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Synthesis and Physiochemical Properties of Herbal Soaps Prepared by Neem Leaves Extract

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Abstract: ***Natural and sustainable alternatives are becoming more and more popular as people become more conscious of the negative impacts that synthetic chemicals have on their health and the environment. Soaps are prepared by the saponification process, which is, reacting the oil which contains triglycerides with Caustic soda (NaOH). In the present work we prepared total five herbal soaps by using Neem leaves extract with 5 different types of oils (Coconut, Olive, Castor, Mustard and Sunflower). In this process turmeric, orange peel powder and coffee powder used as a colouring agent and Lemon grass leaves extract as a flavouring agent. The current study aims to investigate the physio-chemical and antimicrobial properties of synthesized natural soaps. The properties such as pH, moisture content, total fatty matter, total alkali, free alkali, and chloride content are measured. The results of the selected physical and chemical properties of this study show that the moisture content of the neem coconut soap has 6.20% with 9.2 pH value, 74.20% total fatty matter, 1.45 %total alkali and 0.13% free caustic alkali. The results imply that herbal neem coconut and olive soap is suitable for human skin and can be a therapeutic alternative to skin problems and soap with neem mustard and neem Sunflower oil is of poor quality.***

Keywords: Herbal soap, neem leaves, total fatty matter.

I. INTRODUCTION

Conventional soaps typically include harsh chemicals and artificial additions that can be harmful to the environment and human health. However, natural soaps offer a skin and environmentally-friendly substitute. For the safety of the environment and people, it is therefore necessary to make ecofriendly soaps and detergents using natural, biodegradable, and sustainable chemicals. Natural soaps are more in line with nature since they do not generate any hazardous waste or by-products and use less energy during production (Maotsela et al., 2019). For this reason, using natural plant-based components is essential when making handmade or natural soaps.[1]

Neem leaf extract consists of nimbidin, cyclic trisulphide, cyclic tetrasulphide, and polyphenolic flavonoids. These bioactive compounds support antibacterial, antifungal, and anticancer activities. It is also rich in antioxidant which helps develop new skin cell tissues. In Ayurvedic medicines, neem leaf has been used in the treatment of leprosy, eye problems, epistaxis, intestinal worms, anorexia, biliousness, and skin ulcers. Meanwhile, neem oil contains various types of neem limonoids which can prevent mutagenic effect [2,3,4,5]. Soap is sodium or potassium salt of fatty acid produced by saponification reaction using sodium or potassium hydroxide. Based on its chemical properties as an anionic surface-active agent (surfactant), soap is used to clean and Wash skin and clothing. The fatty acids, stearic, palmatic, myristic, lauric and oleic acids, contribute to Lathering and washing properties of the soaps. Herbal soap preparation is a medicine contain antibacterial & antifungal agents which mainly used f part of plants such as like leaves, stem, roots and fruits to treatment for an injury or disease or to achieve good health [6]. The chemical characteristics of soap depend on several factors: the strength and purity of alkali, The kind of oil used, completeness of saponification and age of the soap. Such chemical Characteristics include moisture content, total fatty acids (TFM), pH, free alkali, and percent chloride [7]. Soaps act as emulsifiers or surfactants, softening the horny layer of the epidermis and acts as a germicide by enhancing the permeability of microbial envelope there by disrupting the integrity of microbial cells. Antimicrobial activity of soaps makes them useful agent for bathing, laundry, washing, and cleansing of surfaces [8,9]. In this review article herbal soap prepared from neem leaves with different oils show antibacterial antifungal and anti-inflammatory activity [10]. Other compounds involved in the preparation of the herbal soap are olive, castor, coconut, mustard and sunflower oil. These Compounds are rich in vitamin E, thus help to protect body tissue from damage and heal wounds faster [11]. Thus the producing of this natural remedy using neem leaves extract could produce an affordable herbal soap that is free of harmful chemicals to the skin.

This work aimed to use neem leaves extract with different oils for preparation of natural and sustainable soaps, further evaluate the physical and chemical characteristics of natural soaps.

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II. MATERIAL AND METHOD

All the five varieties of soap making oils were purchases from the local market. Colouring agent used were turmeric powder, orange peel powder and coffee. Flavouring agent was Lemon grass extract. The only reagent used in herbal soap making was Caustic soda of AR grade.

A. Preparation of Soap by using Neem leaf extract

Firstly neem leaves extract was prepared by boiling the leaves. We have to gather 150 g of fresh green Neem leaves, 500 ml of Water and boil it for about 30 minutes. After preparation it filters and collected in fresh beaker. Now 500 ml of distilled water is boiled with 25 ml of coconut oil for 30 minutes. Now 250 ml of Neem leaf extract was added in it. It was again heated for 30 minutes. Now 6 g of caustic soda (NaOH) was weighed in weighing machine. The same amount of caustic soda was added in the solution with continuous stirring with the help of glass rod. Now addition of 2 g of coloring agent's turmeric powder and 50 ml of lemon grass leaf extract. Now Continuous stirring is done till the solution concentrates. When the solution concentrates then it is poured in the beaker. Now placed in a safe area that cannot expose by sun and cut the soap according to the size of moulder. Similarly we have prepared another neem soaps samples with four different oil and colouring agents such as mustard, olive, castor and sunflower oil and orange peel powder, coffee and indigo powder.

