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Formulation And Evaluation Of Oral Paste Made Using Calcium Carbonate Extract From The Shell Of Busicon Carica (Buccinidae)

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ABSTRACT:
The study is aimed at extracting calcium carbonate from the hard shell of *Busycon carica* in the formulation of oral paste. The oral paste preparation was designed using bases and excipients purposed for the treatment of gingivitis, periodontitis and dental plaque. The calcium carbonate was extracted by washing, drying, pulverization of the hard shell and sieving to fine powder particles, then evaluated for such parameters as: proximate, elemental composition, antimicrobial and physicochemical properties. The antimicrobial screening was carried out on five pathogenic organisms including: *Candida albican, Lactobacillus, Streptococcus mutans, Escherichia coli, Actinomyces* and aimed at determining the inhibitory activity of the formulated oral paste against such organisms. The percentage yield of the calcium carbonate extract was 74.28%, while the proximate principle revealed presence of moisture at 0.72%, CHO 1.74%, protein 3.063%, Lipid 0.70%, Fibre 20.32% and 73.46% Ash. Mineral constituents of the powder extracts were also analyzed and the result showed presence of such elements in the order Ca>Mg>Na>Zn. Physicochemical characterization studies of the formulation were found to have pH value of 6.9, good tube extrudability, Spreadability of 5.7cm and absence of hard and sharp edged abrasive particles and with viscosity characteristics value of 40,000Cp. The result obtained indicates that the calcium carbonate extract from hard shell of *Busycon carica* have appreciable viscous property and good abrasive effect hence can be useful in oral paste formulation.

KEYWORDS: *Busycon carica*, calcium carbonate, extraction, oral paste, extrudability.

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I. Introduction

Natural products are considered an excellent source for the discovery and development of drug molecules and pharmaceutical entities owing to their diversity in both structural features and molecular targets. In a broad sense natural products involve substances used for life and could be sourced from plants, animals and minerals and these has been the basis for the treatment of human diseases.

Natural products research continues to explore varieties of lead compounds which may be used as a template for the development of new drugs by the Pharmaceutical industries and the success of natural products is related to natural products chemistry, biochemistry, and pharmacology to exploit the vast diversity of chemical structures and biological activities of the product entities [1].

Plant and animal derived polymers, presents some of the latest research on the applications of natural polymers in drug delivery and therapeutics for health care benefits and estimation by WHO, states that about 80% of the world's population rely on one or more forms of natural product to meet their health care needs. Beside this, they could also be used for beautification and preparation of several cosmetic products hence the relevance of natural products, are vast and cannot be over emphasized [2].

Pharmaceutical formulation: This involves a process where different chemical entities (including the active pharmaceutical ingredient(API) and the excipients) are combined together to produce a product which must be associated with such qualities as: stability and acceptability to the patient and other end users. To achieve these therefore, involve a lot of formulation studies which must focus on such factors as, particle size, polymorphism, pH, and solubility of the material and final product so as to be assured of the dissolution and bioavailability of the formed product [3].

Pharmaceutical formulations can therefore be divided into three application types namely: Oral, parenteral and topical. The oral formulations include, tablets and capsules, the parenteral involves application via, intravenous, intramuscular, intrathecal, intraperitoneal, subcutaneous and intra atrial routes and the drugs are

stored either as liquid or if unstable as in lyophilized form. The third form of administration is the topical route and this involve the formulation intended for application on the body surface (skin) and mucous membrane. They include powders (finely divided solids), ointments (mixture of higher proportion of oil and water), foams, gel (this when in contact with the skin liquefies with alcohol as solvent), lotions, pastes (mixture of oil, water and powder in high proportion) and creams (emulsions of oil and water in almost equal proportion) [4].

Busycon carica

Figure 1: The hard shells of *Busycon carica*

The knobbed whelk is a specy of very large predatory sea snail, a marine gastropod classified in the order: **Phylum:** Mollusca, **Kingdom:** Animalia, **Family:** Buccinidae, **Order:** Neogastropoda

The knobbed whelk is the second largest species of busycon whelk, ranging in size up to 12mm and it is known by the riverine people in Rivers state (south-south) of Nigeria as Ngolo and generally known in English as whelk.

