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"Formulation And Evaluation Of Antifungal Cream"

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The growing resistance to synthetic antifungal agents and increasing consumer preference for natural skin care solutions have prompted the need for innovative herbal alternatives. This thesis presents the formulation and comprehensive evaluation of a polyherbal antifungal cream developed using bioactive extracts from Camellia sinensis, Centella asiatica, Coffea arabica, Psidium guajava, Aloe barbadensis miller, and Thuja occidentalis. Each of these botanicals was selected based on their proven antifungal, antioxidant, and skin-regenerative properties. The study involved the methodical extraction and phytochemical screening of each plant material, confirming the presence of therapeutic constituents such as flavonoids, glycosides, terpenoids, and saponins. Three formulations (F1, F2, F3) were prepared by varying concentrations of emulsifying agents and evaluated for their physicochemical characteristics, including pH, viscosity, spreadability, washability, homogeneity, and stability. Antifungal efficacy was assessed via agar well diffusion against Candida albicans, Aspergillus brasiliensis, and Penicillium chrysogenum. This research validates the synergistic potential of polyherbal formulations in topical therapy and offers a sustainable, skin-friendly alternative to conventional antifungal creams. The study paves the way for further development of safe, effective, and eco-conscious herbal cosmeceuticals.

Keywords: Polyherbal formulation; Antifungal cream; Camellia sinensis; Centella asiatica; Coffea Arabica; Psidium guajava; Aloe barbadensis miller; Thuja occidentalis

1. INTRODUCTION:

1.1 What are Polyherbal Drugs?

Polyherbal drugs are formulations that contain a combination of two or more herbal ingredients in a single preparation. These formulations are designed to enhance therapeutic efficacy through **synergistic action**, where different herbs work together to produce a stronger and broader range of health benefits.

The concept of polyherbalism originates from Ayurveda, which emphasizes that a combination of herbs is more effective and balanced than using a single herb alone[1].

I. **Advantages of polyherbal formulations**:

- Enhanced therapeutic effect (synergy)
- Broader spectrum of activity (e.g., antifungal, anti-inflammatory, antioxidant)
- Reduced risk of side effects due to balancing actions of multiple herbs

- Improved patient compliance due to multi-functional benefits[1].

II. **Types of Polyherbal Drugs**

Polyherbal drugs are classified based on their formulation and application:

a) Based on Dosage Form:

- **Polyherbal Creams**: For skin infections, moisturizing, etc.
- **Polyherbal Gels**: Anti-acne, anti-inflammatory applications
- **Polyherbal Tablets/Capsules**: Immunity boosters, digestive support
- **Polyherbal Oils**: Hair growth, joint pain relief
- **Polyherbal Syrups**: For cough, liver tonics, etc.
- **Polyherbal Soaps/Shampoos**: For skin/hair care[1,2].

b) Based on Intended Use:

- **Cosmeceutical Use**: Skin brightening, anti-aging, antifungal creams
- **Therapeutic Use**: Anti-diabetic, hepatoprotective, anti-arthritic
- **Preventive Use**: Immunity boosters, adaptogens
- **Nutraceutical Use**: Herbal health supplements, multivitamin formulas[1,2].

c) **Limitations of Polyherbal drugs**

Polyherbal drugs while offering numerous benefits like enhanced efficacy and synergistic effects, also come with certain limitations. Here are some of the common challenges associated with polyherbal formulations[2]:

