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FORMULATION DEVELOPMENT AND EVALUATION OF POLYHERBAL ANTIMICROBIAL POWDER

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ABSTRACT

The rise of antimicrobial resistance has led to increased interest in plant-based treatments for skin infections. This study focuses on the formulation and evaluation of an antimicrobial polyherbal dusting powder using Argemone Mexicana and Calotropis procera. Both plants are known for their traditional use and possess significant antimicrobial and wound-healing properties. The herbal powder was prepared using dried and powdered plant materials, followed by physicochemical evaluation and antimicrobial testing against common skin pathogens. Results indicate that the formulation exhibits notable antimicrobial activity, supporting its potential as a natural alternative for managing superficial skin infections.

KEYWORDS: *Polyherbal formulation, Argemone Mexicana, Calotropis procera, antimicrobial activity, herbal dusting powder, skin infections, wound healing.*

INTRODUTION

What is Antimicrobial Powder?

Antimicrobial powder is a substance that contains agents designed to kill or inhibit the growth of microorganisms such as bacteria, fungi, and sometimes viruses. These powders are commonly used in medical, industrial, and consumer products to maintain hygiene and prevent infections or contamination.

Antimicrobial powder is a dry formulation containing agents that inhibit the growth of or kill microorganisms such as bacteria, fungi, and sometimes viruses. These powders are commonly used in medical treatments, personal hygiene products, industrial coatings, and textile applications to prevent infections, reduce contamination, or maintain sterile conditions.

Uses

- Medical applications: Applied to wounds, surgical areas, or skin to prevent infection (e.g., bacitracin or neomycin powders).
- Personal care: Found in foot powders or body powders to reduce odour and microbial growth.
- Textiles and surfaces: Used as an additive in coatings or materials to make them resistant to microbes.
- Industrial: In paints, plastics, or packaging to extend shelf life and reduce contamination risks.
- Industrial and Surface Coatings:
  Incorporated into powder coatings for high-touch surfaces to reduce microbial load.
  Often used in hospitals, schools, and food production facilities.

AVAILABLE PRODUCT IN MARKET

1. Antibacterial Powders

Used for minor cuts, wounds, burns, and skin infections.

a. Neosporin Powder (Johnson & Johnson) – contains neomycin, bacitracin, and polymyxin B.
b. Betadine Powder (Mundipharma) – povidone-iodine powder; antiseptic for wound care.
c. Bacitracin Zinc Powder – used for preventing bacterial infections in wounds.
d. Cipladine Powder (Cipla) – povidone-iodine-based wound antiseptic.
e.

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2. Antifungal Powders

Used to treat skin fungal infections like athlete's foot, ringworm, or candidiasis.

a. Clotrimazole Dusting Powder (various brands: Canesten, Candid) – effective for fungal skin infections.
b. Miconazole Nitrate Powder (Micatin, Daktarin) – broad-spectrum antifungal powder.
c. Ketoconazole Powder (Nizoral Powder) – used for fungal infections and dandruff.
d. Tolnaftate Powder (Tinactin) – over-the-counter antifungal powder.

Other Marketed Prepared Powder

1. Cipladine Powder – Povidone-Iodine 5%
2. Betadine Powder – Povidone-Iodine
3. Neosporin Powder – Neomycin + Bacitracin + Polymyxin B
4. Bacitracin Zinc Powder – Bacitracin Zinc
5. Soframycin Skin Powder – Framycetin sulfate
6. Silverex Ionic Powder – Silver ions for wound healing
7. T-Bact Powder – Mupirocin (some formulations in powder form)
8. Burnol Powder – Aminacrine + Cetrimide
9. Cetrimide Powder – Antiseptic and disinfectant
10. Silver Sulfadiazine Powder – Broad-spectrum antimicrobial for burns
11. Iodine Powder – Elemental iodine (rarely used in pure form now)
12. Dettol Antiseptic Powder – Contains chloroxylenol (select markets)
13. Suthol Powder – Herbal + antiseptic agents (marketed as antimicrobial)
14. Microshield PVP Powder – Povidone-iodine-based antiseptic
15. Boro Plus Antiseptic Powder – Herbal antimicrobial with boric acid
16. Zydip-C Powder – Clobetasol + Clioquinol (antibacterial + steroid)
17. Acnovin Powder – Herbal, with antimicrobial claims (Ayurvedic)
18. Chlorhexidine Dusting Powder – Broad-spectrum antiseptic
19. Polybact Powder – Polymyxin B + Bacitracin
20. Himax Antiseptic Powder – Herbal antiseptic formulation

