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Development and Evaluation of Topical Herbal Formulation for Infectious Eczema

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Abstract: *The study Development and Evaluation of Topical Herbal Formulation for Infectious Eczema presents a comprehensive investigation into the preparation and assessment of a herbal gel aimed at addressing infectious eczema. The research methodology involved meticulous plant collection, extraction, and subsequent physicochemical and phytochemical analyses. Murraya koenigli leaves were collected, identified, dried, and ground into a fine powder before undergoing successive extraction with solvents of increasing polarity. The resulting extracts were concentrated and stored for future use. Physicochemical constants of the powdered drug were determined, including moisture content, total ash value, and extractive values, providing insights into the composition and quality of the herbal material. Preliminary phytochemical evaluations were conducted to identify the presence of specific phytoconstituents such as alkaloids, saponins, flavonoids, phenols, and triterpenoids. These evaluations involved various qualitative tests, each confirming the presence of specific compounds indicative of potential bioactivity. Subsequently, a herbal gel was formulated using the plant extract and Carbopol-934 as a gelling agent, along with other excipients. The gel formulations were evaluated for pH, spreadability, extrudability, and stability over time. Results indicated suitable pH values, spreadability, and extrudability across different formulations, suggesting their potential for dermatological applications. Stability studies demonstrated consistent physical appearance, rheological properties, spreadability, pH, and drug levels over a one-month period, affirming the formulations' stability and therapeutic potential. Overall, this study provides valuable insights into the development of effective herbal formulations for managing infectious eczema, contributing to the advancement of natural-based therapies in dermatology and offering promising avenues for further research and clinical application*

Keywords: Herbal formulation, infectious eczema, phytochemical analysis, topical gel, Murraya koenigii, physicochemical properties, stability study, dermatological applications

I. INTRODUCTION

In recent years, there has been a growing interest in exploring natural remedies for various dermatological conditions, driven by the need for safe and effective alternatives to conventional pharmaceuticals.[1,2] Among these conditions, infectious eczema stands out as a significant challenge due to its chronic and often debilitating nature. Eczema, characterized by inflamed, itchy skin, can be exacerbated by bacterial or fungal infections, leading to further discomfort and complications. While conventional treatments such as topical corticosteroids and antimicrobial agents are commonly used, their long-term use may be associated with adverse effects and the development of microbial resistance. As a result, there is a pressing need to explore alternative treatment options that are both efficacious and safe for long-term use.[3,4]

One promising avenue of research lies in the utilization of herbal formulations, which have been used for centuries in traditional medicine systems for their therapeutic properties.[5] These formulations often contain a complex mixture of bioactive compounds derived from plant sources, which may exhibit antimicrobial, anti-inflammatory, and wound-healing properties. However, despite their potential benefits, the development of herbal formulations for dermatological conditions such as infectious eczema remains relatively unexplored, with limited scientific evidence to support their efficacy and safety.[6,7]

Against this background, this study aims to address the research gap by developing and evaluating a topical herbal formulation specifically targeted at infectious eczema.[8] By systematically investigating the phytochemical

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composition, physicochemical properties, and stability of the formulation, this research seeks to establish its potential as a safe and effective treatment option for this challenging dermatological condition.[9,10] Through rigorous scientific inquiry, this study aims to contribute to the growing body of evidence supporting the use of herbal medicines in dermatology and pave the way for the development of novel therapeutics for infectious eczema.

