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Formulation and Evaluation of Ajwain Exfoliating Cream

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Abstract

Introduction: *Herbal cosmetics are increasingly gaining popularity due to their minimal side effects and natural origin. Ajwain (Trachyspermum ammi) is a well-known medicinal plant with antimicrobial, antioxidant, and anti-inflammatory properties. This study focuses on formulating an exfoliating cream using ajwain powder as the key active ingredient, aiming to provide gentle exfoliation while promoting skin health.*

Methodology: *The exfoliating cream was formulated using ajwain seed powder, a suitable cream base, natural exfoliants, and stabilizers. Multiple batches were prepared with varying concentrations of ajwain to determine the optimal formulation. The evaluation parameters included organoleptic properties, pH, spreadability, washability, grittiness, stability studies, and microbial load testing. In-vitro antimicrobial activity and skin irritation tests were also conducted to assess the safety and efficacy of the formulation.*

Results and Discussion: *The optimized formulation exhibited acceptable pH (5.8–6.2), good spreadability, effective exfoliating action, and excellent washability. No grittiness or phase separation was observed. The cream demonstrated mild antimicrobial activity, especially against common skin pathogens, attributed to ajwain's active constituents like thymol. Stability studies over 4 weeks confirmed the product's physical and chemical stability. The formulation was non-irritant as per skin patch tests, supporting its dermatological safety.*

Conclusion: *The study successfully demonstrated that ajwain can be effectively incorporated into an exfoliating cream formulation. The final product showed desirable cosmetic properties, acceptable safety profile, and potential therapeutic benefits, making it a promising candidate in the herbal skincare market.*

Keywords: Ajwain (Trachyspermum Ammi), Herbal Cosmetics, Exfoliating Creamantimicrobial Activity, Formulation and Evaluation

Introduction

The use of herbs for medicinal purposes dates back thousands of years, forming the foundation of traditional healing systems across various cultures. From ancient civilizations to modern-day practices, the herbal system has evolved significantly, adapting to the changing needs of society while retaining its core principles. This introduction explores the historical context of herbal medicine, its current status in healthcare, and its potential future in an increasingly complex medical landscape. The roots of herbal medicine can be traced to ancient civilizations, where plants were revered for their healing properties. The earliest records of herbal use date back to around 3000 BCE in

ancient Egypt, where papyrus scrolls documented the medicinal applications of various herbs. Similarly, traditional Chinese medicine (TCM), which has been practiced for over 2,500 years, emphasizes the use of herbs in conjunction with other modalities such as acupuncture and dietary therapy. The "Shennong Bencao Jing," an ancient Chinese text, lists hundreds of medicinal plants and their uses, highlighting the deep understanding of herbal properties that existed in ancient times. In India, the Ayurvedic system of medicine, which dates back over 3,000 years, also places significant emphasis on herbal remedies. Ayurvedic texts such as the "Charaka Samhita" and "Sushruta Samhita" detail the therapeutic uses of various plants, emphasizing the importance of balancing the body's energies (doshas) through natural means. These ancient systems laid the groundwork for the herbal practices that continue to thrive today. As civilizations advanced, so did the understanding of herbal medicine.

The Greeks and Romans contributed significantly to the field, with figures like Hippocrates and Dioscorides documenting the medicinal properties of plants. Dioscorides' "De Materia Medica," written in the first century CE, became a foundational text for herbal medicine in Europe and remained influential for centuries [1]. However, challenges remain. The regulation of herbal products varies significantly across countries, leading to concerns about quality, safety, and efficacy. The lack of standardization in herbal formulations can result in variations in potency and potential interactions with conventional medications. Additionally, while some herbs have been extensively studied, many remain under-researched, necessitating further investigation to fully understand their therapeutic potential [2]. In conclusion, exfoliating creams are an essential component of many skincare routines, offering numerous benefits for skin health and appearance. However, as consumer preferences and scientific knowledge evolve, there is a clear need for innovation and adaptation in formulations to ensure they meet the diverse needs of users while promoting skin health effectively and sustainably [3].

