LOW COST TOOTHPASTE FROM OYSTER SHELLS

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In Partial Fulfilment of the Requirements
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Abstract

The Philippines being an archipelago of thousands of islands, is very abundant in marine resources, like the sea shells. Sea shells, too are also domestic and commercial wastes. Seashells, constitutes a large part of the dominant mineral Calcium Carbonate ($CaCO_3$). This mineral content is used for many products, like in chalk and glass making. This is, also an effective abrasive ingredient, in the production of toothpaste. But unlike any other abrasive ingredient, oyster shells offers antimicrobial properties which made it more advantageous.

This is interested in the substitution of oyster shells as the abrasive material in the production of toothpastes. It is also concerned with the effectivity of the substituted ingredient.

Shells were heated up to 100° C and been pounded thoroughly to come up with a refined powder. Then appropriate measures of glycerine, sodium fluoride, water, flavoring, baking soda, preservatives and binders. Then the resulting mixture is then tested for effectivity as a enamel whitener, hardener, and antimicrobial factor.

Comparative results with effectivity of shells broken and comparative study of subject oral microbial activities proved that the product is effective. However, when tested with two other commercialized toothpastes on a single subject oral specimen, results showed that there is no significant difference between the three in antimicrobial effects.

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CHAPTER I
INTRODUCTION

BACKGROUND OF THE STUDY

Toothpastes play an important role in a person's everyday routine to maintain proper hygiene. One does not want their teeth to decay so he brushes it at least twice a day, consuming toothpaste little by little until time will arrive to buy another box for use. Sometimes, it is used more often and consume all in just few days, upsetting the budget for the month.

Some people find it hard to cope up with the expense of buying toothpastes. This problem may not be too alarming but if they fail to buy this kind of dentifrices, dental decay may occur and will be a burden. It is a need to produce quality toothpastes but with less cost. One have to find alternatives for its costly ingredients.

Calcium carbonate, a component of abrasive in a toothpaste, helps keep the teeth strong as well as clean, but it does not occur free in nature. It is a dominant mineral constituent of limestone, marble, pearls, corals and shells of many marine animals.

The Philippines being an archipelago of thousands of islands, is very abundant in marine resources, like the sea shells - thus we can get the component at low cost, and avail it anytime. Sea shells can also be derived from homes, establishments or from

factories manufacturing seafood products. This helps make use of waste materials from these sources, and in turn serve as ingredient for toothpaste. No expense is needed in obtaining these, and indeed recycling wastes.

With this study, toothpastes may cost less, for the benefit of everyone.

STATEMENT OF THE PROBLEM

This study aims to answer the following questions:

1. Are oyster (*Crassostrea gigas*) shells effective as a substitute for the abrasive raw material in the formation of toothpastes?

2. Is there cheaper but effective alternative than the commercial dentifrice in terms of a comparative costs analysis?

3. Can the improvised toothpaste be of high quality in terms of:

a.) its effectiveness in the hardening of teeth

b.) its whitening property

c.) its antimicrobial property

OBJECTIVES OF THE STUDY

The main objectives of the investigation are to:

(1.) make use of oyster shells as a substitute of abrasive ingredient in the production of toothpastes; and

(2.) make a cheaper but quality alternative toothpaste compared to the expensive commercialized one.

SIGNIFICANCE OF THE STUDY

The significance of the study is:

(1.) help people especially the poor, from both urban and rural areas afford a cheaper but effective, quality dentifrice, especially toothpastes, for their oral hygiene; and

(2.) to help control commercial and domestic wastes by recycling and using chicken eggshells and oyster shells as a means of raw material for toothpastes.

SCOPE AND LIMITATIONS

The study is only limited to the use oyster (*Crassostrea gigas*) as a raw material.

Packaging and commercializing are excluded from the study.

This study will be conducted in Philippine Science High School Western Visayas Campus. Testing of product will only be laboratory tests.

HYPOTHESES

We, the researchers, hypothesize that:

1. we will come up with an alternative quality toothpaste which consists the pounded oyster shells as abrasives;

2. sea shells can be a reliable source effective for raw material for the abrasive ingredient of toothpastes;

3. the resulting product will be of high quality standard.

