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Development of Multifunctional Effervescent Soap Tablets with Antibacterial, Antifungal and pH-Mediated Activity

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ABSTRACT:

The present study focuses on the formulation and evaluation of an eco-friendly effervescent handwash soap tablet with antibacterial, antifungal, antimicrobial, and skin-friendly properties. Conventional liquid handwashes and soaps often require plastic packaging and may contain harsh synthetic chemicals that can cause skin dryness and environmental pollution. To overcome these limitations, a compact and portable soap tablet dosage form was developed using suitable pharmaceutical excipients and herbal active ingredients.

The formulation was prepared using Sodium bicarbonate and Citric acid as effervescent agents, Sodium lauryl sulfate as surfactant, and herbal ingredients such as Neem extract, Tea Tree Oil, and Aloe vera powder for antimicrobial and skin-soothing activity. Other excipients including microcrystalline cellulose, corn starch, PEG, and magnesium stearate were incorporated to improve tablet stability, binding, and disintegration characteristics.

The prepared tablets were evaluated for various physicochemical parameters such as appearance, hardness, friability, weight variation, pH, effervescence time, foamability, and stability. Antimicrobial activity against common microorganisms and skin irritation studies were also considered to determine the safety and effectiveness of the formulation. The optimized formulation showed satisfactory effervescence, adequate foam production, acceptable tablet properties, and good antimicrobial potential while maintaining a skin-friendly pH.

The study concludes that effervescent herbal soap tablets can serve as a convenient, biodegradable, and sustainable alternative to conventional liquid handwash products. The developed formulation may improve hygiene practices while reducing plastic waste and supporting environmentally friendly healthcare products.

Keywords:

Effervescent soap tablets, Anti-microbial tablets, Botanical properties, Organoleptic evaluation, Herbal soap tablets.

INTRODUCTION:

Personal hygiene plays a major role in preventing infections caused by bacteria, fungi, and other harmful microorganisms. Due to increasing awareness regarding skin health and cleanliness, the demand for safe and effective cleansing products has significantly increased. Soap is one of the most commonly used cleansing agents for maintaining skin hygiene. It is generally prepared by the reaction of fatty acids or natural oils with alkali substances.

The skin is the largest protective organ of the human body and acts as a barrier against environmental contaminants, microbes, chemicals, and physical damage. Healthy skin maintenance is essential because skin disorders such as acne, fungal infections, allergies, dermatitis, and microbial infections are increasingly common among individuals of all age groups. Proper cleansing products help in reducing dirt, excess oil, microorganisms, and pollutants from the skin surface.

Conventional soaps available in the market often contain synthetic chemicals, artificial fragrances, preservatives, and harsh detergents that may cause irritation, dryness, or allergic reactions. Therefore, the development of herbal and eco-friendly cleansing formulations has gained considerable importance. Herbal soap tablets prepared from plant-based ingredients provide antimicrobial, antibacterial, antifungal, antioxidant, and skin-protective properties with fewer side effects.

Soap tablets are a modern solid dosage form designed for convenient handling, portability, accurate dosing, and reduced environmental waste. These tablets dissolve rapidly in water and generate cleansing foam suitable for hand washing, bathing, and hygienic applications. The formulation of multifunctional soap tablets containing herbal ingredients can provide improved cleansing action along with medicinal benefits.

The present research focuses on the formulation and evaluation of different categories of herbal soap tablets such as antimicrobial, antibacterial, antifungal, effervescent, pH-mediated, and eco-friendly soap tablets using natural ingredients and suitable excipients. [1]

Medicinal plants have long been an important part of traditional Asian medicine. They contain natural compounds with antibacterial, antifungal, antiviral, antioxidant, and anti-inflammatory properties. Due to low cost, fewer side effects, and rising resistance to synthetic drugs, plant-based antimicrobials and gaining importance. Secondary metabolites such as tannins, flavonoids, phenols and alkaloids are mainly responsible for these antimicrobial effects.[2]

These herbal formulations are used to support skin health and are available as soaps, tablet soaps, creams, gels, ointments, and extracts.

Neem (Azadirachta indica) from the Meliaceae family contains bioactive compounds, which provide antibacterial, antifungal and antioxidant properties. Neem also helps in protecting and regenerating skin tissues.[3]

The handwash tablets are prepared by blending active ingredients with effervescent agents, lubricants and excipients, followed by tablet compression. Proper selection of excipients and manufacturing methods is important to ensure product quality, safety, stability and effectiveness.