- **Interactions Between Herbs**: The components of different herbs in polyherbal formulations can interact with each other, sometimes in unpredictable ways. These interactions may affect the bioavailability of certain compounds or cause adverse effects, complicating safety profiles.
- **Adverse Reactions**: Although herbal drugs are considered safe, polyherbal formulations might increase the risk of allergic reactions or side effects due to the combined effects of multiple plant constituents. It may be challenging to pinpoint the specific herb responsible for an adverse reaction.
- **Dosing Challenges**: Determining the optimal dosage of polyherbal drugs is more complex than single-herb formulations. The synergistic or antagonistic effects of various plants can alter the required dose and complicate dosing guidelines.
- **Regulatory Challenges**: Many countries do not have clear regulatory frameworks for polyherbal formulations, leading to challenges in product registration and quality control. This can result in inconsistent product labeling, potentially leading to consumer confusion.
- **Herb-Drug Interactions**: Polyherbal formulations may interact with conventional medications, leading to altered drug metabolism or reduced therapeutic effects. Herbal ingredients might affect liver enzymes or interfere with pharmacokinetics, creating concerns for individuals on prescribed medications[2,3].

1.2 Herbal Drugs in Antifungal Cream Formulation

This study investigates the formulation and evaluation of a novel polyherbal antifungal cream. The cream is developed using plant extracts known for their antimicrobial, antifungal, anti-

inflammatory, and skin-protective properties, namely Camellia sinensis (green tea), Centella asiatica (gotu kola), Coffea arabica (coffee), Psidium guajava (guava leaves), Aloe barbadensis miller (aloe vera), and Thuja occidentalis (white cedar)[4].

A. Camellia sinensis (Green Tea)

Green tea is rich in catechins, particularly epigallocatechin gallate (EGCG), which has strong antioxidant and antimicrobial properties. It helps in protecting the skin from oxidative damage and supporting overall skin health[5].

Fig 1: Camellia sinensis (Green Tea)

B. Centella Asiatica (Gotu Kola)

Gotu Kola is known for its wound-healing properties due to compounds like asiaticoside and madecassoside. It promotes collagen formation, improves skin healing, and provides anti-inflammatory benefits, making it ideal for treating skin conditions[6].

Fig 2: Centella Asiatica (Gotu Kola)

C. Coffea arabica (Coffee)

Coffee is a potent antioxidant due to its chlorogenic acids and caffeine content. It helps in reducing inflammation, neutralizing free radicals, and rejuvenating the skin, making it beneficial for overall skin health and fungal infections[7].

Fig 3: Coffea arabica (Coffee)

D. Aloe vera (Aloe Barbadensis)

Aloe vera contains acemannan and other soothing compounds that promote healing and reduce inflammation. It is widely used for its moisturizing, anti-inflammatory, and antifungal properties, aiding in the healing of fungal skin lesions[8].

Fig 4: Aloe vera (Aloe Barbadensis)

E. Psidium guajava (Guava)

Guava leaves are rich in flavonoids, tannins, and vitamin C, which have antimicrobial and antifungal properties. These components help in treating infections and improving skin health by promoting healing and preventing microbial growth[9].

Fig 5: Psidium guajava (Guava)

F. Thuja occidentalis (White Cedar)

Thuja is known for its antifungal and antimicrobial properties due to thujone and essential oils. It is used to treat skin infections, particularly fungal infections, and helps in promoting skin healing and reducing inflammation[10].

Fig 6: Thuja occidentalis (White Cedar)

These selected herbal ingredients have been chosen for their potent antifungal, antioxidant, and skin-healing properties. Each herb contributes uniquely to the formulation, ensuring a synergistic effect that enhances the cream's overall efficacy. The combination of these natural extracts helps in reducing fungal infections, soothing inflammation, and promoting skin repair. Their bioactive compounds not only target fungal growth but also nourish and protect the skin, making this formulation both therapeutic and skin-friendly.

2. MATERIAL AND METHOD

2.1 MATERIALS:-

The following medicinal plants were used in this study. All plants were procured from local sources in Ujjain, Madhya Pradesh, and authenticated by the Department of Botany, Vikram University, Ujjain.

