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Original Article

FORMULATION AND EVALUATION OF HERBAL SOAP TAKING DIFFERENT BIOACTIVE PLANTS BY COLD SAPONIFICATION METHOD

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ABSTRACT

Objective: The final goal of this research is to develop and evaluate herbal bath soap taking various bioactive herbal plants extract with different ethinic and dermatological importance in ayurveda, namely *Solanum lycopersicum, Sapindus mukorossi, Acacia nilotica, Citrus limon, Aloe barbadensis, Piper betle, Curcuma longa and Cocus nucifera.*

Methods: The extract of all plant materials were obtained through various extraction procedures suitable for them. The extract was then mixed with lye and fatty oil for preparing a soap using the cold saponification method.

Results: The prepared soap was evaluated against marketed soap. The prepared soap was found to be good in appearance, color and odor. pH, % free alkali content, foamability, foam stability, moisture content and alcohol insoluble matter were found to be 9.6, 0.22, 15 cm, 14.5 cm, 3.26 and 17.25, respectively. The antioxidant activity and antibacterial studies were done, which signifies prepared soap to be a potent antioxidant and antibacterial source.

Conclusion: Based on the study results it can be concluded that herbal soap can be formulated using cold process method, taking different parameters in consideration as that of skin condition and as that of herbal potentials and its activity. This sought of herbal formulation can bring a big difference in the field of herbal cosmetic as there are many alignment and related flaws in different polyherbal or chemical-based formulations which can be removed.

Keywords: Herbal soap, Ayurvedic importance, Herbal potentials, Cold saopnification

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INTRODUCTION

Skin is the largest sensory organ in the body. It serves as a barrier that protects the body organs and gathers sensory data from the surroundings. Additionally, it aids in keeping the body's temperature at a healthy level. Diverse distinctive cells and structures can be found in the skin. The hypodermis, dermis, and epidermis are the three primary layers. Each layer contributes in a unique way to how the skin works as a whole [1]. As skin imparts a specialized function to body wellbeing, it is necessary for us to keep it away for skin diseases and alignments. Skin conditions are a prevalent illness. It harms people of all ages, including newborns and the elderly, and does so in several different ways. Infections, allergies, sun exposure, injuries, and other factors can all lead to skin issues [2].

Ever since the earliest times, people have employed medicinal plants as a form of treatment. Various medicinal plants' leaves, stems, and roots have been used as a natural cure to treat a diversity of maladies and afflictions. Even if many plant-based treatments have been replaced by synthetic alternatives, ayurvedic products nevertheless stand out for their effectiveness and safety [3]. The anti-oxidant, anti-bacterial, cytotoxic, anti-microbial, hypotensive, anti-diuretic, anti-inflammatory, anti-spasmodic, anti-diabetic, anti-hemorrhagic, and anti-helminthic qualities of numerous herbs are discovered with high nutritional value. Owing to their high medical value, cost-effectiveness, availability, and compatibility, incorporation of natural products to a preparation helps in treating practically all diseases and skin issues [4]. The active compounds which provide these plants their therapeutic benefits are isolated and used topically in creams, soaps, oils, and ointments to treat skin conditions like acne, eczemas, wounds, and ringworms as well as for cosmetic and anti-microbial purposes. The therapeutic benefits of plants are used in a variety of formulations for both medical and cosmetic purposes [5].

A report published by WHO stated that a whopping 34% of all occupational disorders are skin diseases and data of 2020 revealed that skin diseases death in India reached 17,857 i.e. 0.21% of total deaths. So, in order to counteract the situation, the best option is to incorporate herbal potentials in the formulation, which provide fewer effects and impart good treatment options with lesser side effects and higher safety. So, the present work focuses on the preparation of medicated herbal soap incorporating different herbs active potentials, making it antioxidant and antibacterial active soap, which can be used as a regular bathing soap.