Materials and Methods

Chemicals used

Distilled Water, Methanol, Ferric Chloride ($FeCl_3$), Lead Acetate, Gelatin, Bromine Water, Mayer's Reagent, Dragendorff's Reagent, Wagner's Reagent, Hager's Reagent, Sulfuric Acid and other chemicals were used of analytical grade.

Collection of Plant Materials

In the present research work Trachyspermum ammi fruits were purchased from the loacal market of Raipur, Chhattisgarh, India.

Plant Profile of Trachyspermum Ammi

Attribute	Description
Scientific Name	Trachyspermum ammi (L.) Sprague
Common Names	Ajwain, Carom Seeds, Omam, Om, Omam Seeds, Ajowan
Family	Apiaceae (Umbelliferae)
Genus	Trachyspermum
Synonyms	Carum copticum, Carum ajowan, Ammi ajowan
Plant Type	Annual herb
Native Region	Native to India, Egypt, and the Middle East
Habitat	Grows in dry, sunny areas, commonly cultivated in tropical and subtropical regions
Morphological Characteristics	Height: 30–60 cm Leaves: Pinnate, finely divided Flowers: Small, white or pale pink in umbels Fruits: Small, oval, ridged, brown or grayish-brown seeds (commonly known as ajwain seeds)
Plant Part Used	Seeds, leaves (sometimes used in traditional medicine)
Active Constituents	Thymol, Carvacrol, P-cymene, Terpinene, Shogaol, Fatty acids (linoleic acid)
Traditional Uses	- Used as a spice in cooking (e.g., in curries, pickles, and breads) - Used in traditional medicine to aid digestion, relieve flatulence, and treat coughs and colds [4].
Medicinal Uses	- Digestive aid (stomach problems, indigestion, flatulence) - Antimicrobial, antifungal, and antioxidant properties - Helps in treating respiratory issues like asthma, bronchitis - Carminative and antispasmodic (used for cramps and stomach pain) [5].

Phytochemical Properties	- Antioxidant: Due to the presence of phenolic compounds (e.g., thymol) - Antimicrobial: Active compounds like thymol and carvacrol possess antibacterial and antifungal properties - Anti-inflammatory: Some studies suggest that ajwain seeds may reduce inflammation [6].
Common Uses in Ayurveda	- Used in remedies for digestive issues (e.g., flatulence, indigestion, nausea) - Used as a remedy for cold, cough, and respiratory infections - Sometimes applied topically for joint pain relief
Culinary Uses	- As a spice in cooking, especially in Indian, Middle Eastern, and North African cuisines. - Used in bread (like "Ajwain Paratha"), in curries, lentil dishes, and spice blends (e.g., garam masala) [7].
Growth Conditions	- Prefers well-drained, sandy soil - Requires full sun exposure - Tolerant to heat but sensitive to frost
Cultivation & Harvesting	2–3 months after planting when the seeds are fully matured and dried
Common Pests/Diseases	- Susceptible to aphids, whiteflies, and fungal infections (like powdery mildew) [8].
Chemical Constituents in Seeds	- Essential Oils: Contains about 2–4% essential oil - Thymol: The main bioactive compound, with strong antibacterial and antifungal properties
Conservation Status	Not endangered or threatened; widely cultivated.
Other Applications	- Essential Oils: Used in aromatherapy and as a flavoring agent in foods and beverages - Cosmetic: Some formulations for skin and hair care due to its antimicrobial and anti-inflammatory properties [9].

Quality Assessment/Physiochemical Evaluation of Plant Materials

Plant parts were crushed and converted into fine powders than quality assessment of plant materials was done as per the standard procedure of Ayurvedic Pharmacopeia of India (API). Different parameters were tested with the methods describe in API [10].

Foreign Organic Matters

According to Ayurvedic Pharmacopeia of India, Foreign matter is described as any material that consist of part of organ or organ part from which the drug is derived. The plant should be free from any foreign particle like dust, insects, faecal matter etc. The percentage of foreign matter should not be more than the limit prescribed in monograph. There should not be any contamination in drug material used for developing the formulation [11].

Loss on Drying

The Loss on Drying (LOD) method is a common physicochemical evaluation used to determine the amount of moisture content in a sample, which is important for assessing the quality and stability of herbal products, including Trachyspermum ammi (Ajwain) seeds. High moisture content can lead to mold growth and degradation of active compounds, while low moisture content may affect the quality and usability of the seeds [12].

