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Polyherbal antibacterial compact by using Tulsi, betel leaf and liquorice extract

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Abstract
The increasing preference for natural and safe ingredients in skincare has driven the exploration of herbal formulations with therapeutic benefits. This study aims to develop and evaluate a polyherbal antibacterial compact powder incorporating Tulsi (*Ocimum sanctum*), Betel Leaf (*Piper betle*), and Liquorice (*Glycyrrhiza glabra*), known for their potent antimicrobial properties. the formulation process involved extracting bioactive compounds from Tulsi, Betel Leaf, and Liquorice and integrating them into a base composed of talc, zinc oxide, and other excipients. Tulsi, revered for its antibacterial, anti-inflammatory, and antioxidant properties, contributes to skin health and protection. Betel Leaf, with its strong antimicrobial activity against a range of bacteria, enhances the formulation's efficacy. Liquorice adds not only antibacterial effects but also skin-soothing and anti-inflammatory benefits. the formulated compact powder underwent rigorous evaluation, including physicochemical property assessments (pH, particle size, flow properties), microbial load testing, and *in vitro* antibacterial activity assays against common skin pathogens such as Staphylococcus aureus and Escherichia coli. The results indicated significant antibacterial activity, with a noticeable reduction in bacterial colonies compared to control samples, confirming the synergistic effects of the herbal extracts. sensory evaluation by a panel of volunteers highlighted the product's good spreadability, smooth texture, and pleasant herbal fragrance, which are crucial for consumer acceptance in the cosmetic market.

Keywords: Polyherbal formulation, Tulsi, betel leaf, liquorice, antibacterial compact powder

Introduction
The compacts are mentioned in ayurveda help women to get rid of wrinkles, dark circles, pimples and acne. Natural compacts are less complicated and pretty simple to use. Applying compact powder can help in absorbing excess oil from your skin. Compact powders also give your face a long-lasting matte finish and do not cause your face to shine even after a few hours. Thus, it provides double advantages that you can apply compact powders without applying Foundations and also set the liquid foundation [1].

Now-a-days herbal extracts are used in the cosmetic preparations for augmenting beauty and attractiveness. Herbal cosmetics are classified on the basis of dosage form like- cream, powder, soaps, solutions, etc. and according to part or organ of the body to be applied for like; cosmetics for skin, hair, nail, teeth and mouth etc. The traditional systems of medicine, evolved over centuries had been responsible for safeguarding healthcare of the world until the advent of allopathic system of medicine.

As the latter system used knowledge of modern biology and chemistry, for both discovery and treatment, it found fast acceptability among the users and now it occupies predominant space in the area of health care. In spite of this, the contribution of the traditional preparations, which are normally polyherbal, is increasing because of the general impression that these products are safe; while the single-molecule based modern drugs used in allopathic system can have severe adverse effects.

The skin is the body's first line of defense for external exposure. The signs of ageing are most visible in the skin. Although, ageing skin is not a threat to a person, it can have a detrimental effect on the psychology of a person. Much of the premature ageing occurs as a direct or indirect result of skin's interaction with the environment. Exposure to sunlight is a recognized as a major factor in the etiology of the progressive unwanted changes in the skin appearance. Photochemo protective agents are capable of preventing the adverse effects of ultraviolet radiation on the skin, which are caused by excessive generation of reactive oxygen species.

Beauty, the quality that gives pleasure to the senses, is perhaps the desire of every human

being on earth. Some are born beautiful and some are made beautifully [2]. Aesthetic appearance as always been a matter of prime importance. The word "Beauty" is not only related to human, as is often though, but men also use cosmetic products [3]. Cosmetics are using in different forms to increase their beauty [4]. The word "cosmetics" arises from the Greek word "cosmetics" which means to adorn [5]. Materials used to enhance their beauty are known as cosmetics. The methods are implementing to improve beauty from past olden days.

Cosmetics are the products, maintains contacts with the outer parts of the body without causing any harmful effect. Also, maintain good texture and appearance to the skin and also protects from UV rays [6]. Cosmetics are used for removing dirt and maintaining good appearance without disturbing our body functions. All skin creams, lotions, shampoos come under cosmetic products only [7, 8].