MATERIALS AND METHODS

Collection of plant material

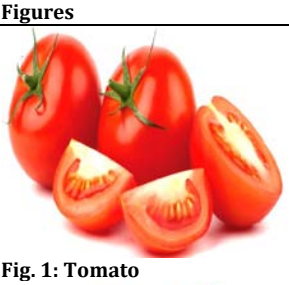
The seeds of *Solanum lycopersicum* and *Sapindus mukorossi*, pods of *Acacia nilotica*, Peels of *Citrus limon*, Leaf of *Aloe barbadensis* and *Piper betle*, and rhizomes of *Curcuma longa* were collected from different matured plants, shaded dried, pulverized and stored in air tight bottles for study. Coconut oil was purchased from local market.

Processing of plant material

Extraction of *Sapindus mukorossi*, *Acacia nilotica*, *Piper betle*, and *Curcuma longa* powder was done by decoction method taking water as a solvent. In a conical flask 10 gm of each powder was added. For 24 h, it was extracted with occasional stirring and extract was collected using rotary evaporator [14]. The latex of *Aloe barbadensis* was scarpped with the help of a spatula; the latex obtained was grinded using mixer grinder and juice obtained after grinding was kept in the water bath until bubbles in the juice disappear and stored in refrigerator for further use. Extraction of *Citrus limon* oil was done using Clevenger apparatus i.e. by hydro-distillation method and oil obtained was stored for further use [15]. Extraction of oil from *Solanum lycopersicum* seeds was done by successive solvent extraction

taking water as a solvent [16]. The oil obtained was separated using a separating funnel, collected and stored for further use.

Table 1: table representing materials and its description

Material	Description	Figures
Tomato	**Botanical name:** *Solanum lycopersicum* **Kingdom:** Plantae **Order:** Solanales **Family:** Solanaceae **Genus:** Solanum **Species:** S. lycopersicum **Parts used:** Seeds. **Uses:** Rich in lycopene, which help in removing dark spots and providing brighter skin, Rich in Vitamin C, which imparts an antioxidant property, Rich in Vitamin K, which imparts blood clotting properties, and antifungal activity [6].	 **Fig. 1: Tomato**
Ritha	**Botanical name:** *Sapindus mukorossi* **Kingdom:** Plantae **Order:** Sapindales **Family:** Sapindaceae **Genus:** Sapindus L **Species:** Sapindus saponaria **Parts used:** Seeds **Uses:** Ditergent, Surfactant [7].	 **Fig. 2: Ritha**
Babul	**Botanical name:** *Acacia nilotica* **Kingdom:** Plantae **Order:** Fabales **Family:** Fabaceae **Genus:** Vachellia **Species:** V. nolita **Parts used:** Fruit pods **Uses:** Ditergent, Surfactant [8].	 **Fig. 3: Babul**
Lemon	**Botanical name:** *Citrus limon* **Kingdom:** Plantae **Order:** Sapindales **Family:** Rutaceae **Genus:** Citrus **Species:** C. limon **Parts used:** peels **Uses:** Contains volatile oil used for aroma, contains Vitamin C, which has antioxidant activity, and antibacterial activity, treat acne [9].	 **Fig. 4: Lemon**
Aloe Vera	**Botanical name:** *Aloe barbadensis* **Kingdom:** Plantae **Order:** Asparagales **Family:** Asphodelaceae **Genus:** Aloe **Species:** A. vera **Parts used:** leaf latex **Uses:** Treats sunburns, acts as a moisturizer, treats acne, antiseptic, wound healing, antibacterial [10].	 **Fig. 5: Aloe vera**
Betel leaves	**Botanical name:** *Piper betle* **Kingdom:** Plantae **Order:** Piperales **Family:** Piperaceae **Genus:** Piper **Species:** P. betle **Parts used:** Leaves **Uses:** Numerous studies on piper betle have revealed that it has significant chemical components and is used for its therapeutic characteristics, such as anti-filarial, anticancer, cytotoxic, anti-allergic, gastro-protective, antibacterial, antifungal study, insecticidal, anti-malaria, antioxidant, chlorophyllase activity, anti-diabetic, anti-platelet, oral hygiene, wound healing activity, and anti-asthmatic effect [11].	 **Fig. 6 Betel**
Turmeric	**Botanical name:** *Curcuma longa* **Kingdom:** Plantae **Order:** Zingiberaales **Family:** Zingiberaceae **Genus:** Curcuma **Species:** C. longa **Parts used:** Rhizomes **Uses:** Wound healing, due to the presence of antioxidant and anti-inflammatory components it provides glow and lusture, Controls psoriasis [12].	 **Fig. 7: Turmeric**