2.1.1 Plant Materials:

Table 1 Used Plant Materials

S. No.	Botanical Name	Common Name	Part Used
1	Camellia sinensis	Green Tea	Leaves
2	Centella asiatica	Gotu Kola	Whole Plant
3	Coffea arabica	Coffee	Seeds (Beans)
4	Psidium guajava	Guava	Leaves

S. No.	Botanical Name	Common Name	Part Used
5	Aloe barbadensis miller	Aloe Vera	Leaf Gel
6	Thuja occidentalis	White Cedar	Leaves/Essential Oil

2.1.2 Chemicals and Excipients:

Table 2 Used Chemicals & Excipients

S. No.	Name	Purpose / Function
1	Stearic Acid	Acts as an emulsifying agent and provides thickness to the cream. Helps in the formation of oil-in-water emulsions.
2	Cetyl Alcohol	Used as an emollient, thickener, and stabilizer; enhances the texture and spreadability of the cream.
3	Glycerin	Functions as a humectant and moisturizer; retains skin moisture and prevents dryness.
4	Triethanolamine	Works as an emulsifier and pH adjuster; helps to neutralize fatty acids and stabilize the emulsion.
5	Sodium Hydroxide	Used to adjust pH to match the natural pH of skin, ensuring skin compatibility.
6	Methyl Paraben	Acts as a preservative to prevent microbial growth and increase shelf life.
7	Propyl Paraben	Works along with methyl paraben as a broad-spectrum preservative; enhances antimicrobial preservation.
8	Distilled Water	Serves as the solvent or aqueous base for dissolving water-soluble ingredients and forming the emulsion.

2.1.3 Instrumets/Equipments:

Table 3 Used Instruments

S. No.	Instrument/Equipment	Role/Function
1	Soxhlet Extractor	Used for continuous hot extraction of plant materials using solvents.
2	Rotary Evaporator	Used to concentrate plant extracts by removing solvents under reduced pressure.
3	Weighing Balance	Used to accurately weigh chemicals and plant materials.

S. No.	Instrument/Equipment	Role/Function
4	Hot Plate with Magnetic Stirrer	For controlled heating and continuous mixing during formulation.
5	Mortar and Pestle	Used for grinding dried plant materials into coarse powder.
6	Beakers and Flasks	Used for mixing, heating, and transferring liquids during preparation.
7	Funnels	Used for filtration and transferring liquids during extraction.
8	pH Meter	Used to determine the pH of the formulated cream.
9	Viscosity Measuring Apparatus (Brookfield Viscometer)	Measures the viscosity of the cream.
10	Glass Slides	Used for spreadability test of the cream.
11	Incubator	Used to maintain optimal temperature for microbial testing.
12	Petri Dishes	Used to culture fungal strains for antifungal activity testing.
13	Micropipette/Dropper	Used to accurately transfer small volumes of liquids.
14	Disc Diffusion Apparatus	Used to perform antifungal activity test and measure zone of inhibition.

2.2 METHOD

2.2.1 Collection and Authentication of Plant Materials

Medicinal plants used in the formulation were collected from the local market of Ujjain, Madhya Pradesh. These were authenticated by Dr. Jagdish Kumar Sharma, Department of Botany, Vikram University, Ujjain.

2.2.2 Preparation of Plant Extracts

- Each plant material was washed, shade-dried, and coarsely powdered.
- The powdered material was extracted using **Soxhlet extraction** with **ethanol** as solvent for 6–8 hours.
- The extracts were concentrated using a **rotary evaporator** and stored in airtight containers at 4°C until further use[11].

2.2.3 Preliminary Phytochemical Screening

All extracts were subjected to preliminary phytochemical screening for the presence of alkaloids, flavonoids, tannins, saponins, glycosides, and terpenoids using standard procedures[12].

2.2.4 Formulation of Polyherbal Antifungal Cream

- The cream was prepared using the oil-in-water emulsion base method.
- Oil phase: Stearic acid, cetyl alcohol, and liquid paraffin were melted together.
- Aqueous phase: Glycerin, propylene glycol, and herbal extracts were mixed and heated.
- The aqueous phase was slowly added to the oil phase with constant stirring.
- Preservatives were added, and triethanolamine was used to adjust the pH and consistency.
- The cream was stirred continuously until it formed a smooth, uniform emulsion and cooled to room temperature[13].