II. MATERIALS AND METHOD

Plant collections

Murraya koeingli leaves were collected, identified under expert guidance and preserved for future reference. The leaves were dried and ground to a very fine powder all other powder are subjected to successive extraction by using different solvent in increasing the order of polarity (pet.ether, chloroform and methanol) in soxhlet apparatus until the eluent became colourless. The prepared extract will be concentrated under reduced pressure and stored in air tight container away from direct sunlight. [12.13]

Extraction

All powder were weighed and defatted with petroleum ether (60-80 °C) in Soxhlet's extractor. The marc was dried and again extracted with methanol for 72hrs in Soxhlet's extractor. The ethanolic extract was evaporated using rotary evaporator. [14,15]

Determination of Physicochemical Constants of the powdered drug

The physicochemical constants of the powdered drug, crucial for quality assessment and formulation development, were meticulously determined. Moisture content, total ash value, acid-insoluble ash, water-soluble ash, alcohol-soluble extractive value, and water-soluble extractive value were evaluated to ascertain the composition and quality of the herbal material. These parameters provide valuable insights into the presence of inorganic residues, soluble constituents, and potential impurities, guiding the standardization and optimization of topical herbal formulations for the effective management of infectious eczema.[16,17]

Preliminary Phytochemical Evaluation of Extract

The preliminary phytochemical evaluation of extract involved various tests to determine the presence of specific phytoconstituents. For saponins, both foam and haemolytic tests were conducted, with persistent foam formation and the appearance of a hemolytic zone indicating the presence of saponins. Alkaloids were tested using Dragendorff's, Mayer's, Wagner's, and Hager's tests, with characteristic precipitates indicating their presence. Flavonoids were assessed through Shinoda, alkaline reagent, and zinchydrochloride tests, where distinctive color changes confirmed their presence. The presence of phenols was determined by observing a deep bluish-green color upon adding ferric chloride solution to the extract. Triterpenoids were identified using Libermann-Burchard and sulfur powder tests, while lignins were detected through concentrated HCl and phloroglucinol treatment, and further confirmed by the thionine test, where a bluish-violet color developed. [18,19]

Preparation of herbal Gel

The gel was prepared using the extract and using Carbopol-940 (1%) as a gelling agent. Gels of extracts as gels were prepared.

Procedure:

Weigh or measure the desired amount of Carbopol 934 and Add it to a clean mixing bowl.
Slowly sprinkle the Carbopol 934 powder into distilled water while stirring continuously to prevent clumping.
Continue stirring until the Carbopol 934 has completely dissolved, and a homogenous mixture is obtained.
Add the extract to the Carbopol 934 mixture while stirring.
Continue stirring until the extract are evenly dispersed throughout the mixture.
Check the pH of the mixture using a pH meter or pH indicator strips. Adjust the pH if necessary using small amounts of sodium hydroxide or hydrochloric acid.
Allow the mixture to sit for 10-15 minutes to ensure complete hydration of the Carbopol 934.
Stir the mixture again to ensure uniformity.
Add the methyl paraben, propyl paraben, and menthol oil to the mixture. Stir well to ensure they are thoroughly mixed.
Check the pH once more and adjust if needed.
Transfer the mixture to a suitable container or dispenser and allow it to cool and gelify.

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Store the herbal gel in a cool, dry place away from direct sunlight.[20,21]

Table 1: Composition of herbal Gel

Composition	F1	F2	F3	F4	F5	F6
extract	1.5	2	2.5	3	3.5	4
Carbopol 934	1	1.5	2	1	1.5	2
Propylene glycol	5	10	15	5	10	15
Methyl paraben	0.2	0.2	0.2	0.2	0.2	0.2
Propyl paraben	0.5	0.5	0.5	0.5	0.5	0.5
Purified water	100	100	100	100	100	100
Menthol oil	0.1	0.1	0.1	0.1	0.1	0.1
Triethonal amine	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.

III. EVALUATION OF PREPARED GEL

- pH
- Spreadability and Consistency
- Homogeneity
- Stability Studies[22-26]

IV. RESULTS AND DISCUSSION

The phytochemical investigation of *Murraya koenigli* revealed the presence of various constituents. Alkaloids, steroids, proteins, carbohydrates, fats & oil, and diterpenes were detected in the plant extract, as evidenced by their respective positive results. These findings suggest the potential bioactivity of *M. koenigli* due to the presence of these phytochemicals, which have been previously reported to possess medicinal properties.

