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FORMULATION AND EVALUATION OF MORINGA OLEIFERA BASED TOPICAL ANTISEPTIC GEL

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Abstract:
Topical drug delivery systems play a vital role in the localized treatment of skin infections, wounds, and inflammatory conditions. Herbal formulations are increasingly preferred due to their safety, affordability, and reduced adverse effects compared to synthetic drugs. Moringa oleifera, a widely used medicinal plant, is rich in bioactive compounds such as flavonoids, phenolics, and alkaloids, which exhibit antimicrobial, antioxidant, and anti-inflammatory properties. The present study focuses on the formulation and evaluation of a topical antiseptic gel containing Moringa oleifera extract. The gel was prepared using Carbopol 940 as a gelling agent and evaluated for physicochemical properties such as pH, viscosity, spreadability, and antimicrobial activity. The results demonstrated that the formulation possessed suitable characteristics for topical application and showed significant antimicrobial activity against common pathogens. Thus, the developed formulation can serve as a safe and effective alternative to conventional antiseptic products. Furthermore, the antimicrobial activity of the formulated gel was assessed against selected microbial strains using standard in-vitro methods. The results demonstrated that the gel exhibited satisfactory physicochemical characteristics with pH in the skin-compatible range, appropriate viscosity, and good spreadability. The formulation also showed significant antimicrobial activity, confirming its effectiveness as a topical antiseptic agent.
In conclusion, the developed Moringa oleifera topical gel represents a safe, effective, and economical herbal alternative to conventional antiseptic formulations. Its natural origin, combined with desirable formulation characteristics and therapeutic efficacy, highlights its potential for future pharmaceutical and clinical applications

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INTRODUCTION:

Topical drug delivery systems are an important class of pharmaceutical formulations designed to deliver therapeutic agents directly to the site of action on the skin. These systems are widely used for the treatment of various dermatological conditions such as infections, inflammation, wounds, burns, and allergic reactions. One of the major advantages of topical delivery is the avoidance of first-pass metabolism and reduced systemic side effects, which enhances patient safety and compliance . Additionally, topical formulations allow localized drug action, improved bioavailability at the target site, and ease of administration.

Among different topical dosage forms such as ointments, creams, and lotions, gels have gained considerable attention in recent years. Gels are semi-solid systems consisting of either small inorganic particles or large organic molecules dispersed in a liquid phase, forming a three-dimensional network structure. They are preferred due to their non-greasy nature, better aesthetic appeal, ease of application, and enhanced drug release characteristics . Furthermore, gels provide a cooling effect upon application and allow uniform distribution of the drug over the skin surface, thereby improving therapeutic efficacy and patient acceptability .

In recent years, there has been a significant shift towards the use of herbal medicines in pharmaceutical formulations. This trend is primarily driven by the increasing awareness regarding the adverse effects and toxicity associated with synthetic drugs. Herbal medicines are derived from natural sources and are generally considered safe, biocompatible, and cost-effective. They contain a variety of bioactive phytoconstituents such as flavonoids, alkaloids, tannins, glycosides, and phenolic compounds, which are responsible for their diverse pharmacological activities including antimicrobial, antioxidant, anti-inflammatory, and wound healing effects .

Moringa oleifera, commonly known as the drumstick tree or miracle tree, belongs to the family Moringaceae and is widely distributed in tropical and subtropical regions, especially in India. It has been extensively used in traditional medicine for the treatment of various ailments due to its rich nutritional and medicinal profile. The leaves of Moringa oleifera are particularly rich in vitamins (A, C, and E), minerals (calcium, potassium, and iron), essential amino acids, and bioactive compounds such as quercetin and kaempferol . These constituents contribute to its wide range of pharmacological activities.

