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Formulation, Physicochemical and Antifungi Evaluation of Herbal Soaps of AzadiractaIndica and ZiziphusMauritiana

Namo Jeremiah Akuaden, I. Y. Chindo,Joel Ogboji
Chemistry Department AbubakarTafawaBalewa University Bauchi, Bauchi State, Nigeria.2019.
Corresponding Author: Namo Jeremiah Akuaden

Abstract: Background:*The need to attain and maintain a healthy skin is on the increase. This has led to antiseptic soap being compounded with complex synthetic chemicals whose safety on human skin and health remains unclear.*
Objectives*: The present work involves the formulation, physicochemical and antifungi evaluation of herbal soaps*
Methods:*The herbal soaps were formulated using bark and seed extracts of Azadirachtaindica and ZiziphusMauritianaand evaluated for various properties like colour, Foam retention (Fr),Foam height (Fh), pH, Free caustic alkali (FCA), Alcohol insoluble matter (AIM) and moisture content. The antifungi activity of the formula was comparatively tested onAspergillusfumigatus andmicrosporumgypseum.*
Results:*Soap base C gave the most stable foam with over 60 minutes of foam retention in distilled water, Soap base A gave the highest emoluency.Physico-chemical tests gave satisfactory results for all tested parameters. The result of the antifungiactivity of the formulated soaps, reveal that formula containing only one extract show less significant antifungi activity than formula with two or more extracts combined.*
Conclusion:*The results of the study offer potential alternative to the cosmetic industry in antiseptic soap production.*
Keywords:*Antifungi activity, Emoluency,Cosmetic industry, Antiseptic, Synthetic chemicals*

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I. Introduction

Skin diseases are among the major public health problems as they have a considerable impact on individuals and communities. They cause pain, suffering, impairment of normal functions and reduced quality of life. The frequency of these skin diseases is on an increase as a result of the increasing unsafe synthetic chemicals compounded into skin care products.

Skin infectionscause by fungi arethe most common and require significant attention for treatment, and also to maintain a healthy skin thereafter. For countless years, skin problems have affected millions of people. The most common skin problems are: Acne, Acne Scars, Eczema, Hives, Skin Rashes, Dry and Cracked Skin, Psoriasis, Stretch Marks, Sun Damage, Skin Dullness and Lack of Elasticity (Ping-Hsienet al., 2007).

In general, fungi live in the dead and top layer of skin cells of moist areas of the body and cause only a minor irritation. Other types of fungal infections could be more serious. They can penetrate into the cells and cause itching, swelling, blistering and scaling. Skin disease therefore constitutes a significant problem all over the world (Ping-Hsienet al., 2007).

Most commercial soap available today inthe marketsare incorporated with chemical agents having antimicrobial activity with potential depilatory properties on skin pathogens. Detergents and soaps are regarded as disinfectants required in daily practices for hygiene. Soaps are cleaning agents, which may be liquid, solid, semisolid or powders. They are used to remove dirt, including dust, microorganisms, stains and bad smells in order to maintain health, beauty and remove bad odor from the body or inanimate objects, including clothes (Ikegbunaet al., 2003). Commercial soap usually are made of toxic mercury, aluminum, barium, bis-phenol, plastics and other chemicals, which are absorbed into the body via the internal lungs from vaporization of the chemicals as well as skin absorption with negative side effects (Aiello et al., 2007).

The problem now is most people do not know the long term consequence of using the commercial soaps. This is because these commercial products contain substances which are considered as unhealthy and could harm the body in the future (Aiello et al., 2007).Recently, the bacterial killing effect of medicated soap was disputed by health experts and the United States Food and Drug Administration (U.S. FDA) queried that there is no clear proof that medicated antimicrobial soap provide additional protection. (U.S. FDA, 2016). This is because they believed most of the soap is deceptive. They are hyped yet actually there is no extra protection they offer. However it was argued that antimicrobial soap is recommended in cases where one has low

immunity and one's skin cannot ably take care of itself says Dr. IhumaOgbonnaya, a consultant physician in Abuja Nigeria (Ihumaet al., 2013).