OWN PREPARATION OVER THE AVAILABLE PRODUCT IN MARKET

Properties

1. The powder should be uniform in composition.
2. It must not produce any local irritation.
3. It should exhibit good flow characteristics and distribute evenly.
4. It should adhere well to the skin upon application.
5. It should possess both adsorptive and absorptive abilities.

Compounding Methods

1) Grinding
2) Weighing
3) Mixing
4) Wrapping

Advantages

- Possess better chemical stability compared to liquid formulations.
- More convenient to transport than liquid dosage forms.
- Well-suited for use in young children and elderly individuals.
- Simple to apply directly onto wounds.
- Cost-effective option.
- Provides a quick onset of action.

Disadvantages

- Challenging to preserve powders with hygroscopic or aromatic components from degradation.
- Inappropriate for drugs that degrade under standard atmospheric conditions.
- Prone to physical instability over time.

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INGREDIENTS

1. Argemone Mexicana Linn

It has been recognized for its antimicrobial properties. In many cases, conventional medications prove inadequate for patients with chronic skin conditions due to side effects and reduced efficacy over prolonged use. Additionally, the emergence of drug-resistant human pathogens to commonly used treatments has further highlighted the need for alternative plant-based therapies.

2. Calotropis Procera

It is a flowering plant species belonging to the family Asclepiadaceae. Globally, it is recognized by several common names including swallowwort, Dead Sea apple, Sodom apple, and milkweed. In India, it is widely known by regional names such as madar in Hindi, orka in Oriya, alarka in Sanskrit, and akanda in Bengali.

3. Starch

It is used as adsorbent in the formulation. It is insoluble residue which remains after a granular starch is partially solubilized by an enzyme. This is used as the base for dusting powder either alone or in combination with other ingredients like talc.

4. Magnesium Stearate

It is clay mineral composed of hydrated magnesium silicate. Talc in powdered form, often in combination with corn starch, is widely used substance known as baby powder. This minerals used as a thickening agent and lubricant. It is also used for the adsorbent action.

5. Kaolin

It is a clay mineral, part of group of industrial minerals. Kaolin is applied to the skin to dry or soften the skin. It also used for the adsorbent action.

6. Zink oxide:

Zinc oxide (ZnO) is an inorganic compound composed of zinc and oxygen. It appears as a white, odourless powder and is insoluble in water. Zinc oxide is widely used for its antimicrobial, protective, and soothing properties, especially in topical and dermatological applications.

MATERIALS & METHODS

Argemone Mexicana Linn

The anti-microbial effect of some plants were attributed the use of conventional medication is often unsatisfactory for many patients with chronic skin disorders because of adverse effects and loss of effectiveness on long term uses.

Moreover, the development of drug resistant in human pathogens against commonly used. Therefore, it has become necessary to search for an alternative safe effect medicinal with little side effects.

Argemone Mexicana Linn known as prickly poppy or Ghamoya (family: Papaveraceae) is an exotic weed indigenous in South America but has widespread distribution in many tropical and subtropical countries including Asia and West Africa.

This plant is common everywhere by roadsides and field in India as well. The plant is an erect prickly annual herb of about 1 meter high, leaves usually 5 to 11 cm long and flower become 4 to 5cm in diameter. The seeds are spherical, shining, black and pitted.

