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FORMULATION AND EVALUATION OF HERBAL PAPER SOAP FOR PERSONAL HYGIENE

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ABSTRACT

Herbal paper soap is an innovative, portable, and eco-friendly cleansing product designed to provide convenient hand hygiene while reducing plastic waste. The present study aimed at the formulation and evaluation of herbal paper soap incorporating Neem (Azadirachta indica) and Aloe vera (Aloe barbadensis Miller) extracts. Neem is well known for its antibacterial, antifungal, and anti-inflammatory properties, making it effective in reducing the growth of pathogenic microorganisms, while Aloe vera possesses moisturizing, soothing, and wound-healing properties that help maintain skin hydration and minimizes irritation. The herbal extracts were incorporated into thin, water-soluble soap sheets that dissolve rapidly upon contact with water, producing sufficient lather for effective cleansing. The formulated herbal paper soap was evaluated for its physical appearance, pH, foam height, disintegration time, and antimicrobial activity. The results indicate that the combination of Neem and Aloe vera produces a stable, skin-friendly, and effective cleansing product suitable for everyday use. Thus, herbal paper soap offers a sustainable and convenient alternative to conventional soaps, combining effective hygiene with the therapeutic benefits of natural herbal ingredients.

KEYWORDS: Herbal paper soap, Neem Extract, Aloe Vera, Water-Soluble Paper, Antimicrobial.

INTRODUCTION

The definition of cosmetic under the law varies slightly between countries but in general terms ‘cosmetic’ means any article intended to be used by means of rubbing, sprinkling or sprayed on, introduced into, or otherwise applied to any part of the human body for cleansing, beautifying, promoting attractiveness, altering the appearance and for maintaining health of the skin and hair, provided that the action of the article on the human body is mild.[1]

The word ‘cosmetic’ shares its roots with the word ‘cosmos’. Derived from the Greek word ‘cosmos’, which means ‘order’ or ‘ornament’. The word ‘cosmetic’, which refers to the outward look, has come to have a second connotation. They concentrate on maintaining the appearance of the external body surfaces, such as the skin, hair, and teeth, as well as deodorizing or perfuming them to eliminate odors. Changing the appearance of these surfaces, safeguarding them, and maintaining their integrity or as in the other sense of ‘cosmos’, keeping things in good order, is reflected in the definition of cosmetic.[2]



Figure 1. Cosmetics.

The earliest form of human cosmetic rituals was body art. Cosmetics were not welcome in Rome, but they were used by some aristocratic Romans of the time. However, historical evidence shows that the Romans actually adopted and adapted cosmetic practices from earlier cultures rather than inventing them. For example, Kohl was used to outline their eyes. In 1888, a deodorant intended for cosmetic purposes was discovered by an anonymous American and was marketed under the tradename 'Mum'. Even after 1900 AD, people did not accept cosmetics. Roll-on deodorant and aerosol deodorant were introduced to the market in 1952 and 1965 respectively.[3]

ANATOMY OF SKIN

The skin, which covers the body's whole exterior, is the biggest organ. The epidermis, dermis, and hypodermis are the three layers of the skin, each of which has unique physical features and purposes. The body's first line, which defends against infection, UV rays, toxins, and mechanical harm is the complex network that makes up the skin. The amount of water released into the environment and temperature are also controlled by this organ. The thickness of the epidermal and dermal layers affects skin thickness, which varies by body region. Because of the stratum lucidum, an additional layer in the epidermis, the hairless skin on the palms of the hands and soles of the feet is the thickest. Thin skin refers to areas that lack this additional layer, because of its thick epidermis. The back has the thickest skin among these areas. Because of its barrier function, the skin is vulnerable to a number of infectious and inflammatory diseases. Furthermore, cosmesis, sensory alterations, and wound healing are important surgical issues. In many areas of medicine, addressing disorders requires an understanding of the anatomy and function of the skin.[4]

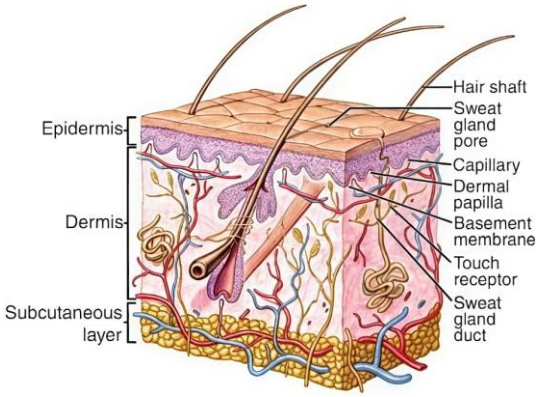


Figure 2: Structure of skin.

STRUCTURE AND FUNCTIONS OF SKIN

The skin consists mostly of three layers. The epidermis is the top layer, the dermis is the layer underneath it, and the subcutaneous tissue is the third and deepest layer. The skin and epidermis sections of the common integument.

➢ The epidermis, or outermost layer of skin, acts as a waterproof barrier and helps to determine skin tone.

