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Formulation and Evaluation of Moringa oleifera Leaf Extract Serum Gel

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Abstract : *Background: Moringa oleifera Lam. (Moringaceae) is widely studied in dermatological and cosmetic formulations due to its high concentration of bioactive phytoconstituents—including flavonoids, phenolic compounds, tannins, saponins, and carotenoids—that provide antioxidant, anti-inflammatory, and antimicrobial benefits. Combining the lightweight absorption of a serum with the structural stability of a gel base offers a promising topical delivery format for skincare applications.*
Objective: This study aimed to extract bioactive compounds from Moringa oleifera leaves, formulate a stable topical serum gel incorporating the extract, and evaluate its physicochemical properties, stability, and functional activity.
Methods: Shade-dried Moringa oleifera leaves were extracted via maceration using an ethanolic or hydroalcoholic solvent and screened for major phytochemical classes. The resulting extract was incorporated into a gel-serum base containing gelling/structuring agents (such as Carbopol or cellulose derivatives), humectants (such as glycerin or butylene glycol), and compatible skincare actives.
Formulations were assessed for organoleptic attributes (color, odor, appearance), homogeneity, pH, viscosity, spreadability, short-term thermal/storage stability, and in vitro antioxidant or antibacterial activity

Keywords: Formulation And Evaluation Of Moringa Oleifera Leaf Extract Serum Gel

I. INTRODUCTION

Antibacterial drugs are agents used to prevent and treat bacterial infections by either killing bacteria (bactericidal) or inhibiting their growth (bacteriostatic). These drugs play a crucial role in modern medicine, helping manage infectious diseases, support surgical procedures, and prevent complications. Over time, however, the overuse and misuse of antibiotics have led to the emergence of resistant strains of bacteria, posing serious global health challenges. As a result, there is a growing urgency to discover and develop novel antibacterial agents that are effective, safe, and less prone to resistance.

Moringa oleifera, known as moringa, has leaves that are usually used as vegetables. Moringa is one of the plants reported to be a source of natural antioxidants (Anwar et al 2007). The content of vitamin E in Moringa leaves has the highest level of 77 mg/100 g (Moyo et al 2011). Vitamin E is the most active form of a-tocopherol. This vitamin is a fat-soluble vitamin (Winarsi 2007). Vitamin E causes moringa to be used for skin preparations.Various research and development are an effort toimprove product quality and safety. One method used is standardizing extracts. The degree of active compounds is an absolute requirement for product quality. Standardization is a series of parameters, proceduresand methods of measurement whose results are related to quality that meets standards and guarantees product stability. The

results of the extraction process can produce specific and non-specific parameters of standardized extracts and are expected to be able to show quality (Azizah & Salamah 2013).

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Moringa oleifera Lam. has been cultivated popularly in many countries, well-known for different medicinal and pharmaceutical benefits [1, 2]. In Vietnam, M. oleifera can grow in many places with appropriate conditions in Ninh Thuan, Phu Quoc, Thanh Hoa, Dong Nai, etc. It has been regarded as a medicinal plant due to and phytochemicals from leaves such as carotenoids, phenolic acids, flavonoids, tannins, saponins, alkaloids, and glucosinolates [3] besides valued nutrients, rich source of Vitamin and minerals [4]. The potential application of