2.2.5 Evaluation of Cream

The formulated cream was evaluated for the following parameters[14,15]:

- **Physical Appearance** (color, texture, homogeneity)
- **pH Determination** (using digital pH meter)
- **Spreadability** (using glass slide method)
- **Viscosity** (Brookfield viscometer)
- **Stability Testing** (at different temperature conditions for 4 weeks)
- **Antifungal Activity**
  - Tested using **disc diffusion method** against Candida albicans and Aspergillus niger.
  - Zone of inhibition was measured and compared with standard antifungal cream.

3. RESULTS AND DISCUSSION

3.1 Evaluation of Herbal Extracts

3.1.1 Characteristics of Extracts

The physical attributes such as state, texture, color, and odor of different herbal extracts were recorded and presented in Table 8.

Table 4 Characteristics of Extracts

Common Name	Botanical Name	State	Nature	Color	Odor
Green Tea	Camellia sinensis	Solid	Sticky	Dark Green	Aromatic
Gotu Kola	Centella asiatica	Liquid	Non-sticky	Transparent	Herbal
Coffee	Coffea arabica	Solid	Non-sticky	White	Odorless
Aloe Vera	Aloe barbadensis	Semi-solid	Sticky	Transparent	Earthy
Guava Leaf	Psidium guajava	Solid	Non-sticky	Light Green	Aromatic

Common Name	Botanical Name	State	Nature	Color	Odor
Thuja Plant	Thuja occidentalis	Liquid	Oily	Light Yellow	Aromatic

3.1.2 Phytochemical Investigation of Extracts

A preliminary phytochemical screening was conducted on various extracts, indicating the presence of bioactive constituents with known pharmacological activities such as antifungal, antimicrobial, anti-inflammatory, antioxidant, and photoprotective effects. The results are summarized in Table

Table 5 Phytochemical investigation of the extract

Constituents	Green Tea	Gotu Kola	Coffee	Guava Leaf	Thuja Oil	Aloe Vera
Alkaloids (Dragendorff's Test)	-	-	+	+	-	-
Glycosides (Legal's Test)	+	+	+	+	+	+
Flavonoids (Lead Acetate Test)	-	-	+	+	+	-
Terpenoids (Salkowski Test)	-	+	+	+	-	-
Phenols (Ferric Chloride Test)	+	+	-	+	+	-
Carbohydrates (Benedict's Test)	-	-	-	-	-	+
Proteins (Biuret Test)	-	-	-	-	-	-
Saponins (Froth Test)	+	-	-	+	-	-
Tannins (Ferric Chloride Test)	+	-	-	+	-	-
Diterpenoids (Copper Acetate Test)	+	+	+	+	+	-

3.1.3 Antifungal Activity of Polyherbal Extracts

Antifungal potential of the polyherbal extract was evaluated using the well diffusion method. The activity was assessed based on the diameter of the zone of inhibition surrounding the wells. Larger zones indicate higher antifungal efficacy. The extract was tested at concentrations of 100 µg, 300 µg, and 500 µg against Candida albicans (ATCC-10231), Aspergillus brasiliensis (ATCC-16404), and Penicillium chrysogenum (ATCC-10108). Results demonstrated significant inhibition zones, as illustrated in **Table 10.**

