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POLYHERBAL DUSTING POWDER AS A TOPICAL ANTIMICROBIAL AGENT: FORMULATION AND EVALUATION STUDY

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Abstract: The present study aimed to formulate and evaluate a polyherbal dusting powder as a topical antimicrobial agent for the management of minor skin infections and moisture-related skin conditions. The formulation was prepared using natural and pharmaceutical ingredients including talc, kaolin, starch, magnesium stearate, almond oil, and clove oil. Clove oil was incorporated for its potent antimicrobial and antifungal activity, while almond oil acted as an emollient and skin-conditioning agent. The dusting powder was prepared by simple mixing and trituration method followed by sieving to obtain a fine and uniform formulation. The prepared formulation was evaluated for organoleptic properties, pH, particle size, abrasiveness, bulk density, tapped density, angle of repose, Carr's index, Hausner ratio, moisture content, and antimicrobial activity using bread slices. The formulation showed satisfactory organoleptic characteristics with a smooth texture, pleasant odor, and non-gritty nature. The pH was found suitable for topical application. Antimicrobial studies demonstrated inhibition of microbial growth in the treated sample compared to the control, indicating effective antimicrobial activity. The study concluded that the formulated polyherbal dusting powder possesses good topical properties and promising antimicrobial potential, making it a safe, economical, and effective herbal formulation for topical use.

Index Terms - Polyherbal dusting powder, antimicrobial activity, Clove oil, Almond oil, Topical formulation, Herbal formulation, Moisture absorption, Skin infections.

I. INTRODUCTION

Skin, the largest organ of the human body, acts as the primary protective barrier against environmental pathogens. However, it is highly prone to microbial infections caused by bacteria and fungi, especially under conditions of excessive moisture, friction, and poor hygiene. These infections may result in irritation, inflammation, and discomfort, necessitating effective topical treatment options.[1]

Topical antimicrobial formulations are widely used to manage such skin conditions. Among them, dusting powders are particularly advantageous due to their ability to absorb moisture, reduce friction, and provide a soothing and cooling effect. They help maintain dryness on the skin surface, thereby creating an unfavorable environment for microbial growth and aiding in the prevention of infections such as fungal infestations and prickly heat.[2]

In the formulation of dusting powders, excipients play a crucial role in determining the product's effectiveness and stability. Ingredients such as Talc, Kaolin, and Starch are commonly used as absorbents and diluents to enhance moisture absorption and improve texture. Magnesium stearate serves as a lubricant and anti-caking agent, improving the flow properties of the powder.[3]

In addition to these base materials, natural oils contribute significantly to the therapeutic efficacy of the formulation. Almond oil acts as an emollient, providing skin nourishment and preventing dryness, while

Clove oil is well known for its potent antimicrobial and antifungal properties due to the presence of eugenol.[4.]

The incorporation of both herbal ingredients and suitable excipients leads to the development of an effective polyherbal dusting powder with enhanced antimicrobial activity. Such formulations offer advantages including safety, cost-effectiveness, and minimal side effects compared to synthetic products. Therefore, the present study focuses on the formulation and evaluation of a polyherbal dusting powder as a topical antimicrobial agent, assessing its physicochemical characteristics and antimicrobial potential.[5,6]

II. Herbal Antimicrobial Agents:

Herbal antimicrobial agents have gained significant importance in recent years due to increasing resistance to synthetic drugs and the demand for safer, natural alternatives. Medicinal plants and their derivatives contain bioactive compounds such as phenolics, flavonoids, and essential oils, which exhibit antimicrobial activity by disrupting microbial cell membranes and inhibiting enzyme activity.[7]

Among natural antimicrobial agents, essential oils have been extensively studied for their potent activity. Clove oil is one of the most effective plant-derived antimicrobial agents, primarily due to the presence of eugenol. Studies have demonstrated that clove oil exhibits strong antibacterial and antifungal activity against a wide range of microorganisms, making it highly suitable for topical formulations.[8,9]

In addition to antimicrobial agents, excipients used in dusting powders also play an important supportive role. Talc and Kaolin are widely used as absorbent materials that help reduce moisture on the skin surface. By maintaining dryness, they indirectly inhibit microbial growth, as many microorganisms thrive in moist environments.[10]

Starch is another commonly used natural excipient that enhances the absorbent property of the formulation and provides a smooth texture. It also contributes to maintaining a dry environment, which is unfavorable for microbial proliferation.[11] Similarly, Magnesium stearate is used as a lubricant and anti-caking agent, improving the flow properties and stability of the powder formulation.[12]