Material	Description	Figures
Coconut Oil	**Botanical name:** *Cocus nucifera* **Kingdom:** Plantae **Order:** Commelinids **Family:** Arecaceae **Genus:** Cocus L **Species:** C. nucifera **Parts used:** oil **Uses:** Treats skin conditions like eczema, psoriasis, reduces stretch mark, relief from sunburn [13].	 **Fig. 8: Coconut oil**
Sodium hydroxide	**IUPAC name:** *Sodium hydroxide* **Other names:** lye, caustic soda **Molecular formula:** 39.997 g/mol **Chemical formula:** NaOH **Appearance:** white, waxy, opaque crystals **Boiling Point:** 1388 °C **Odor:** odorless **Melting point:** 318 °C **Solubility:** Soluble in water, glycerol, negligible in ammonia and insoluble in ether. **Uses:** Use as lye in soap formlation. NaOH when combined with fats/oils produces saponification reaction.	 **Fig. 9: Sodium Hydroxide**
Others Chemicals	Steric acid, soft paraffin, ethanol.	

Formulation of herbal soap

Formulation of soap containg active plant potentials was carried out using cold saponification method. The mixture of several naturally occurring fatty acid salts in the form of sodium or potassium is known as soap [17]. So coconut oil and *Solanum lycopersicum* seed oils as a natural fat and alkali as lye has been used here for saponification reaction as follows: 10.0 gm of coconut oil and 5.0 ml of *Solanum lycopersicum* seed oil was taken in the beaker. In separate beaker 7 gm of alkali (NaOH) was dissolved with 25 ml of ethanol and distilled water with continuous stirring. The oil-filled beaker is then filled with the solution. The resultant mixture was kept at hot plate at low heat with continuous stirring until the smell of oil/fat disappears and lead to formation of homogeneous solution. Whatmann No. 1 filter paper and a Buchner funnel were used to filter the mixture. Filtered obtained was then added with 2 gm of *Sapindus mukorossi* extract, 2 gm of *Acacia nilotica* extract, 2 ml of *Aloe barbadensis* juice, 2 gm of *Curcuma longa* extract, and 2 gm of *Piper betle* extract along with 1 gm steric acid, 0.70 gm soft paraffin and 5 ml ethanol with continuous stirring in water bath until the extract gets dissolved and become homogeneous. To it addition of few drops of *Citrus lemon* peel oil was added and mixed properly. The homogeneous semisolid mixture formed was poured into a mould and allow to solidify at room temperature and physical observation was done for any characteristic changes.

Table 2: Contents of formulation

Ingredient	Quantity	Uses
Coconut oil	10 gm	Natural fat
Tomato seed oil	5 ml	Natural fat
NaOH	7 gm	lye
Ethanol	30 ml	solvent
Ritha seed extract	2 gm	Surfactant/detergent
Babul seed extract	2 gm	Surfactant/detergent
Aloe Vera juice	2 ml	Moisturizer, antiseptic
Turmeric extract	2 gm	Antiseptic, provides glow
Betel leaves extract	2 gm	Antifungal, anti bacterial
Steric acid	1 gm	Hardener
Soft paraffin	0.70 gm	Soothing agent
Lemon peel oil	q. s.	Fragnence
Distilled water	q. s.	Vehicle

Evaluation of soap

The following Physico-chemical parameters were assessed for determining the quality of prepared formulation against marketed herbal Soap.