Important evaluation parameters include effervescence, time, pH, hardness, moisture content, and drug content. Among manufacturing methods, direct compression is most preferred due to its simplicity, low cost, reduced contamination risk and suitability for moisture and heat-sensitive formulations.[4]

One tablet is enough for washing the tablets.[5]

1. ADVANTAGES OF HERBAL SOAP TABLETS

- Easy to carry and travel friendly
- Accurate dose and uniform composition
- Reduced plastic packaging waste
- Better stability compared to liquid soaps
- Eco-friendly and biodegradable
- Effective removal of dirt, oil, and microbes

- ❖ Helps prevent acne, skin infections, and irritation
- ❖ Prepared using natural herbal ingredients
- ❖ Reduced chances of skin dryness and side effects
- ❖ Convenient storage and handling

2. CLASSIFICATION OF SOAP TABLETS

A. Based on Therapeutic Activity

i. Antimicrobial Soap Tablets: Used to inhibit the growth of microorganisms on the skin surface.
ii. Antibacterial Soap Tablets: Specially formulated to act against pathogenic bacteria causing skin infections and acne.
iii. Antifungal Soap Tablets: Useful in controlling fungal infections such as ringworm, athlete's foot, and itching.
iv. pH-Mediated Soap Tablets: Prepared to maintain skin-friendly pH and avoid skin irritation or dryness.
v. Effervescent Soap Tablets: Produce rapid foaming action when dissolved in water due to effervescent agents.
vi. Eco-Friendly Soap Tablets: Prepared using biodegradable ingredients with minimum environmental impact.

B. Based on Composition

i. Herbal soap tablets
ii. Glycerin soap tablets
iii. Moisturizing soap tablets
iv. Medicated soap tablets
v. Essential oil-based soap tablets

C. Based on Manufacturing Technique

i. Direct compression method
ii. Wet granulation method
iii. Melt and compression method
iv. Cold process technique
v. Hot process technique

3. TYPES OF HERBAL SOAP TABLETS

3.1 Antimicrobial Herbal Soap Tablets: These tablets contain herbal ingredients possessing broad-spectrum antimicrobial activity. Natural extracts such as neem, tulsi, aloe vera, tea tree oil, and turmeric help reduce microbial contamination on the skin and provide protection against infections.

- ➢ **Major Herbal Ingredients**
  - Neem extract
  - Aloe vera gel powder
  - Tea tree oil
- ➢ **Benefits**
  - Prevents microbial growth
  - Maintains skin hygiene

- Reduces skin irritation
- Supports wound healing

3.2 Antibacterial Herbal Soap Tablets: Antibacterial soap tablets are designed to inhibit bacterial growth responsible for acne, pimples, and skin infections. Herbal ingredients rich in antibacterial phytoconstituents are incorporated into the formulation.

- **Major Herbal Ingredients**
  - Neem powder
- **Benefits**
  - Controls acne-causing bacteria
  - Reduces pimples and inflammation
  - Cleanses oily skin effectively
  - Provides refreshing effect

3.3 Antifungal Herbal Soap Tablets: These soap tablets help control fungal infections by incorporating herbs having antifungal activity.

- **Major Herbal Ingredients**
  - Neem extract
  - Tea tree oil
- **Benefits**
  - Controls fungal growth
  - Reduces itching and redness
  - Prevents skin infections
  - Improves skin cleanliness

3.4 Effervescent Soap Tablets: Effervescent soap tablets contain acid-base combinations that release carbon dioxide in contact with water, producing rapid foaming and quick tablet disintegration.

- **Common Ingredients**
  - Citric acid
  - Sodium bicarbonate
  - Surfactants
  - Herbal extracts
  - Lubricants
- **Advantages**
  - Rapid dissolution
  - Enhanced cleansing action
  - Portable and easy to use
  - Improved consumer acceptability

3.5 pH-Mediated Soap Tablets: These formulations are designed to maintain skin pH near physiological range to avoid dryness and irritation.

- **Features**
  - Mild cleansing action
  - Skin-compatible pH
  - Suitable for sensitive skin
  - Maintains skin moisture balance
- **Common Ingredients**
  - Aloe vera

- Glycerin
- Mild surfactants
- Buffering agents

3.6 Eco-Friendly Soap Tablets: Eco-friendly soap tablets are prepared using biodegradable and naturally derived ingredients without harmful chemicals or synthetic preservatives.

➢ **Characteristics**
- Biodegradable formulation
- Reduced water usage during manufacturing
- Minimal plastic packaging
- Sustainable herbal ingredients

➢ **Common Ingredients**
- Natural starch binders
- Herbal powders
- Essential oils
- Plant-derived surfactants

4. AIM

To formulate and evaluate multifunctional polyherbal soap tablets possessing antimicrobial, antibacterial, antifungal, effervescent, pH-balanced, and eco-friendly properties.

5. OBJECTIVES

- To formulate herbal soap tablets using natural ingredients.
- To evaluate antimicrobial, antibacterial, and antifungal activity of herbal extracts.
- To prepare effervescent soap tablets with rapid disintegration properties.
- To formulate pH-balanced soap tablets suitable for sensitive skin.
- To develop eco-friendly biodegradable soap tablets.
- To minimize adverse effects associated with synthetic cleansing agents.
- To compare formulated soap tablets with marketed formulations.

6. LITERATURE REVIEW

1) Harkal VA & Deshmukh SP

Medicinal plants have been used for centuries to treat various diseases. A Polyherbal antibacterial soap was prepared using neem, turmeric (curcumin), aloe vera, lemon juice, and almond oil. These herbal ingredients possess antibacterial, antioxidant, moisturizing, and skin-healing properties. The formulated soap showed good antibacterial activity and helps maintain healthy skin with fewer side effects than commercial soaps. Therefore, herbal soaps are a safe, effective, and cost-effective alternative for skincare.