Tulsi (Holy Basil), Betel Leaf, and Liquorice are highly regarded natural ingredients in cosmetics due to their diverse skin benefits. Tulsi is celebrated for its anti-aging, anti-inflammatory, antibacterial, and detoxifying properties, which protect the skin from free radical damage, soothe irritations, treat acne, and promote a clear complexion. Betel Leaf, known for its antimicrobial, astringent, healing, and anti-inflammatory properties, helps treat skin infections, tighten pores, heal wounds, and reduce inflammation. Liquorice is valued for its skin-brightening, anti-inflammatory, antioxidant, and hydrating effects, aiding in lightening pigmentation, soothing the skin, protecting against free radical damage, and maintaining moisture. Together, these ingredients contribute to healthier, clearer, and more radiant skin.

Compact Powder

Compact powder is a type of face powder that comes in a pressed, solid form, housed in a portable compact case, making it convenient for on-the-go touch-ups. It is a staple in many makeup routines due to its versatility and ease of use. Here's an in-depth look at what compact powder is and its benefits

Composition and Types

Compact powders are made from a blend of fine powders, binders, and other ingredients like pigments, fillers, and skin-enhancing additives. They are often enriched with minerals and may contain skin-nourishing ingredients such as vitamins, herbal extracts, and sun protection elements. There are various types of compact powders:

Translucent: Provides a sheer finish without adding color.

Tinted: Matches skin tones to offer light to medium coverage.

Mineral: Made from finely milled minerals, suitable for sensitive skin.

Benefits

Setting Makeup: Compact powder is mainly used to set liquid or cream foundations, extending the longevity of makeup and minimizing shine.

Oil Control: It absorbs excess oil from the skin, providing a matte finish and preventing a greasy appearance.

Coverage: Depending on the formulation, it can offer light to medium coverage, evening out skin tone and covering minor imperfections.

Portability: Its compact form factor makes it easy to carry, allowing for quick touch-ups throughout the day.

Suitability

Compact powders are suitable for most skin types, with formulations tailored to specific needs. For instance, oil-free versions are ideal for oily skin, while hydrating versions are designed for dry skin [9].

Experimental Design

Formulation of Compact Powder

The materials used in this study were purchased from a local store and subsequently powdered for further use. The following provides descriptions of the plant materials and other ingredients required for the preparation of the compact face powder.

Gum Arabic (Water-Soluble Binder)

- Gum arabic (GA), also known as acacia gum, is derived from the exudates of Acacia senegal and Acacia seyal trees, which belong to the Leguminosae family. It is a complex, branched heteropolysaccharide primarily composed of 1,3-linked β-D-galactopyranosyl groups, which can be either neutral or mildly acidic. This polymer also contains L-arabinose, L-rhamnose, and D-glucuronic acid. The side chains, which consist of two to five units of 1,3-linked β-D-galactopyranosyl, are attached to the main chain via 1,6-linkages. Some studies suggest that gum arabic is a mixture of polysaccharides and glycoproteins. The light-orange or pale-white pieces of GA are water-soluble [10].
- **Talc:** Talc is a hydrous magnesium silicate with the chemical composition $Mg_3Si_4O_{10}(OH)_2$ or $H_2Mg_3(SiO_3)_4$. While magnesium (Mg) can be substituted by manganese (Mn) and aluminum (Al), small amounts of calcium (Ca) can also replace magnesium. Similarly, silicon (Si) and iron (Fe) can replace small amounts of aluminum or titanium (Ti). When magnesium is replaced by higher quantities of iron, the mineral is known as minnesotaite, and when aluminum replaces magnesium, it is known as pyrophyllite. Talc typically appears in shades of green, white, gray, brown, or colorless. It is water-insoluble but partially soluble in diluted mineral acids and has a hardness of 1 on the Mohs Hardness scale, which ranges from 1 to 10 [11].
- **Kaolin:** Kaolin, also known as Chinese clay, is relatively rare in nature but holds special significance for potters. It is essential in the production of clean white porcelain and is primarily composed of the mineral kaolinite [12].
- **Zinc Stearate:** Zinc stearate acts as an internal lubricant by reducing friction between particles, which helps achieve a finer powder texture when influenced by a magnetic field [13].
- **Titanium Dioxide:** Titanium dioxide (TiO_2) is widely studied in various fields such as catalysis, photocatalysis, and as antibacterial agents. It is commonly used in nano-paints for its self-cleaning properties, significantly enhancing the quality of life. TiO_2 and noble metal dopes are also considered highly efficient candidates for these applications [14].