In addition, commercial antibacterial soap is a type of soap which contains chemical ingredients which frequently includes triclosan, triclocarbon and chloroxynol. It has been disputed with study findings that these chemicals are no more effective at deactivating viruses than any other kind of soap or detergent (U.S. FDA, 2016).

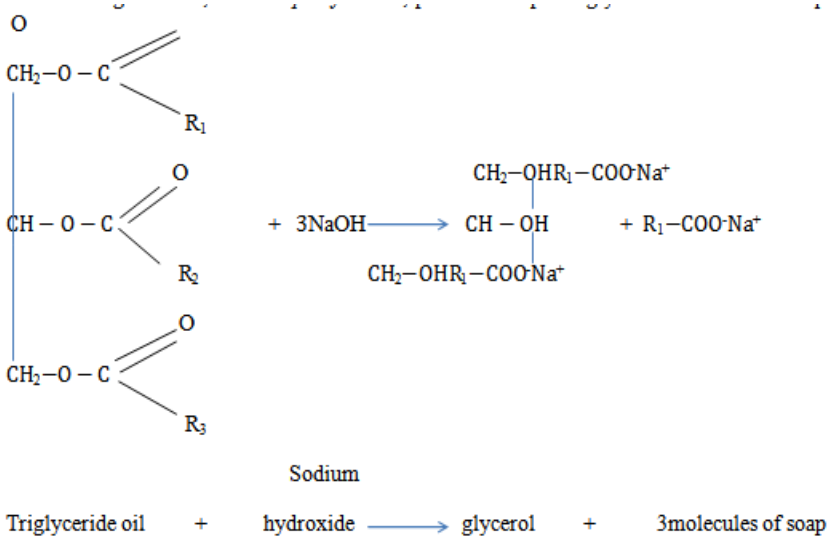
The drawbacks of commercial soap, led people now to be more inclined toward the use of herbal formulations. These problems of commercial soap have been reported to be successfully handled daily by using only what 'mother nature' has to offer to help you nourish your skin (Abhay, 2014).

Herbal soaps do not contain the artificial colors, flavors or fluoride etc., when compare to the contents of commercial products (Deepa and Nikhil, 2015). The antimicrobial activities of the selected plants to be used in this project work are known to exhibits antimicrobial activity against skin pathogens. Herbs are the natural products mostly found in the treatment of almost all diseases and skin problems owing to their high medicinal value, cost-effectiveness, availability and compatibility (Saikiaet al., 2006 and Solanki2011). Hence it can be used in soap base. The attribute of the soap includes gentleness on the skin, rich lather, protection against skin disorders (including rashes, eczema, scabies) treatment of skin infection (such as ringworm), protection of even skin toning and smoothness of the skin (Getradeghana 2000).

Azadirachtaindica(Neem) tree contains many natural substances in its different parts, leaves, seeds, bark, and has many biological activities against disease causing organisms, and it contains about 140 chemical compounds. The leaves and seeds of Neem tree contain active material known as azadiractrin (AZ) ($C_{35}H_{44}O_{16}$) (Sankaramet al., 1987) and have the ability to kill some disease causing fungi, viruses and parasites.Neem extract is very active against skin fungi which cause the ringworm disease. The AZ content in neem oil was highly correlated with its bioactivity against test insects (Ismanet al., 1990). A marked difference has been reported in the yield of AZ from neem seeds from different geographical origins, even in different seasons in the same geographical area (Sidhu and Behl, 1996).Recently, two new tetranortriterpenoids, 11 –epiazadirachtin H (Ramjiet al., 1996) and AZ-K (Govindachariet al., 1992), have been isolated from neem seeds. Although the bark, heartwood, leaves, fruit, and seeds of neem have been investigated chemically for their main biocidal components, the renewable parts (seeds and leaves) received major research attention.The neem oil is Eco friendly and important essential oil due to its insecticidal and fungicidal value in Entomological practices. Neem oil at 5% concentration can be adopted as lethal dose to control white rot fungus in Wood Plastic Particle Board (Sangeethaet al., 2014).