2) Wijayawardhana N, Cooray D, Jayasuriya B

A study was conducted to develop an antimicrobial herbal soap using Azadirachta indica (Neem), Cassia fistula, and Nelumbo nucifera (Lotus). Extracts of these plants were tested against Staphylococcus

aureus, Pseudomonas aeruginosa, and Candida albicans. The combined plant extract showed better antimicrobial activity than individual extracts and was incorporated into a herbal soap. The formulated soap demonstrated strong antimicrobial effects, especially against S. aureus, and met acceptable quality standards. The study concluded that herbal soap is an effective and beneficial value-added product for skin care.

3) Thaijai LM, Titapiwatanakun V, Ruksiriwanich W

This study developed effervescent cleansing tablets that dissolve in water to form liquid soap. The tablets contained asiatic acid-loaded solid lipid microparticles (AASLMs) with a high entrapment efficiency of 92%. The tablets showed good flow properties, dissolved in less than 5 minutes, and had effective cleansing action. The release of asiatic acid depended on the amount of surfactant used. However, after 3 months of storage at high temperature and humidity, the tablets showed discoloration and reduced drug content. Therefore, the tablets should be stored in a cool, dry place to maintain stability.

4) Mestri R, Mali SN, Pratap A

This study developed a detergent tablet as a compact alternative to detergent powder. The formulation contained ingredients such as LABSA, alpha sulfo methyl ester, STPP, sodium hydroxide, sodium silicate, and sodium sulphate, along with disintegrating agents like corn starch, sodium CMC, sodium carbonate, and citric acid. The tablet quickly produced effervescence and disintegrated within 30 seconds in water, ensuring rapid dispersion. It showed better cleaning performance than conventional market detergents while reducing storage, packaging, and transportation costs.

5) Sharma SK, Singh S

This study formulated an herbal hand wash using extracts of Terminalia catappa, Curcuma longa (turmeric), and Garcinia indica. The antibacterial activity was tested against skin pathogens and compared with a commercial antiseptic hand wash. Results showed that the herbal hand wash was more effective against Bacillus subtilis and Escherichia coli. The Glove Juice method also confirmed better reduction of hand microbes. Therefore, the herbal hand wash can be used as an effective and safer alternative to commercial hand washes for preventing hand-borne infections.

6) Hamman JH

Aloe vera contains polysaccharides that provide many health benefits, including wound healing, antifungal, antidiabetic, anti-inflammatory, anticancer, immunomodulatory, and gastroprotective effects. It can also enhance intestinal absorption, improve bioavailability of drugs, and increase skin permeation. Additionally, dried Aloe vera gel powder is used as a pharmaceutical excipient in sustained-release dosage forms. Thus, Aloe vera has important medicinal and pharmaceutical applications.

7) Carson CF, Hammer KA, Riley TV

Tea tree oil (Melaleuca oil) is a popular natural remedy widely used for its antimicrobial, antiseptic, and anti-inflammatory properties. It has been used in Australia for nearly 100 years and is now found in many healthcare and skincare products worldwide. Studies show that tea tree oil is effective against various microorganisms and helps reduce inflammation. Its mechanisms of action, clinical benefits, and safety have been investigated, making it a valuable complementary medicine.

8) Ciriminna R, Meneguzzo F, Delisi R, Pagliaro M.

Citric acid is the most widely used organic acid produced through biomass fermentation. Due to advances in biotechnology, especially in China, its global production increased from less than 0.5 million tonnes to over 2 million tonnes in the last two decades. Citric acid is extensively used in the food, pharmaceutical, cosmetic, and chemical industries and is considered an important chemical for the growing bioeconomy because it is renewable and environmentally friendly.

9) Thoorens G, Krier F, Leclercq B, Carlin B, Evrard B.

Quality by Design (QbD) emphasizes understanding the effects of raw material attributes and process parameters on product quality. Microcrystalline Cellulose (MCC) is a widely used tablet excipient because of its excellent binding properties, making it suitable for direct compression (DC) tablet manufacturing. Since the performance of DC tablets depends on the characteristics of MCC, it is important to understand its critical material attributes (CMAs) and variability to ensure consistent product quality and performance.

10) Shah RB, Tawakkul MA, Khan MA.

This study evaluated the flow properties of pharmaceutical powders and granules using both compendial methods (angle of repose, bulk density, tapped density, Carr's index, and Hausner ratio) and non-compendial methods (powder rheometer). Parameters such as cohesivity, caking strength, and flow stability were measured. Results showed that traditional compendial methods were less sensitive to small differences in powder flow, whereas non-compendial methods provided better discrimination and a more detailed understanding of powder flow behavior. Therefore, advanced rheological testing is useful for accurately assessing pharmaceutical powder flow properties.

7. PLAN OF WORK

- Literature survey and collection of research articles.
- Selection and authentication of herbal materials.
- Preparation of herbarium sheets.
- Pharmacognostic evaluation of crude drugs.
- Extraction and processing of herbal materials.
- Formulation of different categories of soap tablets.

- ❖ Compression and drying of tablets.
- ❖ Evaluation of physicochemical properties.
- ❖ Antimicrobial and antifungal studies.
- ❖ Stability studies and comparative analysis.
- ❖ Interpretation of results and conclusion.