Numerous studies have reported that Moringa oleifera exhibits significant antimicrobial activity against a variety of pathogenic microorganisms, including Staphylococcus aureus, Escherichia coli, and Candida

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albicans. The antimicrobial action is mainly attributed to the presence of flavonoids, phenolic compounds, and isothiocyanates, which disrupt microbial cell membranes, inhibit enzyme activity, and interfere with protein synthesis . In addition to antimicrobial properties, Moringa oleifera also possesses antioxidant and anti-inflammatory activities, which play a crucial role in wound healing and tissue regeneration .

The incorporation of Moringa oleifera extract into a topical gel formulation offers several advantages. It enhances the stability of the active constituents, improves drug penetration through the skin, and allows controlled and sustained release of the drug at the site of application. Moreover, herbal gel formulations are generally well-tolerated and reduce the risk of skin irritation and allergic reactions associated with synthetic antiseptics .

Hence, the present study is aimed at the formulation and evaluation of a topical antiseptic gel containing Moringa oleifera extract. The study focuses on assessing the physicochemical properties, antimicrobial activity, stability, and safety of the formulated gel to establish its potential as an effective herbal antiseptic agent.damage bacterial cell walls and interfere with essential metabolic processes. This study provides strong evidence for the use of Moringa oleifera as an effective antiseptic agent in topical formulations.

- **MATERIALS AND EQUIPMENTS**

MATERIALS

The following materials of pharmaceutical grade or the best possible Laboratory Reagent (LR) grade were used as supplied by the manufacturers. Double distilled water was used throughout the experiment.

Table no 1 :- List of Materials Used

Sr.no	Material used	Category used	Grade
1	Moringa oleifera extract	Active ingredient	Pharma grade
2	Carbapol 940 / HPMC	Gelling agent	LR
3	Propylene glycol	Humectant	LR
4	Methyl paraben	Preservative	Pharma grade
5	Propyl paraben	Preservative	Pharma grade
6	Triethanolamine	Ph adjustment	LR
7	Ethanol	Solvent	LR
8	Glycerine	Moisturizer	Pharma grade
9	Distilled water	Vehicle	Laboratory grade

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EQUIPMENTS USED

Table no 2 :-List of Equipments

Sr.no	Equipment
1	Digital balance
2	Magnetic stirrer
3	PH meter
4	Brookfield viscometer
5	Glass ware
6	Mortal and pestle

Method And Evaluation

Collection and Preparation of Plant Material

Fresh leaves of Moringa oleifera were collected and authenticated. The leaves were washed thoroughly with distilled water to remove dust and impurities. They were then shade-dried at room temperature for several days to preserve heat-sensitive phytoconstituents such as flavonoids and phenolic compounds. After complete drying, the leaves were pulverized into a coarse powder using a mortar and pestle and stored in an airtight container for further use .

Extraction of Plant Material

The powdered leaves were subjected to maceration using ethanol (or hydroalcoholic solvent) for 48–72 hours with occasional stirring to ensure maximum extraction of active constituents. After maceration, the mixture was filtered using muslin cloth followed by Whatman filter paper. The filtrate was then concentrated using a water bath at controlled temperature to obtain a semi-solid extract. The extract was stored in a desiccator until further use

Preparation of Gel Base

Carbopol 940 was selected as the gelling agent due to its high viscosity, stability, and compatibility with active ingredients. A required quantity of Carbopol was slowly dispersed in distilled water with continuous stirring using a magnetic stirrer to avoid clumping. The dispersion was allowed to hydrate and swell for 2–3 hours to form a uniform gel base

Evaluation of Formulated Gel

The formulated Moringa oleifera gel was evaluated for the following parameters: Appearance: Visual inspection for color, clarity, and homogeneity. pH: Measured using a calibrated digital pH meter. Viscosity: Determined using a Brookfield viscometer. Spreadability: Evaluated using a glass slide method. Extrudability: Assessed by applying standard pressure and measuring the amount of gel extruded. Antimicrobial Activity: Tested using the agar well diffusion method against Staphylococcus aureus and Escherichia coli.

