FORMULATION AND EVALUATION OF AYURVEDIC HERBAL SOAP USING *ALTERNANTHERA SESSILIS* FOR SKIN WELLNESS

[1]Devi K, [2]Aniga M, [3]Jayasri J and [4]Kaaviya R

[1]Assistant Professor, Department of Biotechnology, Selvam College of Technology, Namakkal, Tamil Nadu, India

[2,3,4] UG Students, Department of Biotechnology, Selvam College of Technology, Namakkal, Tamil Nadu, India

Abstract

Alternanthera sessilis, locally referred to as Ponnanganni, is a traditional medicinal herb that is well renowned for its therapeutic qualities, especially in the skincare industry. It is known to possess antioxidant, antibacterial, antifungal, and anti-inflammatory compounds that aid in skin healing and protection. In this study, only the powdered form of *Alternanthera sessilis* was incorporated into a glycerine soap base to formulate a herbal soap intended for the treatment of common skin ailments such as acne, rashes, burns, and inflammation. The antioxidant and anti-inflammatory activities of the soap were evaluated using the DPPH assay. Physicochemical analysis revealed that the formulated soap had a green color, pH of 8.0, 33.5% total fatty matter, 4.8% moisture content, and produced 225 ml of lather. Additionally, it contained 0.155% free caustic alkali and 2.21% free carbonated alkali, and was found to be free from grittiness and cracking. These findings imply that the herbal soap is stable, safe, and maybe advantageous for use in skin care products.

Keywords: *Alternanthera sessilis*, herbal soap, total fatty matter, anti-inflammatory, and antioxidant.

1. Introduction

Herbal soaps are an excellent alternative to commercial soaps, which may contain harsh chemicals that could harm the skin. Made from natural herbs and ingredients, herbal soaps are safer and more beneficial for the skin. The growing awareness of skincare and the demand for natural ingredients have influenced the cosmetic and personal care industry to shift towards herbal formulations. Enhanced with antifungal and antibacterial qualities, herbal soaps are frequently regarded as therapeutic. Plant-based materials like leaves, fruits, stems, and roots are used in these soaps to boost general wellbeing, prevent infections, and improve skin health (Wijayawardhana *et al*. 2021). For centuries, plants have been used in traditional medicine to treat and prevent infections. Various bioactive compounds, including flavonoids, terpenoids,

alkaloids, and tannins, present in plants contribute to their antibacterial properties. Herbal soaps serve a dual purpose: they cleanse the skin while delivering therapeutic benefits. Their natural composition ensures that the skin receives essential nutrients without the risk of adverse side effects. (Das, *et al*. 2024). Apart from their medicinal value, herbal soaps are also known for their hydrating and moisturizing effects. Many formulations include natural oils such as coconut oil, olive oil, or castor oil, which help maintain the skin's moisture balance (Deen, *et al*. 2021). Essential oils such as lavender, tea tree, and eucalyptus are commonly added to soap for their therapeutic benefits, offering a blend of calming, anti-inflammatory, and antimicrobial properties. These natural extracts not only enhance the soap's fragrance but also contribute to skin health by soothing irritation, reducing redness, and helping to combat bacteria and other microbes, making the soap both effective and aromatic (Cavanagh, *et al*. 2005).

In the present study, *Alternanthera sessilis* is incorporated for its remarkable therapeutic properties, including potent antioxidant, antimicrobial, and anti-inflammatory effects. Additionally, its proven efficacy in wound healing and treating common skin issues such as pimples and acne further enhances the overall effectiveness of the formulation, making it a valuable addition for promoting healthy and clear skin. The presence of bioactive compounds such as flavonoids, phenols, tannins, and saponins in *Alternanthera sessilis* contributes significantly to its ability to neutralize harmful free radicals, thereby exhibiting strong antioxidant potential. Its anti-inflammatory effects help in soothing irritated skin, reducing redness, and preventing inflammation-related skin conditions. Additionally, the wound-healing activity of the plant aids in the regeneration of skin tissues, promoting faster recovery of minor cuts, abrasions, and skin damage. These combined properties make the soap not only suitable for daily cleansing but also beneficial in maintaining healthy, protected, and rejuvenated skin (Jalalpure, *et al.* 2008).

2. Materials and Methods

2.1 Collection of plant sample:

Alternanthera Sessilis plant sample were collected in Namakkal. The freshly collected plant sample of *Alternanthera sessilis* was subjected to a controlled drying process using a hot air oven. The drying was carried out at a consistent temperature over the course of one week to ensure the complete removal of moisture from the plant material. After confirming the absence of residual moisture, the dried plant material was then ground into a fine, uniform powder using a mechanical grinder (Fig. 1).