DEFINITION OF TERMS

Dentifrices - a powder, paste or other substance used in cleaning the teeth. They are preparations for cleaning and polishing the surfaces of the teeth. Examples of these are tooth powders, toothpastes and mouthwashes.

Toothpaste - is a preparation for cleaning and polishing the surface of the teeth. Together with tooth powder, they are collectively known as dentifrices. It is composed of many ingredients, including mild abrasive for polishing, binding agents, sudsers (foaming agents), flavorings, and humectants to prevent the hardening due to the exposure of air.

The abrasive commonly used in dentifrices include calcium carbonate, magnesium carbonate, calcium pyrophosphate, hydroxyapatite tricalcium phosphate, sodium metaphosphate, dicalcium phosphate, charcoal, and bone ash. Whitening toothpastes contain relatively larger amounts of these polishing agents, and may remove more stains from the teeth. However, they cause more damage to the tooth surface. The ideal dentifrice produces optimum cleaning and polishing with a minimum of wearing the surface of the teeth.

A commonly used binding agent in toothpastes is carrageen, while the widely used sudser, or foaming agent are sodium lauryl sulfate and sodium lauryl sarcosinate. Glycerin is the commonly used humectant. Spearmint, wintergreen and peppermint are popular flavorings added, together saccharin, and other sweeteners, and coloring agents.

Some toothpastes contain fluoride compounds to reduce tooth decay.

Calcium carbonate ($CaCO_3$) - is the most abundant naturally occurring compound of calcium and one of the most widespread minerals. This occurs in limestone, chalk, marble, eggshells, pearls, corals, stalactites, stalagmites and the shells of many marine animals. It exists in two distinctly crystal form - calcite and aragonite. It is the chief constituent of limestone and marble.

Calcite - a hexagonal calcium carbonate, is one of the commonest mineral. It is the stable form of calcium carbonate at all temperature and pressures encountered at or near the Earth's surface. It is a dominant mineral constituent of limestone and its metamorphic equivalent, marble, and is a common mineral in the shells of invertebrates.

Shell - the hard, protective covering of various forms of animals, such as turtles; the eggs of birds and reptiles, or the rigid "external skeletons" of some invertebrates, such as foraminifers, echinoderms, crustaceans, but of especially of mollusks, which includes clams, snails, and other sea shells. It is deposited as calcium carbonate crystals bonded in an organic matrix with a protein called conchiolin. This comprises an outer layer of quinone-tanned protein (periostracum), a columnar crystalline layer usually consisting of either calcite or aragonite, and an inner nacreous layer of thin crystalline sheets.

CHAPTER II

REVIEW OF RELATED LITERATURE

Corals and pearls are said to contain calcium carbonate ($CaCO_3$) on their body composition. The calcium compound too, is said to be present in different shells of invertebrate marine animals, like oyster shells, as well as in a land animal's offspring shell, like that of a hatching snake. It is the one that gives their respective structures the rigidity and the strength.

Shell is deposited in the form of calcium carbonate crystals bonded in a organic matrix with a protein called conchiolin. According to Morton (1979:30), this comprises an outer layer of quinone-tanned protein(periostracum), a columnarcrystaline layer usually consisting of either calcite or aragonite, and an inner, nacreous layer of thin crystalline sheets. The calcium carbonate, its main component, is the inorganic fraction of the shell.

Mollusk, a member of P. Mollusca, is known to contain this calcium compound. A study of the feasibility of a mollusk shell-based adhesive as a substitute for mortar was conducted by Philippine Science High School - Diliman students. The success of the research led them to several developments: the discovery of a cheaper construction material in the form of mollusk-based adhesive, since mortar is the very expensive ingredient that bonds bricks, stone tiles, or concrete blocks into a structure; the creation of a source of revenue and employment; and the lessening of garbage, which makes the mollusk a

applied, where it is mixed with the feeds for the chickens, as local poultry raisers practiced. In this way, the egg coming from a hen would be harder, and would protect more to the inside, than the usual - because of the mixture of shells. The fact was proven by the studies of Aguilar, Apolonio, and Jiz (1995). They studied the subject through feeding hens with different feeds: one with commercialized feed, another treatment was the same but mixed with the eggshells and seashells. They tested the resulting eggs. They found out that the eggs' hardness improved after the hen was fed with the second treatment: a mixture of 30% eggshell-sea shell and 70% commercialized feed. The conclusion was calcium carbonate of the shells infiltrated the eggs. (Aguilar, Apolonio, Jiz. 1995.)