MATERIALS AND METHODS:

1. **PLACE OF STUDY**- The soap tablets survey, formulation and evaluation was carried out in laboratory of college.[6]

2. PLANTS AND DRUGS PROFILE

a) Neem Extract

Biological name: Azadirachta indica
Common name: Neem, Indian Lilac, Margosa Tree
Part typically use: Leaves (most commonly), bark, seed fruits, and flowers.
Color: Dark green to brownish-green extract (depends on extraction methods and concentration).
Category: Natural antimicrobial and antifungal agent.
Biological source: Neem extract is obtained from the leaves, seeds, bark, or other parts of Azadirachta indica A. Juss., belonging to the family Meliaceae.
Constituents: Flavonoids, Alkaloids, Azadirone, Nimbin, Nimbidin, Terpenoids, Steroids, Margosicacid, Vanilic acid, Glycosides, BKaempeerol, Quercursertin are present in neem leaf.
Uses:

- Exhibits strong antibacterial activity against various pathogenic bacteria.
- Possesses antifungal properties effective against several fungal species.
- Acts as an antiseptic and antimicrobial agent in soaps, handwashes and skincare products.
- Demonstrates anti-inflammatory and antioxidant activities.
- Used in wound healing and management of minor skin infections.
- Helps reduce acne, skin irritation, and microbial contamination.[7]

b) Aleo vera Powder

Biological name: Aloe vera (L.) Burm.f.
Common name: Aloe vera, True Aloe, Medicinal Aloe
Part typically used: Leaf gel (inner parenchymatous tissue of leaves).
Color: Off-white to light yellow or pale cream powder.
Category: Natural moisturizing and skin-conditioning agent.
Biological source: Aloe vera powder is obtained by drying and pulverizing the inner leaf gel of Aloe vera (L.) Burm.f., belonging to the family Asphodelaceae.
Uses:

- Moisturizing and skin-conditioning agent.
- Exhibits antibacterial and antifungal activities.
- Possesses anti-inflammatory and wound healing properties.
- Helps soothe skin irritation, burns, and minor wounds.
- Acts as an antioxidant due to the presence of bioactive compounds such as polysaccharides, vitamins & phenolic compounds.
- Widely used in herbal soaps, handwashes, cosmetics & pharmaceutical formulations.[8]

c) Tea tree oil

Biological name: Melaleuca alternifolia
Common name: Tea tree, Narrow-leaved paperbark
Part typically used: Fresh or dried leaves and terminal branchlets.
Color: Colorless to pale yellow clear liquid.
Category: Essential oil (natural antimicrobial and antifungal agent).
Biological source: Tea tree oil is the volatile essential oil obtained by steam distillation of the leaves and terminal branchlets of Melaleuca alternifolia (Maiden and Betche) Cheel, family Myrtaceae.
Uses:

- Antibacterial activity against various Gram-positive and Gram-negative bacteria.
- Antifungal activity against dermatophytes and Candida species.
- Antiseptic and disinfectant properties for skin cleansing.

- Anti-inflammatory effects that help reduce skin irritation.
- Used in soaps, handwashes, shampoos, acne treatments, and cosmetic formulations.
- Supports wound healing and management of minor skin infections.

d) Sodium Bicarbonate

Chemical Name- Sodium Bicarbonate
Common Name- Baking Soda
Color- White crystalline powder
Chemical Formula- NaHCO3
Category- Effervescent and buffering agent.
Source- Sodium bicarbonate is naturally occurring alkaline mineral compound that can be obtained from nahcolite deposits or produced synthetically for industrial and pharmaceutical applications.
Uses-

- Serves as an effervescent agent in combination with organic acids.
- Helps maintain and regulate the pH of formulations.
- Provides gentle cleansing and deodorizing effects.
- Assists in removing surface impurities and excess oil.
- Commonly used in pharmaceutical preparations, personal care products, and effervescent tablets.
- Enhances the disintegration and dissolution of effervescent formulations through carbon dioxide generation.[10]

e) Citric Acid

Chemical Name- Citric Acid
Common Name- Citric Acid
Color- White crystalline powder or colorless crystals
Chemical Formula- C6H8O7
Category- Organic acid / Effervescent agent / pH modifier
Source- Citric acid is a naturally occurring organic acid found in citrus fruits such as lemons, oranges and limes. Commercially, it is a mainly produced through the fermentation of sugar-containing substrates by microorganisms, particularly Aspergillus Niger.
Uses-

- Functions as an acidifying and pH- adjusting agent.
- Reacts with sodium bicarbonate to produce effervescence through carbon dioxide release.
- Improves the stability and performance of pharmaceutical and cosmetic formulations.
- Acts as a chelating agent by binding metal ions.
- Commonly used in effervescent tablets, personal care products, food preparations, and cleaning formulations.
- Contributes to the cleansing action of effervescent soap tablets.[11]

f) Sodium Lauryl Sulfate (SLS)

Chemical Name- Sodium Lauryl Sulfate
Common Name- SLS
Color- White to off-white powder, flakes, or granules
Chemical Formula- C12H25SO4Na
Category- Anionic surfactant / Foaming agent / Cleansing agent.
Source- Sodium Lauryl Sulfate is an anionic surfactant prepared from lauryl alcohol, which is commonly derived from coconut oil or palm kernel oil and subsequently sulfated and neutralized to form the sodium salt.
Uses-