Table 2: Phytochemical investigation

S. No	Phyto-constituents	*Murraya koeingli*
1	Alkaloids	+ve
2	Glycosides	-ve
3	Tannins	-ve
4	Resins	-ve
5	Flavonoids	-ve
6	Steroids	+ve
7	Amino-acids	-ve
8	Proteins	+ve
9	Carbohydrates	+ve
10	Fats & Oil	+ve
11	Phenol test	-ve
12	Diterpenes	+ve

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13	Saponins test	++ve

Alkaloids and steroids, in particular, have been associated with various pharmacological activities, including anti-inflammatory, antimicrobial, and anticancer effects. The presence of proteins, carbohydrates, and fats & oil indicates the nutritional value of the plant, which may contribute to its traditional uses as a food source.

Furthermore, the significant (++ve) result for the saponins test suggests the presence of these compounds in relatively high concentrations, which are known for their foam-forming and emulsifying properties and have been linked to several health benefits, including cholesterol-lowering and antioxidant effects.

Conversely, glycosides, tannins, resins, flavonoids, amino acids, and phenols were absent or present in negligible amounts, as indicated by their negative (-ve) results. While the absence of these compounds does not diminish the potential therapeutic value of *M. koenigli*, it provides insights into its phytochemical profile and aids in understanding its pharmacological properties.

Overall, the results of this phytochemical investigation contribute to the scientific understanding of *M. koenigli* and support its potential utilization in various health-related applications, pending further studies to elucidate its specific bioactive compounds and mechanisms of action.

V. EVALUATION OF PREPARED GEL

pH of gel

The evaluation of the prepared gel included the assessment of its pH. The pH values of the gel samples ranged from 4.8 to 5.2. These results indicate that the pH of the gel formulations falls within the mildly acidic to neutral range.

Table 3: pH of gel

Sample	pH Measurement
F1	4.8
F2	5.1
F3	4.9
F4	5.2
F5	5.0
F6	5.1

The slight variation in pH among the samples may be attributed to differences in the composition and proportions of the gel constituents. The pH of a gel formulation is a critical parameter as it can influence various properties such as stability, compatibility with the skin, and efficacy of active ingredients. In this context, the pH range observed in the gel samples suggests that they are likely suitable for topical application, as they are close to the physiological pH of the skin, which ranges from 4.5 to 5.5.

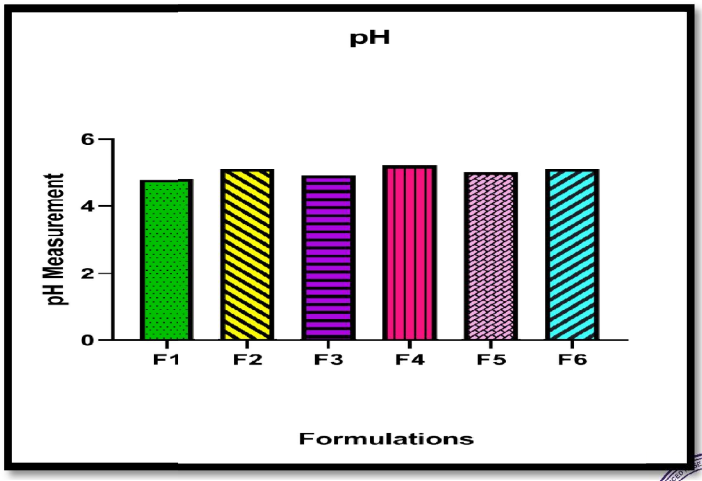

Fig 1: pH of gel

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Maintaining the pH within this range is essential to minimize irritation and ensure the skin's natural barrier function is preserved.

Additionally, the consistency in pH across the samples indicates the reproducibility and consistency of the gel preparation method.

Overall, the pH evaluation of the gel formulations provides valuable insights into their potential suitability for dermatological applications, laying a foundation for further studies to assess their stability, efficacy, and safety profiles.