➢ The dermis is located beneath the epidermis and comprises connective tissue, hair follicles, blood vessels, lymphatic vessels, and sweat glands

➢ The deeper subcutaneous tissue (hypodermis) is composed of both fat and connective tissue.

On thick skin, such as the palms and soles, the epidermis is further divided into five layers (stratum Basale, stratum spinosum, stratum granulosum, stratum lucidum, and stratum corneum), however in other locations, the epidermis only has four layers and lacks the stratum lucidum.

The dermis is separated into two layers: the papillary dermis (upper) and the reticular dermis (lower).

The functions of the skin include.

- **Protection** against microorganisms, dehydration, ultraviolet light, and mechanical damage; the skin is the first physical barrier that the human body has against the external environment.
- **Sensation** of pain, temperature, touch, and deep pressure starts with the skin.
- **Mobility:** The skin allows smooth movement of the body.
- **Endocrine activity:** The skin initiates the biochemical processes involved in Vitamin D production, which is essential for calcium absorption and normal bone metabolism.
- **Exocrine activity:** This occurs by the release of water, urea, and ammonia. Skin secretes products like sebum, sweat, and pheromones and exerts important immunologic functions by secreting bioactive substances such as cytokines.
- **Immunity** development against pathogens.
- **Regulation of Temperature:** Skin participates in thermal regulation by conserving or releasing heat

and helps maintain the body's water and homeostatic balance.

The skin is made up of 3 layers. Each layer has different functions

- ❖ Epidermis
- ❖ Dermis
- ❖ Subcutaneous fat layer (hypodermis).

Table 1: Functions of skin.

Epidermis	The epidermis is the thin outer layer of skin. It contains three types of cells. Squamous cells Basal cells Melanocytes
Dermis	The dermis is the middle layer of skin. The dermis consists of the following: Blood vessels Lymph vessels Hair follicles Sweat glands Collagen bundles Fibroblasts Nerves
Subcutaneous fat layer	The subcutaneous fat layer is the deepest layer of skin. It consists of a network of collagen and fat cells.[5]

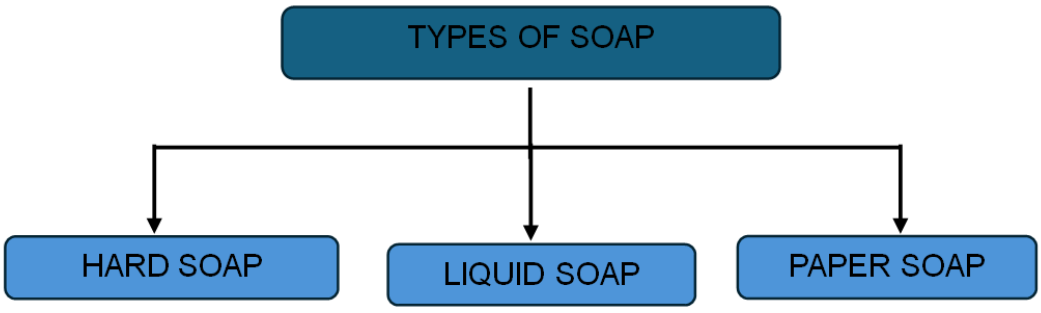
SOAP

Soap is a common cleansing agent well known to everyone and is manufactured in granules, bars, flakes, or liquid form obtained by reacting salt of sodium or potassium of various fatty acids that are of natural origin (salt of non-volatile fatty acids).[6] Soap can also be defined as any water-soluble salt of fatty acids containing eight or more carbon atoms. Soaps are produced for varieties of purpose ranging from washing, bathing, medication etc. The cleansing action of the soap is due to the negative ions on the hydrocarbon chain attached to the carboxylic group of the fatty acids.[7] The affinity of the hydrocarbon chain to oil and grease, while carboxylic group to water is the main reason soap is being used mostly with water for cleaning purposes.[8]



Figure 3: Soap.

TYPES OF SOAP



- **HARD SOAP**

Hard soaps are solid sodium salts of long-chain fatty acids formed by the reaction of fats or oils with sodium hydroxide (NaOH) during the process of saponification.



Figure 4: Hard soap.

ADVANTAGES

- Long lasting
- Low cost/ Economical
- Easy to store
- Produces good foam
- Less wastage during use
- Easy to prepare
- Eco-friendly with less plastic packaging.[9]

- **LIQUID SOAP**

Liquid soap is a clear or opaque aqueous solution of potassium salts of fatty acids obtained by the saponification of vegetable oils or animal fats with potassium hydroxide and used as a cleansing agent.



Figure 5: Liquid soap.

ADVANTAGES

- Easy to use
- Lower contamination
- Easy to carry
- Gentle on the skin.[10]

- **PAPER SOAP**

Paper soap is a slim sheet of soap. It acts as an anionic surfactant utilized with water for cleaning and washing purposes. It is compact, affordable, and user-friendly. The paper utilized in paper soap is eco-friendly. When the paper dissolves in water, even if disposed of, it remains biodegradable and disposable. Washing hands with soap is crucial, as it has been shown to eliminate germs and bacteria effectively.[11]



Figure 6: Paper soap.

