International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 1199-1208 www.ijprajournal.com ISSN: 2249-7781

Formulation and Anti- Microbial Evaluation of Cream From Pentaclethramacrophylla Seeds Oil.

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Date Of Submission: 01-03-2021 Date Of Acceptance: 10-03-2021

ABSTRACT: Creams were, formulated accordingly in batches consisting of P.microphylla seed oil alone (batch A), mixture of the seed oil and coconut oil (1:1) (batch B) and coconut oil alone (batch C). The formulated creams were evaluated for pH, viscosity, conductivity, type of emulsion, antimicrobial activity, accelerated stability test (freeze-thaw- method), and antimicrobial activity on selected microorganisms. The seed oil and coconut oil respectively had a pH of 6.2±0.00 and 3.43±0.06, viscosity 39.83±0.29 and 12.60±0.10, refractive index 1.431±0.001 and 1.456±0.001 while the conductivity value was 0.6±0.11 and 0.3±0.11 at 29.2^{0}C.The antimicrobial effect of the seed oil on the selected microbial isolates was, low compared to coconut oil. Although the antimicrobial effects as obtained, reveal low or moderate activity of cream of batch A, than that of batch B and C, all other parameters assessed, depicted the creams of P.microphylla seed oil content to be of acceptable quality in cosmetic/pharmaceutical cream application.

Keywords: P.microphylla seed oil, creams, formulation, evaluation

I. INTRODUCTION

Pharmaceutically, cream is a semi solid emulsion, containing medicament and intended for external use especially on the skin or accessible mucous membrane to provide localized or systemic action on application site [1].

Creams may, be used for therapeutic and/or prophylactic purposes where high occlusion effect is unnecessary. A bland cream could be applied for its emollient, cooling, or moistening effect on the skin and ideal cream must be associated with such properties as, non-irritant, non- gritty, easily washed away, non- toxic, physically and chemically stable, biocompatible, bio- miscible and rapid onset of action [2].

The creams often comprises of two phases, oil and aqueous in which case, one is dispersed in the other termed the continuous phase and could either be hydrophobic (water-in-oil) or hydrophilic (oil in-water) and are often regarded, as a cosmetic preparation.

Creams mostly are, formulated by the incorporation of cream bases, which acts in such a way to enhance accommodation of additional ingredients and to prevent separation of the phases. They could act as either wetting, detergents, foaming, dispersing, solubilizing, or emulsifying agents. Some desirable qualities of acceptable cream base, includes, production of a stable film at interface, reasonably inert and not reactive, stable to chemical degradation, molecular structure must have a lipophilic and hydrophilic part, depending on the use, it should be odorless, tasteless, and colorless, and it must be of a reasonable cost. Therefore, selection of a type of cream base ultimately determines the type of cream to be, formulated [3].

Rheology and stability of creams

Topical creams are often non-Newtonian and shear thinning hence characterized with visco-elastic network. The rheological character therefore is dependent on the viscosity, type of emulsion and nature of ingredients in the internal phase. Viscosity of an emulsion may be, altered by increasing the content of a single emulsifying agent, reducing globule size via homogenization, or increasing thickness of the continuous phases.

The stability of emulsions which often refers to the ability of an emulsion components to, maintain the original characteristic throughout a desired shelf life without change in organoleptic, viscosity, texture, phase behavior and microbial effect, can be, affected by several factors including, temperature, cohesiveness, relative density, concentration and viscosity of the phases, gravitational forces, and surface properties of constituents [4].

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Cream Instability

The mechanisms of stabilization are different in various emulsion systems hence the stability of liquid emulsion is usually, affected by the processes of flocculation, creaming, and coalescence of dispersed particles. Such may occur respectively as, a result of the forced-orientated aggregation of dispersed droplets and rupture of thin film of continuous phase [5].

Creams (semi- solid formulation), are not susceptible to the aforementioned instability issues because they are more structurally complex and more concentrated than liquid emulsions so instability in this formulations could result from phase behavior of the emulsifier on storage. Reference to this therefore, evaluation of stability of semi-solid emulsions should be, done under storage temperature and over a long period as, they are liable to phase changes at high temperature condition and on heating [6].

Classification and use of Creams: Creams are, classified differently according to their characteristics properties as, cold creams, vanishing creams and based on the type of emulsion to function in widely acceptable form as, cleansing, foundation and massage cream.