Formulation and Optimization of Gelling Agent

Carbopol is a water-soluble polymer that acts as a powerful gelling agent, suitable for making clear gels. To achieve desired gel consistency and spreadability, different concentrations of Carbopol 934, such as 1%, 1.5%, and 2% were used. Based on viscosity and spreadability tests, the optimized concentration was selected

Formulation of Gel Base

The gelling agent was dispersed in a sufficient quantity of water. Propylene glycol, used as a humectant and plasticizer, was added along with other excipients like methyl paraben and propyl paraben. The mixture was stirred continuously. The pH of the gel was adjusted using Triethanolamine (TEA) until neutrality was achieved. The total weight was made up to 30 g

with purified water. The mixture was stirred with a propeller at 500 rpm for 2 hours to remove air bubbles. The gel was kept at room temperature for 24 hours to ensure consistency and stability.

Formulation of Moringa oleifera Gel (30 g):
To prepare 30 g of gel, 0.3 g of Carbopol 934 was dispersed in distilled water and allowed to hydrate. Then, 1.5 ml each of propylene glycol and glycerine were added as humectants. Preservatives, including 0.045 g of methylparaben and 0.009 g of propylparaben, were dissolved and added to the mixture. Afterward, 0.3 g of Moringa oleifera extract was incorporated as the active ingredient. Triethanolamine (1.5 ml) was added dropwise to adjust the pH to 6.8–7.0 and form a clear gel. The final volume was made up to 30 g with distilled water, and the gel was stirred until uniform and left to stabilize for 24 hours.

Formulation of Gel
The formulation of a Moringa oleifera-based topical antiseptic gel involves several systematic steps to ensure effectiveness, safety, and stability. Initially, fresh Moringa oleifera leaves are collected, thoroughly washed, shade-dried, and powdered. The powdered leaves are then subjected to extraction using a suitable solvent such as ethanol or methanol through maceration The obtained extract is filtered and concentrated using a rotary evaporator to remove the solvent, yielding a semi-solid residue. This extract, rich in bioactive compounds, is then incorporated into a gel baseThe gel base is prepared using gelling agents like carbopol 934 which are dispersed in distilled water with continuous stirring. A neutralizer like triethanolamine is added to adjust the pH and to form a clear gel. Preservatives such as methylparaben may be included to ensure microbial stability, along with other excipients like glycerin or propylene glycol to enhance skin hydration and spreadability. Finally, the Moringa oleifera extract is slowly mixed into the gel base under continuous stirring until a uniform, smooth topical gel is formed. The formulated gel is then stored in suitable container

Table no.3 Formulation Table

Sr no	Ingredients	F1	F2	F3
1	Moringa Olifera extract	0.2gm	0.3 gm	0.4 gm
2	Aloevera gel	1.68 ml	1.68 ml	1.68 ml
3	Carbapol 934	0.17 gm	0.3 gm	0.3 gm
4	Propylene glycole	1.68 ml	1.68 ml	1.68 ml
5	Methyl paraben	0.015 gm	0.015 gm	0.015 gm
6	Triethanolamine	q.s to pH 6.5 - 7	q.s to pH 6.5 – 7	q.s to pH 6.5 - 7
7	Water	q.s to pH 6.5 7 q	q.s to pH 6.5 7 q	q.s to pH 6.5 7 q

RESULTS AND DISCUSSION:

Formation and Evaluation of Moringa oleifera leaf extract Formation of moringa oleifera extract
Fresh leaves of Moringa oleifera are collected, washed, and shade dried to remove moisture. The dried leaves are then powdered using a grinder and stored in an airtight container.

The powdered material is extracted using a suitable solvent such as ethanol or methanol maceration method., maceration, it is soaked in solvent for 24–72 hours with occasional shaking.
The obtained extract is then filtered to remove solid residues and concentrated using a water bath or rotary evaporator to remove excess solvent. The final product is a semi-solid or dry extract, which is stored in an airtight container in a cool, dry place for further use in formulation.

Fig no 1 :- Moringa oleifera extract Evaluation of moringa oleifera extract

Characteristic of extracts
theethanolic extract of Moringa oleifera leaves was evaluated for its organoleptic properties including physical state, color, odor, and taste.