Spreadability of gel formulations

The spreadability of the gel formulations was assessed. The spreadability values ranged from 18.36 to 22.16 gm.sm/sec across the different batches.

Table 4: Spreadability of gel formulations

batch	Spraedability (gm.sm/sec)
F1	18.36
F2	20.06
F3	19.37
F4	21.38
F5	22.16
F6	19.45

These values indicate the ease with which the gel formulations can spread over a surface under a standard applied force. Higher spreadability values suggest that the gel formulations have better spreading characteristics, which can enhance their application and absorption on the skin.

The variation in spreadability among the different batches may be attributed to differences in the formulation components, including the type and concentration of gelling agents, emollients, and other excipients used. Factors such as the viscosity of the gel, its texture, and the presence of additives can also influence spreadability.

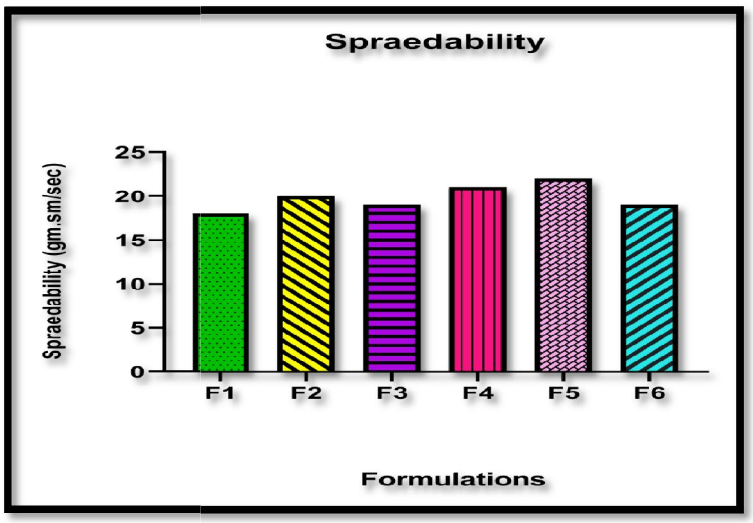

Fig 2: Spreadability of gel formulations

Optimal spreadability is desirable in topical formulations as it ensures uniform coverage and facilitates the application process, improving patient compliance. Additionally, formulations with higher spreadability may require less product per application, which can contribute to cost-effectiveness and minimize wastage.

The spreadability assessment provides valuable information for optimizing the formulation process and determining the suitability of the gel formulations for practical use. Further studies may be warranted to explore the relationship

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between spreadability and other formulation parameters, such as viscosity, texture, and sensory attributes, to refine the gel formulations for specific dermatological applications.

Extrudbility

The extrudability of the gel formulations was evaluated to assess their ease of dispensing from the container. The extrudability values ranged from 50 to 85 g across the different formulations. These values indicate the force required to extrude a specific amount of gel from the container.

Table 5: Extrudbility

Formulation	Extrudability (g)
F1	50
F2	70
F3	85
F4	60
F5	80
F6	75

Higher extrudability values suggest that the gel formulations can be dispensed with less applied force, which can enhance user convenience and usability. Factors such as the viscosity and rheological properties of the gel, as well as the design of the container and dispensing mechanism, can influence extrudability.

The variation in extrudability among the different formulations may be attributed to differences in formulation components, such as gelling agents, thickeners, and viscosity modifiers, as well as variations in formulation processing methods.

Optimizing extrudability is important in topical gel formulations to ensure ease of application, especially for patients with limited dexterity or mobility. Formulations with higher extrudability may also be preferred in clinical settings where rapid and precise dispensing of the product is necessary.