Creamsaid in its emollient effect, retention of moisture, provision of barrier to protect the skin and vanishing effect hence could be of use in hot climates as, a result of sweating on the face, abating sunburns and helps in the removal of dead skin cells, oils, and dirt from skin surface [7].

Cream Formulation

Cream formulation ultimately is made of two phases, and includes, oil, and aqueous phase(s). The ingredients, miscible in each phase is respectively placed in separate vessel, heated at the same temperature and mixed together with continuous gentle stirring as one is being, added in aliquot to the other phase. Mixing, results in a viscous entity, which on cooling solidifies to give a cream. This simple procedure helps to avoid separation while additions of excipient should be steady and without vortexing to avoid entrapment of air and sudden cooling hence, excessive aeration need be, avoided as it can lead to granular product [8].

Anti-microbial: The search for novel drug moiety has led to the acceptance of plant and plant products, which can combat issues like multi-drug resistant strains, leading to the discovery of new lead compounds or antimicrobial compound itself. Some methods involved in the detection/diagnosis of bacteria/bacterial infections includes: gram staining, acid fast bacillus smear and culture, bacteria and blood culture test, protein and immuno fixation, electrophoresis, immunoglobulin blood test and white blood cell in stool test. A couple of methods have also been employed to assess the activity of new antimicrobial agents and include, well diffusion, disk diffusion, broth and agar dilution techniques [9].

Pentaclethramacrophyllacommonly called African oil bean belongs to the family fabaceae. They are trees which can be found in tropical African countries especially Cameroon, Cote d'voire, Democratic Republic of Congo, Ghana, Nigeria and Togo. The tree has a characteristic low branching habit and the compound leaves are usually about 20-45cm long and covered with rusty hairs. Its flowers are commonly yellow or pinkish white and sweet smelling while the fruits are available at most periods of the year because of the presence of the large persistent woody pods. Its fruits split open explosively and, this is the, edible product, a source of the oil, hence the name "the oil bean tree".

P. macrophyllamodulates and fixes atmospheric nitrogen and the fermented seed was, found to be nutritious. Some parts of the plant have medicinal values and the edible oil extracted can be, used for candle making, cooking, and soap [10].

Coconut Oil: Coconut (Cocosnucifera) is a monocotyledon belonging to the Arecqceae family and the order Arecales. C. nuciferais a fruit tree found in warm, humid climates with well-drained soils and it grows in tropical climates that are frost free, such as those in Africa, Asia, Latin America, and the Pacific region**, i**n the United States.

Coconut tree is often referred to as Tree of life because of its multi-dimensional use and the oil consists of triglycerides, mono unsaturated fatty acids (oleic acid), saturated fatty acid and some amount of polyunsaturated fatty acid. The oil is pale yellow to colorless with a characteristic odor of coconut. At low temperature, it appears as white solid, insoluble in water, slightly soluble in alcohol, miscible with petroleum ether and has a, relative density of 0.908-0.921g at 40^0C with refractive index of 1.448-1.450 [11].

Pharmaceutical uses of coconut oil includes, fight against candida, improves digestion, moisturizes skin, reduces cellulite, decreases wrinkles and age spots, balances blood sugar and improve energy, increases HDL and lower LDL

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cholesterol, burns fat, balance hormones, natural throat lozenges, lip balm /natural tooth paste, natural deodorant etc [12].

The aim of this study is, to formulate cosmetic/ pharmaceutical cream using Pentaclethramacrophyllaseeds oil and coconut oil and comparative evaluation of their antimicrobial activities.

II. MATERIALS AND METHOD

Standard glucose and boric acid, stearic acid (lobachemie, India), emulsifying ointment (Pcx" 79), Cetostearyl alcohol, sodium lauryl sulphate, tween 80 (xilong chemical co. Ltd, China), KOH, nutrient agar (Titian bio tech, India) and Muller Hinton agar (Titian bio tech, India), Sabouraud dextrose agar, coconut oil, extracted oil (Pharm Tech lab UniPort, Nigeria), light microphone, pH meter (Helmreasinn, PHS 25), Homogenizer (master chef), Brookfield Viscometer (DV2T, Thermostat hot water bath (HH-6, Techmel and Techmel, USA), refractometer (ABBE, Germany), conductometer probe (DDS-22c, Hanna Instruments), analytical weighing balance (Aculab Sartorius Group England), distillation flask, muffle furnace, porcelain evaporating dish, dessicator, hallow cathode lamp, autoclave, incubator, universal bottles and maccarteney, photocolorimeter, centrifuge (PEC Medicals, USA).