The seed extract of Z. mauritianawas stated to demonstrate antiplasmodial effects. The methanol extracts of Z. mauritiana found in Bauchi State,Nigeria, showed antifungal activity when tested by the agar diffusion method againstdermatophytes.

TheHot Process of Soap making was adopted in this project work. It is a process of adding fats to sodium hydroxide in solution. The resulting reaction, called saponification, produces soap and glycerin. The chemical equation is as follows;



II. Materials and Methods

2.1 Materials

The plant materials Azadirachtaindica,Ziziphusmauritianaseedsand barks were obtained from different spots and locations from Plateau, Kaduna and Nassarawa States during the rainy season in the months of June. Dettol cool medicated soap (to be used as positive control), Palm oil, Coconut oil, NaOH pellets, Sodium Lauryl Sulphate (SLS), Stearic acid and deionized water were purchased from a chemical store in Jos Plateau state. The clinical isolates of Aspergillusfumigatus andmicrosporumgypseumweregottenfrom Jos UniversityTeachingHospital.

2.2 Methods

2.2.1Extraction

The plant seeds were pulverized using a grinding machine. The powdered plant materials were extracted by soaking 200g of each plant powder in 500ml of ethanol and water respectively for 5 days with occasional agitation. The respective mixture were filtered and the filtrate concentrated by evaporating at 45^{o}C. The extract was then dried. The same procedure was observed for the other samples bark.

2.2.2 Preparation of Soap Base Formulation

The method described by(Kandasamy, et al., 2004)was adopted. Two formulations of soap base (A and B 100 g each) were initially prepared by hot processes using the basic soap ingredients: palm kernel oil (PKO), sodium hydroxide (NaOH) and distilled water, in concentrations shown in Table 1.

In the hot process, after mixing the warm aqueous NaOH solution with the heated oil (PKO), the hot slurry was further heated on a water-bath until a suitable endpoint for the required heating process was reached, indicated by whitish coagulates appearing in the hot slurry. The slurry was then poured into moulds and allowed to set, and subsequently cured over the next four weeks.

Other soap base formulations (C, D, E and F; 100 g each; Table 1) were also prepared by the hot process using coconut oil and/or palm kernel oil, in varied proportions of the soap base ingredients as well as inclusion of excipients, such as sodium lauryl sulphate (a surfactant), stearic acid (fatty acids) intended to enhance performance and stability of the soap.

2.2.3 Determination of physicochemical Properties of Soap Base Formulations

2.2.3.1 Foaming retention testing

To determine the foaming propensity, a 1 g portion of each soap formulation was dissolved in 10 ml of water (distilled and tap water) by minimum heat (≤60°C) and 5 ml of the resultant solution was transferred into a 10-ml test tube. The test tube was shaken for 1 min using a vortex test tube mixer (Salford Scientific Supplies Ltd, Henderson Biomedical, UK) and then left to stand undisturbed. The time taken for the soap solution to defoam, in triplicate tests, was recorded.

2.2.3.2 pH determination

The pH value of 1 g sample of each soap formulation dissolved in 10 ml of distilled water was determined in triplicates with a digital pH meter (HM Digital Inc. Culver City, USA) at preset time intervals.

2.2.3.3 Emolliency test

Emolliency test evaluates occlusiveness of soap formulations. A 2 g portion of each soap formulation was smeared onto the surface of white sheets of paper over approximately 5 cm^2 surface area and left to stand on the laboratory shelf for 24 h after which the degree of translucency was graded into a three-level ranking: mild, moderate, or strong translucency.

2.2.4 Preparation and Determination of Physicochemical Properties of Herbal Soap Formulations

A.indicaand Z. mauritianapreparations as well as equal quantity combinations (1:1 w/w ratio mixing) of the preparations, namely: all bark extracts mixed (B_c), all Seed oil extracts mixed (S_c) and both bark and seed extracts mixed BS_c were each incorporated into the selected soap base formulation (coded A) at the slurry stage of the preparation process before pouring into moulds. The different test preparations were incorporated at concentrations of 6, 7, 9 or 11%w/w into the soap base formula A (Table 1). Foaming propensity test and pH determination at preset intervals over 4 weeks were carried out on the resulting herbal soap formulations. Similar tests were carried out on the positive control soap, Detol, a commercial antiseptic soap product containing Triclocarban as the active (antimicrobial) agent.