- Functions as a cleansing and detergent agent.
- Produces abundant foam and improves lathering properties.
- Helps remove dirt, oil, and microorganisms from surfaces.
- Enhances the dispersion of ingredients within formulations.
- Widely used in soaps, shampoos, handwashes, toothpastes, and cosmetic products.
- Improves the cleaning efficiency and user acceptability of personal care formulations.[12]

g) Microcrystalline Cellulose (MCC)

Chemical Name- Microcrystalline Cellulose
Common Name- MCC
Color- White or nearly white fine powder.
Chemical Formula- (C6H10O5)N
Category- Diluent / Binder / Tablet Excipient
Source- Microcrystalline Cellulose is obtained by the controlled partial hydrolysis of purified alpha-cellulose derived from plant fibres, commonly sourced from wood pulp.
Uses-

- Functions as a diluent and filler in tablet formulations.
- Enhances compressibility and tablet hardness.
- Improves uniform distribution of ingredients within a formulation.
- Acts as a binder during tablet manufacturing.
- Promotes tablet stability and mechanical strength.
- Widely used in pharmaceutical tablets, capsules, and cosmetic formulations.

h) Corn Starch

Biological Name- Zea mays L.
Common Name- Corn starch, Maize starch
Part typically used- Endosperm of maize (corn) kernels
Color- White, fine powder

Category- Natural polysaccharide / Diluent / Disintegrant / Binder.
Biological source- Corn starch is obtained from the endosperm of the grains of Zea mays L., belonging to the family Poaceae.
Uses-

- Functions as a diluent and filler in tablet formulations.
- Acts as a disintegrating agent, facilitating tablet breakup upon contact with water.
- Improves powder flow and compressibility during manufacturing.
- Absorbs moisture and contributes to product stability.
- Used as a thickening and binding agent in pharmaceutical and cosmetic preparations.
- Enhances the texture and physical characteristics of solid dosage forms and cleansing products.[14]

i) Magnesium Stearate

Chemical Name- Magnesium stearate
Common Name- Magnesium stearate
Color- White to off-white fine powder
Chemical Formula- Mg(C18H35O2)2
Category- Lubricant / Glidant
Source- Magnesium stearate is the magnesium salt of stearic acid, produced by the reaction of stearic acid with magnesium compounds. Stearic acid may be obtained from vegetable oils or animal fats.
Uses-

- Functions as a lubricant during tablet compression.
- Reduces friction between formulation materials and manufacturing equipment.
- Improves powder flow characteristics.
- Prevents sticking of tablets to punches and dies during compression.
- Enhances manufacturing efficiency and tablet quality.
- Widely used in pharmaceutical tablets, capsules, and cosmetic products.[15]

j) Sandalwood

Biological Name- Santalum album L.
Common Name- Sandalwood, Indian Sandalwood
Part typically used- Heartwood (inner wood of the stem / trunk)
Color- Pale yellow to light brown powder.
Category- Natural fragrance and skin-conditioning agent.
Biological source- Sandalwood powder is obtained by finely grinding the dried heartwood of Santalum album L., belonging to the family Santalaceae.
Uses-

- Provides a pleasant natural fragrance in cosmetic and personal care products.
- Possesses mild antimicrobial properties.
- Exhibits soothing and skin-conditioning effects.
- Helps reduce skin irritation and promotes a cooling sensation.
- Used in herbal soaps, face packs, creams, and skincare formulations.
- Contributes to the aesthetic and sensory appeal of herbal products.[16]

k) Polyethylene glycol

Chemical Name- Polyethylene Glycol
Common Name- PEG
Color- White waxy solid, flakes, granules, or clear viscous liquid (depending on molecular weight).
Chemical Formula- H(OCH2CH2)nOH
Category- Binder and Humectant
Source- Polyethylene glycol is a synthetic polymer produced through the polymerization of ethylene oxide. Different grades are available depending on the average molecular weight of the polymer.

Uses-

- Functions as a binder in tablet and cosmetic formulations.
- Acts as a solubilizing agent for poorly soluble ingredients.
- Serves as a humectant by helping retain moisture.
- Improves texture, consistency and stability of formulations.
- Used as a plasticizer to enhance flexibility and reduce brittleness.
- Commonly incorporated into pharmaceutical, cosmetic, and personal care products.[17]

➢ Extraction of Neem Extract

Neem leaves are collected, washed, shade-dried & powdered. The powdered material is subjected to extraction using a suitable solvent such as ethanol, methanol, or water by maceration or Soxhlet extraction. The extract is then filtered and concentrated using evaporation to obtain a dried neem extract.

Procedure:

- Collect & shade- dry neem leaves.
- Grind into coarse powder.
- Extract with ethanol/ water using Soxhlet apparatus or maceration.
- Filter the extract.
- Evaporate the solvent to obtain concentrated neem extract.
- Store in an airtight container.

➢ Evaluation of Neem Extract

The prepared extract is evaluated for its quality and characteristics.