Procedure:

Preparation of the Sample:

- Weigh an empty, clean crucible (or heat-resistant container) to the nearest 0.0001 g.
- Crude drug was taken (usually 5 g) of Trachyspermum ammi seeds to the crucible. The exact weight is crucial for calculating the moisture content.
- Weigh the crucible containing the sample accurately to the nearest 0.0001 g.
- Drying the Sample:
- Place the crucible with the seeds into a preheated drying oven at 105°C (± 2°C). The drying temperature may vary slightly depending on specific protocols or the sensitivity of the sample.
- Leave the crucible in the oven for about 4–6 hours or until the weight of the sample stabilizes. During the drying process, moisture from the seeds evaporates [13].

Cooling the Sample:

- After the specified drying time, remove the crucible from the oven using tongs or forceps (be careful to avoid burns).
- Allow the crucible and its contents to cool in a desiccator to prevent the sample from absorbing moisture from the air [14].

Weighing the Sample:

- After cooling, weigh the crucible containing the dried Ajwain seeds accurately to the nearest 0.0001 g.
- Record the weight.
- Loss on Drying (LOD) %=Initial weight of the Sample−

Final weight of the sample/Initial weight of the sample ×100

Total Ash Value [6]

The Total Ash Value is an important physicochemical test used to determine the inorganic matter (minerals) present in a sample after complete combustion. The test is useful for quality control and standardization of herbal products like Trachyspermum ammi (Ajwain) seeds to assess purity, determine possible contamination, and ensure that the mineral content is within acceptable limits [15].

Procedure

Preparation of the Sample:

- Weigh an empty, clean crucible to the nearest 0.0001 g (accurate balance required).
- Add about 2–5 g of Trachyspermum ammi seeds to the crucible.
- Weigh the crucible along with the sample of seeds to the nearest 0.0001 g.

Ashing Process:

- Dry the sample (if necessary) by heating it at a low temperature (~100°C) in an oven to remove any moisture before proceeding with ash determination.
- Place the crucible containing the sample in a muffle furnace and ignite it at 600°C ± 50°C. The goal is to burn off all organic material (such as volatile oils, fats, and carbohydrates), leaving behind the inorganic ash (minerals).
- The temperature must be consistent and high enough to ensure complete combustion of organic matter.
- Allow the sample to burn for 3–4 hours or until it reaches a constant weight. The organic matter should be completely incinerated by this time, leaving only the inorganic ash behind [16].

Cooling:

- Once the combustion is complete, carefully remove the crucible from the muffle furnace using tongs or forceps (be cautious as the crucible will be extremely hot).
- Place the crucible in a desiccator and allow it to cool down to room temperature.
- Weighing the Ash:
- Once the crucible has cooled to room temperature, weigh it again to the nearest 0.0001
- Record the final weight of the crucible with the ash.

Calculation of Total Ash Value:

The Total Ash Value is calculated using the following formula:

Total Ash % = Weight of sample taken/ Weight of ash × 100

- Weight of ash = Final weight of the crucible + ash – weight of the empty crucible.
- Weight of sample taken = Initial weight of the crucible + seeds – weight of the empty crucible [9].

Determination of Extractive Value

Determination of Alcohol soluble extractive value

5gm of powdered drug was macerated with 100 ml of alcohol in cork fitted conical flask. Solution was shaken frequently for 6 hrs and was allowed to stand for 18 hrs. After 18 hr. content was filtered and 25 ml of filtrate was evaporated to dryness in a shallow dish at 105°C to constant weight and percentage of alcohol soluble extractives was calculated with reference to air dried drug [17].

Determination of water-soluble extractives

5gm of powdered drug was macerated with 100 ml of water in cork fitted conical flask. Solution was shaken frequently for 6 hrs and allowed to stand for 18 hrs. After 18 hr. content was filtered and 25 ml of filtrate was evaporated to dryness in a shallow dish at 105°C to constant weight and percentage of water soluble extractives was calculated with reference to air dried drug. The data generated in respect of above findings will be used as in-house standards.