The paper soaps are created from glycerine, which acts as a plasticizer. The soap sheet allows for hand washing by effectively destroying 99.9% of bacteria by simply adding water right before use. Each travel pack contain 10-20 thin sheets, with each sheet intended for a single handwashing session, making it convenient.[12]

The paper soap is compact and easy to transport, with only a few tablets needed to wash hands, providing disinfection and cleaning, which is a great ally for maintaining hygiene. Paper soaps are particularly well-suited for travellers. Designed with travel needs in mind, these soaps are highly effective and convenient. For quick hand washing anywhere at any time, carry these global mart paper soaps for a hygienic journey.[13]

These paper soaps come in attractive packaging and shapes, packed in travel-friendly, easy-to-carry tubes. They are lightweight and thin, becoming effective in warm water. The paper soap is very straightforward to use; the addition of moisture prevents dry hands while its fragrance helps keep the hands smelling fresh.[14]

ADVANTAGES OF PAPER SOAP

- Light weight
- Ready to use
- Gentle on skin
- Ease of carrying
- Earth friendly
- Low cost
- Biodegradable, compostable

HERBAL PAPER SOAP

Herbal paper soap is a lightweight, biodegradable made up of thin sheets of paper mixed with soap solution which incorporated with herbal ingredients that dissolve in water and produce adequate foam.[15]

WHY HERBAL PAPER SOAP?

Herbal paper soap, crafted from natural plant extracts, essential oils, and herbs, is mild on the skin, providing antibacterial, antifungal, moisturizing, and antioxidant

advantages while being environmentally friendly and devoid of harsh chemical.[16]



Figure 7: Herbal paper soap.

ADVANTAGES OF HERBAL PAPER SOAP

1. **Eco-friendly and Sustainable Packaging:** One of the most significant advantages of herbal paper soap is its environmentally friendly nature. Traditional soap products often come in plastic packaging, which contributes to plastic pollution and has long-lasting negative effects on the environment. In contrast, herbal paper soap typically uses biodegradable paper or similar materials that have a lower environmental impact. This helps reduce plastic waste and is a step toward more sustainable personal care products.
2. **Portability and Convenience:** Herbal paper soap is compact, lightweight, and portable, making it a perfect solution for people on the go. Whether traveling, at the gym, or simply commuting, the paper soap can be carried in a wallet, purse, or bag without the need for bulky containers. This convenience adds to its appeal, particularly for people who need to carry soap but do not want the inconvenience or mess of liquid soap or soap bars.
3. **Natural and Gentle Ingredients:** Herbal paper soaps are made with natural plant- based extracts such as aloe vera, lavender, chamomile, tea tree oil, and neem. These ingredients are known for their skin benefits, including moisturizing, soothing, and anti-inflammatory properties. They tend to be gentler on the skin compared to synthetic chemicals found in many conventional soaps, making them a great choice for individuals with sensitive skin or allergies.

DISADVANTAGES OF HERBAL PAPER SOAP

1. **Fragility and Durability:** One of the main disadvantages of herbal paper soap is its fragility. Paper soap sheets are thin and may tear easily, especially if they are not stored properly or if exposed to moisture. This could lead to wastage, as the sheets might break before use. Proper storage and handling are necessary to ensure that the paper soap maintains its integrity until it is needed.
2. **Limited Lathering Ability:** Paper soap may not lather as effectively as traditional soap bars or liquid soap. Some users may find the lather to be less rich or foamy, which could affect the overall satisfaction with the product. This issue can be mitigated by refining the formulation to create a foamier and more effective paper soap, but it remains a challenge for some products.
3. **Limited Availability and Market Penetration:** Herbal paper soap is still a relatively niche product in the market, and its availability may be limited compared to more conventional soap options. For consumers looking for an easy-to-find product, herbal paper soap may not be as accessible. Additionally, the production of paper soap may require specialized equipment, making it more difficult for small manufacturers to produce at scale.[17]

APPLICATIONS

1. **Antibacterial and Antifungal Qualities:** It possesses compounds like flavonoids and essential oils that inhibit the growth of bacteria and fungi, making the soap effective for hygiene maintenance.
2. **Anti-inflammatory and Calming Effects:** It alleviates irritated skin and helps diminish inflammation, making it suitable for sensitive or acne-prone skin.
3. **Natural Antioxidants:** Contains antioxidants that shield the skin from free radical damage, thus slowing down the aging process of the skin.
4. **Healing Properties:** Its antimicrobial and antiseptic characteristics assist in the healing of minor cuts, wounds, and insect bites.
5. **Aroma and Visual Appeal:** The inherent fragrance of the plant lends a delightful sent to the soap, enhancing the overall experience for the user.[18]