Fig 1: Coarse powder of *Alternanthera sessilis*

2.2 Preparation of plant extract:

2 grams of powdered *Alternanthera sessilis* plant sample transferred into a sterile, contamination-free container. To initiate the extraction process, 100 milliliters of ethanol was added to the container and transferred onto an orbital shaker for homogenization. At room temperature, the sample was constantly stirred for 24 hours at a constant speed. After the homogenization, the mixture was subjected to filtration (Whatman No.1) in order to separate the plant residue from the solvent extract. This ethanol-based extract was then stored in a refrigerator at a controlled temperature of 4°C until further analysis (Fig. 2).

Fig 2: Ethanolic leaf extract of *Alternanthera sessilis*

2.3 Phytochemical analysis:

Chemical tests were carried out on the extract using standard procedures to identify the constituents as described by Suchitra et al. 2013.

2.3.1 Test for Alkaloids (Mayer's test):

Mayer's reagent was added in five drops to one milliliter of plant extract. A creamy white precipitate was produced, indicating the presence of alkaloid groups.

2.3.2 Test for glycosides:

To 1ml of plant extract, 1ml of acetic acid, few drops of 5% ferric chloride, and 1ml of concentrated sulphuric acid was added. When brown ring development occurs, cardiac glycosides are present.

2.3.3 Test for tannins:

After dissolving 1 ml of extract in 5 ml of distilled water, the mixture was boiled for a few minutes and then cooled. The mixture was treated with 1-2 drops of 0.1% ferric chloride solution and observed for brownish green or a blue black coloration that indicates the presence of tannins.

2.3.4 Test for flavonoids:

Few drops of concentrated sulfuric acid was carefully added along the test tube wall after 2.5ml of ammonia solution and 1ml of extract were combined in a test tube. The presence of flavonoids is indicated by a yellow coloring.

2.3.5 Test for steroids:

1ml of acetic anhydride and 2ml of concentrated sulfuric acid were added to 0.5ml of sample. The presence of steroids is indicated by the production of violet to blue or green.

2.3.6 Test for saponins:

A stable, long-lasting foam was obtained by rapidly shaking 1 milliliter of the sample with 2 milliliters of distilled water and adding 8 drops of olive oil. The emulsion's creation suggests that saponins are present.

2.3.7 Test for terpenoids:

A few drops of concentrated sulfuric acid were carefully put around the test tube wall to create two layers after 0.5 ml of the sample and 2 ml of chloroform were added. Terpenoids are confirmed to be present by an interface with a layer of reddish brown color.

2.4 Antioxidant assay

The antioxidant activity of the extract was determined using the DPPH (2.2-Diphenyl-1-picrylhydrazyl) free radical scavenging assay. The S. nigrum extract in concentration from 1 to 5 mg/ml and 5 ml 0.004% (w/v) solution of DPPH was The obtained mixture was vortexed, incubated for 30 min in room temperature in a relatively dark place and then was read using spectrophotometer at 517mm. The lank was 80% (v/v) methanol. Measurements were taken in triplicate. Inhibition (1 was calculated as follows:

1% [Abs0-Absl Abs0] *100

Abs0 = absorbance of 0.004% DPPH without analyte.

Abs1 = absorbance of 0.004% DPPH plus the test compound.

2.5 Anti-inflammatory assay:

Bovine serum albumin (BSA) is used as a protein. A reaction mixture consists of various concentrations of plant extract 1000 micro liter (100-500 microgram/ml), 450 micro liter of (5% w/v aqueous solution) bovine serum albumin. 1400 micro liter of phosphate buffered saline. As a negative control, distilled water is used in place of the extracts in the mixture above. The mixes are then heated to 70 degrees Celsius for five minutes after being incubated at 37 degrees Celsius for 15 minutes. After cooling under running apwater, their absorbances are measured at 660 nm. In this triplicate experiment, the percentage inhibition for protein denaturation is computed using the following formulas:

% Inhibition of denaturation = (1-D/C) * 100.

Where, D is the absorbance of test sample and C is the absorbance of negative control

2.6 Formulation of soap:

Take 100gm of glycerin soap base in a beaker with the help of weighing machine. Use the double boiler method to melt the soap base. Add 1g of *Alternathera sessilis* powder in the melted soap base. Mix it well using glass rod. Add 10ml of coconut oil and 3ml of lavender essential oil in the soap base. After proper mixing, pour it in the silicone mold and let it cold down for 24hrs.

2.7 Evaluation of soap:

The evaluation of soap involves assessing its key attributes, such as appearance, lathering ability, cleansing efficiency, and skin compatibility.

2.7.1 Determination of color:

The color and clarity were examined with the naked eye against a white background.

2.7.2 pH:

To determine the pH, a 1% soap solution was prepared by dissolving 1 gram of soap in 100 milliliters of distilled water. Until the solution was fully dissolved, it was vigorously agitated. After that, a calibrated digital pH meter was used to measure the pH. An alternative method for getting approximate values is to utilize pH indicator strips.