Preparation of hydroalcoholic extract (Soxhlet Extraction)

Materials Needed:

- Ajwain seeds (90g)
- Methanol (300 mL)
- Soxhlet apparatus (including the extraction chamber, siphon, condenser, and boiling flask)
- Heating mantle or water bath (set to 65°C)
- Separatory funnel (for separating extracted solution, if needed)
- Filter paper (if needed for purification of extract)
- Weighing balance (for accurate measurement)

Procedure:

Preparation:

- 90g of ajwain seeds and grinded them coarsely to increase the surface area for extraction.
- The extraction chamber was cleaned and properly fitted to the condenser and boiling flask.

Solvent Preparation:

- 300 mL of methanol measured and poured it into the boiling flask of the Soxhlet apparatus. Methanol will act as the solvent for the extraction.

Loading the Extractor:

- The ground ajwain seeds (90g) into the extraction thimble (usually a cellulose thimble). This thimble will hold the plant material during the extraction process.
- Inserted the thimble containing the ajwain into the Soxhlet extraction chamber.

Assembling the Soxhlet Apparatus:

- The Soxhlet chamber connected to the condenser, ensuring that the cooling water flows properly to prevent overheating.
- The boiling flask beneath the extraction chamber was fitted.

Heating:

- Placed the boiling flask with methanol on a heating mantle or water bath. Fixed the temperature to 65°C. The solvent (methanol) will begin to evaporate and condense in the Soxhlet chamber.
- The methanol vapors were condensed into the extraction chamber, where they were dissolved the active compounds from the ajwain seeds. The condensed liquid will then siphon back into the boiling flask.

Extraction Process:

- The process was continued for 12 hours, during which time the methanol will repeatedly extract the compounds from the ajwain seeds. The cycle of solvent boiling, condensation, and siphoning should occur continuously during this period.
- The extraction chamber was filled with solvent, and after a certain amount of time, the solvent was siphon back into the boiling flask, allowing fresh solvent to extract the ajwain's active compounds.

Completion of Extraction:
- After 12 hours, the extraction process stopped. The methanol was have extracted the desired compounds from the ajwain seeds.

Post-Extraction:
- The boiling flask from the heating source was removed. If needed. The extract can be concentrated further by removing the solvent (methanol) under reduced pressure using a rotary evaporator or simply evaporating it under low heat if desired.

Final Steps:
- Once the methanol is removed, the concentrated ajwain extract was collected.

Preliminary phytochemical screening of HA extracts
Saponins Test
Saponins are glycosides with foaming properties when shaken with water. Here are the chemicals commonly used in their detection:
Frothing Test:
- Distilled Water: Used to extract saponins from the plant material by boiling or soaking.
- Test: Shake the plant extract with water and observe if foam persists, indicating the presence of saponins.

Frothing with Alcohol:
- Ethanol or Methanol: Solvent used for extraction.
- Test: After shaking the extract with alcohol, foam formation indicates the presence of saponins.

Tannins Test
Tannins are polyphenolic compounds that often form precipitates with metal salts. The following reagents are commonly used for tannin detection.

Ferric Chloride ($FeCl_3$) Test:
- Ferric Chloride ($FeCl_3$): A reagent that reacts with tannins to form a blue, green, or black color.
- Test: Add a few drops of ferric chloride solution to the plant extract. A color change to blue, green, or black indicates the presence of tannins.

Lead Acetate Test:
- Lead Acetate ($Pb(C_2H_3O_2)_2$): Forms a white precipitate with tannins.
- Test: Add lead acetate solution to the plant extract. A white precipitate indicates tannins [18].

Alkaloids Test
Alkaloids are nitrogenous organic compounds with pharmacological effects, and several reagents are used to detect them. Common tests for alkaloids include:
Mayer's Test:
- Mayer's Reagent: A solution of potassium mercuric iodide (KHI).
- Test: Add Mayer's reagent to the plant extract. A creamy white precipitate indicates the presence of alkaloids.

Dragendorff's Test:
- Dragendorff's Reagent: A solution of bismuth nitrate ($Bi(NO_3)_3$) in acetic acid, usually combined with potassium iodide.
- Test: Add Dragendorff's reagent to the extract. A bright orange or reddish-brown precipitate indicates the presence of alkaloids.