The same is applied to human framework, the calcium we take orally infiltrates to our bones and teeth, hence the rigidity and strength. The human body primarily depends on calcium to harden and strengthen one's set of bones and teeth. This was the reason why some dentifrice use calcium compounds for abrasives, because it does not only polish through its fine particles, but it penetrates the teeth too, to improve its hardness, and strength.

Calcium carbonate is used as an abrasive ingredient in detrifrices, such as toothpastes and tooth powders. Together with calcium hydrosphate, magnesium carbonate, hydroxypatite tricalcium phospate, sodium methapsphate, dicalcium phospate, charcoal and bone ash, their effectiveness is determined upon it's particles' uniformity, size and hardness. This is why whitening toothpastes polish well because they have relatively larger amounts of these cleaning agents.

In a study, eggshells were proven to be raw materials for toothpaste production, it ensures the consumers of a good quality toothpaste produced, and the efficiency

since it could me homemade. The qualitatative determination analysis of calcium carbonate in eggshells established its presence while the quantitative determination showed the potential of eggshells as the principal constituent toothpaste. The results are also showed that a satisfactory amount of calcium carbonate was present in eggshells. More than half of the total raw material is calcium carbonate. Impurities present in eggshells were also found to be approximately *two* to *four percent*. Such quantity was negligible to harm the product unless they were chemically active to destroy colloidal balance as well as the chemical composition of other components of toothpaste. However, the usual impurities with in calcium carbonate were often stable compounds, and where therefore incapable of reacting with other constituent of the toothpaste. (Arinque, R. 1993. Toothpaste production from eggshells).

With eggshells as the base, the product obtained was white in color, as that of commercial toothpaste in consistency, except for the microscopic grits, the presence of which, was a disadvantage for the commercial grade ones. There was an observed separation of the aqueous phase by the paste and became moldy when exposed to atmospheric condition, since there were no preservatives. (Arinque, R. 1993.)

Twenty per cent (20%) of the toothpaste made up the abrasive agents. Other components include the humectant, usually the glycerin, and water - which gives the 75% of the product; foaming agents, usually sodium lauryl sulfate and sodium lauryl sarconsinate; and flavoring agents like peppermint, wintergreen and spearmint, make the 1 - 2%; coloring agents; binders such as carrageen and pacifiers give the 1 - 1.5%;

and the fluoride compounds have a part of 0.1 - 0.3% (Encyclopedia Americana. 1991. Connecticut, USA).

* * *

According to studies made by the American Chemical Society, dental creams are complex dispersions. Toothpastes are mixtures of abrasives and surfactants; anticaries agents, such as fluoride; tartar control ingredients, such as tetrasodium pyrophosphate and methyl vinyl ether/maleic anhydride copolymer; pH buffers; humectants, to prevent dry-out and increase the pleasant mouth feel; and binders, to provide consistency and shape (Table 1). Binders keep the solid phase properly suspended in the liquid phase to prevent separation of the liquid phase out of the toothpaste. They also provide body to the dentifrice, especially after extrusion from the tube onto the toothbrush. Table 2 lists typical ingredients used in formulations; the final combination will depend on factors such as ingredient compatibility and cost, local customs, and desired benefits and quality to be delivered in the product.

TABLE 1. Components of toothpaste

Ingredients	Wt%
Humectants	40-70
Water	0-50
Buffers/salts/tartar control	0.5-10
Organic thickeners (gums)	0.4-2
Inorganic thickeners	0-12
Abrasives	10-50
Actives (e.g., triclosan)	0.2-1.5
Surfactants	0.5-2
Flavor and sweetener	0.8-1.5

(Fluoride sources provide 1000-15000 ppm fluorine.)