Table 1: Composition of soap base formulations

MaterialsMaterial Concentration (% w/w)							
Single oil (PKO)	Single oil (CO)	Two oil combined (PKO + CO)					
	A	B	C	D	E	F	
Palm kernel oil (PKO)	68.4	60.8		0.0	0.0	29.0	26.0
Coconut oil (CO)		0.0	0.0	63.3	60.5	30.0	29.0
NaOH pellets		5.0	7.5	8.0	7.5	8.5	8.0
Distilled water		26.6	33.3	28.7	33.0	28.5	29.0
SLS		0.0	0.0	0.0	0.0	2.0	3.5
Stearic acid		0.0	0.0	0.0	0.0	3.0	4.5

SLS: Sodium Lauryl Sulphate

2.2.5 Physico-Chemical Characterizations of Formulated Soap

The chemical characterization was done as described by (Atiku,et al., 2014), with some modifications. The formulated dried herbal bath soap was further evaluated and characterized for pH, Total Fatty Matter (TFM) and moisture content.

2.2.5.1Estimation of saponification value

Saponification value gives an idea on the amount of NaOH (lye) needed to make soap. 1 g of oil was weighed and transferred into a round bottom flask. 20 ml of 0.50N alcoholic caustic potash was added to it. Sample without oil was also set for blank titration. Both were refluxed in round bottomed flasks for 1 hour. After refluxing, both the round bottomed flasks were allowed to cool. Both samples were titrated using 0.50N HCl with phenolphthalein indicator. Disappearance of pink colour was noted as indicative of the end point. These values were noted to determine the saponification value using the formula:

saponification valu =

(titre value of blank in ml − titer value of sample in ml)x normality of KOH x equivalent weight of KOH

Saponification Value =

(Titre value of blank in ml – Titre value of sample in ml) x Normality of KOH x equivalent Weight of KOH)

One gram of oil.

2.2.5.2Determination of pH value

pH of the soap was determined by touching the pH strip to the freshly prepared soap and also by dissolving one gram in ten milliliters of solution when using pH meter. (Add the ph model)

2.2.5.3Determination of alcohol insoluble matter

5 gm of soap was taken in a cornical flask and 50 ml of ethanol added and shaken vigorously to dissolve. The solution was filtered through a filter paper with 20 ml warm ethanol and dried at 105℃ for 1 hour. The weight of dried paper was taken.

% alcohol insoluble matter = Wt of residue×100

Wt of soap.

2.2.5.4 Determination of colour

Colour determination was done by visual inspection against a white background.

2.2.5.5 Determination of foam height

5g of soap was weighed into a 100ml glass beaker. 10ml of distilled water was added to it, marsh and allowed to stand for 30 minutes (this allows the soap to disperse in the water). The contents of the beaker were stirred and the slurry was transferred to a 250ml graduated measuring cylinder. The residue in the beaker was rinsed and transferred with further 5-6ml portion of water to the cylinder. The contents of the cylinder were stirred to ensure a uniform suspension.The cylinder was stoppered and subjected to 12 complete shakes. The cylinder was allowed to stand for 5 minutes and the volume of foam calculated as:

Foaming ability = L_1-L_2

L_1 = volume in ml of foam with water

L_2 = volume in ml of water only. The procedure was repeated for each toothpaste that was tested.(Kandarpet al., 2014).