B. Determination of total fatty matter (TFM)

The total fatty matter test is carried out by reacting soap with acid in the presence of hot water and measuring the fatty acids obtained [12]. About 10 g of finished soap was weighed and 150 ml distilled water was added and heated. The soap was dissolved in 20 ml of 15 % H_2SO_4 while heating until a clear solution was obtained. Fatty acids on surface of the resulting solution was solidified by adding 7g of bee wax and reheated. The set up was allowed to cool to form cake. Cake was removed and blotted to dry and weighed to obtain the total fatty matter using a formula:

$$\% \text{ TFM} = A - X/W * 100$$

where A= weight of wax+ oil , X= weight of wax , W= weight of soap.

C. Determination of total alkali

The total alkali is determined by titrating excess acid contained in the aqueous phase with standard volumetric NaOH solution. Procedure in [13] was modified and used. Ten grams of finished soap was weighed and 100 ml of neutralized alcohol was added to it. Five ml of 1 N H_2SO_4 solution was added to the mixture and heated till the soap sample dissolved. Test solution was titrated against 1 N NaOH using phenolphthalein as indicator. The total alkali was obtained with the formula;

$$\% \text{ Total alkali} = VA - VB/W * 3.1$$

where VA= Volume of acid, VB= Volume of base, W= weight of soap.

D. Determination of free caustic alkali

5 grams of finished soap was weighed and dissolved in 30 ml 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 H_2SO_4 [14]. Free caustic alkali- the volume of the acid obtained was calculated using the formula;

$$NaOH = 0.31 \times VA / W$$

where VA = Vol. of acid, W= weight of soap

E. Determination of pH

Ten grams of the powdered soap was weighed and dissolved in distilled water in a 100 ml volumetric flask. This was made up to prepare 10 % soap solution. The pH of the 19 % soap solution was determined using a pH meter. Two grams of finished soap was dissolved in 10 ml of distilled water and stirred till sample dissolved. The pH was determined with pH meter

F. Determination of % moisture Content

Approximately 5 g of samples was accurately weighed using analytical balance (sensitivity 0.1 mg) into dried, tarred moisture dish and dried in an oven (Memmert, Germany) for 2 hr at 101 ± 1 ^{0}C and repeated until a constant weight (difference between two measurement not exceed 0.5 mg/g of sample) was reached. The % moisture was calculated using the following formula

$$\% \text{ Moisture} = C_s - C_h / C_s - C_w * 100,$$

C_w = weight of crucible , C_s= weight of crucible + sample, C_h= weight of crucible + sample after heating.

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G. Determination of (%) chloride

Ten grams of finished soap was weighed and 100 ml of distilled water added to it and heated to dissolve sample. The resulting solution was transferred into a 250 ml volumetric flask and 20 ml of 15 % $Ca(NO_3)_2$ was added to it and shaken to dissolve the soap. 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 until a pink colour was obtained. Resulting solution was titrated against 0.1 N $AgNO_3$ using K_2CrO_7 as indicator, till a brick-red colour was obtained.

% Cl^- = Titre volume * 0.585/ Weight of soap

TABLE 1
PHYSIOCHEMICAL PROPERTIES OF HERBAL SOAPS PREPARED FROM NEEM LEAVES EXTRACT

Properties	Neem Coconut soap	Neem Olive soap	Neem Castor soap	Neem Mustard soap	Neem Sunflower soap
% Total fatty matter	74.20	72.12	68.48	64.32	60.0
% Total alkali content	1.45	2.88	3.25	3.80	4.20
% Free alkali content	0.13	0.18	0.24	0.40	0.46
% Moisture content	6.30	5.11	5.85	3.95	3.20
% Chloride content	1.15	1.26	1.30	1.40	1.56
pH	9.2	9.4	9.8	10	10.6

III. RESULTS AND DISCUSSION

Four herbal soaps were made in the current study using neem leaves extract with 5 different types of oils (Coconut, Olive, Castor, Mustard and Sunflower). Table 1 compare the synthesized soaps' properties such as TFM, total alkali, free alkali, moisture content, chloride content and pH.

TFM is how much fat substance the soap has, i.e., it is the indication of soap quality. The more it has better the quality of the soap. Higher TFM soaps clean better, last longer, create more lather, don't leave skin feeling dry, and cause less skin damage. Coconut and olive soaps, which fall within grade 1 quality and have the highest TFM of 74% and 72%, respectively, among the chosen soaps, are regarded as effective soaps. The remaining soaps fall under grade 2, which has a very low TFM 60 to 65%.

The soap's total alkali content is a crucial characteristic that ascertains the presence of all the alkaline compounds, including hydroxides, carbonates, and bicarbonates. It gauges how harsh soap is on the skin. While ISO standards specify an alkali level of 2-3%. coconut and olive soap is in range while mustard and Sunflower oil soap has higher chloride value as compared to standard data.