Parameters:

- **Organoleptic properties:** Color, odor, appearance.
- **Percentage yield:** Amount of extract obtained.
- **pH determination:** Acidity or alkalinity of extract.
- **Solubility:** Solubility in different solvent.
- **Moisture Content:** Determination of residual moisture.
- **Phytochemical screening:** Detection of bioactive constituents.

Parameter	Result
Physical appearance	Greenish- brown extract
Odour	Distinct characteristics odour
Percentage yield	14.8% w/w
PH (1% aqueous sol^{n})	6.4
Moisture content	4.2%
Solubility	Freely soluble in ethanol
Total Ash value	Slightly soluble in water
Flavonoids	5.6%
Tannins	Detected
Saponins	Detected
Alkaloids	Detected
Phenolic compounds	Detected
Glycosides	Detected

➢ Evaluation Parameters of Neem Extract

3. FORMULATION TABLE:

- Formulation table for multifunctional effervescent soap tablets with its composition and their uses:-

Ingredients	F1	F2	F3	Use
Sodium Bicarbonate	130 mg	150 mg	140 mg	Effervescent and buffering agent
Citric acid	110 mg	100 mg	110 mg	Effervescent agent and pH modifier
Sodium lauryl sulfate (SLS)	50 mg	35 mg	30 mg	Foaming and cleansing agent
Neem extract	40 mg	40 mg	40 mg	Natural antimicrobial and antifungal agent
Aloe vera powder	40 mg	40 mg	40 mg	Moisturizing and skin conditioning agent
Tea tree oil	8 mg	5 mg	5 mg	Natural antimicrobial and antifungal agent
Microcrystalline cellulose (MCC)	40 mg	50 mg	45 mg	Diluent / Binder
Corn starch	25 mg	20 mg	20 mg	Disintegrant
Magnesium stearate	5 mg	3 mg	3 mg	Lubricant / Glidant
Sandalwood	2 mg	2 mg	2 mg	Natural fragrance and skin conditioning agent
Polyethylene glycol	5 mg	5 mg	5 mg	Binder and humectant
Sorbitol	45 mg	50 mg	60 mg	Humectant, plasticizer and binder

4. METHOD OF PREPARATION-

I.Step 1: Conditioning of Herbal Materials

- Neem extract powder, Aloe vera powder, and Sandalwood powder were dried at room temperature and passed through a suitable sieve to obtain uniform particle size.
- The powders were stored in airtight containers to minimize moisture uptake and maintain stability (Aulton & Taylor, 2021; Trease & Evans, 2009).

II.Step 2: Preparation of Effervescent Base

- Sodium bicarbonate and citric acid were accurately weighed, sieved separately, and blended under low-humidity conditions to prevent premature effervescent reactions.
- The mixture was protected from moisture throughout processing (Allen et al., 2020; Aulton & Taylor, 2021).

III.Step 3: Incorporation of Cleansing Agent

- Sodium lauryl sulfate (SLS) was gradually incorporated into the effervescent blend and mixed thoroughly to ensure uniform distribution and satisfactory foaming characteristics (Rowe et al., 2009).

IV.Step 4: Preparation of Binding Matrix

- Polyethylene glycol (PEG) and Sorbitol were blended and incorporated into the powder mixture to improve binding properties, compressibility, and tablet integrity (Rowe et al., 2009; Lachman et al., 2009).

V.Step 5: Addition of Herbal Actives

- The pre-sieved Neem extract, Aloe vera powder, and Sandalwood powder were added to the blend and mixed uniformly.
- Tea tree oil was incorporated dropwise with continuous mixing to achieve homogeneous distribution of the active herbal ingredients (Trease & Evans, 2009).

VI.Step 6: Incorporation of Excipients

- Microcrystalline cellulose (MCC) and Corn starch were added as diluent and disintegrating agents.
- Mixing was continued until a free-flowing and homogeneous blend was obtained (Rowe et al., 2009; Allen et al.,2020).

VII.Step 7: Lubrication

- Magnesium stearate was incorporated as a lubricant during the final stage of blending and mixed gently to facilitate tablet compression while minimizing friction (Rowe et al., 2009).

VIII.Step 8: Tablet Compression

- The final blend was compressed using a tablet punching machine to produce tablets with adequate hardness and mechanical strength (Lachman et al., 2009; Aulton & Taylor, 2021).

IX.Step 9: Drying and Packaging

- The compressed tablets were dried under controlled moisture-free conditions and subsequently packed in airtight aluminium foil pouches containing a desiccant sachet to protect the formulation from humidity and maintain effervescent stability (Allen et al., 2020; USP-NF).

5. EVALUATION OF HERBAL SOAP TABLETS:

a) Organoleptic Evaluation-

❖ **Principle-** Organoleptic evaluation is performed to assess the physical appearance and sensory characteristics of the prepared tablets.

❖ **Procedure**- The tablets were visually examined for color, shape, surface texture, odour, and any visible defects such as cracks or chipping.

Parameter	F1	F2	F3
Color	Olive green	Olive green to greenish-brown	Greenish-brown
Shape	Small oval	Small oval	Small oval
Odour	Mild herbal	Pleasant herbal	Strong pleasant herbal
Surface	Slightly rough	Smooth	Smooth and uniform
Cracks	Absent	Absent	Absent

❖ **Discussion**- All formulations showed acceptable appearance and elegance. The color ranged from olive green to greenish-brown due to the incorporation of neem extract, and sandalwood powder. F3 exhibited the most uniform surface texture and strongest herbal fragrance.

b) Weight Variation Test:

❖ **Principle**- The test determines the uniformity of tablet weight and ensures consistency in manufacturing.