LITERATURE REVIEW

1. **Bhoir *et al.* (2026)** formulated and evaluated herbal paper soap containing neem, turmeric, and aloe vera extracts for antibacterial, wound-healing, and skin-protective properties. The formulation used water-soluble paper as the carrier material and hydroxypropyl methylcellulose (HPMC) as a film-forming polymer, along with suitable cleansing and moisturizing agents. The prepared herbal paper soap strips were evaluated for organoleptic properties, size, pH, foamability, disintegration time, weight variation, and skin irritation. The strips showed satisfactory physical characteristics, good flexibility, adequate foam formation, rapid disintegration in water, acceptable weight uniformity, and no signs of skin irritation. The study concluded that the developed herbal paper soap could serve as a portable, convenient, eco-friendly, and effective alternative to conventional soap while providing additional antibacterial and skin-protective benefits.
2. **Mulimani *et al.* (2026)** reviewed the formulation, properties, and effectiveness of herbal paper soap as

a portable, biodegradable, and eco-friendly alternative to conventional soap. The review highlighted that herbal paper soap consists of water-soluble sheets incorporated with natural herbal extracts, which rapidly dissolve in water, produce lather, and aid in the removal of dirt and microorganisms. *Tagetes erecta* L. was particularly emphasized for its antibacterial, antifungal, anti-inflammatory, antioxidant, and skin-soothing properties, making it a suitable herbal ingredient for paper soap formulations. The study also discussed the advantages of herbal paper soap, including its lightweight nature, portability, convenience, affordability, skin-friendliness, and biodegradability. Overall, the review suggested that herbal paper soap offers a sustainable and effective approach to personal hygiene by combining the cleansing properties of soap with the therapeutic benefits of medicinal plants.

3. **Antony *et al.* (2025)** developed and evaluated an antibacterial herbal paper soap containing essential oil of *Ocimum basilicum* L. The study aimed to formulate a convenient, eco-friendly, biodegradable, and effective alternative to conventional soaps. The essential oil was extracted from basil leaves by hydro-distillation using a Clevenger apparatus and incorporated into a paper soap formulation containing tragacanth, sodium lauryl sulphate, glycerine, colour, and water-soluble paper. The prepared formulations were evaluated for physicochemical properties, including appearance, size, shape, pH, foam height, foam stability, foam retention, spreadability, solubility, and antibacterial activity. Among the formulations, F2 showed better overall characteristics, including improved foam properties, spreadability, and significant antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. The study concluded that *Ocimum basilicum* essential oil-based herbal paper soap has considerable potential as a portable, sustainable, and effective antibacterial hygiene product.
4. **Gaywal *et al.* (2024)** formulated and evaluated a herbal soap containing extracts of Azadirachta indica (neem) and Ocimum tenuiflorum (tulsi), selected for their traditional medicinal and antibacterial, antifungal, antioxidant, and anti-inflammatory properties. The herbal soap was prepared using aqueous extracts of neem and tulsi and evaluated for various physicochemical and functional parameters, including appearance, odour, pH, foam height, foam retention, moisture content, cleansing ability, and skin irritation. Among the prepared formulations, F2 showed the best overall characteristics, with satisfactory foam properties, a moisture content of 6.83%, good cleansing ability, and no significant skin irritation in volunteers. The study concluded that the combination of neem and tulsi extracts can be effectively incorporated into herbal soap formulations and may serve as a promising natural alternative to conventional soaps containing synthetic chemicals due to its antimicrobial properties and good skin compatibility.
5. **Surya *et al.* (2021)** reviewed the recent developments and changing trends in the cosmetic industry, emphasizing the increasing demand for cosmetic products and the growing interest in safe, effective, and natural formulations. The author discussed the evolution of cosmetics, the use of various active ingredients, and the importance of product quality and safety. The review also highlighted the growing preference for herbal and natural cosmetics due to increasing consumer awareness regarding the potential adverse effects of synthetic ingredients. The study concluded that the cosmetic industry is continuously developing through advancements in formulation technology and the increasing demand for innovative and safer cosmetic products.
6. **Barton *et al.* (2020)** discussed the scientific principles underlying cosmetic products and their development. The author described cosmetics as scientifically formulated products designed to improve personal hygiene, appearance, and skin health, while emphasizing the importance of understanding the properties and functions of cosmetic ingredients. The book highlighted the role of scientific research in formulation development, product safety, efficacy, and consumer acceptability. This reference provides a comprehensive foundation for understanding the chemistry, formulation, and scientific aspects of modern cosmetic products.
7. **Bonifant and Holloway (2019)** reviewed the effects of ageing on skin integrity and wound healing. The authors reported that ageing causes significant structural and physiological changes in the skin, including thinning of the epidermis, reduced collagen and elastin production, decreased vascularity, and impaired immune function, all of which compromise skin integrity and delay the wound-healing process. They further emphasized that older adults are more susceptible to skin injuries, pressure ulcers, and chronic wounds due to these age-related changes and associated comorbidities. The review highlighted the importance of comprehensive skin assessment, preventive skin care measures, adequate nutrition, and early clinical intervention to maintain skin health and promote effective wound healing in the elderly population.
8. **Phulensarama *et al.* (2017)** emphasized the growing importance of cosmetovigilance in India due to the increasing use of cosmetic products and the occurrence of various adverse reactions associated with them. The authors highlighted the need for systematic monitoring, assessment, and reporting of cosmetic-related adverse effects to ensure consumer safety. They also discussed the lack of adequate awareness and reporting systems for cosmetic adverse events in India and stressed the

importance of establishing a structured cosmetovigilance system. The study concluded that effective cosmetovigilance is essential for identifying potential risks, improving the safety profile of cosmetic products, and protecting public health.

