



Formulation of Herbal Soap using extract of *Solanum xanthocarpum* species

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Abstract: The therapeutic herbal soap was formulated using selected plant samples Yellow-Fruit Nightshade (*Solanum xanthocarpum*), Aloe vera (*Aloe barbadensis*), Wild turmeric (*Curcuma aromatica*), Coconut oil (*Cocos nucifera*) and Lavender essential oil. The efficacy of the sample soap was tested and compared with a branded soap. The prepared herbal test sample was analysed for pH, colour, odour, appearance, foam retention, foam height, total fatty matter, alcohol soluble matter and moisture content. The result of the present work was satisfactory as the prepared sample soap was effective against the microbe *Staphylococcus aureus* and its shelf life was for one month. The formulated soap was orange in colour, smooth textured with aromatic odour. The pH of the sample soap was

8.04, foam height 7 cm, foam retention for over 4 minutes, total fatty matter 0.03%, alcohol soluble matter 25%, and moisture content 1.01%. The prepared test sample and branded soap both were subjected to antimicrobial assay by agar well diffusion technique and zone of inhibition was observed. It was indicated that both formulated herbal soap and branded soap showed zone of inhibition but the prepared test sample was found more effective against *Staphylococcus aureus* than *Staphylococcus epidermis*.

Keywords: *Solanum xanthocarpum*, Antimicrobial assay, Agar well diffusion technique, *Staphylococcus aureus*, *Staphylococcus epidermidis*.

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Introduction:

Soap is a salt of fatty acids used in a variety of cleansing and lubricating products. In a domestic setting, soaps are usually used for washing, bathing and other types of housekeeping. In industry soaps are used as thickeners, components of some lubricants and precursors to catalysts. When used for cleaning, soap solubilizes particles and grime which can then be separated from the article being cleaned. Where soaps act as surfactants or emulsifying oils enable them to be carried away by water. Soap is created by mixing fats and oils with a base as opposed to detergent which is created by combining chemical compounds in a mixer. Humans have used soap for cleaning for millennia. Evidence exists of the production of soap like materials in around 2800 BC in ancient Babylon.

The production of toilet soaps usually entails saponification of triglycerides, which are vegetable or animal oils and fats. An alkaline solution (often lye or sodium hydroxide) induces saponification whereby the triglyceride fats first hydrolyze into salts of fatty acids. Glycerol (glycerin) is liberated. The glycerin is sometimes left in the soap product as a softening agent, although it is sometimes separated. Handmade soap can differ from industrially made soap in that an excess of fat or Coconut Oil.

The addition of glycerol and processing of this soap produces glycerin soap. Superfatted soap is more skin-friendly than one without extra fat, although it can leave a “greasy” feel. Sometimes, an emollient is added, such as jojoba oil or shea butter. Sand or pumice may be added to produce a scouring soap. The scouring agents serve to remove dead cells from the skin surface being cleaned. This process is called exfoliation.

Kantakari is also known as “Indian nightshade or “Yellow-berried nightshade”. It is an important medicinal herb and is also a member of Dashmul (ten roots) of the Ayurveda (Parmar et al., 2010). The herb is pungent and bitter in taste. Applying a paste of Kantakari powder with water on joints helps to reduce joint pain due to its vata balancing property. Massaging the scalp with Kantakari juice mixed with equal quantity of water might prevent hair fall and promote hair growth. Kantakari fruit might be useful for pimples. Kantakari can also be used as soap which can be effective for common skin problems. The paste of Kantakari fruit applied topically to the affected area might help in reducing pimples due to its antibacterial and anti-inflammatory activities (Reddy and Reddy, 2014). Aloe vera (*Aloe barbadensis*) is a short succulent herb resembling a cactus, with green dagger shaped fleshy, spiny and marginated leaves, filled with a clear viscous gel. Aloe vera has potent antibacterial, antifungal, and antiviral properties that provides many benefits and increase performances in beauty and skin care. This is also responsible for the powerful laxative effects of aloe vera. The antimicrobial effects of Aloe vera has been attributed to the plant's natural anthraquinone (Arunkumar and Muthuselvam, 2009). However, all leaf extract may contain anthraquinone. Aloe vera contain 75 active ingredients such as vitamins, enzymes, minerals, sugars, saponins, and amino acids. Due to presence of