2.7.3 Determination of percentage of free alkali:

After adding around 5 g of the sample to 50 ml of neutralized alcohol, the mixture was heated for 30 minutes under reflux on a water bath, cooled, and then 1 ml of phenolphthalein solution was added. Then, 0.1N HCL was added immediately to titrate it.

2.7.4 Total Fatty Matter (TFM):

After dissolving 10 g of the prepared soap in 150 ml of distilled water, the mixture was heated. To this, 20 ml of 15% H2 SO4 added while heating until a clear solution was obtained. Fatty

acids that are present on the surface of the resulting solution are solidified by adding 7 g beeswax and heated again. Then, it was allowed to cake. The cake was taken out, allowed to dry, and then weighed using the formula to determine the TFM.

% TFM = (Weight of the cake-Weight of the wax) in g/Weight of the soap in g>100.

2.7.5 Moisture content:

A dryer was used to dry the soap between 100 and 115°C after it was weighed and recorded as the sample's wet weight. After cooling, the sample was weighed to determine its dry weight. The formula was used to calculate the moisture content.

% Moisture content = Initial weight/Final weight * 100.

2.7.6 Lather volume:

Lather volume was determined by dissolving a fixed amount of soap in a measured volume of distilled water and shaking vigorously for a set time. The resulting foam was allowed to stabilize, and the total lather volume was recorded in milliliters using a graduated cylinder.

2.7.7 Freedom from grittiness

To assess freedom from grittiness, a small amount of the soap was rubbed between the fingers and observed for any gritty or sandy texture. A high-quality soap should feel smooth and uniform to the touch.

2.7.8 Freedom from cracking:

To assess this parameter, the soap was visually inspected for any visible cracks or fractures along its surface after being stored under standard conditions for a specified period. A high-quality soap should retain its shape and texture without signs of cracking, ensuring that it remains durable and functional throughout its use.

2.7.9 Irritancy test:

The soap's irritancy potential was assessed using a patch test. A small amount of the soap, diluted in water, was applied to the forearm of a volunteer. After 24 hours of application, the test area was observed for any signs of irritation, such as redness, swelling, itching, or other adverse reactions. The absence of these symptoms indicated that the soap was non-irritating and safe for use.

Results and Discussion

Phytochemical analysis:

A wide range of bioactive components were found in the plant extract after preliminary phytochemical screening, highlighting its possible medicinal use. The analysis confirmed the presence of tannins, known for their astringent and antimicrobial properties; flavonoids,

which exhibit strong antioxidant and anti-inflammatory activities; Additionally, the extract contained steroids and terpenoids, compounds often associated with anti-inflammatory, analgesic, and antimicrobial effects. The presence of glycosides indicates potential cardiotonic and detoxifying properties (Table 1). Although saponins were not detected in the preliminary screening, this may be attributed to the nature of the solvent used during extraction, which might not have effectively solubilized these compounds. However, based on previous reports and traditional knowledge, it is well-established that the plant contains saponins (Umate and Marathe (2017)). These compounds are known for their wide-ranging biological activities, including antimicrobial, anti-inflammatory, antioxidant, hypocholesterolemic, and immunomodulatory effects. Their presence further enriches the pharmacological profile of the plant and supports its potential application in both preventive and therapeutic medicine. These findings provide a foundational basis for further pharmacological and toxicological investigations into the plant's medicinal applications.

Table 1. phytochemical analysis of *Alternanthera sessilis* extract

S. No	Phytochemicals	Result	Observation
1.	Alkaloids	+	Formation of white precipitate
2.	Glycosides	+	Brown ring
3.	Tannins	+	Brownish green
4.	Flavanoids	+	Fluorescent yellow
5.	Steroids	+	Formation of green color
6.	Saponins	+	Emulsion
7.	Terpenoids	+	Formation of reddish brown color

Antioxidant assay:

The antioxidant activity of plant extract *Alternanthera sessilis* is done by DPPH assay. Absorbance is measured by using UV visible spectrophotometer and then calculated by using DPPH assay formula. The values of ascorbic acid and plant extract are used to plot the graph.

