTILIZING OYSTER SHELLS AND *Moringa oleifera* (MALUNGGAY) SEEDS AS MAIN COMPONENT" by Juphel Ace Guerra and celman Elden Sudaria, in partial fulfillment of the requirements in Technology Research II has been examined and is recommended for acceptance and approval.

July 10, 1998
Date

Eduardo Ongcol
Mr. Eduardo Ongcol
Tech. Res. Adviser

This research paper is accepted and approved in fulfillment of the requirements for Technology Research II.

Date

Prof. Rebecca Yandog
Director PSHSWVC

Acknowledgments

The researchers would like to express their deepest gratitude to all the people who in one way or the other helped, contributed and guided us along the process of our research work.

Especially to GOD Almighty, to our families, to the faculty and staff of Philippine Science High School, to Sir Ed Ongcol and Ma'am Josette Biyo, to all the Seniors, to everybody who we may forget but deserves our fittest and utmost thanks.

We really appreciated your concerns.

ABSTRACT

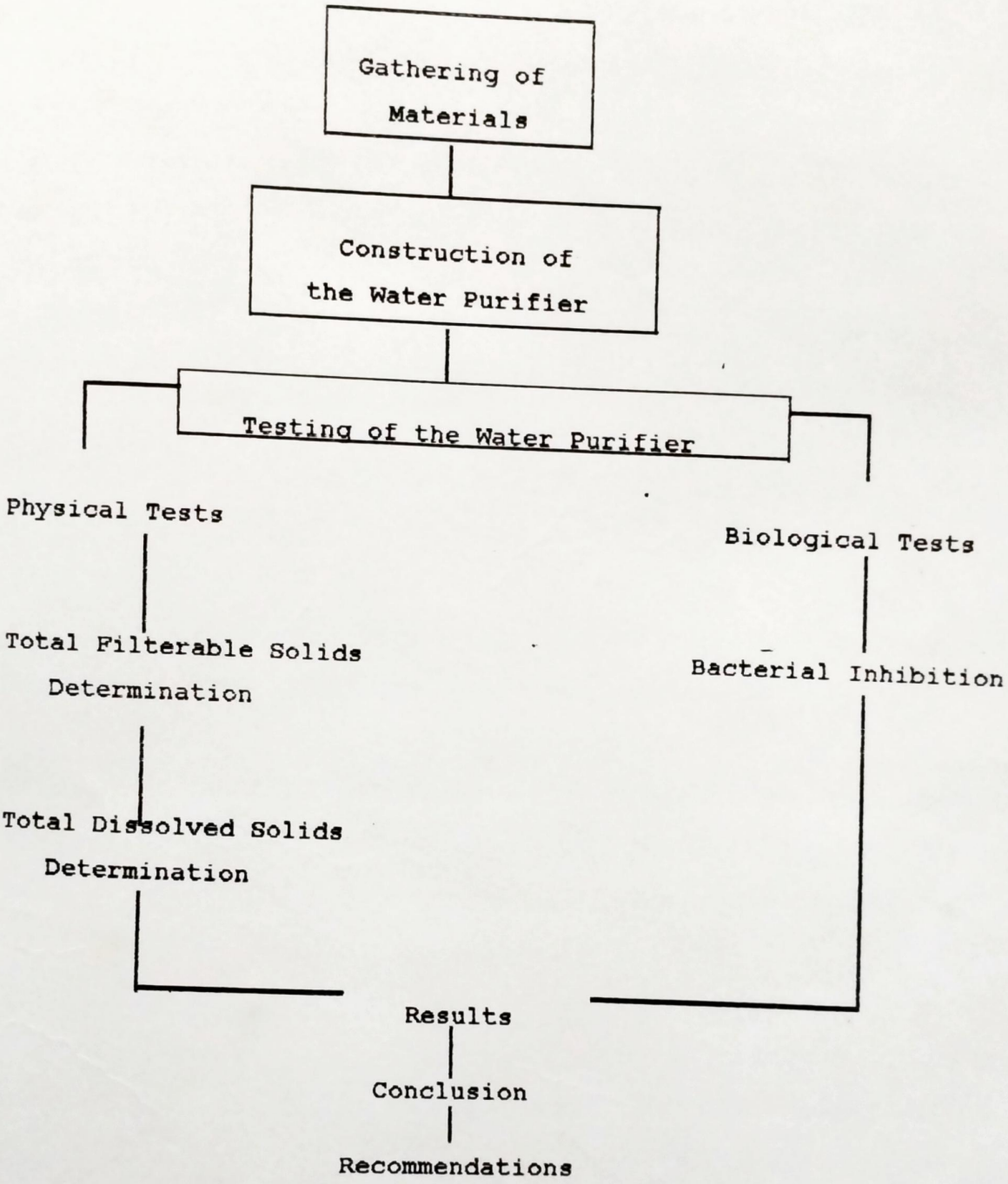
Water is very important for the human body to function. It is one of the major constituents of living matter. Most of living matter contains 50 to 90 percent of water or liquid.