Natural oils also contribute significantly to the therapeutic efficacy of herbal formulations. Almond oil is widely used as an emollient due to its moisturizing and skin-soothing properties. It helps prevent dryness and irritation while supporting skin barrier function, which is essential in protecting against microbial invasion.[13]

The combination of antimicrobial agents like clove oil with absorbent and supportive excipients such as talc, kaolin, and starch results in a synergistic effect. This not only enhances antimicrobial activity but also improves the overall performance of the formulation. Therefore, polyherbal dusting powders incorporating these ingredients represent an effective, safe, and economical approach for the management of topical microbial infections.[14]

III. Dusting Powders:

Dusting powders are finely divided solid dosage forms intended for external application to the skin. They are commonly used for their ability to absorb moisture, reduce friction, and provide a soothing and protective effect. These powders are especially useful in managing skin conditions such as irritation, fungal infections, and excessive perspiration.[15]

An ideal dusting powder should possess good flow properties, uniform particle size, and non-irritant characteristics. The choice of excipients plays a crucial role in determining the effectiveness of the formulation. Materials such as Talc and Kaolin are widely used due to their absorbent and protective properties.[16]

Starch is another important excipient that enhances moisture absorption and improves the texture of the powder. It also helps maintain dryness, thereby limiting microbial growth. Lubricants such as Magnesium stearate are incorporated to improve flowability and prevent clumping of the powder.[17]

Dusting powders can be classified into medicated, surgical, and cosmetic types. Medicated dusting powders contain active agents such as antimicrobial or antifungal substances to treat infections. Surgical powders are sterile and used in clinical settings, whereas cosmetic powders are mainly intended for personal care.[15]

Recent studies emphasize the incorporation of herbal ingredients into dusting powders to enhance safety and therapeutic efficacy. Essential oils such as Clove oil exhibit strong antimicrobial activity due to the presence of eugenol, while Almond oil provides emollient and skin-conditioning effects.[18,19] These polyherbal formulations are gaining popularity as safer alternatives to synthetic formulations with fewer side effects.

Thus, dusting powders remain an effective and versatile topical dosage form, and their combination with herbal antimicrobial agents offers a promising approach in the development of safe and efficient formulations.

IV. Materials and Methods:

a. Materials

1. Talc

Talc is a naturally occurring hydrated magnesium silicate widely used in dusting powders. It possesses excellent moisture-absorbing and lubricating properties, providing a smooth and silky feel to the formulation. It helps reduce friction and protects the skin from irritation, making it an ideal base for topical powders.[16]

Fig No.1

2. Kaolin

Kaolin is a fine, white clay with high absorbent capacity. It is used as a protective and soothing agent in dusting powders. It helps in absorbing excess moisture and toxins from the skin while forming a protective layer, thereby reducing irritation and promoting skin comfort.[15]

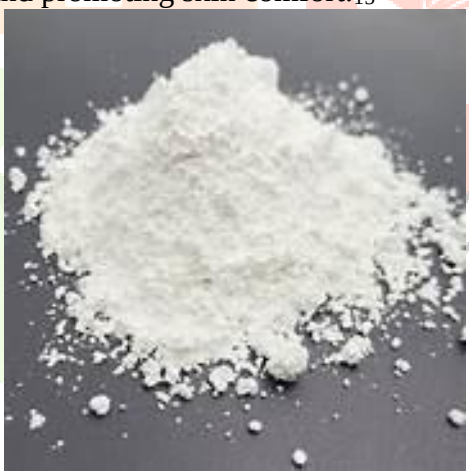


Fig No.2

3. Starch

Starch is a natural polysaccharide obtained from plant sources such as corn or rice. It acts as an excellent absorbent and diluent in dusting powders. It improves the texture, enhances spreadability, and helps maintain dryness, which is essential to prevent microbial growth.[17]

Fig No. 3

4. Magnesium stearate

Magnesium stearate is commonly used as a lubricant and anti-caking agent in powder formulations. It improves the flow properties of the powder and prevents clumping, ensuring uniform application and stability of the formulation.[20]

Fig No. 4

5. Almond oil

Almond oil is a natural oil rich in vitamins and fatty acids. It acts as an emollient, providing hydration and nourishment to the skin. It helps in soothing irritation, improving skin texture, and maintaining skin barrier function.[21]

Fig No.5

6. Clove oil

Clove oil is an essential oil known for its strong antimicrobial and antifungal properties due to the presence of eugenol. It is widely used in topical formulations to inhibit the growth of microorganisms and prevent infections. Additionally, it provides a mild warming and soothing effect.[19]