Table 6 Antifungal activity of extract

S. No.	Test Parameters	UOM	Test Method	Specification	Result (mm)	Photo
1	Antifungal Activity against Candida albicans ATCC 10231 (100µL/100µg)	mm	Well diffusion method	≥3 mm	4	
2	Antifungal Activity against Candida albicans ATCC 10231 (100µL/300µg)	mm	Well diffusion method	≥3 mm	6	
3	Antifungal Activity against Candida albicans ATCC 10231 (100µL/500µg)	mm	Well diffusion method	≥3 mm	8	
4	Antifungal Activity against Aspergillus brasiliensis ATCC 16404 (100µL/100µg)	mm	Well diffusion method	≥3 mm	3	
5	Antifungal Activity against Aspergillus brasiliensis ATCC 16404 (100µL/300µg)	mm	Well diffusion method	≥3 mm	6	
6	Antifungal Activity against Aspergillus brasiliensis ATCC 16404 (100µL/500µg)	mm	Well diffusion method	≥3 mm	8	
7	Antifungal Activity against Penicillium chrysogenum ATCC 10108 (100µL/100µg)	mm	Well diffusion method	≥3 mm	4	
8	Antifungal Activity against Penicillium chrysogenum ATCC	mm	Well diffusion method	≥3 mm	5	

S. No.	Test Parameters	UOM	Test Method	Specification	Result (mm)	Photo
	10108 (100µL/300µg)					
9	Antifungal Activity against Penicillium chrysogenum ATCC 10108 (100µL/500µg)	mm	Well diffusion method	≥3 mm	8	

3.2 Formulation of Polyherbal Cream

Three cream formulations (F1, F2, F3) were prepared by varying concentrations of stearic acid (11, 12, 13 g) and cetyl alcohol (1, 1.5, 2 g) respectively.

Fig. 7 Formulation F1

Fig. 8 Formulation F2

Fig. 9 Formulation F3

3.3 Evaluation of Polyherbal Cream

3.3.1 Physical Appearance

The prepared cream formulations underwent thorough evaluation to assess their organoleptic characteristics, including visual color, surface texture, fragrance, and uniformity. The findings from these assessments are detailed below.

Table 7 Physical appearance of polyherbal cream

S. No.	Parameter	F1	F2	F3
1	Colour	Beige	Beige	Light Beige
2	Texture	Smooth	Smooth	Smooth
3	Odour	Herbal	Herbal	Herbal
4	Homogeneity	Good	Good	Good

3.3.2 pH Determination

The pH levels of all formulated creams were determined using a properly calibrated digital pH meter to ensure accuracy and consistency across the samples.

Table 8 Measurement of pH

Formulation	pH
F1	4.7
F2	5.2
F3	5.3

3.3.3 Viscosity

Viscosity was measured using a Brookfield Viscometer (RV6 spindle at 60 rpm).

Table 9 Measurement of Viscosity

Formulation	Viscosity (cps)
F1	2356 ± 0.6
F2	4220 ± 0.2
F3	5283 ± 0.3

3.3.4 Spreadability

Measured using standard spreadability apparatus.

Table 10 Measurement of Spreadability

Formulation	Spreadability (g·cm/sec)
F1	12.8
F2	12.4
F3	11.1

3.3.5 Washability

Washability was assessed by applying the cream on the skin and rinsing under running tap water.

Table 11 Measurement Washability

Formulation	Washability
F1	Good
F2	Good

Formulation	Washability
F3	Good

3.3.6 Homogeneity

Homogeneity was visually observed.

Table 12 Homogeneity Check

Formulation	Homogeneity
F1	Nil
F2	Nil
F3	Nil

3.3.7 Type of Smear

Smear type was determined by placing cream on paper and observing after a set time.

Table 13 Smear Types

Formulation	Type of Smear
F1	Oily
F2	Matte
F3	Flaky

3.3.8 Irritation Test

To assess potential skin sensitivity or irritation, a patch test was performed by applying a small quantity of each cream formulation to a marked area on the forearm. The test sites were monitored carefully, and observations regarding any redness, itching, or adverse reactions were recorded after a 24-hour period.

Table 14 Irritation Types

Formulation	Irritation	Edema
F1	Nil	Absent
F2	Nil	Absent
F3	Nil	Absent

3.3.9 Stability Studies

Stability of each formulation was studied under different temperatures (4°C and 40°C) over 30 days. Parameters such as color, appearance, pH, odor, viscosity, and spreadability were monitored.