The determination of percentage chloride levels in soap is important as excess amount causes soaps to crack. The % Cl- value (1.15 and 1.26) of coconut and olive soap is in range while mustard and Sunflower oil soap has higher chloride value as compared to standard data.

Bath soap typically has a pH of 8 to 10, which is alkaline. A pH of greater than 11 will irritate and be harsh on the skin; a pH of less than 8 will not result in lathering or cleaning action. The moisturising effect alters the cleaning activity. The moisturising impact is low while the washing power is great, and vice versa. For optimal cleaning and moisturising properties, handmade soap and bath water with a pH of 9 are often advised. The soap prepared by coconut oil 9.2 pH value as compare to soap with Olive and castor oil while soap with mustard and Sunflower oil has higher pH value.

It was also observed that the coconut oil and olive soap have high percentage of moisture content so it is soft as compared to soap with castor oil and soap prepared with mustard and Sunflower oil has lower percentage of moisture content. Optimum moisture content helps in creating a rich and cream lather.

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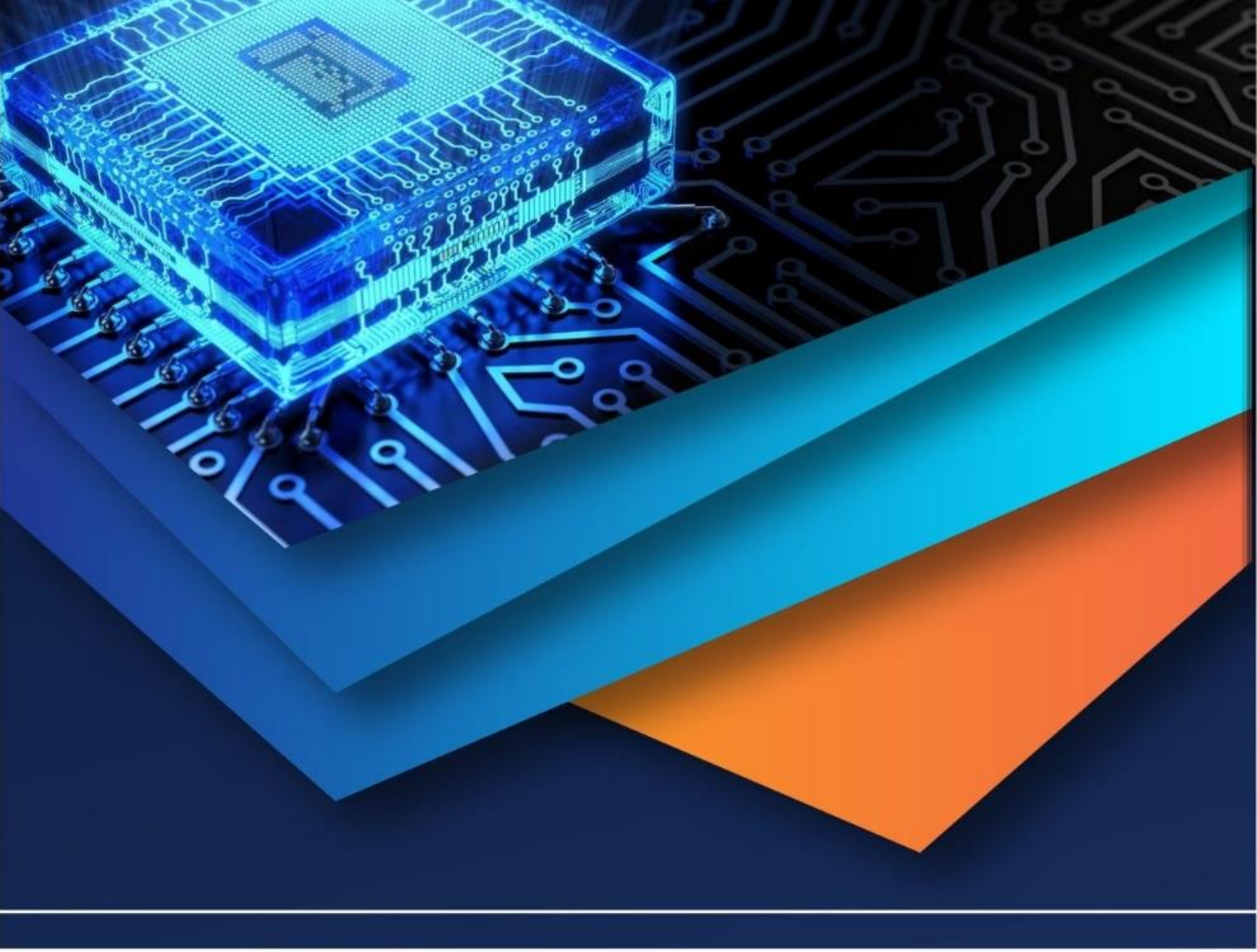

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