Wagner's Test:
- Wagner's Reagent: A solution of iodine (I_2) in potassium iodide (KI).
- Test: Add Wagner's reagent to the plant extract. A reddish-brown precipitate indicates alkaloids.

Hager's Test:
- Hager's Reagent: A solution of picric acid ($C_6H_3(NH_2)O_2$).
- Test: Add Hager's reagent to the extract. A yellow precipitate indicates the presence of alkaloids.

Tannic Acid Test:
- Tannic Acid: In some cases, tannic acid is used to precipitate alkaloids, particularly in qualitative tests.
- Test: Add tannic acid to the extract. A precipitate indicates alkaloids, particularly those with higher nitrogen content.

Sulfuric Acid Test:
- Concentrated Sulfuric Acid (H_2SO_4): A strong acid that may cause alkaloids to form a colored solution.
- Test: Add concentrated sulfuric acid to the extract. If alkaloids are present, a reddish, orange, or purple color may develop, depending on the alkaloid [19].

Preparation of Herbal Exfoliating cream
Preparation of Cream:
- All the glasswares was to be properly cleaned and dried
- Then all the ingredients of oil phase such i.e. Lanoline, Stearic acid, Cetyl alcohol were
- taken in a clean beaker and heated on water bath (Given in table 1).
- Then into the oil phase 1 g of ajwain extract was added and heated with stirring to get a homogenous mixture.
- Then in another beaker ingredients of aqueous phase e.g. KOH, Propylene Glycol and water were taken in a beaker and heated on water bath and stirred to get a solution. 5. After that the mixture of oil phase was adfded slowly into aqeous phaes with constant stirring and heating, mixed throughly.
- Then the perfuming agent and preservative was added into it.

The preparation was cooled down at room tempreture to get cream [20].

Table 1: Composition & Function of Cream

S. No.	Ingredients	Quantity Taken	Function
(Oil Phase			
1.	Lanoline	2g	Emollient
2.	Stearic acid	10g	Emulsifier
3.	Cetyl alcohol	1g	Emulsifier
4.	Extract	lg	Wound Healing
A) Aqueous Phase			
1.	Potassium Hydroxide	0.40	Cleaning agent
2.	Propylene Glycol	lg	Moisurizer
3.	Water	78g	Vehicle
4.	Peppermint	q.s.	Perfumes
5.	Methyl Paraben	q.s.	Preservative

Evaluation of exfoliating cream

i. pH Determination

Dilute 1g of the exfoliating cream in 10 mL of distilled water and measure the pH using a calibrated digital pH meter.

ii. Viscosity

Use a Brookfield Viscometer with an appropriate spindle (e.g., spindle No. 4 at 25°C) to determine the viscosity.

iii. Grit Size and Distribution (Scrub Particles)

Use a microscope or particle size analyzer to evaluate the size and uniformity of exfoliating granules.

iv. Spreadability

Place 1g of cream between two glass slides and apply 500g weight for 1 minute. Measure the diameter of the spread cream.

v. Skin Irritation Test

Apply the cream to a small area of human or animal skin (e.g., patch test on forearm), observe for 24–48 hours.

Result and Discussion

Physicochemical evaluation of plant materials

It was observed that all physicochemical evaluation parameters contain i.e. foreign organic matter, Total ash, of plant drug was found to be within Ayurvedic pharmacopeia limits given in table 2.

Table 2: Physicochemical evaluation of plant materials

Physicochemical evaluation	Percentage yield
Foreign organic matter	0.002%
Total ash value	3.48±23%
Loss on drying	2.03±25%

Percentage yield of all the hydoalcoholic plant extracts

Table 3: Percentage yield of all the hydoalcoholic plant extracts

Name of Plant Drug	Powdered Plant Drug (gm)	Solvent used Methanol
Trachyspermum ammi	90 gm	300 ml

The percentage yields of HA plant extract are given in table 3.

Preliminary Phytochemical screening of HA plant extracts

Results of phytochemical screening are shown in table 4. It was found that extract contain all tested phytochemical compounds.