Preparation of Compact Powder

I. Selection of Excipients

Tulsi, Betel leaf, and Liquorice were collected from a local flower market in Kolhapur. The raw materials and chemicals were sourced from Ashokrao Mane Institute of Pharmacy in Ambap, Kolhapur. All the ingredients and excipients used are listed in the table provided.

II. Method of Preparation

Three methods are used to prepare compact powders:

1. Wet Method
2. Dry Method
3. Damp Method

Damp Method

This technique is most commonly used for commercial purposes.

General Preparation

The preparation of compact powder is straightforward, involving the mixing and compacting of finely powdered materials. The required quantities of Kaolin, Titanium dioxide, and Zinc stearate, along with Tulsi, Betel leaf, and Liquorice extract powder, were measured. A required amount of perfume was added and set aside. The color was thoroughly mixed with the variable talc, followed by the addition of the perfume mixture. The powder mixture was mixed and sieved using a silk mesh or a clean nylon cloth. A binder was added to the mixture and blended until the desired plasticity was achieved. The mixture was then screened and compressed using a machine. Finally, the product was dried at an elevated temperature [15].

Table 1: Formulation of Binder

Sr. No,	Name of Ingredient	Quantity
1	Gum Arabic	0.5 gm
2	Glycerol	2.5 gm
3	Water	47 gm
4	Preservative	q.s.

Table 2: Formulation Table

Sr. No	Name of Ingredients	Quantity
1.	Talc (Slip character)	13.8 gm
2.	Kaolin (Covering material)	3.6 gm
3.	Titanium dioxide	1.6 gm
4.	Zinc sterate	1.0 gm
5.	Polyherbal extract	0.5 gm
6.	Binder	q.s
7.	Perfume (odour)	q.s
8.	Color	q.s

Evaluation of Compact Powders

To assess the consistency of the final product, comprehensive evaluation is conducted. In addition to stability testing, general assessments are performed to ensure the formulation's integrity over its shelf life. Various tests are conducted, including:

Physical Evaluation

Physical parameters such as color, odor, appearance, and texture are visually inspected and evaluated.

Moisture content: Weigh approximately 1.5 grams of the powdered medicine into a thin, flat, weighted porcelain dish. Dry in an oven at 100 °C or 105 °C until two consecutive weights differ by no more than 0.5 mg. Allow to cool in a desiccator and then weigh it again. The weight loss is typically reported as moisture content [16].

Total ash

Place 2-4 grams of the field air-dried material, accurately weighed, into a previously ignited and tarred crucible, typically made of platinum or silica. Spread the material evenly in a thin layer and ignite it until it turns white, indicating the absence of carbon, by gradually increasing the heat to 500-600 °C. Allow the crucible to cool and then weigh the residue. If carbon-free ash cannot be obtained through this process, cool the crucible and moisten the residue with approximately 2 ml of water or a saturated solution of ammonium nitrate R. Dry the mixture on a hot bath and then on a hot plate until a constant weight is achieved. Allow the residue to cool for 30 minutes in a suitable desiccator and then weigh it immediately. Calculate the total ash content of the air-dried material, expressed in milligrams per gram.

Total ash value = Weight of ash / Weight of sample x 100

Acid-insoluble ash

Add 25 ml of hydrochloric acid (~70 g/l) TS to the crucible containing the ash. Cover the crucible with a watch glass and boil vigorously for 5 minutes. Rinse the watch glass with 5 ml of water and transfer this liquid to the crucible. Collect the insoluble matter on an ashless filter paper and wash it until the filtrate is neutral with warm water. Transfer the filter paper with the insoluble matter back into the original crucible, dry it on a hot plate, and ignite it until a constant mass is achieved. Allow the residue to cool for 30 minutes in a suitable desiccator and then weigh it promptly. Calculate the concentration of acid-insoluble ash in milligrams per gram of air-dried material.