Anti-Bacterial Property

Susceptibility testing

Antimicrobial activity of the various oils was, assessed using Mueller Hinton agar and the agar plates inoculated with 0.1 ml broth culture of test organisms. Sterile cork borer was, used to make agar wells on the media and 2 drops of the oil introduced into the wells. The plate was, allowed to stand up to 30mins for pre diffusion of the oil and incubated at 37^{o}C for 24 h and the inhibition zone diameters, measured in millimeters (mm).

Table1: Formulation of Cream

Lipid phase	**%w/w**
P. macrophylla oil	25.98
Stearic acid	4.00
Emulsifying ointment	12.00
Cetostearyl alcohol	4.99
Aqueous phase	**%w/w**
Water	32.98
Sodium lauryl sulphate	4.99
Tween 80	9.00
Potassium hydroxide	6.00
Fragrance	0.06

The oil phase was, prepared by melting and mixing the oily ingredients including, stearic acid (4.00%), emulsifying ointment (12.00%), and the extracted oil (25.98%) uniformly together in same vessel at 70^{0}C.

The aqueous phase was similarly prepared by mixing the ingredients: sodium lauryl sulphate (4.99%), potassium hydroxide (6.00%) and tween 80 (9.00%) in water (32.98%) at same temperature (70^{0}C) until all the ingredients dissolved.

Maintaining same temperature condition, the aqueous phase was, added in, aliquots to the oil phase with moderate homogenization until cool. The fragrance (0.06%) was later, added to the mixture when in the molten state at between 25^{o} to 30^{o}C and homogenized.

The procedure was, repeated with coconut oil used alone and that involving ratio 1:1 of coconut oil to P. macrophylla oil.

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Cream Evaluation

Organoleptic properties: The cream was evaluated for appearance, color, pearlscence, roughness and odor.

pH evaluation: 1.0g of cream was dispersed with 10ml of water and the pH electrode inserted while connected to power source. The test was, conducted in, triplicates and reading recorded when stable.

Viscosity: Using the Brookfield viscometer, temperature probe attached to spindle guard leg of the viscometer was, lowered into the beaker containing about 10g of the cream until the spindle is, fully immersed in the sample. The procedure was, repeated at 30^0C, 50^0C and 75^0 C after 30 minutes. The displayed viscosity in centipose (cP), rpm and % torque was recorded on the viscosity data sheet.

Homogeneity: A small amount(0.01g) of cream was, pressed between the thumb and index finger to determine the smoothness and consistency of the formulation then the three batches of formulated creams subjected to centrifugation at 3000rpm for 30 minutes and at room temperature while placing 5 g of each sample on separate centrifugal tubes.

Wetness: This was, determined by separately applying 1.0gram of the cream on the skin surface of 15 human volunteers at three consecutive days and observing for the rate and extent of disappearance of the cream on the skin

Moisturization and type of Smear: 1.0gram of each batch of cream was, applied on skin surface of 15 human volunteers, then, observed for the type of smear formed by application of water to wash it off. This was, repeated for three days using, separate group of 15 human volunteers at same time of the day.

Emolliency: The emolliency, slipperiness and amount of residue left was determined after application of 1.0 gram of the cream on the dry skin of 15 human volunteers and the extent to which it lubricated or softened the skin observed. This was, also repeated on different groups of 15 volunteers for three days at same time.

Type of Emulsion: Dilution test was used while, about 2.0gram of the cream was, diluted with 50ml of water and oil using two separate beakers and emulsion type determined by observing for stability or breaking in the different media.

Conductivity: Using the Prob-conductometer an electrode was, inserted into a beaker containing a solution of 1.0gram of the various cream samples in 50ml of water. Test was, conducted in triplicates at room temperature and the readings recorded when spindle was, observed to be stable.

Dye solubility test: Crystal violet dye was, mixed with a little portion of the cream and a drop of the cream/dye mixture placed on a microscope slide, covered with a cover slip, and examined under the microscope.

Refractive Index: This was, verified using the refractometer and the reading recorded.

Thermal Stability: The creams were, exposed to temperatures of 29^o, 40^o and 60^oC to enable a study of the form the sample will take under varying environmental condition to determine the appropriate storage temperature.