9. **Taiwo and Osinowo (2001)** evaluated the potential of various agricultural wastes, including cocoa pod husks, palm bunch waste, sorghum chaff, and groundnut shells, as alternative raw materials for traditional black soap production. The authors reported that the ash obtained from these agro-wastes contained significant amounts of potassium and sodium compounds, with potassium carbonate being the predominant alkali responsible for the saponification process. The soaps produced from these agro-waste ashes exhibited excellent solubility, consistency, cleansing efficiency, and lathering properties, demonstrating their suitability as effective soap-making materials. The study concluded that the utilization of agro-wastes in soap production not only offers a sustainable and cost-effective alternative to conventional alkalis but also promotes environmental waste management through the value-added use of agricultural residues.
10. **Mitsui *et al.* (1997)** provided an overview of cosmetics and their significance in daily life, highlighting their role in cleansing, beautifying, protecting, and maintaining the health and appearance of the skin, hair, and other external parts of the body. The author explained that cosmetics have evolved considerably from traditional preparations to scientifically developed products containing various functional ingredients. The book also emphasized the importance of formulation, quality, safety, and efficacy in the development of cosmetic products. This work provides a fundamental understanding of the concept, history, functions, and scientific basis of cosmetics.

OBJECTIVE

- To formulate the herbal paper soap using water soluble paper.
- To formulate a portable herbal paper soap incorporating herbs such as Neem and Aloe vera.
- To perform various evaluation test for the prepared herbal paper soap.
- To evaluate anti-microbial activity of the herbal paper soap against selected microorganisms.

MATERIALS REQUIRED AND METHOD

Table 2: Role of ingredients.

SI NO	MATERIAL	ROLE / USES
1	Neem	Antibacterial and antiseptic agent
2	Aloe vera	Skin soothing and healing agent
3	SLS	Foaming and cleansing agent
4	HPMC	Film-forming polymer
5	Glycerin	Moisturizing agent
6	Lavender oil	Fragrances
7	Distilled water	Solvent
8	Water soluble paper	Carrier material

1. NEEM



Figure 8: Neem.

Botanical Name: Azadirachta Indica
Kingdom: Plantae
Class: Dicotyledonae
Phylum: Spermatophyta
Subphylum: Angiospermae
Order: Rutales
Family: Meliaceae
Genus: Azardica
Species: Azardica Indica
Synonyms: Margosa, Nimtree, Indian Lilac
Biological Source: The biological source of neem is the Azadirachta indica tree.
Chemical constituents: Neem (Azadirachta indica) contains various chemical constituents, including the prominent limonoid azadirachtin, along with other compounds like nimbin, nimbolide, and gedunin, known for their diverse biological activities.
Medicinal Uses: Neem, a plant with a long history of medicinal use, is known for its antibacterial, antifungal, and antiviral properties, and is used in traditional medicine for various ailments, including skin conditions, diabetes, and digestive issues.
Mode of Action: Neem, particularly its active compound azadirachtin, exerts its effects on insects through various

mechanisms, including acting as an antifeedant, disrupting insect growth and reproduction, and repelling pests.[19]

2. ALOE VERA



Figure 9: Aloe vera.

Botanical Name: Aloe barbadensis Miller
Kingdom: Plantae
Order: Asparagales
Family: Asphodelaceae
Subfamily: Asphodeloideae
Genus: Aloe
Species: Aloe Vera
Synonyms: Aloe, Aloe vera, burn plant, and lily of the desert.
Biological Source: The biological source of aloe vera is the succulent plant Aloe barbadensis Miller, also known as Aloe vera, specifically the gel and latex derived from its fleshy leaves.
Chemical constituents: Aloe vera contains a wide array of chemical constituents, including vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids, and amino acids, along with products of the isoprenoid pathway like carotenoids, steroids, terpenes, and phytosterols.
Medicinal Uses: Aloe vera, known for its medicinal properties, has been traditionally used to soothe burns, wounds, and skin irritations, and may also aid in digestion, constipation, and even help manage blood sugar levels.
Mode of Action: Aloe vera's mechanism of action involves a combination of properties, including anti-inflammatory, wound-healing, and antioxidant effects, which are mediated by compounds like polysaccharides and glycoproteins that stimulate skin growth, collagen synthesis, and immune responses.[20]

3. SODIUM LAURYL SULPHATE



Figure 10: Sodium lauryl sulphate.

- Sodium lauryl sulfate (SLS) is a surfactant.
- It makes soap foamier.
- Sodium lauryl sulfate helps to stabilize and thicken solutions with ingredients of differing solubility.
- It allows products to achieve a more uniform texture for easier, and smoother application.

4. GLYCERIN



Figure 11: Glycerin.