2.2.5.6Determination of free caustic alkali

A modified method was used [29]. Five grams of finished soap was weighed and dissolved in 30ml of ethanol. Few drops of phenolphthalein indicator and 10 ml of 20 % $BaCl_2$ were added. The resulting solution was titrated against 0.05 M H2SO4 [26]. Free caustic alkali- the volume of the acid obtained was calculated using the formula;

NaOH= 0.31 x$\frac{Va}{W}$, where Va = Vol. of acid
W = weight of soap

2.2.5.7Determination of foam height (propensity)

The same procedure implored for the soap base was observed here using the herbal soaps

2.2.5.8 Determination of percent (%) chloride.

In the determination of % chloride, 10 grams of soap was weighed and made up to 100 mL of distilled water and heated to dissolve sample. The resulting solution was transferred into a 250 mL volumetric flask and 20 mL of 15% ($Ca(NO_3)_2$) added to it and shaken to dissolve the soap completely. Distilled water was added to the solution to the 250 mL mark. The solution was filtered and methyl red added to 100 mL of the filtrate. The solution was titrated against 10 N H_2SO_4(aq) until a pink color was obtained. The resulting solution was titrated against 0.1 AgNO3 using K2Cr2O7 as indicator till a brick red color was obtained. The following formula was used for the calculation of the %chloride

$$\%\text{Chloride} = \frac{\text{titer voloume}}{\text{Weight of soap}} \times 0.585$$

2.2.6 Antifungi Test

2.2.6.1Clinical sample collection of skin microbes

The method described by Itaruet al., (2005) was adopted with little modifications.After scrubbing the area of the affected skin of volunteer patients with methylated spirit using a sterile scissors and swab and allowed to dry, the open end of a sterile plastic cylinder, with an area of 4.9 cm^2, was manually placed on the affected skin. The area inside was scrubbed using a sterile swab (Nissui) moistened with anaerobic dilution liquid for 30s. The dilution liquid consisting of 4.5 g KH_2PO_4, 6.0 g Na_2HPO_4, 0.5g L-cysteine HCl.H_2O, 0.5g Tween 80 and 1.0g agar per litre of solution, pre-saturated and sealed with 100% CO_2 gas. The tip of the swab was then broken with the wall of a glass tube containing 1ml of the dilution liquid, so that the wet tip was dropped into the fluid without contamination. After sampling, the tube was immediately capped and shaken for 30seconds to suspend the bacteria. A volume of 300µl of the suspension was used for the culture method.

2.2.7 Agar- well diffusion method

The medium was prepared by dissolving 33.9 g of the commercially available Muller Hinton Agar Medium (HiMedia) in 1000ml of distilled water. The dissolved medium was autoclaved at 15 lbs pressure at 121°C for 15 minutes. The autoclaved medium was mixed well and poured onto 100mm petriplates (25-30ml/plate) while still molten.

One litre of nutrient broth was prepared by dissolving 13 g of commercially available nutrient medium (HiMedia) in 1000ml distilled water and boiled to dissolve the medium completely. The medium was 44 dispensed as desired and sterilized by autoclaving at 15 lbs pressure (121ºC) for 15 minutes.

Petriplates containing 20ml Muller Hinton medium were seeded with 24hr culture of bacterial strains. Wells were cut and 20 µl of the formulated herbal soap solution were added. The plates were then incubated at 37°C for 24 hours. The antifungiactivity was assayed by measuring the diameter of the inhibition zone formed around the well (NCCLS, 1993). Gentamycin disc(standard antibacterial agent) was used as a positive control.

III. Results and Discussion

3.1 Results

Bark extracts of the plants gave higher recovery than the seed extracts

Table 2: Percentage Weight Recovery of Extracts from 200g of Powdered Plants

Plants	Seed	Bark
Azadirachta indicia	2.7	3.5
Ziziphusmauritiana	2.6	4.5

3.2 Foam Retention and pH test of Soap Bases

Table 3: Foam Retention (FR) and pH of Soap Base Formulation

Base Formulation		Foam duration (Min.)				pH				
Dw	Tw	D1	W1	W2	W3	W4				
A		20.218.0				8.5	8.3	8.1	6.8	6.8
B		17.310.4				11.8	11.8	11.3	11.1	11.1
C		60.87.0				11.9	11.1	10.8	10.8	10.7
D		48.06.211.4	11.1	11.1		11.1	10.9			
E		21.218.4				11.0	10.8	10.7	10.7	10.7
F		42.023.1				12.8	12.3	11.9	11.8	11.8