Shell description

The shell of most knobbed whelks is dextral, meaning that it is right-handed. If the shell is held in front of the viewer, with the spiral end up and the opening facing the viewer, the opening will be on the animal's right side. The shell is thick and strong and has six clockwise coils. The surface is sculpted with fine striations and there is a ring of knob-like projections protruding from the widest part of the coil. The color is ivory or pale gray, and the large aperture (the inside of the opening) is orange. The canal inside is wide and the entrance can be closed by a horny oval operculum [5]

Life habits

The knobbed whelk lives sub tidally and is migratory, alternating between deep and shallow water, depending on the time of year.

During the weather extremes of the summer and winter months, these sea snails live in deep water, at depths of up to 48 m. In the milder weather of the spring and fall they live in shallow water, on near-shore or intertidal mud and sand flats.

On the shallow-water mud flats whelks prey on oysters, clams, and other marine bivalves. They wedge a bivalve open using the edge of their shell, and insert their long proboscis to eat the flesh of their victim. They rasp at the flesh using their radula, a rough tongue-like organ that has thousands of tiny denticles (tooth-like protrusions) [6].

Reproduction

Figure 2: Whelk egg case

Mating and egg laying occur during the spring. Internally fertilized eggs are surrounded by a transparent mass of albumen, a gel-like material, and are laid in protective flat, rounded egg capsules joined to form a paper-like chain of egg cases, commonly called a "Mermaid's Necklace". After laying their egg cases, female knobbed whelk will bury one end of the egg case into the substrate, thus providing an anchor for the developing fertilized eggs and preventing the string of egg cases from washing ashore where it would dehydrate. Fertilized eggs develop in the capsules and the young emerge with a shell approximately 2–4 mm in length. But could be preyed upon by crustaceans, horseshoe crabs, and fish while the adult whelks can be eaten by loggerhead sea turtles [7].

Human use

The knobbed whelk is used by humans as food in such dishes as salads (raw), burgers, fritters, and chowders. As with the conch shells, the shell of the knobbed whelk can be made into a natural bugle by cutting off the tip of the spire in order to form a mouthpiece.

Calcium Carbonate

Calcium carbonate is a chemical compound with the formula $CaCO_3$. It is a common substance found in rocks as the minerals calcite and aragonite and is the main component of eggshells, snail shells, seashells and pearls.

It has the chemical Formula signified as $CaCO_3$ with molar mass of 100.0869 g/mol, density: 2.71 g/cm³ and melting point of 825 °C [8]

Properties

Calcium carbonate is a natural pure white granule, which can be prepared flexibly to produce various colored products and used in case of a large amount of filling, so that the products can still maintain good mechanical properties and it has excellent dispersion.

It can mix with polyethylene resin for blow molding, extrusion, etc., is easy to disperse, has strong covering power and adhesion and can improve the rheological property of the product and improve its formability. It is a commonly added abrasive that helps to remove extrinsic stains deposited on the tooth surfaces. Apart from its abrasive effect, calcium carbonate can deposit and block the dentinal tubules and prevent dentine hypersensitivity. However, excess calcium in the body can cause build-up on arterial walls of the heart, can also cause kidney stones, loss of appetite, constipation, nausea and vomiting, increased thirst or urination, muscle weakness, bone pain, confusion, lack of energy [9].

Sources

Sea shells are formed by the process of bio-mineralization where living organisms produce inorganic solids. Sea shells are the protective layers of marine animals called mollusks and other sea animals. It includes clams, oysters and snails. Most of these animals do not have a backbone and are called invertebrates. Seashells are excreted from the outer surface of the animal called the mantle and are mostly made of calcium carbonate with a bit of protein. Calcium carbonate does not dissolve in water and is made up of calcium ions that are secreted from cells of these animals and the carbonate ions present in water. The quantity of the calcium that is produced from different sources is not one and same and they can take the form of two different minerals, Calcite is the stable form, whereas aragonite is metastable and this over time, or when heated, can ultimately transform into calcite [10]. Proteins secreted by the animals' body helps in the crystallization process and the shell grows outwards at its margins and following ageing of the animal, the shell gets larger and more calcium carbonate is exuded from the mantle. Color patterns are specific to different species making it relatively easy to differentiate various species.