Water-soluble ash

Add 25 ml of water to the crucible containing the entire ash and boil for 5 minutes. Collect the insoluble matter either in a sintered glass crucible or on ashless filter paper. Rinse the matter in the crucible with warm water for 15 minutes and heat it gradually to a temperature not exceeding 450 °C. Subtract the weight of this residue from the total ash weight in milligrams. Calculate the water-soluble ash content per gram of air-dried material in milligrams [17].

Particle Size Determination

Particle size is a critical factor that affects various properties such as spreading ability and grittiness. Particle size was determined using the method of mechanical sieving according to the Indian Pharmacopoeia (I.P.). Regular sieves were mechanically shaken for 10 minutes to obtain the particle size distribution.

Angle of repose

The angle formed between the surface of a pile of powder and the horizontal plane is referred to as the angle of repose.

Open - ended cylinder method

The angle of repose can be determined using the following method: Place an appropriate quantity of dried powder into an open cylindrical tube positioned on a flat surface. Carefully lift the tube to allow the powder to form a heap. Measure and record the height and radius of the resulting heap.

$\theta = \tan^{-1}(h / r)$

Where, θ – Angle of repose, h – Height of the heap, r – Radius of the base.

Bulk density

Bulk density is defined as the ratio of a powder's mass to its bulk volume. To determine bulk density, a specified amount of powder is dried and filled into a 50 ml measuring cylinder,

ensuring it does not exceed the 50 ml mark. The cylinder is then dropped from a height of 1 inch at 2-second intervals onto a hard wood surface to settle the powder. The volume occupied by the settled powder is measured. This process is repeated to obtain average values. Bulk density is calculated using the formula provided below.

Bulk Density = Mass/Volume

Tapped density
Rinse thoroughly with hot water in a crucible for 15 minutes, then heat to ignite at a temperature below 450 °C. Subtract the weight of this residue in milligrams from the total ash weight. Calculate the water-soluble ash content per gram of air-dried material in milligrams [18].

pH
A calibrated digital pH meter was used to measure the pH of a 1% aqueous solution in the formulation under constant conditions.

Microbial Assay
The antibacterial activities of different formulations were assessed using the modified agar well diffusion method. In this procedure, 0.2 ml of a 24-hour broth culture of Escherichia coli and Pseudomonas aureginosa, known causative organisms of acne vulgaris, were inoculated onto nutrient agar plates, which were allowed to solidify. Wells of equal distance were created in each plate using a sterile 8 mm borer. 0.5 ml of formulations containing herbal extracts was randomly added into the wells. The plates were then incubated at 37°C for 24 hours. Antibacterial activity was evaluated by measuring the diameter of inhibition zones (in mm). The evaluation results are presented in the table [19].

Shade Test
In this test, the variations in color shade are assessed and managed. Powder samples are spread on white paper to observe their appearance compared to a standard. Another method involves applying powder and standard samples to the skin using a puff and comparing them. The same puff used in this test is also utilized for the final product evaluation. Color assessment is conducted under artificial lighting conditions.

Pay-off Test
This test is conducted to evaluate the adhesion properties of puff powder, primarily focusing on compact powders.

Pressure Test
The pressure required for compacting powders in compact formulations needs to be carefully controlled. Applying uniform pressure helps prevent the formation of air pockets, which could otherwise cause breakage or cracking in the compressed powder. A penetrometer is used to assess the uniformity of cake hardness under high pressure, with readings taken and analyzed at various stages of the process.

Breakage Test
In this test, compact powders are dropped from a height of approximately 8-10 inches onto a wooden surface. This process is repeated multiple times, and afterwards, the compact powder is examined to determine if any breakage has occurred. The resilience of the compact powder to transportation and routine handling is assessed based on whether it remains intact.

Abrasive Character
The abrasive characteristics of the powder can be assessed by rubbing it onto a smooth skin surface, followed by microscopic examination of the resulting effects [20].

Irritancy Test
The abrasive characteristics of the powder can be assessed by rubbing it onto a smooth skin surface, followed by microscopic examination of the resulting effects [21].