Fig No.6

b.Formulation Table:[22]

Sr.No	Ingredient	Quantity Taken	Role
1.	Starch	25g	Absorbent and soothing agent
2.	Talc	55g	Provides smoothness and lubrication
3.	Kaolin	15g	Absorbs moisture and impurities
4.	Magnesium Stearate	5g	Improves flow property and adhesion
5.	Almond oil	4ml	Moisturizer and skin nourishing agent
6.	Clove oil	2ml	Anti-microbial and anti-fungal agent

Table No:1 Formulation Table

c. Method of preparation:

The polyherbal antimicrobial dusting powder was prepared by simple mixing and trituration method. All powdered ingredients including Starch, Talc, Kaolin, and Magnesium stearate were accurately weighed according to the formulation table. The powders were separately passed through sieve no. 80 to obtain uniform particle size and remove impurities.[15]

The sieved powders were transferred into a clean and dry mortar and mixed thoroughly by trituration to achieve a homogeneous blend. After uniform mixing of the dry ingredients, Almond oil and Clove oil were added dropwise with continuous mixing to ensure uniform distribution throughout the formulation.[16]

The prepared powder was triturated continuously until a smooth and free-flowing powder was obtained. Finally, the formulation was passed again through sieve no. 120 to obtain fine particles and packed in a clean, dry, airtight container for further evaluation studies.[23]

Fig no.7

V. Evaluation Parameters of Polyherbal Dusting Powder:

The prepared polyherbal dusting powder was evaluated for various physicochemical and micromeritic parameters to determine its quality, stability, and suitability for topical application.

1. Organoleptic Characteristics

The formulation was visually examined for colour, Odor, appearance, texture, and grittiness by simple observation.[23]

2.pH Determination Using pH Paper

The pH of the prepared polyherbal dusting powder was determined using pH paper to ensure that the formulation is compatible with the skin and does not cause irritation. About 1 g of the dusting powder was accurately weighed and dispersed in 100 mL of distilled water. The mixture was stirred properly to obtain a uniform suspension. A strip of pH paper was then dipped into the suspension for a few seconds and removed carefully. The color developed on the pH paper was compared with the standard color chart provided with the pH paper to determine the pH value of the formulation.[16]

3. Particle Size Analysis

Particle size of the powder was determined using sieve analysis and microscopic method to ensure uniformity and smooth application.[15]

4. Abrasiveness Test

The powder was rubbed on a smooth surface and examined for grittiness or abrasive particles using a microscope. A good dusting powder should be free from abrasive particles.[24]

5. Bulk Density

Bulk density was determined by transferring a known quantity of powder into a graduated cylinder and measuring the bulk volume occupied by the powder.[24]

$$\text{Bulk Density} = \frac{\text{Mass of Powder}}{\text{Bulk Volume}}$$

6. Tapped Density

Tapped density was measured after mechanically tapping the graduated cylinder containing the powder until constant volume was obtained.[24]

$$\text{Tapped Density} = \frac{\text{Mass of Powder}}{\text{Tapped Volume}}$$

7. Angle of Repose

Angle of repose was determined by funnel method to evaluate the flow properties of the powder.[17]

$$\theta = \tan^{-1}\left(\frac{h}{r}\right)$$

Where:

- h = height of powder cone
- r = radius of powder cone

8. Carr's Index

Carr's compressibility index was calculated using bulk density and tapped density to assess compressibility and flowability of the powder.[17]

$$\text{Carr's Index} = \frac{\text{Tapped Density} - \text{Bulk Density}}{\text{Tapped Density}} \times 100$$

9. Hausner Ratio

Hausner ratio was determined as an indicator of powder flow characteristics.[17]

$$\text{Hausner Ratio} = \frac{\text{Tapped Density}}{\text{Bulk Density}}$$

10. Moisture Content

Moisture content was determined to evaluate stability and prevent microbial contamination during storage.[16]

$$\% \text{ Moisture Content} = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \times 10$$

11.Antimicrobial Activity Using Bread

The antimicrobial activity of the prepared polyherbal dusting powder was evaluated using bread slices. One bread slice was kept untreated as control, while another was treated with the dusting powder suspension. Both samples were stored at room temperature and observed for microbial growth.[2]

VI. Results:

1. Organoleptic Characteristics

parameter	Observation
colour	Off-white to light cream colour
odor	Pleasant aromatic odour characteristic of clove oil
Appearance	Fine, smooth, and homogeneous powder
Texture	Soft and free-flowing
grittiness	Absent (non-gritty)

2.pH Determination Using pH Paper

The pH of the prepared polyherbal dusting powder was determined using pH paper and was found to be 6.5–7.0.