these ingredients, it helps to protect from ultra violet radiation coming from the sun which cause various skin disorders. Curcumin is a polyphenolic molecule derived from the rhizome of *Curcuma longa* L (Shamim et al., 2011). This compound has been used for centuries due to its anti-inflammatory, antioxidant, and antimicrobial properties. These make it ideal for preventing and treating skin inflammation, premature skin ageing, psoriasis, and acne. Additionally, it exhibits antiviral, antimutagenic, and antifungal effects. Curcumin provides protection against skin damage caused by prolonged exposure to UV radiation. It reduces wound healing times and improves collagen deposition (Sikha et al., 2014). Coconut sps. is termed “Kalpavriksha” in Sanskrit because it has multiple nutritional and therapeutic values. Coconut oil has been traditionally used as moisturizer since centuries by people in the tropical region. Clinical studies have revealed that coconut oil improves the symptoms of skin disorders by moisturizing and soothing the skin (Agrego and Verallo, 2004). Therefore, the medicinal properties of plants help reduces skin diseases. The purpose of this study involves the preparation of test samples followed by agar well diffusion technique to check the effectiveness and shelf life of the test samples. This Scientific study is based on the hypothesis that many plants extract have antibacterial properties and can be used effectively to maintain the healthy and glowing skin (Rani and Pragya, 2016).

Hypothesis:

The hypothesis of the research and objective of the herbal soap were formulation of test sample (therapeutic herbal soap) from plant extract, evaluation test (pH, physical parameters) of the test samples, antimicrobial assay of the test sample by using agar well diffusion technique, comparison of minimum zone of inhibition of the test sample with the branded soap by observing the microbial growth.

Materials and Methods:

Preparation of test sample, herbal soap: The different plant materials collected were *Solanum xanthocarpum*, Aloe vera, Wild turmeric and Coconut oil. Leaves of Aloe vera and Wild turmeric were collected from Gardanibagh, Patna. *Solanum xanthocarpum* was

collected from Bihta, Patna. Coconut oil was collected from Boring road, Patna. Leaves of *Solanum xanthocarpum* and leaves of aloe vera were washed under running water and allowed to shadow dry under the sun for 10 days. Then the ingredients were grounded into the fine particles in a mortar and pestle. The powdered forms were weighed: *Solanum xanthocarpum* 20 gm, Aloe vera 8 gm, and wild turmeric 2 gm respectively. The powdered plant materials were loaded into the thimble and were placed inside the Soxhlet extraction while using ethanol as a solvent for getting crude plant extract. Then it was stored in a air tight vials inside the refrigerator for 1 to 2 days. The extract was then concentrated to dryness by using hot air oven(75°C). The herbal soap formulation was done while mixing compositions of different plants extracts and ingredients (Parveen et al., 2018).

Composition of the herbal Soap (100gm):

Solanum xanthocarpum- 20gm of leaves, Aloe vera- 8gm, Wild turmeric 2gm, Coconut oil- 100 ml, Lavender essential oil- 1ml and Glycerine soap base-100gm were taken.

The Soap base (Glycerine) was taken in a beaker and was melted in hot air oven. Along with Glycerin, extract of *Solanum xanthocarpum*, Aloe vera and Wild turmeric was added. Then coconut oil and lavender essential oil was also added and stirred continuously to mix the herbal soap ingredients. Then it was poured in a soap mould and cooled for 12 hours.

Efficacy test of the prepared therapeutic herbal soap: The formulated herbal soap was further evaluated by observing the following physical parameters like its colour, odour, state, appearance, pH, foam retention, foam height, alcohol insoluble matter, total fatty matter and moisture content. The colour, odour and appearance of the soap was observed by visual examination only. The prepared herbal soap was found to be solid in nature. The appearance of the soap was smooth texture. For pH, test was done by mixing 10 ml of distilled water and 2g of the prepared soap. A pH meter was used to measure the pH (Rajat et al., 2024). Foam retention was observed by making 25 ml of 1% soap solution. The volume of the foam was measured every minute. For measuring the foam height, sample soap weighing 0.5 grams was taken

and dissolved in 25 ml of distilled water. The volume was made up to 50 ml. by adding more distilled water. After giving 25 strokes, the aqueous volume was measured up to 50 ml, and the foam height was measured above the aqueous volume. The Total Fatty Matter (TFM) was estimated by reacting soap with acid in the presence of hot water and measuring the resulting fatty acid. After dissolving 10g of the designed soap in 150ml of distilled water, the mixture was heated. 20 ml of 15% H₂SO₄ were added to the mixture and heated until a clear solution was achieved. The resulting solution's surface fatty acid was solidified by heating it once again and adding 7g of beeswax.

For measuring the moisture content of the sample soap, 5g of the sample was precisely weighed, moved to a known-weight tarred porcelain dish, and then heated to 105°C for 2 hours in a hot air oven. In order to determine the true weight of the tarred China dish, the sample and the dish were weighed together. To determine the % moisture content, the content's weight was recorded (Rajat et al., 2024).