In this present and modern time, pollution has worsened. The drinking water has been greatly affected that it now caused diseases that has made people suffer.

A water purifier is one of the most common solutions that can be thought of here. A water filter and purifier is greatly needed by the suffering human race.

Table of Contents

PARADIGM


Gathering of Materials
Construction of the Water Purifier
Testing of the Water Purifier
Physical Tests
Biological Tests
Total Filterable Solids Determination
Bacterial Inhibition
Total Dissolved Solids Determination
Results
Conclusion
Recommendations

INTRODUCTION

A. Background of the Study

Water is very important for the human body to function. It is the one of the major constituents of living matter. From 50% to 90% of the weight of living organism is water. Water in our body is very essential that drinking 6 - 8 glasses of it per day is required.

Aside from this, water is also used in different processes like in cooking food. It is used in washing the vegetables and meat. Thus, if the water is not purified, the microorganisms in it could prove very disastrous and even fatal to all.

Pollution has increasingly damaged the water supply like the rivers and spring water, and many diseases, like typhoid, came about. Pure water is an odorless and tasteless commodity that the researchers want to obtain.

Here in the Philippines, many of the low-income Filipinos obtain their water supply from artesian wells or from their nearest river. Water from these sources may contain vast amounts of microorganisms like bacteria that many of these families suffer from typhoid. In squatter areas a great number of cases of typhoid is prominent especially in little children.

With this in mind, the researchers came about the idea of making a cheap but efficient water purifier from local materials - malunggay seeds and oyster shells, because low-income families cannot afford to buy the commercialized water purifier. Malunggay seeds and oyster shells are the main purifying agents. The filtration system is composed of sand and charcoal, which will serve as filter.

Malunggay seeds have been tested to attract the bacteria that forms flocs around the seed. Thus, separating the bacteria from the water and making the water safer to drink.

Oyster shells were also found to have purifying properties.

B. Statement of the Problem

Can a home-made water purifier from local materials be effective in the filtration and purification of drinking water?

C. Objectives of the Study

Specifically, the research aims to develop and improve a more effective but less expensive water purifier.

D. Significance of the Study

Water plays a very important role in living things. It is vital in digestion and in circulation of food, excretion of wastes and proper metabolism.

But water is fast becoming very polluted by germs. In rural areas where most people obtain their water supply directly from their artesian wells, they are not certain of the purity of the water they drink.

This water purifier will help these low-income families in ensuring their water supply from the hazards of pollution.

E. Scopes and Limitations

The study covers only the making the water purifier from local materials and the testing of the device from its efficiency in the filtration and purification of the drinking water.

However, certain factors hindered the study, like the materials used. And the water purifier did not at all destroy all the bacteria but at least reduced their quantity to a minimum extent.

F. Hypothesis/Hypotheses

The researchers hypothesize that the water purifier made from local materials can filter and purify the drinking water up to a very minimal existence of germs, bacteria, solids and other harmful substances.

DEFINITION OF TERMS

Ramapithecenes - represents the earliest genus of the hominid(humanlike) line after its divergence from the pongid family of apes.

Typhoid - a severe, generalized human disease, caused by the bacterium Salmonella typhi, which enters the body in water or food contaminated with the feces or urine of a carrier of the disease.

Turbidity - murkiness in water due to suspended materials.

Mollusks - member of phylum, *Mollusca*, generally shelled and bilaterally symmetrical invertebrates possessing a muscular foot which is used for digging, swimming, or creeping.

Filtration - the act or process of separating suspended particles, like solids, from liquids using a filter.

Aeration - to impregnate with air.

Water - a clear, colorless liquid made up of oxygen and hydrogen (H_2O). It is the most common substance on the Earth's surface.

Flocculation - separation of suspended solids during waste water treatment by chemically created clump of flocs.

Flocs - small, light masses of fine flaky precipitate.

Review of Related Studies and Literature

Water - a simple compound of both hydrogen and oxygen has been considered as man's best friend ever since the first Ramapithecenes appeared on the face of the earth.