Another important consideration when formulating dentifrices is the incorporation of active ingredients. Currently marketed dentifrices are complex, multifunctional formulations that not only provide basic cleaning of the tooth and gum surfaces but also are used as delivery vehicles for ingredients active against diseases such as caries and gingivitis. Fluoride salts have been used extensively for the past 25 years to reduce the incidence of caries in the general population. More recently, the introduction of triclosan in toothpaste (15-17) has made formulation even more challenging. Dentifrice components commonly used in toothpaste must be formulated so that they do not interfere with the activity of these ingredients. (Prencipe, et al. 1996)

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Two different fluorine salts are used in fluoride toothpastes. They are Sodium Fluoride and Tin (II) Fluoride. It took dental researchers many years to determine the "right" type of usable fluoride. A brief history of the development o f fluoride toothpaste is as follows. In 1942, V.D. Cheyne used Potassium Fluoride (KF) and B.G. Bibby used Sodium Fluoride (NaF) to show that fluoride applied topically to teeth reduced tooth decay. The Council on Dental Therapeutics of the ADA gave who all hearted approval in 1947 for the use of topical NaF as a therapeutic measure in the control of cavities by the dentist (Muhler, et al., 182). Tin (II) Fluoride was later discovered as a better cavity controlling agent. In 1960, the ADA gave its stamp of approval to Crest toothpaste, made by Proctor and Gambel, for successfully incorporating fluoride into toothpaste. A new era of oral hygiene was born.

Cavities, also known as caries, are lesions on teeth. Cavities start on the tooth's enamel, the outer layer of a tooth. Enamel is also part of the tooth toothpaste protects. Enamel is mostly Ca10(PO4)6OH2 (hydroxyapatite), and is approximately 97% by weight of mineral, 1% organic matter, and 2% water (Bruedevold, 33)

* * *

Oyster shells, being a bivalve mollusk, have certain elements of hardness. They contain calcium carbonate, too, like corals and the pearls. Oysters are also mollusks of the class Bivalvia or Pelecypodia. The true oysters, which include the edible oysters are characterized by rough irregularly-shaped shells. They are found in shallow, brackish, or tidal waters throughout all regions of the world except the coldest. Adult oysters live attached to an object. Its shells are composed of substances secreted by the glands of mollusks. They consist largely of carbonate of lime. It have three layers: the outer surface is covered with thin layer of thorn-like material which contains no lime. Beneath this is the layer of carbonate of lime. Lastly, forming the internal layer in certain groups of mollusks, but not at all, is the nacre, or mother of pearl.

In a study, oyster shells were found to contain calcium oxide which can kill microorganisms at a time, just like chlorine. According to the results, 1.0 grams of powdered oyster shells is needed to kill all microorganisms at a time in 150 mL in 25 minutes. The laboratory test conducted on the water sample showed that it is positive, for killing bacteria specifically Klebsiella Spp. The powdered oyster sample contains a total of 22.88% calcium oxide. Based on its effectiveness in killing microorganisms in

water, it was concluded a good substitute for chlorine in purifying water. It is not expensive and more practical to use. (Natividad, C.M. et al. 19 . Oyster Shells as Water Purifier. Unpublished Paper. Guimaras Polytechnic College, Buenavista, Guimaras).

With the result, the researchers recommended that their project can give background on oyster shells and their many uses. If this can kill bacteria in water, perhaps it can help too as an ingredient in toothpaste production. (Natividad, C.M., et al. 19).

* * *

In the market today, a renewed consciousness has struck the people's minds. Excessive advertisement has brought about confusion in the choice of toothpaste brand to use for many claim that they are the best.

One property of a toothpaste brand to consider in the best selection is how much bacteria it could eliminate. This led researchers to the idea of conducting a test for the best toothpaste which can eliminate the most number of bacteria in the tooth cavity.(Guanzon III et al. 1996).