To ensure the effectiveness, safety, and shelf-life of the developed polyherbal cream formulations, comprehensive stability studies were conducted under different storage conditions. In this study, three formulations—F1, F2, and F3—were evaluated for their physical and chemical stability by storing them at two different temperatures: 4°C (refrigerated condition) and 40°C (accelerated condition). Observations were made on Day 7, Day 15, and Day 30, and the creams were assessed for colour, appearance, pH, odour, viscosity, and spreadability. These parameters provide critical insight into how the formulations react to different storage conditions over time.

The data generated from this evaluation helps identify the most stable formulation, suitable for long-term usage and commercial production. Among the tested samples, noticeable changes were observed in F1 and F3, particularly at elevated temperatures. These included slight changes in colour (e.g., darkening) and pH shift, whereas Formulation F2 maintained its physical integrity and showed no significant variation, indicating better resistance to temperature-induced degradation.

Table 15 – Stability Study of Polyherbal Cream

Test & Formulation	At 4°C			At 40°C		
Days	**Day 7**	**Day 15**	**Day 30**	**Day 7**	**Day 15**	**Day 30**
1. Colour						
F1	Off-white	Off-white	Light Off-white	Dark Off-white	Dark Off-white	Dark Off-white
F2	Off-white	Off-white	Off-white	Off-white	Off-white	Off-white
F3	Light Off-white	Light Off-white	Light Off-white	Off-white	Off-white	Off-white
2. Appearance						
F1	Semisolid	Semisolid	Semisolid	Semisolid	Semisolid	Semisolid
F2	Semisolid	Semisolid	Semisolid	Semisolid	Semisolid	Semisolid
F3	Semisolid	Semisolid	Semisolid	Semisolid	Semisolid	Semisolid
3. pH						
F1	4.7	4.7	4.8	4.8	4.8	4.9
F2	5.2	5.2	5.2	5.2	5.2	5.2
F3	5.3	5.4	5.7	5.5	5.7	5.9
4. Odour						
F1	Herbal	Herbal	Herbal	Herbal	Unpleasant	Unpleasant
F2	Herbal	Herbal	Herbal	Herbal	Herbal	Herbal
F3	Herbal	Herbal	Herbal	Herbal	Herbal	Herbal
5. Viscosity (cps)						
F1	2356±0.6	2309±0.2	2283±0.1	2364±0.5	2307±0.5	2282±0.3
F2	4220±0.2	4221±0.3	4224±0.7	4220±0.7	4223±0.4	4224±0.2
F3	5283±0.3	5289±0.1	5284±0.3	5284±0.1	5173±0.7	5284±0.7
6. Spreadability (g·cm/sec)						
F1	12.80	12.56	11.52	12.78	11.63	11.18
F2	13.27	13.29	13.22	13.27	13.20	13.17
F3	11.74	11.19	10.18	11.22	10.59	12.18

4. CONCLUSION

This study highlights the potential health benefits of Withania coagulans, Picrorhiza kurroa, and Gymnema sylvestre, particularly in managing diabetes and improving overall well-being. The extracts demonstrated promising antidiabetic properties, including improved blood sugar control, enhanced insulin sensitivity, and better lipid profiles, which may contribute to reducing the risk of diabetes-related complications. Additionally, the presence of bioactive compounds in these plants suggests their potential to reduce inflammation, oxidative stress, and hepatotoxicity, while also supporting cardiovascular health, immune function, and

cognitive performance. Their ability to aid digestion, promote the absorption of essential nutrients, and manage obesity further reinforces their therapeutic value. Overall, these medicinal plants offer a natural and holistic approach to health management, with significant implications for diabetes treatment and general wellness. Further research and clinical studies are recommended to validate these findings and explore their broader applications in modern medicine.

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