Table 1. Taxonomical classification of Argemone Mexicana Linn

Sr. no.	Rank	Description
1.	Species	Argemone Mexicana Linn
2.	Genus	Argemone Linn (Prickly poppy)
3.	Family	Papaveraceae
4.	Order	Ranunculales
5.	Class	Magnoliophyta (Flowering plant)
6.	Phylum	Tracheophyta
7.	Kingdom	Plantae

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Figure 1: Argemone Mexicana

Antimicrobial Activity



Phytochemical components & their antimicrobial activity

1. **Berberine** –
   Broad-spectrum antimicrobial; effective against bacteria, fungi, and protozoa.
2. **Protopine** –
   Exhibits antibacterial and antifungal properties.
3. **Sanguinarine** –
   Known for strong antimicrobial, antifungal, and anti-inflammatory actions

Calotropis Procera

Calotropis procera is a species of flowering plants in the family of Asclepiadaceae. Worldwide, it has various socially accepted names such as swallowwort, Dead Sea apple, Sodom apple or milk weed.

Whereas in India, the plant is popularly known as madar in Hindi, orka in Oriya, alarka in Sanskrit and akanda in Bengali. In Arkelavana (Ayurveda formulations), C. procera is commonly known as Aak.

In traditional system of medicine, due to the medicinal value of C. procera, it is widely known procera reaches up to 6-8 feet (rarely to as much as 15 feet). The flower of this plant is mainly 5-20 cm long, 4-10 cm wide and basically borne in pairs.

The plant and plant extracts of Calotropis have been utilized in modern pharmaceutical companies recently.

Table 2. Taxonomical classification of Calotropis procera

Sr. no.	Rank	Description
1.	Species	Calotropis procera
2.	Genus	Calotropis
3.	Family	Asclepiadaceae
4.	Order	Gentianales
5.	Class	Magnoliopsida
6.	Phylum	Tracheophyta
7.	Kingdom	Plantae

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Figure 2. Calotropis Procera



Antimicrobial Activity
Phytochemical components & their antimicrobial activity
1. Cardiac Glycosides
Examples: Calotropin, Uscharin, Calotoxin
Activity: Disrupt microbial cell membrane potential; show bactericidal and fungicidal properties.
Effective Against: Staphylococcus aureus, Escherichia coli, Candida albicans

2. Alkaloids
Examples: Calotropamine, Calotropagenin
Activity: Inhibit microbial protein synthesis and interfere with DNA replication.
Effective Against: Both Gram-positive and Gram-negative bacteria

3. Flavonoids
Examples: Quercetin, Kaempferol derivatives
Activity: Disrupt microbial membranes and inhibit nucleic acid synthesis.
Effective Against: Bacteria and fungi, including Pseudomonas aeruginosa and Candida spp.

Plan of work
- Selection of drugs
- Collection of recipients
- Selection of procedure
- Formulation of dusting powder

Procedure
- Collect the roots of the argemone mexicana and Calotropis procera keep it for shed dry for 2 days.
- Then after drying transfer into blender and blend well.
- Weight given quantity of ingredients mentioned in the formulae.
- Transfer it to a clean mortal- pestle. Triturate all the ingredients until fine powder is obtained. Pass this Powder through the sieve 85#

FORMULA

Sr. no.	Ingredient	Quantity	Role
1.	Argemone mexicana	6mg	Antimicrobial agent
2.	Calotropis procera	6mg	Detoxifying agent
3.	Starch	3.75mg	Diluent
4.	Magnesium Stearate	6mg	Lubricant/ Glidant
5.	Kaolin	6mg	Adsorbent
6.	Zink Oxide	2.25mg	Dusting agent/ Stabilizer

Table 3. Formula of Antimicrobial Powder

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EVALUATION

a. Organoleptic Properties

- Color: greenish color
- Odor: mild aromatic
- Texture: smooth texture

b. PH

PH of the powder found to be 5.6 & it does not cause any irritation to the Skin.

c. Particle Size

The particle size of prepared powder was determined by using microscope and sieve analysis. It is found to be 129 microns.

d. Bulk Density (BD)

A known amount of granules was transferred into a 25ml of measuring cylinder, carefully level the powder without compacting and measure the bulk volume

Formula

Bulk Density = weight of powder / Bulk Volume

e. Tapped Density(TD)

Tapped density is the ratio of weight of powder to the Tapped volume. It was determined by tapping a measuring cylinder containing fixed quantity of powder for the specific period of time.