In a study conducted by Philippine Science High School students, they aimed to determine which brand of toothpaste can best eliminate bacteria, in a process using three replicates of the toothpaste to be tested. Agar was prepared in a 250-mL flask. When cooked and ready, it was poured into three petri dishes and were labeled A, B, and C. Brand A has sodium monofluorophosphate as its active antimicrobial ingredient, while B has fluoride (not specified), and C has Allantonin, Triclosan, Sodium monoflurophosphate. The oral cavity of each panelist was wiped off using the sterilized cotton swabs. Bacterial growth was sought for the next 48 hours. A rating of 1 to 3 was used in comparing

the amount of bacteria that were observed per block. Brand A resulted as the first or the best toothpaste, followed by B, and then by C.

This study shows the importance of conducting tests for different brands of toothpastes so that one would know which has the best cleaning effect and have the idea on what to buy for his use. This research gave the right antimicrobial ingredients to include in order to produce the best toothpaste.

* * *

Chapter III
Methodology

The methodology of this research consists of four phases. The first phase concerns the planning and gathering of raw materials, as well as the equipments to be used. The second phase is the preparation of the toothpaste mixture itself. The third is preparing and performing the test. The last is the observation and the gathering of data.

PHASE 1

Raw materials to be used in this research were based from the gathered related literature. These are the main components of improvised toothpaste making: oyster shells, distilled water, glycerine, citric acid, soap dust, sodium fluoride, sodium bicarbonate, a bottle of oil of wintergreen, fruit flavoring, agar, broil cube. Equipments to be used are stirring rod, measuring cups and teaspoons, beakers for mixing and storage, graduated cylinder, and heating devices for heating the mixture like oven and hot plate; pestle for pounding the shells, and a 250mL beaker for the container. For the product testing part, which is phase 3, the experiment requires cotton balls and buds, vinegar, agar, broth cubes, beaker, mollusk shells, petri dishes, test tubes, crucible tongs, pipette, alcohol burner, Erlen-Meyer flasks, filter paper, and stirring rod.

Raw materials will be collected at residential and commercial areas where these shells are utilized.

PHASE 2

The second phase is the experimentation for producing the product in the laboratory. The initial procedure of the experiment is the preparation of the oyster shells to be pounded. The first step is to clean the shells through thorough brushing the outer part. Then pounding it will follow using the pestle and mortar. To make the shells finer to pound, drying it in the oven to about 90 degrees is necessary, until moisture escapes the shell. The next step is the step by step combination of raw materials to produce a toothpaste. First, 20ml of the prepared oyster shells water is mixed with 20 ml sodium bicarbonate. The solution is then combined with 5mL glycerin; 1mL soap dust, 0.5mL sodium fluoride, 0.5 mL oil of wintergreen, 0.4mL citric acid, 0.5mL food color, and 0.5mL fruit flavoring. Then distilled water is mixed thoroughly to a proper consistency which is 7mL. Then covering of the beaker with filter paper to prevent contamination from different factors.

PHASE 3

First there will be physico-chemical assessment of the product and these are getting its pH value, its physical appearance, state, taste, smell, color, and texture.

Then a vinegar test will be done to test the effectiveness of the abrasive. A mollusk shell will be prepared, which will divided into two parts, part A with no toothpaste

treatment, and part B with the alternative toothpaste treatment.. The shell is then brushed with the alternative toothpaste continuously for 15 minutes. After which, it is then soaked in an acetic acid solution or vinegar. For every 12 hours, to test for the hardness, there will be inspection if there is physical changes to the mollusk shell.

Another mollusk will be tested and another trial will be done.

The test for antimicrobial property will be conducted next. The preparation for the testing is also very essential. The materials needed are 14 grams agar, 1 liter of distilled water, filter paper, cotton balls and swabs, newspaper, and ethyl alcohol. Equipment needed are nine petri dishes, 3 50 mL beaker and a 250 mL flask, 5 test tubes and heating devices like hot plate, oven, alcohol lamp and incubator.

The first procedure for testing is to prepare agar. First place 2.8 grams of agar in a 250mL flask. On the other hand, 100 mL of prepared distilled water is poured into the flask, and the apparatus is placed in a hot plate. Thorough mixing is necessary with the stirring rod. As it boils, get it from the plate, and start to autoclave it so that it would be sterilized.