Humans and water, until now are still considered as inseparable abstracts - just like the sea and the sky, or electricity and magnetism.

This research aims to free water from impurities so as to ensure the health and safety of human consumers. We all know that today, diseases such as typhoid fever emerge from impure water supply drank by the less fortunate people living in rural areas who cannot buy expensive water purifiers. This research aims to solve these problems.

The traditional method of water treatment includes disinfection, often called chlorination. This is the most important part of water treatment. Disinfection scientifically means to detect and kill microorganisms that contaminates water.

The presence of sediments in water is also considered in water treatment. Turbidity is due to small particles that block the transmission of light and thereby make the water cloudy. A simple method of removing floating and large suspended-plant materials is by the use of fine screens, but the safest method is by chemical coagulation. Chemical coagulation is a flocculation process used to treat turbidity by the use of aluminum sulfate, ferric chloride, or ferric sulfate. This process makes the particles grow larger until the become heavy enough to settle out in a period of 1-2 hours.

Sometimes, microorganisms such as algae in surface waters, and sulfides in ground water can affect the taste and odor of drinking water. Water treatment plants solve this problem by the addition of activated carbon to the water followed by removal using the process of sedimentation. Chlorine and ozone can also be good substitutes for carbon.

The most common water treatment process is filtration. That is, the process of separating particles from water by allowing water to flow in a container filled with sand or anthracite coal.

Ground water has a great possibility of being contaminated calcium and magnesium bicarbonates. This causes the 'hardness' of a water supply. Chemical coagulation, that is, this time the addition of lime to react with the calcium and magnesium bicarbonates forming a precipitate of calcium carbonate that can be removed by sedimentation, is very effective. It is also possible to solve this problem by the exchange of the hardness ions, calcium and magnesium for the non-hardness ions, sodium. This process is called ion exchange or sometimes known as demineralization.

Water can also be contaminated by toxic elements such as iron and manganese. Aeration, exposing water to the air to allow these substances to oxidize is the process used to cope up with this kind of problem.

Modern water treatment also includes the addition of fluorides in low amounts to help reduce the number of dental cavities, primarily among children. This process is called fluoridation. (Collier's Encyclopedia, 1995)

* * *

Meanwhile, *Moringa oleifera* (malunggay), particularly its seeds was found to have the natural ability to attract

and stick bacteria and viruses to form flocs. The trapped bacteria and viruses then settle down into filter beds. Results show that crushed malunggay seeds have water- purifying properties as proven by various experiments conducted. (Mira, A. E. et al, 1993)

The versatile seeds of malunggay can also be used to make cooking oil, soap, cosmetics, lamp fuel, and ointment for skin infections. This tough tree can withstand drought and strong winds. Paper manufacturers even use its pulp for making paper. It is also a good source of fuel. (Bato Balani Sophomore, 1996)

Researchers further discovered that malunggay seeds are good suplements for persons who are deficient in iron (Bayadog, C. B. et al, 1993) and that it is possible to make capsules and multivitamin balls out of it (Calantas, C., Villanueva L., Padernilla, N., 19).

Upon encountering these studies about the wonders of the malunggay, we, the researchers, found out that most studies about malunggay were intended for its purifying capabilities.

A study conducted by Carlos, C. C. (1993) was further conducted to find out more about the water purifying abilities of malunggay. His main objective was to determine the effectiveness of mallungay as a water purifying agent and also to determine the time the malunggay-treated water remains potable after treatment. This purification involves the removal of colloidal particles imparting turbidity and the subsequent removal of microorganisms. Twelve types of water samples were artificially prepared in the laboratory with turbidities simulating conditions of the water source in the field. In order to determine the seeds' effect on

different concentrations of bacteria, a mixture of pathogens with bacterial concentrations of 100, 1000, 100000, and 1000000 CFU/mL were seeded to individual water samples each containing one of the three levels of turbidity. *Moringa oleifera* seeds were found to be effective purifying agents for artificially prepared contaminated and turbid water samples. It primarily causes a reduction in turbidity for coagulating particles in water. Bacterial growth was noted 4 to 24 hours later.

* * *

Aside from maluggay, shells of oysters (mollusks of the Class Bivalvia or Pelecypoda) were also found to have water purifying capabilities (Natividad, C. M., Alerta, E., Depanallo, F., 1995). Shells of oysters are composed of substances secreted by the glands of the mollusks. They consist largely of carbonate and lime. The experiment conducted involved the pulverization of oyster shells. After which, the pulverized oyster shells were added to different water samples and after 25 minutes, each water sample was checked for bacterial presence or the presence of microorganisms. Then, the number or the amount of oyster shells to be added are varied to test for its efficiency. Results showed that all microorganisms were killed within 25 minutes using 1.0 g of powdered oyster shells in 150mL of water. It also showed that as the amount of powdered oyster shells are increased, the mortality rate of bacteria and microorganisms in the water samples also increased.