- Glycerin is a nontoxic, odorless, and colorless liquid.
- Glycerin is used as a humectant in soap products.
- damage caused by dryness.
- It's also an emollient, which means it can soften skin.
- Glycerin will make sure that your skin will maintain its own moisture in order to protect it.
- It can increase skin hydration, relieve dryness, and refresh the skin's surface.[21]

5. LAVENDER OIL



Figure 12: Lavender oil.

- Antioxidant protection
- Used as a diabetes natural treatment
- Promotes healthy skin and hair
- Improve sleep
- Relieves pain

6. HPMC



Figure 13: HPMC.

- Used as thickener of liquid preparation
- Enhanced cleaning performance
- Stabilizing emulsions
- Skin conditioning properties
- Eco-friendly characteristics.[22]

7. WATER SOLUBLE PAPER

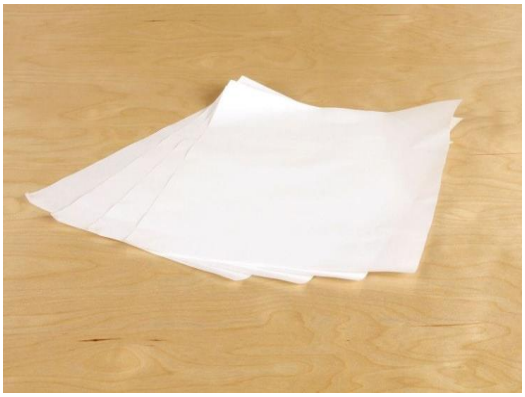


Figure 14: Water soluble paper.

- Water-soluble paper is an innovative material designed to dissolve in water, offering a sustainable alternative to tissue paper, filter paper etc. This type of paper, also known as "hydro soluble paper".
- It is made from made from Sodium Carboxy Methyl Cellulose and wood pulp.
- Water-soluble paper is not toxic, ecofriendly and 100% biodegradable.[23]

METHOD OF PREPARATION

A. PROCEDURE OF ALOE VERA EXTRACTION USING MACERATION METHOD

1. Fresh aloe vera leaves were collected and washed thoroughly.
2. The green peelings were stripped from the leaves.
3. The inner gel was carefully extracted from the leaves using a knife or a spoon.
4. The gel was finely chopped and crushed.
5. Approximately 10 g of aloe vera gel was weighed out.
6. Alcohol or distilled water was added to the gel.
7. The resultant mixture was allowed to macerate for 24 hours.
8. It was occasionally agitated during the period of maceration.
9. The resultant mixture was filtered through filter paper.
10. The filtered solution was collected as aloe vera extract.



Figure 15: Aloe vera extraction.

B. PROCEDURE OF NEEM EXTRACTION USING MACERATION METHOD

1. Fresh neem leaves were collected and washed well with water.
2. Leaves were shade dried for few days.
3. Leaves were dried and powdered using grinder.
4. Neem powder (10 g) was taken in a clean container.
5. The powder was added with ethanol or distilled water.
6. The mixture was kept closed for 24-72 h.
7. The mixture was shaken from time to time during maceration.
8. After maceration, the mixture was filtered through filter paper.

9. The collected neem extract was the filtrate obtained.
10. The extract was kept in an air tight container for further use.



Figure 16: Neem extraction.

C. METHOD OF PREPERATION OF HERBAL PAPER SOAP

1. HPMC was allowed to soak in 10-15mL of distilled water.
2. The solution was stirred continuously until a gel formation occurs.
3. Then SLS was introduced to the gel base to form a proper mixture.
4. Glycerin was added to help in maintaining moisture and softness.
5. Neem and aloe vera extracts were slowly dripped into the mixture using a dropper.
6. Lavender oil was also added in few drops to give a pleasant aroma.
7. Paper strips of water-soluble paper were placed on a clean and flat surface.
8. Then, using a brush, a thin layer of the prepared solution was applied to each strip.
9. The coated strips were kept for drying in sun light for 4-5 hours.
10. Once dried completely, the strips were then cut to suitable sizes.
11. The herbal paper soap strips were kept in airtight container.[24]

FORMULATION

SI NO.	INGREDIENTS	F_1	F_2	F_3
1.	Neem	6 ml	4 ml	2 ml
2.	Aloe Vera	6 ml	4 ml	2 ml
3.	SLS	1.3 g	0.76 g	0.46 g
4.	Glycerin	0.37 g	0.37 g	0.37 g
5.	HPMC	0.45 g	0.45 g	0.45 g
6.	Lavender Oil	5 drops	5 drops	5 drops
7.	Distilled Water	q. s	q. s	q. s

EVALUATION OF HERBAL PAPER SOAP

1. Organoleptic evaluation

Physical characteristics such as Colour and Appearance were checked by naked eye; odour was identified by Smelling.

2. pH

The pH test is done to determine whether the soap is safe and gentle for skin use. Skin has a natural pH of around 5.5, so the soap should ideally be between 5.5 to 6.

Procedure

1. Take one strip of the herbal paper soap.
2. Dissolve it in 10 ml of distilled water in a clean beaker.
3. Stir gently until fully dissolved.
4. Measure the pH using: pH paper/strip (dip and compare with colour scale), or Digital pH meter (more accurate; calibrate before use).