Seawater acidification will lead to a shift in inorganic carbon equilibria towards higher CO_2 and lower carbonate ion (CO_3^{2-}) concentrations. The carbonate ion is one of the building blocks of calcium carbonate ($CaCO_3$) and results by process of simplified reaction $CO_3^{2-} + Ca^{2+} \rightarrow CaCO_3$.

Oral paste formulation

Preparation of oral paste could involve such processes as, the dry gum and wet gum methods.

Toothpaste is a dentifrice used to clean, maintain and improve the health of teeth. It is mainly used to promote oral cleanliness and also acts as an abrasive that helps to prevent the dental plaque and food particles from the teeth, aids in the removing and/or veiling of halitosis, and releases active ingredients such as fluoride to aid in preventing tooth and gum disease (eg. Gingivitis) [11].

The various ingredients of toothpaste, included such as: abrasives which helps to wash off bacteria films, fluorides to harden the tooth against caries, thickeners which aids the ribbon to be strong, foaming agent to remove fatty films, sweeteners which plays the role as non-nutritive and help stop proliferation of bacteria, humectants aid in the retention of water within the formulation over time, foaming agents this helps in the dispersion of the toothpaste in the oral cavity and enhance the cleaning property by acting as surfactant and removing the debris and plaque from the oral cavity. Others excipients include; sweeteners, flavoring agents, coloring agents, preservatives, anti-calculus agents, whitening agents and anti-halitosis agents. Tooth paste therefore contains active and inactive ingredients which have their role proposed in accordance to the oral condition of the target audience [12]. It is therefore, the responsibility of the oral care professional to understand the ingredients in toothpastes and direct patients to different products based on their individual needs.

Toothpastes should be associated with such properties as: good abrasive effect, non-irritant and nontoxic, impart no stain in tooth, keep the mouth fresh and clean, Prolonged effect, cheap and easily available [13]

The idea of making tooth looking clean and healthy has been a common practice for decades but the way of this practice has changed over time. The initial practice involved, use of chewing stick, application of ingredients such as honey and oil along with other pleasant tasting ingredients although this was harmful to the teeth and gums. Others included use of tooth powder, and this was stored in tin and the brush has to be dipped into the wetted powder before use hence resulting to waste. Common in the early part of the 18th century was brushing with dry baking soda or salt and this was not appealing to most people. In 1877, toothpaste was mass produced in jars by Colgate company and in 1892, the first collapsible toothpaste tube was produced while in 1914, breakthrough in the formulation and acceptance of toothpaste occurred with the introduction of fluoride (sodium fluoride), which impacted greatly in the improvement of the densifiers [14].

Evaluation methods of toothpaste

This involves physical examination concerning color, odor, taste, smoothness and relative density where the smoothness will be tested by rubbing the paste formulation with the hand.

Inertness of the tube could be ascertained by ensuring that the container used does not produce corrosion or deterioration at normal storage condition of 45±2^{O}C for ten days.

Other parameters to be determined includes, pH, homogeneity at 27±2^{O}C, determination of presence of sharp and abrasive particles by scratching content in the finger on butter paper of 15-20cm, foamability to determine the foaming ability, presence of moisture and volatile materials adopting the Cleg Anthrone Technique and assessment of the anti-microbial activity applying the disc diffusion method [15].

The study is aimed at the extraction, analysis, and characterization of calcium carbonate from the shells of *Busycon carica*, formulation of oral paste using the extracted calcium carbonate and determination of anti-microbial activities of the formulated paste.

II. Materials

Hard shell of Busycon carica (obtained from Borikiri market, Port Harcourt), dilute H_2SO_4, 0.3M di ammonium hydrogen phosphate, aquades (distilled water), sodium lauryl sulphate, menthol, nutrient agar, sabroud agar, Muller Hinton agar, stone mortar, Digital viscometer (Brook field), muffle furnace, oven (Memmert Germany), porcelain evaporating dish, universal bottles and McCartney bottles.

Method

Sample collection and preparation

The *B.carica* hard shells were sourced from Creek road market, Borikiri, Port Harcourt. The hard shells were washed and dried before pulverization using a stone mortar.