Spreadability: This was determined by measuring the spreading diameter of 1.0 g of sample placed between two horizontal glass plates (2.5 x 7.1cm) after 10 seconds. The standard weight applied to the upper plate was 500g.The distance in which the upper glass slide moves over the plate in 10secs was, noted and the test carried out in triplicate for each cream.

The spreadability (s) calculated;

$$S = \frac{M \times L}{T} \quad \text{------ (1)}$$

S = spreadability, L= length moved on the lower glass slide, T= time taken, M = weight applied to the upper plate

Free Alkali Test: 5.0g each of the formulated cream was, placed in a 250 ml flask. The samples were, dissolved in 100ml of distilled water by gentle warming, then the resultant solution cooled to room temperature and 3 drops of 0.1% methyl orange indicator added and titrated with 0.05M H_2SO_4 solution.

Calculation:

$$\text{Free alkali (expressed as } Na_2O) = \frac{Vx100 \times 0.0031\%}{W} \quad \text{-------- (2)}$$

Where: V=volume (ml) of 0.05M H_2SO_4 solution W= weight (g) of the sample.

Freeze Thaw Test: About 20g of each batch of cream was, placed in a freezer at -10^0C for 24 hours then, removed and, allowed to thaw at room temperature (25^oC). The sample was further, placed in an oven at, 50^0C for 24 hours, removed, and allowed to equilibrate at room temperature. This test was, carried out in two cycles and the pH, appearance, and odor observed and recorded.

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Microbial analysis of cream: 250ml of double strength Muller Hinton agar (for the cream) and 250ml of single strength Muller Hinton agar (for the oil) were prepared. 20ml of each preparation was transferred into a, well-labelled agar pour bottle and autoclaved at 120 ^{0}C, for 15mins.

The agar was, allowed to cool, and 0.1ml of each organism inoculated into the agar and swirled, gently. The agar - organism mixture was, transferred aseptically into a sterile petri dish and allowed to solidify. On solidification, three holes were bored into the agar using a sterile cork borer of 6mm. One hole was, filled with positive control (Gentamicin 100mg/ml), another with negative control; dimethyl sulfoxide (DMSO) and thirdly the extracted oil and coconut oil respectively was, filled into the hole in the single strength plate and the cream into the double strength plate. The plates were, left on the table- top for a while to, allow for diffusion, and then incubated for 24hours at 37^{0}C. This method was, repeated for all the bacteria isolates.

For the fungi isolate, Sabouraud dextrose agar was, used and following the same technique, extracted oil and coconut oil were used as test samples while ketoconazole 100mg/ml was used as positive control and incubation done on the bench at 28.0 ^{0}C

III. RESULTS

Table 2: Physicochemical characterization of Pentaclethramacrophylla seed oil and Coconut oil

Characteristics	Pentaclethramacrophylla oil	Coconut oil
Colour	Brownish-yellow	Pale yellow
Odour	Agreeable	Agreeable
State at room Temperature (29.38^{o}C)	Liquid	Liquid
pH	6.2±0.00	3.43±0.06
Viscosity(cP)	39.83±0.29 at 31.1^{0}C	12.60±0.1 at 29.4^0 C
Density (g/ml)	0.89	0.91
Specific gravity	0.90 ±0.002	0.92±0.005
Refractive index	1.431 ±0.001	1.456 ±0.001
Conductivity(µS/cm)	0.6 ± 0.11 at 29.2^{0}C	0.3 ±0.11 at 29.2^{0}C

Table 3: Antimicrobial/antifungal effects of the oils and reference standards on some isolates

	Agents	E. coli	S.aureus	P. aeruginosa	K. pneumoniae	C. albicans	B. cereus
Zone of inhibition (mm)	Gentamicin (100mcg/ml)	28	25	18	21	0	40
	Ketoconazole (100mcg/ml)	0	0	0	0	24	0
	Extracted Oil	0.6	0.1	0	0	0.1	0.3
	Coconut Oil	14	11	7	0	19	3

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Fig 1: Cream formulated with Oil

Fig 2: Cream Formulated with 1:1 of **P. macrophylla** and coconut oil

Fig 3: Cream Formulated with Coconut Oil

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Table 5: Physical Characterization of Formulated Creams