3. Foam Height

The sample was dispersed in 20 ml of distilled water and then transferred into the measuring cylinder and then it was Shaked for a min and immediately its foam height was calculated.

4. Foam retention

The soap strips were taken and added in water solution in a measuring cylinder the cylinder was covered with hand and was shaken for 10 times. The volume of the foam was checked in 1 minute interval.

5. Paper Spreadability

To check how easily the soap spreads on paper. Use a fixed quantity of the test substance (e.g., 0.5 mL for liquid sample). Place the sample at the centre or a corner, depending on your testing requirements. Let the substance spread naturally for a set time (e.g., 1minute). Measure the diameter of the spread liquid using a ruler.

6. Disintegration test

Disintegration test of formulated herbal paper soap was carried out to determine the time required for complete dissolution of the strip in water. A strip of herbal paper soap was put in a beaker containing distilled water at room temperature and the time taken for complete disintegration/dissolution was recorded with the help of a stopwatch.

7. Antimicrobial activity

Agar well diffusion method was used. Petri plate containing 20ml of Mueller Hinton agar were seeded

with 48 hr culture of *Escherichia coli.* Four wells were created in which one acts as control and in the rest three wells, different concentrations of the extract were added. The plates were incubated at 37^0 C for 48hr. The zone of inhibition was observed.

8. Stability Test

Herbal paper soap strips were stored at room temperature and under refrigerated conditions for 30 days. The sample were evaluated on the 1st, 15th and 30th days for changes in appearance, texture and pH. The observations were recorded and compared to assess the stability of the formulations during the storage period.[25]

RESULT AND DISCUSSION

1. ORGANOLEPTIC EVALUATION

Table 4: Organoleptic evaluation.

S.NO	PARAMETER	F_1	F_2	F_3
1.	Colour	Pale yellow	Pale yellow	Pale yellow
2.	Odour	Characteristic	Characteristic	Characteristic
3.	Appearance	Smooth	Smooth	Smooth



Figure 17: Organoleptic evaluation.

The formulations F_1, F_2, and F_3 showed a pale-yellow colour, characteristic odour, and smooth appearance, indicating acceptable organoleptic properties.

2. pH

Table 5: Ph.

PARAMETER	F_1	F_2	F_3
pH	5.53	5.89	5.60



Figure 18: pH.

The pH values of F_1, F_2, and F_3 ranged from 5.5 to 6.0, indicating an acidic nature suitable for skin application.

3. FOAM HEIGHT

Table 6: Foam height.

PARAMETER	F_1 (ml)	F_2 (ml)	F_3 (ml)
Foam height	10	7	5



Figure 19: Foam height.

Among the three formulation F_1 showed the highest foam height and was considered the best formulation based on foaming ability.

4. FOAM RETENTION

Table 7: Foam retention.



Figure 20: Foam retention.

Among the three formulations, F_1 showed highest foam retention time and was considered as best formulation based on foam retention.

5. PAPER SPREADABILITY

Table 8: Paper spreadability.

PARAMETER	F_1 (cm)	F_2 (cm)	F_3 (cm)
Paper spreadability	0.5	0.5	0.4

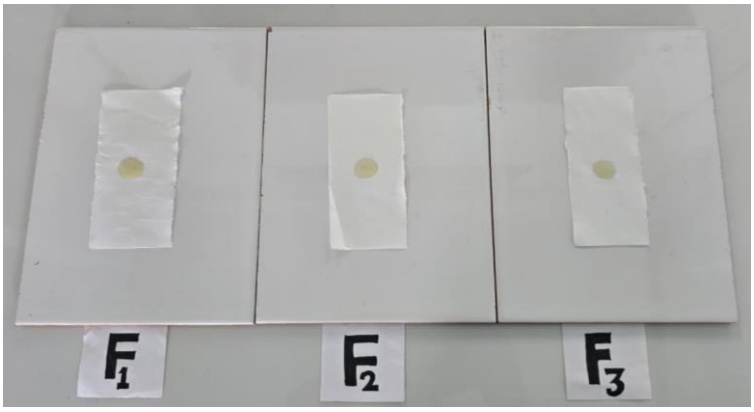


Figure 21. Paper spreadability.

6. DISINTEGRATION TEST

Table 9: Disintegration test.

PARAMETER	F_1 (sec)	F_2 (sec)	F_3 (sec)
Disintegration test	18	19	19

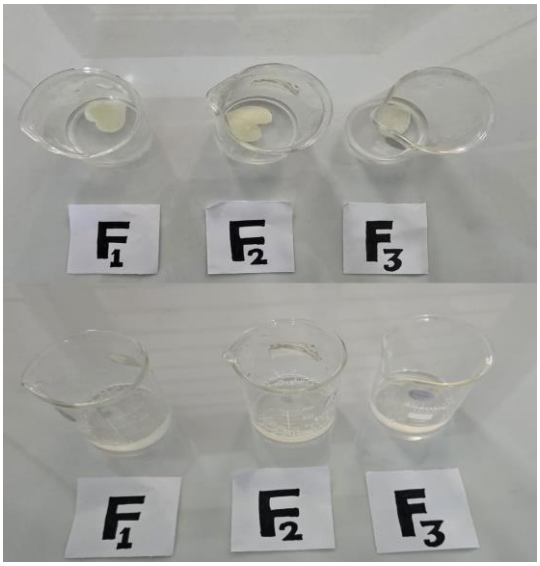


Figure 22: Disintegration test.