Extraction of calcium carbonate

About 700g of the dried shells was weighed, washed with tap water to remove dirts from the outer surface and the inside of the shells. The shells were then boiled for 30 minutes using a steel container and dried in an oven at 60^{O}C. Dilute sulphuric prepared at a ratio of 15:85 was used to wash the dried shells and a cleaning brush was used to remove stains from the surface. The shells were dried again in the oven at same temperature for 3 days. After drying, the shells were pulverized into powder using the stone mortar and pestle. The resultant small grains were further pulverized and sieved by passing through the 125µm sieve aperture to obtain fine powder of calcium carbonate [16]. The obtained powder was stored in air tight container to prevent infiltration and absorption of air.

Percentage yield

This was calculated as:- $\frac{\text{Weight of extracted calcium carbonate}}{\text{Weight of powdered hard shells}} \times 100$

Physicochemical properties of calcium carbonate extract

The organoleptic properties (physical properties) involving, colors, odors, texture and appearance of the extract was observed

Proximate analysis of the extract

Determination of carbohydrate was carried out adopting the Cleg Anthrone method and the % CHO as glucose calculated as: $\frac{25 \times \text{absorbance of sample}}{\text{Absorbance of standard glucose}} \times 1$

The protein content was determined adopting the Kjeldahl method involving digestion, distillation and titration procedures and the percentage of organic nitrogen determined as [17]:

% Organic Nitrogen = Titre value x 1.4 x 100 x 100
1000 x 20 x 0.1
Where; Titre value = volume of HCl used in titration with ammonium distillate
1.4 = Nitrogen equivalent to the normality of 0.1N HCl used in titration
100 = total volume of digestion, 100 = percentage factor
20 = conversion factor from gram to milligram weight of sample digested
The moisture content was determined adopting the Air Oven method and the % moisture content calculated as:
Weight of fresh sample – weight of dried sample x 100
Weight of fresh sample used
The Ash value was analyzed adopting the Furnace method and the % ash content calculated as:
Weight of crucible + Ash sample – weight of crucible x 100
Weight of sample before drying 1
The Lipid content was determined by adopting the Soxhlet method and the % lipid calculated as:
% Lipid = Weight of flask and extract – Weight of empty flask x 100
Weight of sample extracted

Fibre content was determined by difference using the relation:
Fibre content = 100 – Ɛ (other parameters)
Elemental analysis of extracted extracted calcium carbonate powder

Here about 5g sample of the powder was ashed in a muffle furnace at a temperature of 630^{O}C for 3 hours. The ashed sample was dissolved in 10 ml of concentrated Hydrochloric acid and heated on an electro-thermal heater hot plate. The solution of the ash was diluted to 50ml with aquade, then filtered and used for the analysis of metal ions using atomic absorption spectrophotometer [18].

With proper choice of appropriate wave length, the chosen elements at concentration of ppm or mg/ml were determined. Magnesium at 285.4nm, sodium at 589nm, calcium content at 422.7nm, Zinc at 213.8nm and lead at 283.306nm.

Formulation of oral paste (target weight (45g))

Ingredients	Content
Calcium carbonate extract	89.0%w/w
0.3M di ammonium hydrogen phosphate	100ml
Aquades	50ml
Methyl paraben	0.6%w/w
Sweetener	1.33%w/w
Carboxyl methyl cellulose	2.67%w/w
Sodium lauryl sulphate	3.5%w/w
Glycerine	0.5ml
Sorbitol	0.5%w/w
Menthol	0.1%w/w

The preparation of oral paste was carried out by adoption of trituration method.

The fine powder of calcium carbonate extract (40g) was calcined at 1000^{O}C for 5 hours to convert it to calcium oxide. 100ml of 0.3M di ammonium hydrogen phosphate [$(NH_4)_2HPO_4$] solution was introduced dropwise into the CaO suspension with continuous agitation then allowed to stand for 24 hours at room temperature. The precipitate formed was filtered using whatman filter paper no. 12 then dried at 110^{O}C for 5 hours.

The aquades (50ml) was boiled and added with methyl paraben (0.3g) and sweetener (0.6g) agitated to dissolve then carboxyl methylcellulose (CMC) (1.2g) was dispersed at 70^{O}C and homogenized to form a gel.

The resultant hydroxyl apatite powder (filtered calcium carbonate powder) was triturated and then mixed with sodium lauryl sulphate (1.6g) and added with glycerine, sorbitol (0.2g) and the CMC gel. The prepared menthol (0.05g) was dissolved in alcohol(90%v/v) and added to the preparation with continuous agitation to ensure even distribution of all constituents and to obtain a resultant homogenous paste [19].