Dw: Distilled water, Tw: Tap water, D1: Day 1, W1, 2, 3, 4: Week 1,2,3,4

Varying time was observed for complete foam collapse of the different soap base in aqueous solution. This variation is implicative of the different concentration of ingredients used in the soap base formulation. While formulation C gave the most stable foam in distilled water with over 60 minutes of foam retention, formulation B had the least foam stability with approximately 17 minutes in distilled water (table 3). Soap base F had the highest foam stability in tap water (23.1 min) while Soap base D had the least foam stability; lasting approximately 6 min (table 3). Overall it was observed that the foams persisted longer (indicating higher foaming capacity and foam stability) in distilled water than in tap m water (community pipe-borne supply). This could be due to the fact that tap water is likely to contain divalent and trivalent metals which may reduce foaming and foam stability of the monovalent sodium soaps in water by forming water immiscible divalent soaps.

Soap base (C and D) containing only coconut oil retain their foam much longer than soap base with only palm kernel oil and soap base containing both oils. As expected all the soap base formulations produced alkaline pH solutions (Tokosh and Baig, 1995), values of which decreased gradually over 4 weeks of study (table 3). Relatively high concentrations of NaOH used with low oil concentrations resulted in higher pH of the soap base solutions (E, F) (table 1 and 3). The result obtained here bears some similarities with a study by (Ayedele, 2017).

3.3 Emolliency Test

Results from emolliency test show a direct relationship between translucency and concentration of oil in the soaps.

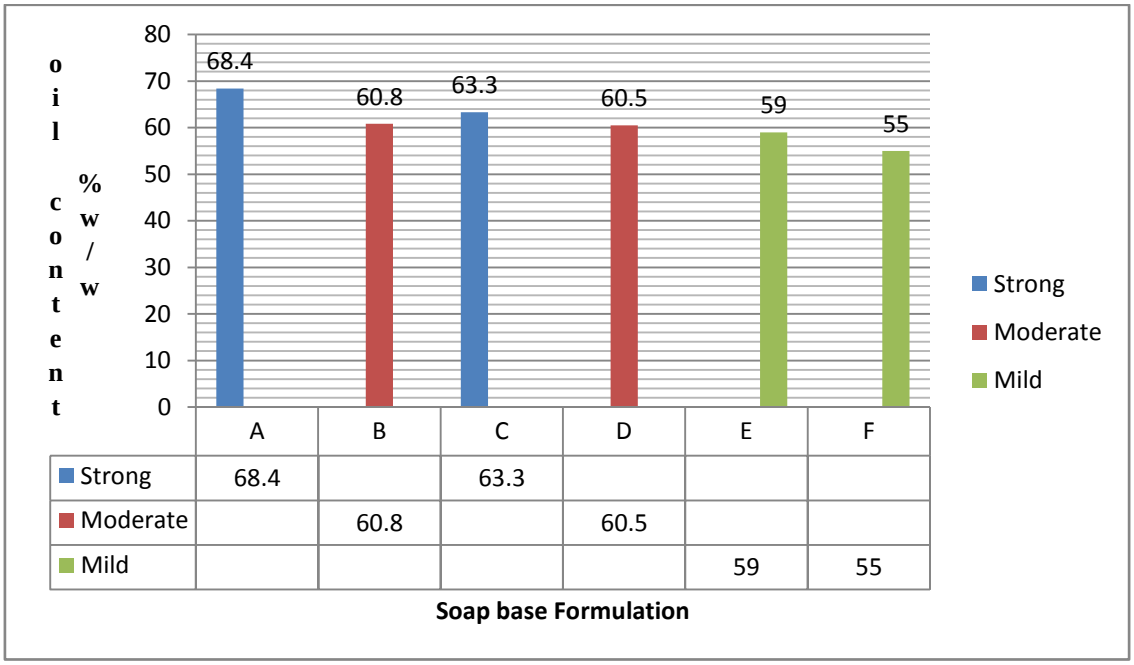


Figure 1: Emollience ranking of soap base formulation relative translucency produced on white paper

The emolliency results rank of soap base formulations (Figure 1) showed a trend. It revealed that the relative translucency produced by the formulations bear a significant general correlation with overall concentrations of oil present in the soap base formulations (Figure 1). Consequently, most of the soap base formulations that produced strong translucency (A and C) contained very high total oil concentrations (Figure 1).