Physical parameters

The color and clarity of the prepared soap were observed with naked eye keeping it on white background. The order of the soap was smelled.

pH

The pH of the prepared soap was measured by digital pH meter. The prepared formulation was dissolved in 100 ml distilled water and kept for 2 h. pH measurement of the solution was done using a previously calibrated pH meter.

% free Alkali content

The beaker containing 10g of dried soap was then filled with 150 ml of distilled water. To dissolve the soap, it was heated for 30 to 40 min at reflux on a water bath. This solution was cooled, transferred with the washings to the 250 ml conical flask, and the capacity was filled with distilled water. Two drops of the phenolphthalein indicator were added to 10 ml of the soap solution in the titration flask. The solution was then titrated against 0.1M HCl until it turned colorless.

Foamability

50 ml of distilled water was taken and 2 gm of soap sample was dissolved completely by stirring. It was then transferred into a 250 ml measuring cylinder along with washings. The volume was made up to 200 ml by adding distilled water. 25 uniform strokes were given to the mixture and kept stand still for some time until the water volume comes to 200 ml. The foam height was measured from above the water volume.

Foam stability

Same quantity of soap sample and quantity of distilled water along with process was carried out as that of foamability and the mixture

was kept stand still for 30 min. After 30 min measurement of foam height was done from above the water volume.

Moisture content

A sample of soap weighing 10g was weighed right away and noted as "wet weight of the sample." Using the appropriate drying equipment, this wet sample was dried to a constant weight at a temperature not to exceed 115 °C. After cooling, the sample was weighed once more to determine its "dry weight." The following equation was used to calculate the sample's moisture content.

$$\%Weight = A\text{-}B/B \times 100$$

Where; %Weight = % of moisture in sample, A = weight of wet sample (gm), B = weight of dry sample (gm).

Alcohol insoluble matter

50 ml of warm ethanol was introduced to a conical flask containing a 5 gm sample of soap in order to dissolve it. Using tarred filter paper and 20 ml of warm ethanol, the liquid was filtered and then dried at 1050 C for an hour. The weighted filter paper had dried out.

Biological parameters

Antioxidant activity

Antioxidant activity was carried out using the reducing power method. In this approach, a rise in the reaction mixture's absorbance denotes a rise in antioxidant activity or reducing power. In this procedure, 2.5 ml of 0.2 Molar phosphate buffer (pH 6.6) and a 1 percent w/v solution of potassium ferricyanide are combined with 1 ml of test sample diluted with distilled water (2.5 ml). After that, this combination is incubated for 20 min at 500 °C. After incubation, the mixture is recovered, and 2.5 ml of 10% $C_2HCl_3O_2$ is added. The reaction mixture is centrifuged for 15 min at 250 rpm, and the upper supernatant layer of the solution (2.5 ml) is removed and combined with 2.5 ml of purified water and 0.1 percent ferric chloride (0.5 ml). In comparison to a control, the resultant solution is exposed to UV at 700 nm [19].

Antibacterial assay

The antibacterial experiment was conducted against two bacterial strains, Gram-positive (B. subtilis) and Gram-negative (S. Typhi), using the disc diffusion method. In this method, nutritional agar medium plates were seeded with 100 l of suspension of each microbe, containing around 100–150 CFU/ml. After being dried and sanitized, filter paper discs (6 mm in diameter) soaked in 400 g of test solution were gently placed on the agar plates. The antibacterial activity of the extracts was assessed following a 24-hour incubation period at 37 °C by measuring the diameter of the zone of inhibition in millimeters [20].

RESULTS

The obtained for Physico-chemical and biological evaluation are summarized below in tables.