The obtained final product was stored and allowed to stand for 24 hours then the paste formed was filled into a collapsible tube and stored for observation and further studies.

Oral paste evaluation
The formulated paste was observed for its organoleptic properties as appearance, color, odor and texture.
Determination of pH

I.0g of the paste was scooped into a 150ml beaker and dispersed with 10ml of freshly boiled and cooled water and stirred properly at $27^{O}C$ to make a thorough suspension. Then the pH of the suspension was determined using a digital pH meter.

Determination of foamability

The foamability of the product was evaluated by dispersing 1.0g of the paste in 10ml of water in measuring cylinder noting the initial volume and then subjected to up and downward movement for 10 rotations and the final volume of foam noted [20].

Determination of spreadability

The spreadability is often used to denote the extent or area to which the paste can readily spread upon application. This was assessed by weighing out 1.0g of the paste into the center of a glass slide (10x10cm) and placing another glass slide above it carefully then again placing about 50g weight carefully at the center of upward slide. The diameter of the paste in centimeter after 15 minutes was measured.

The spreadability (S) = $M \times \frac{L}{T}$

Where S= spreadability, M= weight applied to upper surface, L= length moved on the lower glass slide
T= time taken (minutes)

Determination of tube extrudability

The formulated paste was filled into a clean lacquered aluminum collapsible one-ounce tube with a tip of 5mm opening and pressure applied on tube with aid of a finger. Tube extrudability was determined by measuring the amount of paste extruded through the tip upon application of determined pressure.

Determination of Viscosity

Paste viscosity was measured and evaluated using Brookfield digital viscometer using spindle no.3 by application of increasing values of the shear rate to help determine possible flow behavior of the paste, and the assessment was carried out at controlled temperature of $30^{O}C$.

Determination of hard and sharp edged abrasive particles

The paste was extruded from about the entire length (15cm) of the collapsible tube of each paste sample on butter paper. All the samples were observed and assessed by pressing the finger along the entire heap and length of the paste for presence of hard and sharp edged abrasive particles.

Antimicrobial Analysis

Preparation of paste solution was done by weighing out 1.0g of paste into a beaker and aseptically dissolving it in 10ml of sterile water to make a 10%w/v solution. The mixture was used to carry out the antimicrobial analysis.

Preparation of test organism solution

5ml of the formed sterile water was aseptically transferred into a macConkey agar bottle. Using a wire loop, a colony of the test organisms including, *E.coli, Lactobacillus, Stretococcus mutans, Actinomyces* and *Candida albicans* from culture medium was inoculated into 5ml water in the bottle and shaken.

Agar diffusion assay

0.1ml culture of the test organisms was added to a nutrient agar and poured into a universal bottle and mixed properly. The content of the mixture was poured into a sterile petri dish and allowed to solidify.

Using a sterile cork - borer, 4 discs were removed from the agar layer in other to produce 4 wells in the agar paste. Using a sterile pipette, drops of the paste solution were added into the corresponding wells and the fourth well filled with the control solution (Di methyl sulfoxide)

The plates were allowed to stand at room temperature for 15 minutes for proper diffusion of the paste then incubated at $37^{O}C$ for 24 hours. The diameter of zones of inhibition were measured through the base of the plate and this was repeated for all the test organisms [21].