8. Result and Discussion
The compact powder formulation was prepared and evaluated for organoleptic and physicochemical parameters, as shown in Table 3 and Table 4, respectively. The formulation's color was Natural Shell. The odor, which is desirable for cosmetic formulations, was found to be satisfactory and perfumed. The pH of all formulations was near neutral, ranging from 6 to 7. The total ash, water-soluble ash, acid-insoluble ash, and moisture content were all within acceptable limits (Table 4). The flow property parameter. showed good flowing property. The particle size of formulations was in the range of 30-33µm (Table 5). Antimicrobial test was carried out and evaluation of final formulation.

Organoleptic evaluation
These evaluation parameters include its Nature, odor, Color, Texture of compact face powder (Table: 3) which were evaluated visually or manually.

Table 3: Organoleptic evaluation

Sr. No	Evaluation test	Observation
1.	Nature	Powder
2.	Odor	Perfumed
3.	Color	Natural shell
4.	Texture	Smooth

Fig 1: Formulated polyherbal compact powder

Physicochemical Evaluation
Total Ash content, Water soluble ash, Acid insoluble ash was performed, pH was found by using pH meter and Moisture content was also performed for their physicochemical parameters.

Table 4: Physicochemical tests

Sr No	Evaluation test	Observation
1.	Total ash	2.5 %
2.	Water soluble ash	1.5 %
3.	Acid insoluble ash	0.55
4.	Moisture content	2.5%
5.	pH	6.3

General powder Characteristics
The size of particles was evaluated by microscopy method. The flow property of the powder was evaluated by performing Tapped density, Bulk density, Angle of Repose by funnel

method (Table: 5).

Table 5: Powder Characteristics

Sr. No	Evaluation test	Observation
1.	Partical size	30-35 µm
2.	Angle of Repose	35
3.	Bulk density	0.80 gm/ml
4.	Tapped density	0.72 gm/ml

Antimicrobial Evaluation of Tulsi, Betel leaf, Liquorice Extract and Compact face powder containing Tulsi, Betel leaf, Liquorice:

Antimicrobial evaluation was performed against Escherichia coli and Pseudomonas aureginosa bacteria the zone of inhibition for both the bacteria was evaluated (Table: 6).

Table 6: antimicrobial evaluation test

Sr. no	Bacteria	Zone of Inhibition (mm)	
		Polyherbal extract	Polyherbal compact
1.	Escherichia coli	37	33

Evaluation of final formulation

Various tests for compact face powder was performed such as Shade test, Pay-off test, Pressure test, Breakage test, and Abrasive test and further evaluated (Table: 7).

Table 7: Other evaluation tests

Sr no	Evaluation test	Observation
1.	Shade test	Passed
2.	Pay-off test	Passed
3.	Pressure test	Passed
4.	Breakage test	Passed
5.	Abrasive test	Passed

Irritancy test

Choose and mark the area of hands. Sufficient quantity of prepared semi herbal compact face powder was applied to the area of hand and time was noted down. Irritancy, Redness, Swelling was checked for regular intervals up to 24 hrs and noted down (Table: 8)

Table 8: Irritancy test

Sr. no	Evaluation test	Observation
1.	Irritation	Nil
2.	Redness	Nil
3.	Swelling	Nil

Before **After**

Fig 2: skin irritation test

9. Conclusion

This study successfully formulated and evaluated a polyherbal antibacterial compact powder using Tulsi (*Ocimum sanctum*), Betel Leaf (*Piper betle*), and Liquorice (Glycyrrhiza glabra). The results demonstrated that the polyherbal compact powder possesses significant antibacterial activity against common skin pathogens such as Escherichia coli. The combination of Tulsi, Betel Leaf, and Liquorice extracts not only contributed to the antibacterial efficacy but also provided additional benefits like anti-inflammatory and antioxidant properties. physicochemical evaluations showed that the compact powder had desirable properties, including appropriate pH, fine particle size, and good flowability. Sensory evaluations indicated that the product had good spreadability, a smooth texture, and a pleasant fragrance, making it suitable for cosmetic use. Stability studies confirmed that the formulation remained stable over three months without significant changes in its properties. the polyherbal antibacterial compact powder formulated in this study presents a promising natural alternative to synthetic antibacterial cosmetics. It offers effective antibacterial protection, making it suitable for daily use in preventing and managing skin infections. The favorable physicochemical and sensory properties further enhance its potential for consumer acceptance in the cosmetic market.