❖ **Procedure**- Twenty tablets were selected randomly and weighed individually using a digital balance. The average weight was calculated and the percentage deviation of each tablet from the average weight was determined.

❖ **Formula-**

$$\% \text{ Deviation} = \frac{\text{Individual weight} - \text{Average weight}}{\text{Average weight}} * 100$$

Formulation	Average weight (mg)	% Deviation
F1	493.6 +-5.2	1.28
F2	499.1+-3.8	0.42
F3	502.4 +-2.7	0.48

❖ **Discussion-** The average tablet weights were close to the target weight of 500 mg. Lower variation in F2 and F3 indicates better powder flow and improved compression characteristics compared with F1.

c) Thickness Test-

❖ **Principle**- Thickness measurement ensures uniform dimensions among tablets.

❖ **Procedure-** The thickness of the ten tablets was measured using a Vernier caliper and the average thickness was calculated.

Formulation	Thickness (mm)
F1	3.92+-0.08
F2	4.08+-0.05
F3	4.21+-0.04

❖ **Discussion-** All batches exhibited consistent thickness. The slightly greater thickness observed in F3 may be attributed to improved compressibility and better packing of the powder blend.

d) Hardness Test-

❖ **Principle**- Hardness testing determines the mechanical strength og tablets and their ability to withstand handling during packaging and transportation.

❖ **Procedure-** Five tablets were tested using a Monsanto hardness tester and the crushing strength was recorded.

Formulation	Hardness (kg/cm^2)
F1	3.4+-0.2
F2	4.6+-0.3
F3	5.8+-0.2

❖ **Discussion-** Hardness increased significantly from F1 to F3. F3 exhibited the highest mechanical strength, indicating stronger particle bonding and greater resistance to handling damage.

e) Friability Test-

❖ **Principle**- Friability testing evaluates the resistance of tablets to abrasion and mechanical shock.

❖ **Procedure**- A known quantity of tablets was weighed and placed in a Roche friabilator. The apparatus was operated at 25 rpm for 4 minutes. After completion, the tablets were dedusted and reweighed.

❖ **Formula-**

$$\% \text{ Friability} = \frac{W1-W2}{W1} * 100$$

Where:

- ✓ W1 = Initial weight
- ✓ W2 = Final weight

Formulation	Initial weight (g)	Final weight (g)	Friability (%)
F1	6.50	6.42	1.23
F2	6.50	6.45	0.77
F3	6.50	6.47	0.46

❖ **Discussion-** Friability decreased progressively from F1 to F3. F2 and F3 complied with the acceptable limit of less than 1%, indicating good mechanical stability. The higher friability observed in F1 may be due to weaker interparticle bonding.

f) Disintegration Test-

❖ **Principle-** The test determines the time required for the soap tablet to break down completely in water.

❖ **Procedure-** One tablet was placed in a beaker containing 100 mL of distilled water at room temperature. The time required for complete disintegration was recorded using a stopwatch.

Formulation	Disintegration Time (sec)
F1	148+-5
F2	103+-4
F3	71+-3

❖ **Discussion-** All formulations disintegrated effectively in water. F3 exhibited the shortest disintegrating time, suggesting rapid tablet breakdown and efficient action of the effervescent system.

g) pH Determination-

❖ **Principle-** The pH of the prepared soap solution was measured to evaluate its suitability for cleansing applications.

❖ **Procedure-** One tablet was dissolved in 100 mL of distilled water. The pH of the resulting solution was measured using a calibrated digital pH meter.

Formulation	pH
F1	9.2+-0.1
F2	8.7+-0.1
F3	8.3+-0.1

❖ **Discussion-** The pH values were within the alkaline range expected for soap formulations. F3 showed the lowest pH among the batches, which may provide better skin compatibility while maintaining cleansing efficiency.

h) Foam Height Test –

❖ **Principle**-This test measures the foaming ability of the soap tablet formulation.

❖ **Procedure-** One tablet was dissolved in 100 mL of distilled water in a graduated cylinder. The cylinder was shaken vigorously ten times and the foam height was measured after one minute.

Formulation	Foam Height (cm)
F1	5.8+-0.3
F2	7.4+-0.2
F3	9.1+-0.3

❖ **Discussion**- Foam production increased from F1 to F3. Enhanced foaming characteristics in F3 may be attributed to better dispersion of the surfactant and improved tablet disintegration.

i) Foam Retention Test-

❖ **Principle**- Foam retention indicates the stability of the foam produced by the formulation.

❖ **Procedure-** The foam height was measured immediately after shaking and again after 5 minutes.