Table no 4 ; Characteristics of Moringa oleifera Leaf extract

Characteristics	Observation
Physical states	Semisolid
Colour	Greenish brown
Odour	Herbal
Taste	Bitter

Physiochemical Investigation of the Extract

The phytochemical screening of the ethanolic extract of Moringa oleifera leaf revealed the presence of several bioactive compounds including flavonoids, tannins, phenolics, ++ Indicate the strong presence of active constituent.

Table no 5 :- Phytochemical constituents of Moringa oleifera extract

Constituent	Test	Endpoint	Result
Flavonoids	Ferric chloride	Green colour	++
Tannins	Ferric chloride	Greenish black	++
Alkaloids	Dandruffs reagents	Orange colour	++
Proteins	Ninhydrin	Yellow colour	++
Amino acid	Ninhydrin	Purple colour	++

Anti microbial Activity of the extract

he antimicrobial activity was determined by zone of inhibition method using standard bacterial strains such as Staphylococcus aureus, Escherichia coli, and Candida albicans. Standard drugs like Gentamicin (10 µg) and Fluconazole (25 µg) were used for comparison. From the results, it was observed that the Moringa oleifera extract exhibited notable antimicrobial activity, with moderate to good zones of inhibition. However, the activity was slightly less potent than the standard antibiotics. The gel formulation showed no microbial contamination, ensuring its safety for topical use.

Fig no 2 :- Antimicrobial Activity

alkaloids, saponins, proteins, and glycosides. These compounds are widely known for their antimicrobial, antioxidant, and anti-inflammatory properties.

Optimization of gelling agent

Carbopol is a water-soluble polymer that acts as a powerful gelling agent, suitable for making clear gels. To achieve desired gel consistency and spreadability, different concentrations of Carbopol 934, such as 1%, 1.5%, and 2% were used. Based on viscosity and spreadability tests, the optimized concentration was selected.

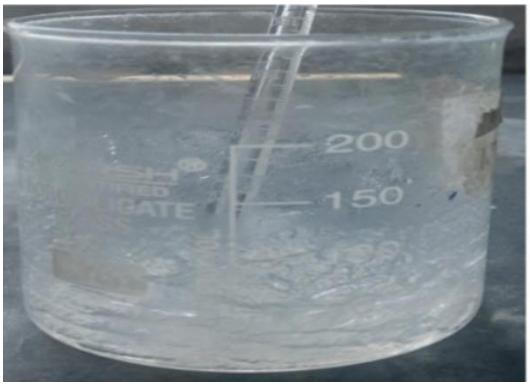

Fig no 3 :-Carbopol 934 gel

Formulation of gel containing moringa oleifera extract

To prepare 30 g of gel, 0.3 g of Carbopol 934 was dispersed in distilled water and allowed to hydrate. Then, 1.5 ml each of propylene glycol and glycerine were added as humectants. Preservatives, including 0.045 g of Methylparabn and 0.009 g of propylparaben, were dissolved and added to the mixture. Afterward, 0.3 g of Moringa oleifera extract was incorporated as the active ingredient. Triethanolamine (1.5 ml) was added dropwise to adjust the pH to 6.8–7.0 and form a clear gel. The final volume was made up to 30 g with distilled water, and the gel was stirred until uniform and left to stabilize for 24 hours.