The 250 mL flask with liquid agar will then be poured into three petri dishes. This would be for the bacterial subculture. Oral cavity of the first subject panelist is to be scrubbed using the swabs. The swabs will be inoculated across the agar containing petri dish using antiseptic techniques. Another trial is to be made, but with a different panelist to be scrubbed and to be streaked in a different petri dish. There will be three trials.

After 72 hours, when there is enough mouth bacteria present in the three petri dishes, preparing of inoculi is necessary. First, for every 0.5g of broth cube, add a gram of agar and 150 mL water into a beaker. Heat it on a hot plate and stir. Then when it boils, remove it from the heating device and filter it using filter paper, funnel, a ring stand, and another beaker beneath. Meanwhile, preparing of three new agar-petri dishes is a need.

After the filtration, getting 6 colonies of microorganisms to be placed to the mixture from the subculture through wire loop method will be done. Then a sterilized pipette will get 4mL from the combined mixture and to be placed to a new sterilized agar containing petri dish using antiseptic techniques. When finished from a set of culture; another mixture of broth cube and agar will be done but with another subculture. These processes will result to evenly-distributed mouth microorganisms to be ready for a filter paper disc method.

At the next method, one will soak a milliliter product to a 3 mL distilled water for 15 minutes. To compare and analyze, two other toothpastes which is of commercially manufactured, will be soaked too. Then little filter paper discs will be placed to the solution and thereafter be placed in geometrical positions using antiseptic techniques to the new three agar-containing petri dishes. Let it incubate for a day.

Another microbial test will be done. This will be for the purpose of comparing the microbial activity of the panelist's mouth without brushing with the alternative toothpaste, and with brushing. This will need six petri dishes for 3 panelists. Using the same technique as used to evenly-distribute bacteria as above, each panelist's mouth

again will be swabbed again, culture it and place it on an agar containing dish; then brushes with the product and again with the processes.

PHASE 4

The results to the mollusk shell will be recorded for every trial. Every 12 hours there will be observation.

Recording of data gathered from the antimicrobial property tests will be done. To measure the potential of the alternative toothpaste, measuring the diameter of inhibition zones of the first batch agar petri dishes will be done. To conclude results statistics will be used, and the outcome of the statistical data will be charted and tabled.

To measure for the second test of the antimicrobial property, is to count colonies that will be appearing after the antiseptic techniques.

Every data and observation during the experiment will also be recorded.

CHAPTER IV

RESULTS AND CONCLUSION

I. RESULTS

The most consistent of 6 products is composing:

Ingredients	Amount	Percentage (%)
Oyster Powder	20.00g	36.97
Baking Soda	20.00g	36.97
Glycerin	5.00mL	9.24
Sodium Fluoride	0.25g	0.46
Citric Acid	0.30g	0.56
Detergent	0.50g	0.92
Distilled H_20	7.70mL	4.23
Fruit flavor	0.05mL	0.09
Agar	0.30g	0.56

general characteristics

pH value: 10 basic

color: green

flavor: minty, yet salty

texture: rough

consistency: not too much; semi liquid state

The first part of Phase 3 showed results that 15 minutes of brushing with the alternative toothpaste and soaking it with vinegar for 24 hours:

Observations

The Initial State of the Shell

The shell has thick covering, and it shines.

After brushing, 12 Hours After

The shell is dissolved by the acid and began to lose its luster and calcium covering.

After 24 Hours

It was found out the shell become thinner.

After 48 Hours

Treatment of part A was observed to be cracked while treatment of part B is still intact while on a solution of acetic acid.

Antimicrobial Test

First Part

All of the dishes (A,B, and C) showed that some of the paper discs' inhibition zones were inconsistent though their pairs showed some results. All of the discs showed on low effectiveness on specimen of different panelists A, B, and C. This is because of contimination of agar nutrient before the test due to lack of specific sterilization instrument (autoclave). The oven was the alternate strerilization equipment. It was set to 131 degrees to level the temperature given by the autoclave.