3. Particle Size Analysis

The particle size analysis of the prepared polyherbal dusting powder was carried out using standard sieve analysis. The formulation passed completely through sieve no. 120, indicating fine and uniform particle size distribution.

4. Abrasiveness Test

The formulation was found to be non-abrasive and smooth, indicating its suitability for safe topical application without causing skin irritation.

5. Bulk Density

The bulk density of the prepared antimicrobial dusting powder was found to be **0.5318 g/cm³**, indicating good packing ability and satisfactory flow characteristics of the formulation.

6. Tapped Density

The tapped density of the prepared antimicrobial dusting powder was found to be **0.9669 g/cm³**, indicating good compressibility and packing characteristics of the powder formulation.

7. Angle of Repose

The angle of repose of the prepared antimicrobial dusting powder was found to be 43°, indicating poor flow property of the powder formulation**.**

8. Carr's Index

The Carr's index of the prepared antimicrobial dusting powder was found to be **44.99%,** indicating poor flow property and high compressibility of the powder formulation.

9. Hausner Ratio

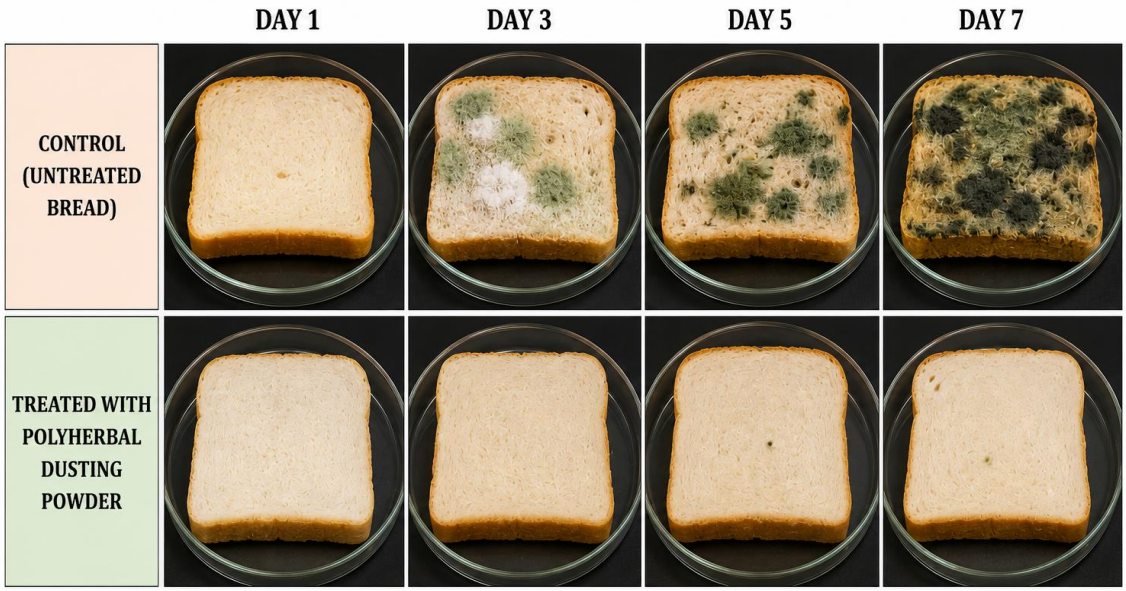
The Hausner ratio of the prepared antimicrobial dusting powder was found to be 1.81, indicating poor flowability and high cohesiveness of the powder formulation.

10. Moisture Content

The moisture content of the prepared antimicrobial dusting powder was found to be 4.92%, indicating acceptable moisture content and good stability of the formulation.

11.Antimicrobial Activity Using Bread

The antimicrobial activity of the prepared polyherbal dusting powder was evaluated using bread slices stored at room temperature for seven days. The untreated control bread slice showed visible microbial growth, discoloration, and fungal contamination from Day 3 onwards. In contrast, the bread slice treated with the polyherbal dusting powder showed significantly reduced microbial growth and remained comparatively fresh throughout the study period. The antimicrobial effect observed may be attributed to the presence of clove oil containing eugenol, which possesses strong antibacterial and antifungal activity. The results indicated that the formulated polyherbal dusting powder exhibited effective antimicrobial activity and may be useful for preventing microbial contamination and skin infections.



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