Soap base formulation F, which gave the least translucency on white paper, contained two oils combined in its formula (Table 1). Of the six soap bases prepared, soap base A which contained a relatively higher proportion of Palm kernel oil demonstrated the highest emolliency (Figure 1).

A possible reason why formulation D, having less oil component (60.5) than B with oil component (60.8) (Table 1), demonstrated stronger emolliency (Figure 1), is that its coconut oil component possesses greater oleaginous (lipophilic) property than does palm kernel oil (the oil component of formulation B; Table 1); formulation B being a similar (single oil) composition soap product with higher oil concentration level (Table 1), but showing only mild occlusive character (Figure 1).

Soap base formulation A was finally selected as the most suitable for incorporation of the plant extracts, since it demonstrated the highest emolliency (Figure 1) and consistently showed the lowest pH values throughout the 4 weeks of study (Table 3).

Emolliency test result bears some similarity with that of Parente et al. (2008). Emolliency test usually evaluate occlusiveness of the soap formulations. Occlusive agents such as the residual oils in soap formulation produce translucency on white paper. Therefore the extent of translucency shows the relative amount of residual oils present in the soap sample after the saponification process. The result in Figure 1 illlustrates this where the highest emolliency was observed with soaps containing high concentrations of oils, singly or combined. Emollients are occlusive, humectant and/or restorative in their mechanism of action. Occlusive agents builds a thin skin surface film that preventing moisture loss, primarily due to the presence of natural oils (Choi and Maibach, 2005; Bouwstra and Ponec, 2006). Topical products containing emollients can corrects problems in skin scaling disorders and may also have suppressive effects on epidermal thickening, in addition to anti-inflammatory activity and transient relief from irritation (Nola et al., 2003). Due to its possible benefit of contributing its moisturizing quality to the user's skin (Tucker, 2011), the glycerol (end-product of saponification reactions) in all the soap formulations of this study was not separated from the soap.

3.4 Physicochemical Test

The results show that the incorporation of the herbal extracts to the soap base A did not significantly alter its physicochemical parameters.

Table 4: Physicochemical Parameters of herbal Soap Formula

Plant Ext. (% w/w)	Conc.	Colour (min)	Fr (cm)	Fh	pH	FCA (%)	AIM	Moisture (%)	NaCl (%)		
Bark											
B_{Ai}10		Brown	18.0			49.8	7.0	0.065	13.0	12.0	0.23
B_{Zm}10		Brown	18.5			37.7	7.5	0.075	12.0	13.0	0.65
B_c10		Brown	18.5			39.4	7.5	0.094	15.0	11.7	0.55
Seed											
S_{Ai}10		Brown	16.5			22.5	7.7	0.056	14.0	11.5	0.65
S_{Zm}10		Brown	15.0			14.5	7.9	0.086	15.0	11.6	0.62
S_c10		Brown	15.5			45.0	7.5	0.086	17.0	11.3	0.58
BS_c10			Brown			17.8		50.2	6.2	0.120	16.0	11.8	0.64
D	10	Blue	21.0	53.0		10.4	0.1	16.5	10.5		0.15		
SON		-	-			≥15.0	≥50	≤8.5	≤0.5	-	-		≤0.75

Fh: Foam height, Fr: foam retention, B_{Ai}: Soap with Azadirachtaindica bark, B_{Bm}: Soap withZiziphusmauritiana bark, B_c: Soap with Bark extracts combined,S_{Ai}: Soap with AzadirachtaindicaseedS$_{Bm}$: Soap withZiziphusmauritianaseed, S_c: Soap with Seed extracts combined, BS_c: Soap with Bark + Seed extracts. SV: Saponification value, AIM: Alcohol insoluble matter, SON: Standard Organisation of Nigeria, FCA: Free Caustic Alkali

The Stability of foam of the herbal soap formulations in distilled waterwere in closer range to those of SON (Table 4) however were slightly lower than that of the control soap, Detol, which lasted 21.0 min in distilled water. The pH values of the herbal soap solutions (Table 4)were close to those of the soap base A (Table 3), suggesting that incorporation of the extracts did not alter the physicochemical properties of the soap base considerably. Dettol aqueous solutions demonstrated a higher pH value (10.4) than the herbal soaps (10.0; Table 4) but the values were not significantly different and remained constant throughout the study period.