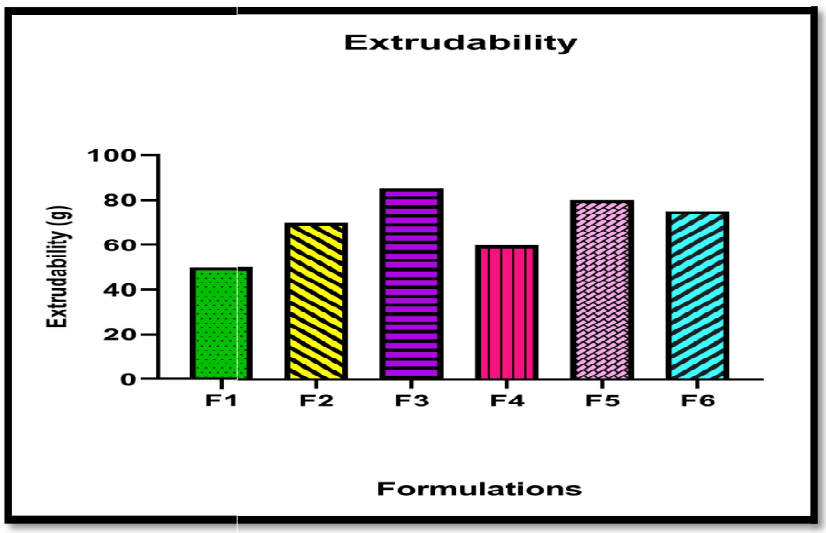

Fig 3: Extrudbility

The assessment of extrudability provides valuable insights into the formulation characteristics and can guide formulation optimization to improve user experience and facilitate practical application. Further studies may be warranted to explore the relationship between extrudability and other formulation parameters and to refine the gel formulations for specific dermatological applications.

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Stability studies

Stability studies were conducted to assess various properties of the gel formulations over a period of one month. The properties evaluated included physical appearance, rheological properties, spreadability, pH, and drug level.

Table 6: Stability studies

Property	Initial Value	Value after 1 month
Physical Appearance	Uniform gel	Uniform gel
Rheological Properties	Consistency: good Extrudability: good	Consistency: good Extrudability: good
Spreadability	Good	Good
pH	6-7	6-7
Drug level	Maintained	Maintained

The physical appearance of the gel formulations remained consistent throughout the stability study period, with all formulations maintaining a uniform gel consistency. This indicates the stability of the formulations with respect to their visual appearance, which is an important factor for consumer acceptance.

Rheological properties, including consistency and extrudability, were also maintained over the one-month period, with all formulations demonstrating good consistency and ease of extrusion from the container. This suggests that the formulations retained their desired texture and flow characteristics, which are crucial for ease of application and product performance.

Spreadability, another key parameter in topical formulations, remained good for all formulations throughout the stability study. This indicates that the ability of the gel formulations to spread evenly over the skin surface was preserved over time, ensuring consistent coverage and efficacy.

The pH of the gel formulations remained within the desired range of 6-7, both initially and after one month of stability testing. Maintaining pH within this range is important for ensuring compatibility with the skin and minimizing irritation, making this result indicative of the formulations' stability and safety for topical use.

Furthermore, the drug level in the gel formulations was maintained over the duration of the stability study, indicating that the active ingredients remained adequately dissolved or dispersed within the gel matrix. This is essential for ensuring consistent therapeutic efficacy of the formulations over time.

VI. CONCLUSION

The study Development and Evaluation of Topical Herbal Formulation for Infectious Eczema focused on the meticulous preparation and evaluation of a herbal gel aimed at managing infectious eczema. Plant material, primarily Murraya koenigli leaves, was collected, extracted, and subjected to rigorous physicochemical and phytochemical analysis. The herbal gel was formulated using Carbopol-934 as a gelling agent, incorporating the plant extract and other excipients. The evaluation of the gel involved assessing pH, spreadability, extrudability, and stability over time. Results revealed the presence of bioactive constituents in the plant extract, promising therapeutic potential. The gel formulations demonstrated suitable pH, spreadability, and stability characteristics, suggesting their potential for dermatological applications. Overall, this study lays the groundwork for further research into the development of effective herbal formulations for managing infectious eczema, contributing to the advancement of natural-based therapies in dermatology.

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