Shelf life of test sample: Branded soap (Sodium Lauryl Sulphate (SLS) and parabens soap) was taken as a control. Pure culture of microorganisms *Staphylococcus aureus* and *Staphylococcus epidermidis* was collected from Patho labs, Bailey Road, Patna

Antimicrobial assay of the test sample: A Nutrient agar medium was prepared and poured into sterile petri dishes to solidify. For making the agar wells, a sterile cork borer (1mm) was used, two wells were made on each plate (for test sample and control). The spread plate method was used to inoculate the plates with the pure culture. 2 µg of control was transferred into the well of each plate, 2 µg of fresh sample was transferred into well of four plates nutrient agar media. The plate was then incubated at 37°C for 24 hours. Post incubation, the plates displayed agar diffusion around the wells, and the result were determined by measuring the zone of inhibition. The zone of inhibition for the organism resistance was observed (Aneja, 2018).

Statistical analysis: All values were recorded in triplicates and expressed as mean ± standard deviation (SD). Statistical analysis was performed using ANOVA.

Results and Discussion:

After one month the prepared therapeutic herbal soap was subjected to biochemical tests to check different parameters.

Table 1. Characterization of test sample

Sl. No.	Parameter	Standard Value	Observed value
1.	Colour	–	Brown
2.	Odour	–	Aromatic
3.	Appearance	–	Smooth Texture
4.	pH	8-10	8.04
5.	Foam Height	1.3-22 cm	7 cm
6.	TFM (Total Fatty Matter)	36.8%	0.03%
7.	Alcohol Soluble Matter	17.60%	25%
8.	Foam Retention	Over 5 min	Over 4 min foam was stable
9.	Moisture content	About 10%	1.01%

The results in the Table 1, shows that the freshly prepared test sample was Brown in color and has a pleasant, refreshing odour, as well as smooth consistency and a pH to be neutral (pH 8.04).

Table 2. Microbial assay of the test sample

SAMPLE	ZONE OF INHIBITION	
	<i>Staphylococcus aureus</i> (avg.) in mm	<i>Staphylococcus epidermis</i> (avg.) in mm
1. Test sample	20±0.5 mm	26±0.5 mm
Control 1	36 mm	30 mm
2. Test sample	62±0.5 mm	28±0.5 mm
Control 2	36 mm	30 mm

The antimicrobial activity of the test sample was determined using the agar well-diffusion method. Plates inoculated with pure culture showed zones of inhibition of varying diameter against the antibiotic (used as a control) and the test sample poured into the well. The zone of inhibition was measured and compared to the

suppressive properties of the control and the test sample against microbes. In Table 2, the observed zone of inhibition for *Staphylococcus aureus* of control 1 and control 2 was found to be 36 mm respectively. The zone of inhibition of test sample were 20±0.5mm and 62±0.5mm. It was concluded that the test sample was more effective against control 2. The zone of inhibition of the test sample was lesser than the control 1. The observed zone of inhibition for *Staphylococcus epidermidis* for control 1 and control 2 were found to be 30mm respectively while the test sample was 26±0.5mm and 28±0.5mm. The results indicates that the both formulated herbal soap and branded soap showed zone of inhibition but prepared test sample was more effective against *Staphylococcus aureus*. This shows formulated soap has antimicrobial property and it is effective against the common skin problems, since branded soap causes many side effects such as thinning weakness or washing of the skin or leads to dryness and burning sensation on the application site. As reported by Chen et al., (2016) the maximum zone of inhibition of *Staphylococcus aureus* was in 23.5±0.2 mm for plant based formulation. All the ingredients used in the herbal soap (*Solanum xanthocarpum*, aloe vera, wild turmeric, glycerine) have been found to be antimicrobial. So, the herbal soap shows antimicrobial property due to the plant extracts present in the formulated therapeutic herbal soap.

Conclusion:

The produced compound was tested well, yielding favourable findings multiple times. The fact that a small group of volunteers had used these soaps and found them to be skin-friendly indicates that soap does not irritate skin. The prepared therapeutic herbal soap was found to be eco-friendly without causing any harmful effect to our skin and are safe to use without causing side effects. The formulated herbal soap was found to be effective against *Staphylococcus aureus* and *Staphylococcus epidermidis* which are mostly found on the skin. As both the formulated soap and branded soap are effective against the bacteria, the maximum zone of inhibition was observed against *Staphylococcus aureus*. This maybe because of the reason that the formulated sample soap from the plant extracts has antimicrobial properties and it is effective against the common skin problems. Whereas the branded soap available in the

market causes many side effects such as thinning, weakness, or washing of the skin or leads to dryness and burning sensation on the application site. Thus, on the basis of observed data of the research work done, it can be scientifically concluded that the extract of the plant used in formulating the herbal soap has the potential and further work can be suggested.

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