All the herbal soaps appeared to have a brown colour suggesting the dominant colour of most of the extarcts. Overall herbal Soaps containing the combined extracts of the plants show a better foam formation and stability. The skin has a pH range of 4 to 6. Skin products are expected to have pH as close to this range as much as possible in order to reduce irritation. Where the pH of the formulated herbal soap product bears closer value to the pH range for the skin that of the control (detol) is not within close range. However the control soap is popularly used with no reported adverse effect on the skin due to pH.

Moisture content is a parameter that measures the shelf life of a product. High moisture content in soap would lead to reaction of excess water with un-saponified fat to give free fatty acid and glycerol in a process called hydrolysis of soap on storage. All the formulated soaps fall within the limits of Encyclopedia of Industrial Chemical Analysis (10 – 15%).

Free caustic alkali measures the abrasiveness of any given soap. This mostly results from improper or incomplete saponification. From the current analysis, the % alkalinities of the formulated soaps were similar to that of SON. This shows that there are no free NaOH in those soaps (table 4).

The determination of percentage chloride levels in soap is important as excess amount causes soaps to crack. From this study, the % NaCl for the formulated soaps remain within the limit of ≤0.75 set by the standard organization of Nigeria. The reason for high chloride content of the soap may be caused by the use of chlorinated water to dissolve NaOH pellets.

Table 5: Antifungi Activity Zone of Inhibition (mm) of Formulated Soaps

Soaps	Concentration (mg/ml)							
	11		9		7		6	
	A_fM_g		A_fM_g		$A_fM_gA_fM_g$			
B_{Ai}	-	0.30	-	0.25	-	-	-	-
S_{Ai}	-	0.12	-	-	-	-	-	-
B_{Zm}	-	-	-	-	-	-	-	-
S_{Zm}	-	-	-	-	-	-	-	-
B_c	1.54	1.75	1.10	1.25	0.82	0.78	0.24	0.76
S_c	0.65	0.80	0.35	0.52	-	-	-	-
BS_c	0.70	0.77	0.45	0.60	-	0.20	-	-
D	2.5	2.85	2.10	2.24	1.73	1.92	1.55	1.83

D: Detol, -: no inhibition, A_f: Aspergillusfumigatus, M_g: Microsporumgypseum

With regard to the antifungal activity of the formulated soaps, the results reveal that formula containing only one extract show less sifgnificantantifungi activity than formula with two or more extracts combined (table 7). This indicates a possible potent synergism for the different constituents present in this organic extract which is together responsible for the characteristic antifungal activity recorded during this study. Microsporumgypseumais more inhibited of the two microorganisms and formula with bark extracts demostratedsignificant antifungal effect on tested organisms than formula with seed extracts. Formula containingZiziphusmauritiana extracts didn't show any activity on tested organism, whereas, the others demonstrated very weak antifungal activities with inhibition zones range of 1.10-1.75 mm (table 5). In contrast to these results, Harami (2006) reported that the same alcoholic extract of Ziziphusmauritianaroot exhibited antifungal activity against Aspergillusfumigatus.This study is not able to provide any justification for this difference however it is worth mentioning that the present study used soap formula containing Ziziphusmauritianaextracts and not the unadulterated extracts in the antifungi test.Some others organs of the plant namely: the roots and the fruits were reported by some studies (A Saeedet al., 1995 and DKB Runyoroet al., 2006) to have antifungal activity against some fungi particularly Candida albicans. Overall antifungi activity was concentration dependant and detol (positive control) showed superior activity to formulated soaps in all cases.

IV. Conclusion

Although the herbal soaps may not significantly be superior in antifungi activity to the conventional soap comparatively tested, phytochemicals present in the herbs strengthens,nurish and moisturisethe skin. The

herbal soaps serve as good choice for people of all age with skin that is reactive to most synthetic chemical skin products.

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