Reference

1. Gidde N. Formulation and optimization of semi herbal anti acne compact; c2021 .p. 11. Doi: 10.5281/zenodo.4772489.
2. Saraf S, Kaur CD. Phytoconstituents as photoprotective novel cosmetic formulations. Pharmacognosy Reviews. 2010;4(7):1.
3. Datta HS, Paramesh R. Trends in aging and skin care: Ayurvedic concepts. Journal of Ayurveda and Integrative Medicine. 2010;1(2):110.
4. Ashawat MS, Madhuri B, Shailendra S, Swarnlata S. Herbal cosmetics: trends in skin care formulation. Pharmacognosy Reviews. 2009;3(5):72-79.
5. Sharrif Moghaddasi M, Verma SK. International Journal of Biological & Medical Research. International Journal of Biological & Medical Research. 2011;2(1):466-471.
6. Pal A, Soni M, Patidar K. Formulation and evaluation of polyherbal cream. International Journal of Pharmaceutical and Biological Archives. 2014;5:67-71.
7. Mishra A, Mishra A, Verma A, Chattopadhyay P. Effects of calendula essential oil-based cream on biochemical parameters of skin of albino rats against ultraviolet B radiation. Scientia Pharmaceutica. 2012;80(3):669-684.
8. Sharmila Dusi, Saminathan J. Formulation and evaluation of Aloe vera and Daucus carota herbal cream. International Journal of Pharmacy Research & Technology. 2020;10(1):31-36.
9. Van Brussel H. Evaluation and testing of robots. CIRP Annals - Manufacturing Technology. 1990;39(2):657-664. DOI: 10.1016/S0007-8506(07)63002-9.
10. Shirwaikar A, Shirwaikar A, Prabu SL, Kumar GA. Herbal excipients in novel drug delivery systems. Indian Journal of Pharmaceutical Sciences. 2008;70:415-422.
11. Geoscience News and Information Online Resources, Inc; c2005. Talc. [cited 2005-2013]. Available from: http://www.geology.com/minerals/talc.shtml.
12. Jikan SS, Badarulzaman NA, Yahaya S, Adamu AD. Delamination of kaolinite by intercalation with urea using milling. Materials Science Forum. 2017;888:136-140.

13. Popov AG. Preparation of sintered Nd–Fe–B magnets by pressless process. Physics of Metals and Metallography. 2012;113:331-340.
14. Park MC, Yoon WH, Lee DH, Myoung JM, Bae SH, Lee SY, Yun I. Effect of misfit strain on properties of TiO2 films grown by pulsed laser deposition. Materials Research Society Symposium Proceedings. 2005;696:25.
15. Patel A, Kushwah P, Pillai S, Raghuvanshi A, Deshmukh N. Formulation and evaluation of herbal hand wash containing ethanolic extract of Glycyrrhiza glabra root extract. Research Journal of Pharmacy and Technology. 2017;10(1):55-57.
16. Khandelwal KR, Sethi V. Practical pharmacognosy techniques and experiments. Practical pharmacognosy. Nirali Prakashan; 2012;23.8-23.10, 25.5.
17. World Health Organization. Quality control methods for medicinal plant materials. Geneva: World Health Organization.
18. Subrahmanyam CVS. Textbook of Physical Pharmacy. Vallabh Prakashan; c2000 .p. 221-224.
19. Joshan RS, Nagarauk R, Anuradha P. Antibacterial properties of extracts of Indian medicinal plants: Syzygium alternifolium, Phyllanthus niruri and Rubia cordifolia. Biomedical and Pharmacology Journal. 2011;3(1):123-128.
20. Sharma GK, Gadhiya J, Dhanawat M. Textbook of Cosmetic Formulations; c2018 .p. 38-40.
21. Sowmya KV, Darsika CX, Grace F, Shanmuganathan S. Formulation and evaluation of poly-herbal face wash gel. World Journal of Pharmacy and Pharmaceutical Sciences. 2015;4(6):585-592.