Evaluation of exfoliating cream

1. pH Determination

The pH should typically be in the range of 4.5–6.5, which is compatible with the natural pH of human skin.

2. Viscosity

A suitable exfoliating cream should have a viscosity range of 10,000–50,000 cP, depending on its formulation for ease of application and spreadability.

3. Grit Size and Distribution (Scrub Particles)

Table 4: Preliminary Phytochemical screening of HA plant extracts

Constituent	Inference	Observation
Alkaloids	+	Foam formation
Tannins	+	Color changed (black)
Saponins	+	Precipitate formation (cream, orange)

Grit particles should be smooth, uniform, and range between 100–500 microns for effective exfoliation without damaging skin.

4. Spreadability
A good spreadability value typically ranges from 5–7 cm, indicating ease of application on the skin.

5. Skin Irritation Test
There should be no redness, itching, or irritation, indicating that the formulation is dermatologically safe.

Conclusion

Trachyspermum ammi, commonly known as ajwain or carom seeds, has a rich history rooted in traditional medicine and culinary practices, particularly in South Asian cultures. Historically, the seeds have been utilized for their therapeutic properties, including digestive aid and antimicrobial effects. The significance of Trachyspermum ammi extends beyond its culinary uses, as it has garnered attention in the field of cosmetic formulations due to its bioactive compounds. The extraction of these compounds, particularly through methanol, has proven effective in isolating the phytochemicals responsible for the plant's beneficial properties. Methanol extraction is favored for its efficiency in dissolving a wide range of polar and non-polar compounds, making it an ideal solvent for obtaining a concentrated extract rich in essential oils, flavonoids, and other phytochemicals.

The physicochemical tests conducted on the methanol extract of Trachyspermum ammi provide critical insights into its properties, including moisture content, ash value, and pH, which are essential for determining the quality and stability of the extract. These tests are fundamental in establishing the extract's suitability for cosmetic applications, ensuring that it meets the necessary standards for safety and efficacy. Furthermore, the identification tests for alkaloids, saponins, and tannins reveal the presence of these bioactive compounds, which are known for their antioxidant, anti-inflammatory, and antimicrobial properties. Alkaloids contribute to the antimicrobial activity, saponins enhance skin penetration and emulsification, while tannins provide astringent properties that can benefit skin health. The preparation of an exfoliating cream using the methanol extract of Trachyspermum ammi demonstrates the practical application of its bioactive components in cosmetic formulations. The formulation process involves combining the extract with suitable emulsifiers, stabilizers, and other ingredients to create a cream that not only exfoliates but also nourishes the skin. The exfoliating properties of the cream are attributed to the presence of natural exfoliants derived from the plant, which help in removing dead skin cells, promoting cell turnover, and enhancing skin texture. The incorporation of Trachyspermum ammi extract into the cream not only adds functional benefits but also aligns with the growing consumer demand for natural and plant-based skincare products [21].

The safety and efficacy of the prepared exfoliating cream, a skin irritation test is essential. This test assesses the potential for adverse reactions when the cream is applied to the skin. Conducting such evaluations is crucial in cosmetic formulation development, as it ensures that the product is safe for consumer use. The results of the skin irritation test provide valuable information regarding the cream's compatibility with human skin, guiding further formulation adjustments if necessary. A well-conducted skin irritation test can help establish the cream as a viable product in the competitive skincare market. In summary, the exploration of Trachyspermum ammi fruit, from its historical significance to its modern applications in cosmetic formulations, highlights the potential of natural ingredients in skincare. The extraction process, physicochemical characterization, and identification of bioactive compounds underscore the importance of scientific rigor in developing effective and safe cosmetic products. The successful formulation of an exfoliating cream enriched with Trachyspermum ammi extract not only showcases the versatility of this plant but also emphasizes the importance of thorough evaluation processes, such as skin irritation tests, in ensuring product safety. As consumers increasingly seek natural alternatives in their skincare routines, the integration of traditional medicinal plants like Trachyspermum ammi into modern formulations represents a promising avenue for innovation in the cosmetic industry. Future research could further explore the synergistic effects of combining Trachyspermum ammi with other natural ingredients, potentially enhancing its efficacy and broadening its application in skincare products [22].

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