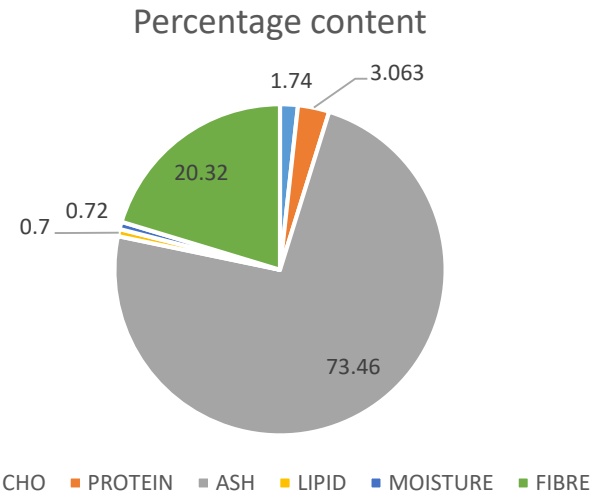
III. Results

Percentage yield of calcium carbonate extract = 74.29%

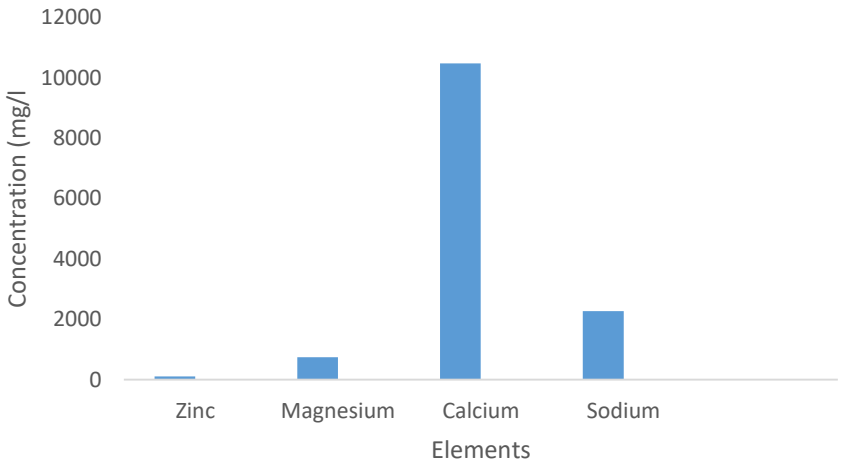
Figure 1: Calcium carbonate powder extract

Physical characterization of extracted calcium carbonate powder

Properties	**Observation**
Color	Pale white
Odor	Characteristic
State at room temperature (29-38^{O}C)	solid
Density (g/ml)	2.85
Solubility in water	Insoluble



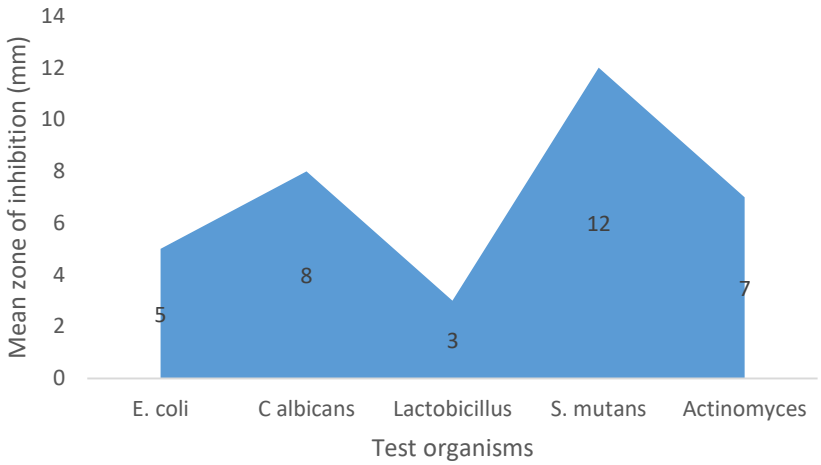
Proximate Analysis of Powdered calcium carbonate extract



Elemental analysis of Calcium Carbonate Extract

Physical Characterization of the formulated Paste

Parameters	Observations
Color	Light brown
Odor	Characteristic
Stability	Stable
pH	6.9
Viscosity (Cp)	4000Cp
Abrasiveness	Smooth
Tube extrudability	Good
Foamability	Fair



Antimicrobial Effects of Formulated Paste on isolates

IV. Discussion

Toothpastes are complex mixtures of abrasives and surfactants; anticaries agents, such as fluoride; tartar control ingredients; pH buffers; humectants (to prevent dry-out and increase the pleasant mouth feel); and binders, to provide consistency and shape. Binders keep the solid phase properly suspended in the liquid phase to prevent separation of the liquid phase out of the toothpaste.

The objective behind the use of tooth paste is its ability to deliver preventive and therapeutically active agents such as fluoride, metal salts and pyrophosphate. These agents may be useful for calcium inhibition and also reduce the growth of plaque and to treat dentine hypersensitivity along with dental hygiene.