The tapped density was calculated by using following formula.

Tapped Density = Weight of Powder / Tapped

Figure 3. Bulk Density Measurement



f. Angle of Repose

Angle of repose is used to check the flowability of the granules in hopper before compression of tablet. Fixed funnel method is used to check the angle of repose. At the specific height the funnel was fixed on the graph paper which is placed horizontally at surface. Then the granule was passed to the funnel until the apex of the pile touched to the tip of the funnel. Radius was measured by using scale and determined the angle of repose by using following formula.

Angle of repose = tan-1(h/r)

Where,
h – Height of pile.
r – Radius of pile

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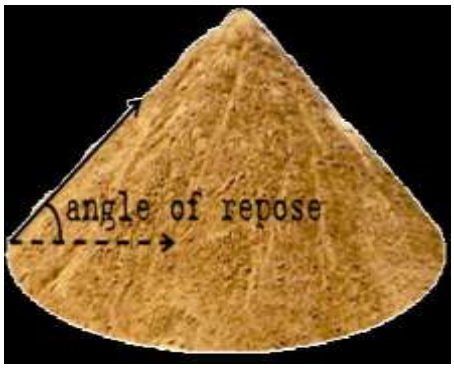


Figure 4. Angle of Repose

g. Carr's Index

Carr's index was used to check the compressibility and flow of the granules from hopper. It is expressed in percentage. The Carr's index of the powder was found to be 9.80%.

Carr's index was calculated by using following formula.

Carr's Index = Bulk Volume – Tapped volume / Bulk volume × 100

h. Hausner Index

It was determined after the measuring of Tapped density and bulk density. The Hausner ratio of the powder was found to be 1.28.

It is the densification of the herbal powder mixture which may result from the vibration of the feed hopper which was calculated by using below formula

Hausner Ratio = Tapped Density / Bulk Density

i. Moisture Content

The Moisture content was found to be 14.45% w/v.

Sr. No	Physical parameters	Values of Optimum Formulation	Standard Value
01	pH	5.6	6.4
02	Angle of Repose	23	25.75
03	Bulk Density	0.46	0.53
04	Tapped Density	0.51	0.57
05	Carr's Index	9.80%	7.0 %
06	Hauser's Ratio	1.10	1.07
07	Moisture content	14.45% w/v	15 % w/v

Table 4. Evaluation Parameter

CONCLUSION

Polyherbal dusting powder Formulation was found to be in obedience with all properties of powder and exhibited satisfactory result. The research paper concludes that **Argemone mexicana** & **Calotropis procera** powder exhibits significant anti-microbial activity. Through various experimental procedures, also the formulation shows better antimicrobial properties.

Thus, the formulation can be used as antimicrobial powder.

The formulated antimicrobial powder containing Argemone mexicana and Calotropis procera demonstrates promising potential as a plant-based alternative for microbial control. The ingredients selected are supported by traditional and modern literature for their antimicrobial, adsorptive, and skin-protective properties. The formulation meets acceptable pharmaceutical standards for physical and functional characteristics. The powder exhibited:

- A skin-friendly pH of 5.6
- Good flow properties (angle of repose: 23°, Carr's Index: 9.80%, Hausner Ratio: 1.10)
- Acceptable bulk (0.46 g/cm³) and tapped density (0.51 g/cm³)
- A particle size of 129 microns
- Moisture content within permissible limits (14.45%)

Organoleptic evaluations also confirmed favorable sensory attributes (smooth texture, mild aroma, and greenish color), enhancing its acceptability for topical application.

In summary, this herbal antimicrobial powder is stable, effective, cost-efficient, and easy to apply, with potential for broader

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application in skin care and wound management. Further clinical studies and microbial assays are recommended to validate and enhance its efficacy.

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