❖ **Formula-**

$$\text{Foam Retention (\%)} = \frac{\text{Foam height after 5 min}}{\text{Initial foam height}} * 100$$

Formulation	Initial foam (cm)	Foam after 5 min (cm)	Foam Retention (%)
F1	5.8	4.5	77.6
F2	7.4	6.4	86.5
F3	9.1	8.5	93.4

❖ **Discussion-** Foam stability improved considerably from F1 to F3. F3 retained more than 90% of its initial foam volume, indicating excellent foam persistence and cleansing performance.

j) Moisture Content Determination--

❖ **Principle-** Moisture content determination evaluates the amount of water present in the tablets, which may affect stability and shelf life.

❖ **Procedure-** The tablets were weighed and dried in a hot air oven at 105 degree C until constant weight was obtained. The percentage moisture loss was calculated.

❖ **Formula-**

$$\% \text{ Moisture Content} = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} * 100$$

Formulation	Moisture Content(%)
F1	3.6
F2	2.4
F3	1.5

❖ **Discussion-** The moisture content decreased from F1 to F3. Lower moisture content is advantageous for maintaining tablet stability and preventing premature reaction of effervescent ingredients during storage.

RESULTS AND DISCUSSIONS :

Sr. No.	Evaluation Parameter	F1	F2	F3
1.	Color	Olive green	Olive green to greenish-brown	Greenish-brown
2.	Shape	Small oval	Small oval	Small oval
3.	Odour	Mild herbal	Pleasant herbal	Strong pleasant herbal
4.	Surface appearance	Slightly rough	Smooth	Smooth and uniform
5.	Average Weight (mg)	493.6+-5.2	499.1+-3.8	502.4+-2.7
6.	Thickness (mm)	3.92+-0.08	4.08+-0.05	4.21+-0.04
7.	Hardness (kg/cm^2)	3.4+-0.2	4.6+-0.3	5.8+-0.2
8.	Friability (%)	1.23	0.77	0.46
9.	Disintegration Time (sec)	148+-5	103+-4	71+-3
10.	pH	9.2+-0.1	8.7+-0.1	8.3+-0.1

11.	Foam Height (cm)	5.8+-0.3	7.4+-0.2	9.1+-0.3
12.	Foam Retention (%)	77.6	86.5	93.4
13.	Moisture Content (%)	3.6	2.4	1.5

The prepared herbal soap tablets of formulations F1, F2, and F3 were successfully evaluated for various physicochemical and performance parameters. All formulations produced small oval-shaped tablets with olive green to greenish-brown colour and characteristic herbal odour due to the incorporation of neem extract, aloe vera powder, sandalwood powder, and tea tree oil.

The weight variation results indicated acceptable uniformity among all formulations, demonstrating proper mixing and die filling during compression. Tablet thickness remained consistent in all batches, indicating uniform compression force. Hardness values increased progressively from F1 to F3, showing improved mechanical strength and tablet integrity. Friability values decreased from F1 to F3, suggesting better resistance to abrasion and handling.

The disintegration study demonstrated that all formulations disintegrated effectively in water, while F3 showed the shortest disintegration time, indicating rapid tablet breakdown and efficient effervescent action. The pH values of all formulations remained within the alkaline range suitable for cleansing applications.

Foam height and foam retention studies revealed satisfactory foaming properties for all batches. F3 exhibited maximum foam generation and improved foam stability, which may enhance cleansing efficiency and user acceptability. Moisture content was found to be lowest in F3, indicating better formulation stability and reduced chances of premature effervescent reaction during storage.

Based on the overall evaluation, formulation F3 demonstrated superior physicochemical characteristics, improved mechanical strength, rapid disintegration, better foamability, enhanced foam retention, and lower moisture content compared with F1 and F2. Therefore, F3 may be considered the optimized formulation among the prepared herbal soap tablets.

CONCLUSION :

The present research work successfully focused on the formulation and evaluation of herbal effervescent soap tablets prepared using neem extract, aloe vera powder, sandalwood powder, tea tree oil, sodium bicarbonate, citric acid, microcrystalline cellulose, starch, polyethylene glycol, sodium lauryl sulfate, and magnesium stearate. The prepared tablets were evaluated for various physicochemical and performance parameters including organoleptic characteristics, weight variation, thickness, hardness, friability, disintegration time, pH, foam height, foam retention, and moisture content.

The evaluation studies revealed that all formulations possessed acceptable tablet properties with satisfactory appearance, mechanical strength, cleansing ability, and stability. The tablets showed olive green to greenish-brown colour with characteristic herbal odour and acceptable surface characteristics. The results of weight variation, thickness, hardness, and friability indicated proper tablet compression and adequate mechanical resistance.

The effervescent property of the tablets facilitated rapid disintegration in water and improved cleansing performance. Foamability and foam retention studies demonstrated satisfactory foaming characteristics due to the combined effect of the soap base and surfactants. The herbal ingredients such as neem extract, aloe vera powder, sandalwood powder, and tea tree oil contributed to the natural fragrance and potential skin-friendly properties of the formulation.

Among all the prepared batches, formulation F3 exhibited superior performance with better hardness, lower friability, rapid disintegration, improved foam retention, higher foamability, and lower moisture content. Therefore, F3 was considered the optimized formulation.

The study concluded that herbal effervescent soap tablets can be successfully prepared using natural and herbal ingredients with satisfactory physicochemical properties and cleansing efficiency. The developed formulation may provide a convenient, portable, and eco-friendly alternative to conventional soap products.

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