Along with refreshing breath, removal of food particles, reduction of superficial plaque or stain, polishing of tooth surface is the function of toothpaste or dentifrices

The percentage yield of the calcium carbonate extract from the hard shells of Busycon carica was 74.29 % which is a high value and an indication that the shells are rich in calcium carbonate.

Upon consideration of the physical characteristics of the extract it was observed that the density of calcium carbonate was 2.85mg/ml, and as shown in table 2, the powder extract appears solid at room temperature, pale white in colour and has characteristic odour.

The calcium extract based on result of proximate analysis had 1.74%, 3.063% , 73.46%, 0.72% and 20.32% of carbohydrate, protein, Ash, lipid, moisture and fibre respectively.

The ash content in foods involves the burning away of organic contents leaving inorganic matters. This helps in the determination of the amount and types of mineral constituent in the food or substance, and also important because the amount of mineral content determined can assist in knowing the physicochemical properties of the substance as well as retard the growth of micro-organisms. Therefore, mineral constituent is very vital in food nutrition, quality, and equating to water could be microbial viable.

Elemental analysis of the extract reveals presence of calcium (10,466.7mg/kg), magnesium (744.4mg/kg), sodium (2,269mg/kg) and zinc 102.2mg/kg). The analysis therefore shows significantly rich high calcium content of the shells of *Busycon carica* and calcium is an important nutrient for healthy teeth and helps to strengthen the hard outer part (enamel) of the tooth which is regarded as the teeth's defense against erosion and cavities.

Calcium carbonate is also regarded as one of the most important abrasives useful in toothpaste and abrasives are substances useful in grinding and polishing. They remove the element adhering to the teeth surface without scratching the surface. Although the abrasiveness of the substance is dependent on the hardness of the abrasive, morphology of the particle and concentration in the product formed. The absence of hard and sharp edged abrasive particles in the formulation can be attributed to proper extraction and refining of calcium carbonate in the formulated oral paste.

Following the antimicrobial analysis of the oral formulation, the paste was tested against both gram positive, gram negative and fungi organisms including, *E. coli, S.mutans, L.actinomyces* and *C. albicans* as shown in table 4. For all the isolates the formulated oral paste showed appreciable activity against the tested organisms and this reveals that the oral paste has considerable anti- microbial activity.

The pH of the paste was observed to be slightly alkaline and this depicts non irritating and non- corrosive property of the paste. The stability, viscosity and foaming ability as observed in the formulated paste is an indication that the oral paste can effectively be useful in cleaning the oral cavity and reducing the microbial flora in the environment.

From the analysis of the final product (oral paste) it could be affirmed that there was no interaction between all the ingredients used in the formulation including: the active pharmaceutical ingredients, abrasives, humectants, detergents, binders, sweeteners, preservatives and antioxidants, and flavors and that they were used in adequate concentration and combinations to avoid damage to teeth and gums. Hence the product could be assumed to be safe, effective and well-formulated, based on evaluation results of the oral paste. More so as none of the formulated batches showed any dried nature, the colour of the formulations was cream white, their appearance was paste-like and all the batches were easily extruded from the collapsible tube and were observed to be of smooth texture, appreciable foaming ability, good spreading ability, adequate water activity and conducive pH. All these aforementioned properties are suspected to be enhanced by the proper choice and concentration of excipients especially sodium lauryl sulphate at concentration of 0.5-2%w/w as dentifrice detergent.

V. Conclusion

After the extraction process by washing, drying, pulverization and sieving of the hard shell to fine powder particles, the percentage yield of the calcium carbonate extract from the hard shells of *Busycon carica* was found to be about 74.29 %, an indication of a rich source of calcium from the shells.

Oral paste formulated showed activity against tested strains of isolated microorganisms and this reveals it to have considerable anti- microbial activity.

The pH of the paste as observed, revealed slight alkalinity thus depicting non irritating and non- corrosive property while the stability, viscosity and foaming ability as observed is an indication that the oral paste can effectively be applied in the cleansing of the oral cavity and reducing the microbial flora in the environment hence the formulated paste could be useful for calcium inhibition, reduction in the growth of plaque and applicable in the treatment of dentine hypersensitivity along with dental hygiene.

Based on the outcome of the results obtained from the study therefore, the formulated oral paste can elicit its primary function of refreshing breath, removal of food particles, reduction of superficial plaque or stain and polishing of tooth surface an activity comparable to standard formulations

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