F_1 showed the shortest disintegration time as compared to F_2 and F_3, indicating faster disintegration and was considered the best formulation based on this parameter.

7. ANTIMICROBIAL TEST

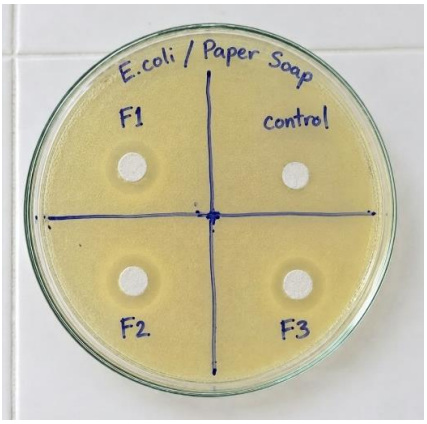


Figure 23: Antimicrobial test.

The antimicrobial activity was studied by using agar well diffusion method. The formulations F_1, F_2, and F_3 exhibited antimicrobial potential due to the presence of neem and aloe vera. Zones of inhibition were observed around the samples, indicating antimicrobial activity against E. coli.

From the above given results, we have concluded that F1 is the best formulation. So, we perform stability test in F_1 formulation.

8. STABILITY TEST

Table 10: Stability test.

DAYS	PARAMETER	OBSERVATION	
		ROOM TEMPERATURE	REFRIGERATION
1st day	Appearance	Pale yellow	Pale yellow
	Texture	Smooth, flexible	Smooth, flexible
	pH	6.5	6.5
15thday	Appearance	No significant change	No significant change
	Texture	Smooth, slightly dry	Smooth, flexible
	pH	6.4	6.5
30th day	Appearance	No significant change	No significant change
	Texture	Slightly dry	Smooth
	pH	6.3	6.4

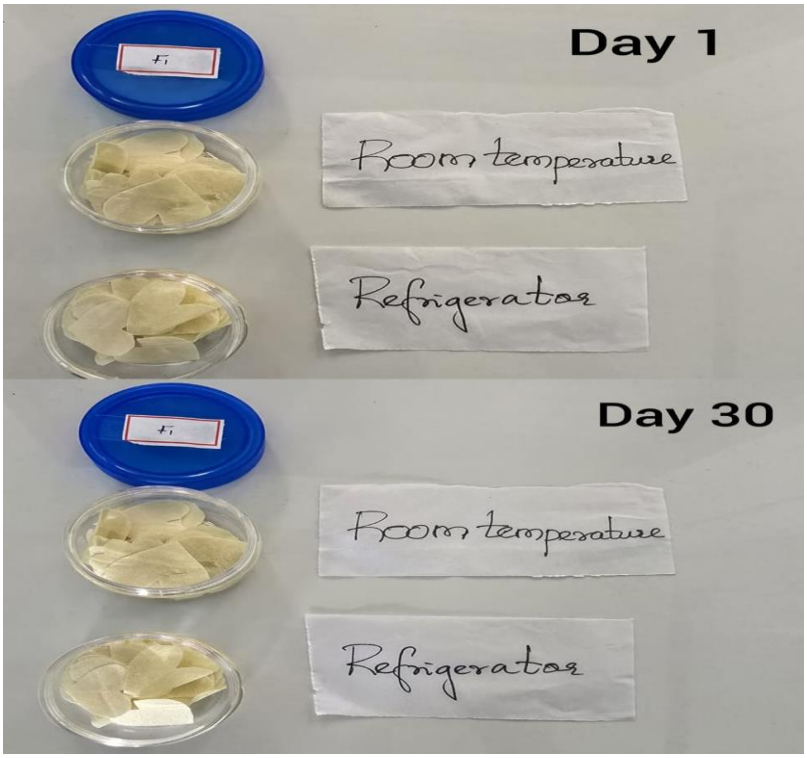


Figure 24: Stability study.

The herbal paper soap (F_1) showed good stability for 30 days under both room temperature and refrigeration, with minimal changes in pH and texture, and better physical stability under refrigeration.

CONCLUSION

In this study, herbal paper soap using neem and aloe vera for personal hygiene was successfully formulated and evaluated. Among the different formulations, F_1 showed comparatively better results based on pH, foaming ability, foam retention, disintegration test and stability studies. The formulated herbal paper soap demonstrated potential antimicrobial activity due to the beneficial properties of neem and aloe vera. The antimicrobial activity for three formulation was evaluated against *Escherichia coli* (E. coli), and the observed zone of inhibition indicated the formulation's antimicrobial potential. Overall, the developed herbal paper soap offers a convenient, portable, and promising alternative to conventional soap for maintaining personal hygiene, particularly during travel and outdoor activities.

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