Fig. 10: Prepared soap and marketed soap

Table 3: Physico-chemical parameters of formulation

Parameters	Prepared herbal soap	Marketed herbal soap
Physical parameters (Color, Clarity andodor)	Color: Light yellow Odor: Pleasant Clarity: Crystal clear	Color: Green Odor: Pleasant Clarity: Turbid
pH	9.6	7.8
% free alkali content	0.22	0.25
Foamability	15 cm	5.2 cm
Foam stability	14.5 cm	4.5 cm
Moisture content (%)	3.26	1.56
Alcohol insoluble matter	17.25	17.60

Table 4: Antioxidant activity of the formulations

Concentration (µg/ml)	Prepared herbal soap absorbance	Standard herbal soap absorbance
0.1	0.224	0.251
0.2	0.321	0.142
0.3	0.332	0.082
0.4	0.521	0.211
0.5	0.662	0.098

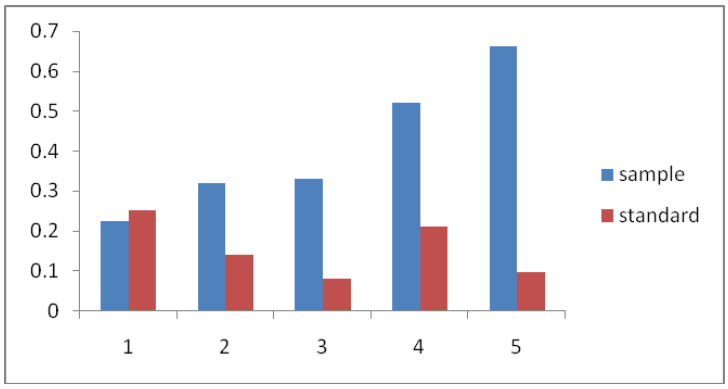


Fig. 11: Antioxidant activity of the standard and prepared herbal soap

Table 5: Zone of inhibition of the formulations

Samples	Dose (µg/ml)	Zone of inhibition GM–ve bacteria (*S. typhi*) (mean of 3)	Zone of inhibition GM+ve bacteria (*B. subtilis*) (mean of 3)
Prepared soap	400	0.80	0.82
Marketed soap	400	0.75	1.62

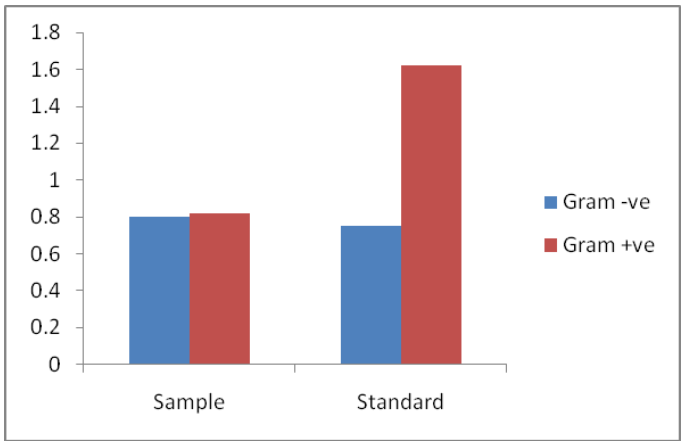


Fig. 12: Antibacterial activity of the standard and prepared herbal soap

DISCUSSION AND CONCLUSION

The Physico-chemical and biological parameters of the prepared soap were studied. The formulation was good in appearance, with pleasant odor and color. The pH was found to be in range which is specified i.e. 7-10. Other parameters like % free alkali content, Foamability, Foam stability, moisture content, and alcohol insoluble matter was determined which was signifying the standard values for soap. Biological parameters like Antioxidant and Antibacterial study was conducted, which indicates the prepared soap to be a potent antioxidant and antibacterial source. Based on the study results, it can be concluded that herbal soap can be formulated using cold process method taking different parameters in consideration as that of skin condition and as that of herbal potentials and its activity. This sought of herbal formulation can bring a big difference in the field of herbal cosmetic as there are many alignment and related flaws in different poly herbal or chemical-based formulations which can be removed.

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Nil

AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

CONFLICT OF INTERESTS

Declared none

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