Table 2. Antioxidant activity of *Alternanthera sessilis*

CONCENTRATION	ABSORBANCE	%INHIBITION
20µl	0.018	97.6
40µl	0.083	88.9
60µl	0.442	41.0

80µl	0.356	51.3
100µl	0.445	40.6

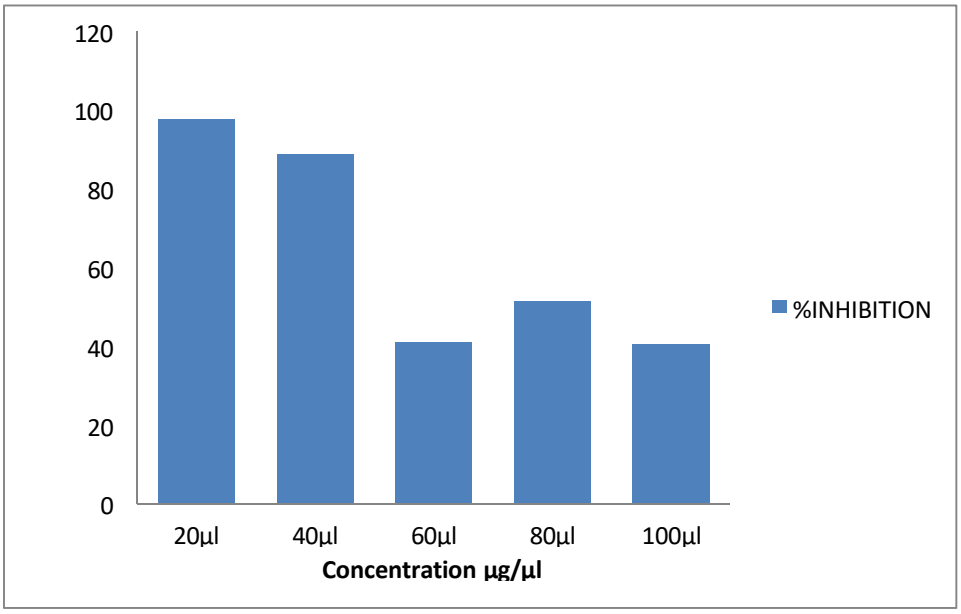

Fig 3: Antioxidant analysis of *Alternanthera sessilis*

Anti-inflammatory assay:

The anti-inflammatory potential of herbal soaps is an important aspect to evaluate, as it can help soothe the skin and reduce irritation or redness caused by environmental factors. In this study, the anti-inflammatory activity of the soap was assessed using an in vitro method, such as the albumin denaturation assay or lipoxygenase (LOX) inhibition assay. For the albumin denaturation test, a known concentration of the soap extract was mixed with bovine serum albumin (BSA) and incubated at a specific temperature. The inhibition of protein denaturation was measured by determining the absorbance change. The lipoxygenase assay measures the ability of the soap extract to inhibit the activity of the lipoxygenase enzyme, which is involved in the inflammatory process. The reduction in enzyme activity reflects the anti-inflammatory potential of the soap.

Table 3: Anti-inflammatory activity of *Alternanthera sessilis*

CONCENTRATION	ABSORBANCE	%INHIBITION OF DENATURATION
100µl	0.124	51.7
200µl	0.276	46.7
300µl	0.346	38.1
400µl	0.466	40.5
500µl	0.432	66.7

Formulation of Herbal soap:

The herbal soap was meticulously formulated using plant extracts rich in a wide spectrum of phytochemicals, including alkaloids, tannins, flavonoids, phenols, steroids, terpenoids, saponins, and glycosides. These bioactive compounds are known for their therapeutic properties and contribute significantly to the functional efficacy of the final product. The soap exhibited a natural green coloration, which is likely attributed to the presence of plant pigments such as chlorophyll and other phytoconstituents. This coloration enhances the product's natural appeal and reflects its botanical origin. In terms of texture, the soap was smooth and pleasant to the touch, offering a gentle application experience on the skin.

Fig 4: Herbal soap of *Alternanthera sessilis*

Evaluation of Herbal soap:

Evaluation tests were used to identify the quality, stability, and effectiveness of the herbal soap formulation.

Table 4: Physicochemical evaluation results of *Alternanthera sessilis*

PARAMATERS	RESULT
Color	Green
pH	8.0
Total Fatty Matter	33.5%
Moisture content	4.8%
Lather	80ml
Free caustic alkali	0.155%
Free carbonated alkali	2.21%
Freedom of grittiness	Nil
Freedom of cracking	Nil

Irritancy test:

Through initial application on college volunteers, the herbal soap's suitability for skin was evaluated. Following application, no signs of irritation, redness, itching, or discomfort were observed on any of the test areas. The absence of irritation indicates that the soap is gentle on the skin and well-tolerated, even by individuals with sensitive skin.

Conclusion:

The herbal soap was successfully formulated using a plant sample collected from Namakkal, Tamil Nadu. Preliminary skin application tests revealed no irritation or adverse effects, suggesting that the soap is safe for regular use. Taken together, these findings suggest that the formulated herbal soap not only possesses desirable physical and chemical properties but also offers therapeutic benefits due to its rich phytochemical profile. This supports its potential as a safe, natural, and effective alternative to conventional chemical-based soaps, catering to the growing demand for plant- based and skin-friendly personal care products.

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