Fig no 4 :- formulation of moringa oleifera extract gel

Evaluation of gel Measurement of pH

The pH of all prepared formulation ranged from 5.7–5.9. The pH of the prepared gel formulation was considered to be acceptable to avoid the risk of irritation upon application to the skin. The result was shown in the table

Table no 6 :- Measurement of PH

Formulation code	Measurement of PH
F1	5.7
F2	5.9
F3	5.8

Determination of viscosity

Viscosity is an important property of fluids which describes a liquid's resistance to flow and is related to the internal friction within the fluid. This rheological property helps in determining consistency and also the diffusion rate of drug from gel. The measurement of viscosity of the prepared gel was done with Brookfield viscometer with spindle no: 62. The results were shown in Table No. 12. By keeping the viscosity below

Table no 7 :- Measurement of viscosity

Formulation code	Viscosity [cps]
F1	1428±0.1
F2	1425±0.75
F3	1358±0.25

- **Spreadability study**

Spreadability is a key parameter that influences the ease of application and user acceptability of topical formulations. It indicates how uniformly the gel spreads when applied to the skin, affecting both the therapeutic efficiency and patient compliance. The spreadability of Moringa oleifera-based gel formulations (F1, F2, and F3) was determined using the slide slip method. A fixed amount of gel was placed between two glass slides, and a standard weight was applied. Thetime required for the upper slide to move a certain distance was recorded, and spreadability was calculated using the following formula:

{Spreadability (S)} =M×L/T Where: S = Spreadability (gm.cm/sec) M = Weight applied (g) L = Length moved by the slide (cm) T = Time taken (sec)

Table no 8 :- Spreadability study

Formulation code	Spreadability [gm.cm/sec]
F1	18.37
F2	19.34
F3	21.12

Discussion

the formulated Moringa oleifera topical gel showed satisfactory physicochemical properties such as good homogeneity, appropriate pH, viscosity, and spreadability, indicating its suitability for skin application. The presence of bioactive constituents like flavonoids and phenolic compounds contributed to significant antimicrobial activity against common pathogens such as Staphylococcus aureus and Escherichia coli.

The formulation remained stable under different storage conditions without significant changes in appearance or pH. No signs of skin irritation were observed, indicating safety for topical use. Overall, the results suggest that the Moringa oleifera-based gel can be an effective and safe herbal alternative to conventional antiseptic formulations.

- **Summary and conclusion Summary**

Moringa oleifera is a well-known medicinal plant possessing significant antimicrobial, anti-inflammatory, and wound-healing properties. Various phytoconstituents such as flavonoids, tannins, saponins, and phenolic compounds contribute to its antiseptic activity. Due to these properties, it is considered a promising natural alternative for topical formulations.

The aim of the present study was to formulate and evaluate a topical antiseptic gel containing Moringa oleifera extract. The gel was prepared using suitable gelling agents such as Carbopol (or other polymer used), along with appropriate excipients to achieve desirable consistency, stability, and spreadability.

Different formulations were prepared by varying the concentration of polymer and other excipients. All formulations were evaluated for physicochemical parameters including:

pH Viscosity
Spreadability Extrudability Drug content
In-vitro antimicrobial activity
The results indicated that as the concentration of gelling agent increased, viscosity increased, while spreadability decreased slightly. All formulations showed acceptable pH suitable for skin application, indicating non-irritant nature.
Among all batches, the optimized formulation (e.g., MGX) showed:
Good consistency and smooth texture viscosity and spreadability
Uniform drug content
Significant antimicrobial activity against common pathogens
Stability studies revealed that the optimized formulation remained stable under different storage conditions without significant changes in physical appearance, pH, or activity.

CONCLUSION:

From the present study on Moringa oleifera based topical antiseptic gel, the following conclusions can be drawn:
The herbal extract of Moringa oleifera can be successfully incorporated into a topical gel formulation using suitable polymers.

All prepared formulations showed acceptable physicochemical properties within standard limits.
The optimized formulation demonstrated good spreadability, viscosity, and stability, making it suitable for topical application.

The antimicrobial study confirmed that the gel possesses effective antiseptic activity against selected microorganisms.
The formulation was found to be non-irritant and safe for skin application due to its suitable pH and natural origin.

Increase in polymer concentration improved gel consistency but affected spreadability, hence an optimized balance is required.

Overall, the developed Moringa oleifera antiseptic gel can be considered a safe, effective, and cost-efficient herbal alternative to conventional antiseptic formulations. It provides potential benefits such as reduced side effects, better patient compliance, and natural therapeutic action.

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