* * *

Ensuring the safety of a drinking water requires money, so to solve this problem, various studies have been conducted.

Acoyong, M. et al (1992) constructed an improved, low-cost home-made water filter-purifier which uses a two stage purifying method. The first stage used was the chlorine treatment stage and the second stage was the filtration and purification stage.

Gabitoya, D. S. (1992) also made an improvised two stage water purifier, but this time, the first stage is the filtration process utilizing charcoal, fine sand, and coarse sand filtering system, while the second stage involves the pasteurization of water over a burner.

* * *

Various Filipino inventors also devoted their time to construct water or liquid purifiers.

Lee, R. M. (1990) invented a basin-like purifier using the gravitational force that filters the impurities in the liquid such as water, cooking oil, medicinal oil, and the likes by pouring the liquid inside the basin-like body provided with three connectors namely - the tubular stand support system a filtering state connector, and a collar.

Likewise, Go, A. K. (1992) constructed a filtering device for liquid containers. It is a filtering device comprising in combination in combination with a container having a threaded mouth, a tubular member inserted to the container, a filterring member fitted to the bottom portion of the tubular member and a dispenser cap having inner threads screwably attached to the threaded mouth of the container in communication with the top portion of the tubular membrane.

Lastly, Martin, R. R. (1992) invented the blue capsule filter. The application of this invention is to act as a filtering device for tanks. The construction of a blue capsule filter consists of a polyglass filter tank

constructed by a fiberglass reinforced high density polyethylene inner shell capable of withstanding 20 to 50 psi working pressure. An upper strainer made out of slotted pipe secured on a cross tee connector mounted inside at the upper portion, and a lower strainer made out of slotted pipe covered with sackcloth positioned at the lower portion of the filter tank.

* * *

As a whole, these works inspired us, the researchers to construct a better water purifier, if possible, intended to be used by the people.

METHODOLOGY

The researchers divided the methodology into two major parts: the construction of the water purifier and the testing of the water purifer.

A. Construction of the Water Purifier

To construct the water purifier, the researchers divided the cylindrical container into three unwequal parts. Each part represents a single working level.

The first working level from top to bottom is the filtration level, comprising the sand (coarse and fine) and the charcoal filtration system.

The second working level would be the malunggay seed treatment level. The researchers used the smaller container to hold this second working level. It will be the one holding the malunggay seeds.

The oyster shell treatment level will be the third working level. It will occupy the space under the second working level. The pounded oyster shells will be placed in this working level.

To avoid the possibility of sand leaking out to the water and for total filtration, several pieces of filter papers are placed on every working level.

A sprinkler at the top lid of the purifier is made to distribute finely the water coming from the water inlet. A filter paper is also placed on the sprinkler in order to filter solids in the water more effectively.

B. Testing of the Water Purifier

In testigng the water purifier's (filtration and purification) effectiveness, the researchers came up with the following parameters: Total filterable solids, total dissolved solids, and heterotrophic bacteria inhibition.

Water Sample Collection

Four types of water sources where drinking water is commonly gotten from weere chosen by the researchers: Maasin watershed, NAWASA, and the PSHS-WV water source, which is a deep-well water source. Water samples of 1 Liter each were collected from these sources to be tested with the water purifier.

The testing process of the water purifier's capabilities were tested at the PSHS-WV laboratory.

Total Filterable Solids Determination

1. The initial weight of the filter paper was recorded.
2. 200-mL water sample was filtered with the use of the funnel, Erlenmeyer's flask and filter paper. A prototype of the original 3-stage water purifier was constructed using the filter paper.
3. The filter papers were dried.
4. The filter papers were again weighed.
5. The other water samples left were then filtered in the same prototype purifier and steps 2 - 4 were repeated for every water sample.
6. The amount of filtered solids was determined by subtracting the initial weight from the final weight.

Total Dissolved Solids Determination

1. The initial weight of the eveporating dish was recorded.

2. 20-mL of the water sample was placed in the evaporating dish.