Second Part

There is a great difference between the bacteria colonies present in the brushed petri dish and the unbrushed petri dish. This proves that the product has antimicrobial property present. This part's results, however, is not yet that concluded since some of the agar petri dishes showed that the streaking of bacteria was not evenly to all the parts. Specimen from petri dishes (A and B) were not that evenly spread that results were not that accurate. Dishes only show that there is a significant colony quantity difference between dish of specimen.

Cost Analysis

Cost Analysis	Price per production
soap	P 0.04
glycerine	3.17
flavoring	0.32
distilled water	0.00
sodium fluoride	1.67
agar	1.78
baking soda	2.25
oyster shells	0.00
citric acid	0.41
TOTAL (product cost/100mL)	P17.79

Average Commercial Toothpaste Price (per 100mL): P 32.325*
* based suggested retail prices of 4 commercial leading brands

II. CONCLUSION

We conclude that a cheaper but an effective toothpaste from oyster shells could be a good alternative to those commercialized ones.

III. RECOMMENDATION

The product may be not as competitive to the commercialized ones because of its rough texture. Since it is homemade, the binder being used is agar, and not actives were used because triclosan is not available is unavailable and is expensive. To make the texture smooth, intensive refining is needed.

Methods used in antimicrobial testing must be added so that streaking of oral specimen is evenly distributed throughout. Making sure that the sterilization and other instruments work is must. More precise testing for its whitening and hardening tests is a must too.

The researchers suggest to that if they plan to continue with our study, they will have to gather more data and use more techniques in the testing parts. We also recommend those to be in the field of oyster shells since it has a lot of things to offer like

making glass, chalk and other products.

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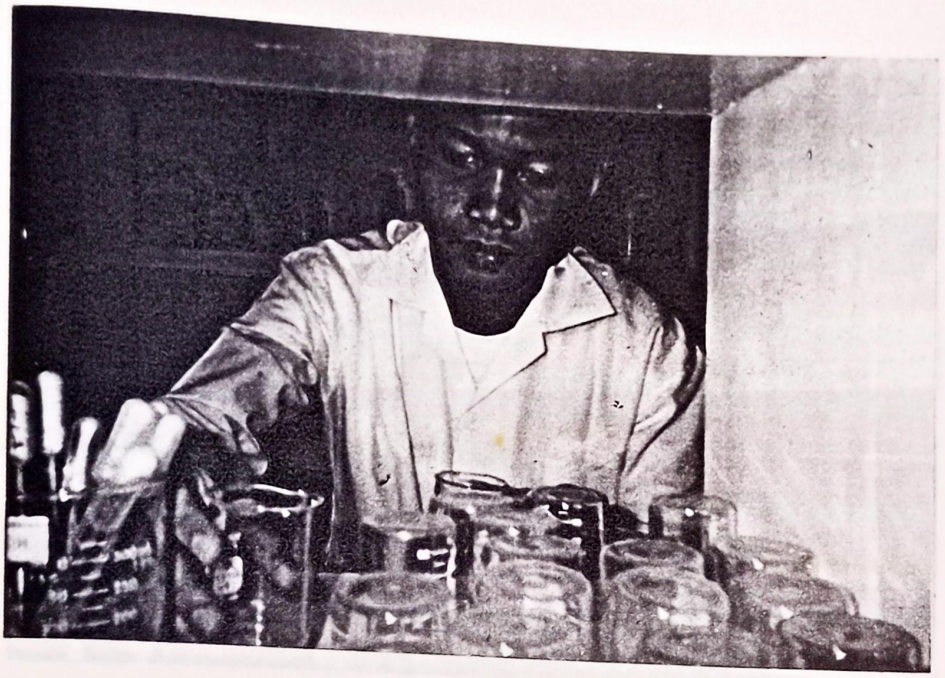
http://www.catalog.com/dentist/toothpast.html

Plate Number 1



Researcher Eman Amuan while he prepares the necessary laboratory apparatus.

Plate Number 2

The researchers. (*starting from left*) Eman Amuan, Harold Solis, and Arik de la Cruz.