Physical Parameters	Observation		
	Cream A	Cream B	Cream C
Appearance	Yellow	Pale Yellow	White
pH	8.67±0.11	8.40±0.10	7.53±0.06
Homogeneity (By touch and visual)	homogeneous, smooth and consistent	homogeneous, smooth and consistent	homogeneous, smooth and consistent
Viscosity (cP)	8687.67±30.45 at 30^0C	3772.00±13.86 at 30.7^0C	2501.67±2.88 at 30.3^0C
Dilution test	o/w	o/w	o/w
Robustness (spreadability and wetness)	spreadable and moisturizes skin surface	spreadable and moisturizes skin surface	spreadable and moisturizes skin surface
Type of smear	non greasy	non greasy	non greasy
Emolliency	no residue left	no residue left	no residue left
Refractive index	1.625 ±0.00	1.645±0.00	1.662±0.00
Conductivity (µS/cm)	321±3.78 at 28.4^0C	673±0.29 at 30.1^0C	1966±0.66 at 30.1^0C

Table 6: Centrifugation Test

Sample	Observation
Cream A	no separation occurred
Cream B	no separation occurred
Cream C	separation occurred

Table 7: Thermal Test for Creams

Temperature	Cream A	Cream B	Cream C
29.38^0	stable	stable	stable
60^0C	liquefied within 140 secs	liquefied within 96 secs	liquefied within 36 secs

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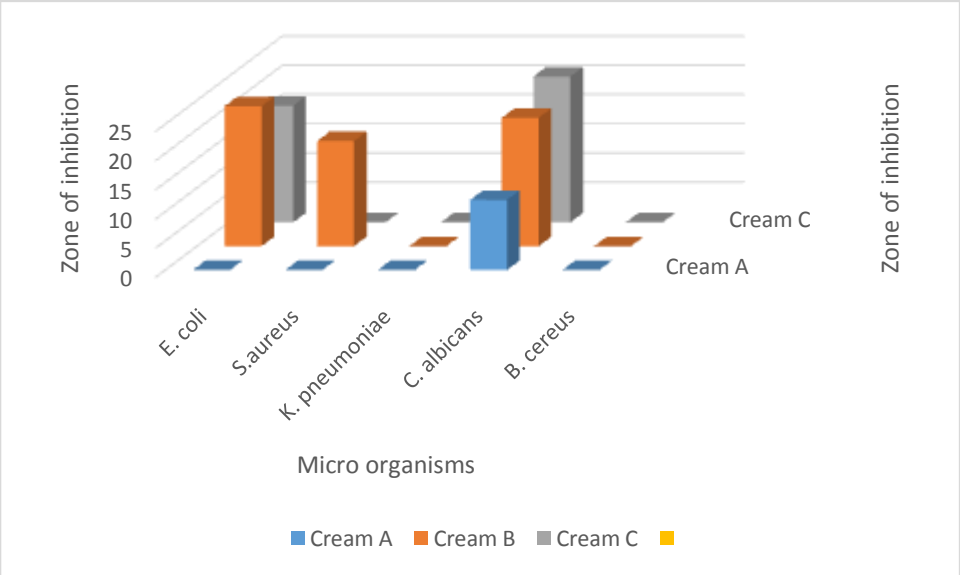

Fig4: Antimicrobial effects of the Creams on some isolates

Table 8: Free Alkali Test for Creams

PRODUCTS	CREAM A			CREAM B			CREAM C		
Sample	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Titre value	6.5ml	6.5ml	6.5ml	6.1ml	6.1ml	6.1ml	4.6ml	4.6ml	4.6ml
Average Titre value	6.5ml			6.1ml			4.6ml		

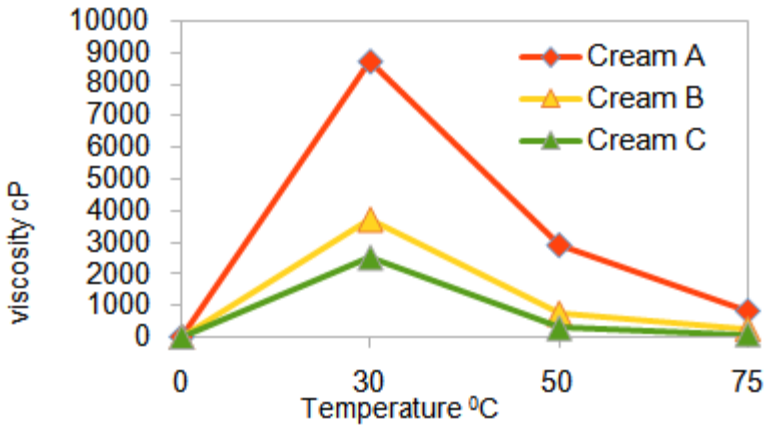

Fig 5: Relationship between viscosity and temperature

Cream A = Cream formulated from oil of P. macrophylla, Cream B = Cream formulated using 1:1 of P. macrophylla and coconut oil and Cream C = Cream from only coconut oil