3. The evaporating dish with the water sample was placed on the hot plate.

4. After evaporating, the weight of the evaporating dish was again recorded for the final weight.

5. The water samples were filtered in the water purifier and steps 2 - 4 were repeated for every water sample.

6. The amount of total dissolved solids was determined by subtracting the initial weight of the evaporating dish to its final weight.

HETEROTROPHIC BACTERIA INHIBITION

1. The petri dishes were washed thoroughly and sterilized using the pressure cooker. Autoclve at:

Steam Pressure: 115 psi

Temperature: 121°C or 250°F

Holding Time: 15 minutes

2. Mueller Hinton II agar was the agar used as culture medium. About seven grams of the specified agar was weighed and mixed with the corresponding amount of water.

3. Using tongs, about 12 - 15 mL of the melted agar medium was poured in each of the sterilized petri dishes.

4. The agar was allowed to harden for 15 - 20 minutes but not more than 20 minutes. The plates were then sterilized in the autoclave.

5. After autoclaving, the agar plates were oven dried to 100°C and allowed to harden.

6. A drop of every water sample was inoculated in the agar medium.

7. The inoculated agar plates were incubated in the oven at 37°C for 24 hours. Colonies in each agar plates formed after the end time.

8. The water samples were purified using the water purifier and steps 6 - 7 were repeated for each water sample.

9. Comparisons between the two water samples using the counting of bacteria colonies were done.

RESULTS

A. Total Filterable Solids

Water Source	Weight of Solids	
	Before Filtration (grams)	After Filtration (grams)
PSHS-WV water source	0.05	0.02
Maasin watershed	0.10	0.03
NAWASA	0.04	0.04

B. Total Dissolved Solids

Water Source	Weight of Solids	
	Before Filtration (grams)	After Filtration (grams)
PSHS-WV water source	0.02	0.04
Maasin watershed	0.04	0.01
NAWASA	0.00	0.00

C. Bacteria Inhibition Testing Results

(1) Before treatment

* PSHS-WV water source ——— 18 colonies
* Maasin watershed ——————— 27 colonies
* NAWASA ——————————— 13 colonies

(2) After treatment

* PSHS-WV water source ——— 10 colonies
* Maasin watershed ——————— 17 colonies
* NAWASA ——————————— 11 colonies

ANALYSIS OF RESULTS

The results of the different test parameters showed that the water purifier have purifying properties.

In the total filterable solids test, most of the solids were eliminated after the filtrationprocess. The same held true for the total dissolved solids. But a small glitch came up in the PSHS - water source where the weight of the solids increased by 0.02 grams. It was believed to have been affected by external factors.

In the bacteria inhibition testing, results showed that the number of bacteria colonies have declined after the oyster-malunggay treatment.

CONCLUSION

Therefore, the researchers conclude that a three-stage water purifier utilizing *Moringa oleifera* (malunggay) seeds and oyster shells as main component is effective in the filtration and purification of the water source.

RECOMMENDATIONS

The researchers recommend that other local materials be tested for purification properties.

They also suggets that a more advanced water purification and filtration testing technique be employed to ensure the total effectiveness of the product.

LITERATURE CITED/BIBLIOGRAPHY

Acoyong, M. et al. 1992. Improved and low-cost home-made water filter purifier. Unpublishedpaper. Victorias, Negros Occidental.

Alamban, R. 1993. Chemistry: water for everyone. Bato Balani Junior. 13(3); 5 - 7.

Bayadog, C. et. al. 1993. The wonder of malunggay seeds. Unpublished paper. Washington Elementary School, Negros Occidental.

Billena, J. et al. 1997. Water quality assessment of Maasin Dam. Unpublished paper. PSHS-WVC, Jaro, Iloilo City.

Calantas, C. et. al. Powdered malunggay as multivitamin capsules and balls. Unpublished paper. Calaparan Elementary School. Arevalo, Iloilo.

Carlos, C. 1993. Use of malunggay (*Moringa oleifera*) seeds as purifying agents for contaminated water. R&D Philippines. 11(2): 40 - 41.

Gabitoya, D. 1992. Improvised water purifier. Unpublished paper. La Carlota North elementary school. La Carlota city, Negros, Occidental.

Natividad, C. et. al. 1995. Oyster shells as water purifier. Unpublished paper. Guimaras Polytechnic College, Buenavista, Guimaras.

BOOKS:

Kingfisher Science Encyclopedia, Water supply, vol. 10, p. 746.

The New How It Works. Softening (Water Supply), vol. 23, pp. 3104 - 3105.

Collier's Encyclopedia. 1995. Water treatment. 1995 ed., pp. 361 - 362. New York: P. F. Collier, L.P.