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Table 9: Freeze-Thaw Test

	Observation		
Parameters	Cream A	Cream B	Cream C
Appearance	Stable	Stable	Cracking occurred
Color	yellow	pale yellow	white
Odor	Same as original formulation	Same as original formulation	Same as original formulation
pH	8.6	8.3	9.5

IV. DISCUSSION

Following, the experimental proceedures, three batches (A, B and C) consisting respectively of P. macrophyllaseedoil, 1:1 ratio mixture of P. macrophylla seed oil with coconut oil, and coconut oil creams were, formulated with such oil as the lipid phase. Analysis of oils revealed the existence of similarities in properties relating to the smear, emolliency, robustness, homogeneity, type of emulsion as observed in the dilution and dye test shown in Table 5.

The result of density of the P.microphylliaoil was 0.89mg/ml and specific gravity 0.90 ±0.002, while that of coconut oil was 0.91g/ml and specific density 0.92±0.05 and tis depicts the oil to be less dense than water hence has appreciable flow characteristic comparable to coconut oil and such property enhances good spreadability especially in cream formulation.

The color of the resulting creams were yellow, pale yellow and whitish for batch A, B and C respectively. This variation in color could be influenced by the viscosity of the oil used where from study, the P.microphylla oil was found to be 39.83±0.29 cP at 31.1^0C while that of coconut oil was 12.60±0.1 at 29.4^0 C. The level of viscosity of the oil has influence on the extent of liquefaction of formulated creams. Hence as shown in table 7, batch A formulated using, P.microphylla oil alone was observed, to be stable up to 146 seconds, while batch C made using coconut oil alone, liquefied within 36 seconds and batch B was intermediate after being exposed to same temperature of 60^oC. This appreciably viscous nature of the P.microphyllia oil could be of relevance in pharmaceutical cream formulation and advantageous in maintaining stability and even of greater effect compared to such known naturally sourced ones as coconut oil used in cosmetic formulations.

The formed creams including all the three batches observed, appeared to be elegant and cosmetically appealing and the pH of the creams though slightly alkaline was close to neutral with cream from P. macrophyllaoilbeing 8.67 that from 1:1 ratio of P. macrophyllaand coconut oil giving 8.40 while cream of coconut oil was 7.53. This result signifies characteristic inertness and non-corrosiveness hence the creams could be subtle and acceptable on eventual application to human skin although that made using coconut oil alone could exert anti-bacterial effect as influenced by the slightly acidic characteristic of the oil lower pH of the resultant cream.

Stability testing showed the coconut oil cream as the least stable especially at 60^0C while at close to room temperature (29.38^0C) all three batches were stable depicting such to be a conducive state for storage of the creams. Centrifugation test even at high rate (3000rpm) showed separation of only the coconut oil cream as the cream seem not to withstand the stress applied but P. macrophylla seed oil was observed to be more stable hence could possess the ability to withstand stress and maintain homogeneity upon application as cosmetic and pharmaceutical cream and under varying stress conditions.

Freeze-thaw test after two cycles showed a noticeable change in pH and cracking of the batch containing mainly coconut oil than the creams consisting of P.macrophylla seed oil used alone and that in a 1:1 ratio of the seed oil and coconut oil. This implies that the cream formulated with P.micropylla oil is more structurally complex and stable hence on transportation especially during importation and exportation to different parts of the continents the cream having such content is, capable of being maintaining homogeneity than that formulated with only coconut oil.

V. CONCLUSION

Antifungal and antibacterial cream can, successfully be, formulated using the extracted P. macrophylla seed oilalthough it had minimal effect on tested microorganism, but due to the stable, inert, emollient property and its rich mineral content, there is the justification of its consideration not only in cosmetic but also in Pharmaceutical and dairy cream formulation.

The inclusion of the oil in pharmaceutical /cream formulations will help to improve the quality, elegance, aesthetic, moisturizing, and antiseptic effect of such resultant product on the human skin. This attribute is therefore, encouraging hence advice for the sourcing, continuous search, and development of local natural product as substitute for high cost imported and synthetic raw materials.

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