M. oleifera leaf comes from its effective biological properties as anti-proliferative especially in breast cancer [5], anti-inflammatory activities with proved mechanisms of actions [6], and anti-diabetic property [3] with in-vivo therapy test on hyperglycemic disease [7]. Among them, the antimicrobial and antioxidant properties are indeed the remarkably medicinal values in leaf extracts [8, 9]. Its leaf extracts have been proved to inhibit effectively pathogenic bacteria such as Staphylococcus aureus and Escherichia coli so that they are considered as good sources of natural agents used for bacterial infection prevention or food preservation [10]. However, stage of maturity of M. oleifera has been proved to affect leaf extract, its biological contents and activities. The effects of age or stages of maturity on leaf phenolic extracts' biological properties were studied with M. oleifera grown in different countries with different environment and conditions [11]. Antibacterial and antioxidant properties together with phytochemical content were identified different leaf extracts of M. oleifera with different extraction solvents such as aqueous, methanolic, ethanolic, acetone extracts in which methanolic leaf extracts have been proved to have more TPC [12, 13] and effective antibacterial activity [14]. Due to the potential medicinal benefits of M. oleifera, besides applications in medicine as antibacterial agents [15] and food control agents [16], M. oleifera has been applied as an alternative to antibiotics in Agriculture to reduce microbial populations and enhance innate immunity, in Poultry health to increase growth performance, egg production and quality [17], in dental pathogen treatment and even Cosmetic industry to improve skin health [19]. Therefore, the main purpose of this study was to study on M. oleifera grown in Binh Phuoc, Vietnam and evaluate the effect of age on leaf methanolic extract, total phenoli Moringa oleifera contains ß-carotene, protein, vitamin C, calcium and potassium that can be used as natural antioxidant (Krisnadi, 2013). In addition, other studies have also shown that moringa leaves contain phenolic compounds, flavonoids and carotenoids Based on the content of active ingredients, moringa leaves have various properties such as antioxidants, antimicrobials, natural food preservatives, and anti-inflammatory Indonesia as a tropical country has a high intensity of sunlight, so one part of the body that was affected by the condition is the skin. The skin, as one of the body's protective organs, can undergo an excessive dryness (Rawlings et al., 2000). Therefore, it needs a certain dosage form that can be used to protect and to maintain the moisture of skin. Antioxidant and anti-inflammatory properties of moringa leaves are expected to protect the skin from free radicals that are caused by sunlight or other factors. A previous study have shown that moringa leaf extract can be applied intopical form for the prevention and treatment of oxidative and anti-aging stress diseases (Atif et al., 2013). A research by Sugihartini et al. (2016) showed that a 3% concentration of extract in cream was able to improve skin smoothness. The increasing concentration of extract in cream will increase SPF value. This study will focus on the formulation of extract in the form of lotion and gel preparation with an extract concentration of 3%. The evaluations of dosage form will consist of physical properties of the preparation and the SPF value.

II. LITERATURE REVIEW

Nining Sugihartini (et.al)2018 Reported that Moringa oleifera leaf extract has an antioxidant activity so it can be used to protect the skin. The aim of this study is to determine the extract specification and formulation in lotion and gel as sunscreen agent. Moringa oleifera leaf extract was obtained by maceration method using ethanol 70%. The extracts were identified for chemical content and specification test of extract. After that, extract was formulated into gel and lotion. The evaluation of gel and lotion includes physical characteristics (spreadability and adhesivity) and the value of Sun Protection Factor. The result showed that Moringa oleifera leaf extract contained alcaloids, flavonoids and poliphenols. The value of moisture content, ash content, acid soluble ash, and β-caroten were 5.75%, 0.19%, 0.16%, and 0.46%, respectively. The IC50 of antioxidant activity was 516.28. The value of Sun Protection Factor of the 5% octyl metoxycinnamate solution, gel (contain 5% extract), and lotion (contain 5% extract) were 33.25, 34.75, 24.98,

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and 25.89, respectively. The lotion and the gels have a strong sunscreen activity and meet the requirements of physical properties for preparations.

Duyen Thuy T (et.al)2023 Study that Moringa oleifera leaves of different ages grown in Binh Phuoc, Vietnam were harvested for methanol extraction, total polyphenol content (TPC) and biological activity determination. Three groups of age were collected for research including leaves 5-10 days-old (L1), 25-30 days-old (L2) and 45-50 days-old (L3). The TPC determined (mg GAE/g crude extract) in leaf methanolic extract (LME) was 64.43 ± 2.57; 47.75 ± 3.11 and 24.8 4 ± 1.72 for L1, L2, L3 respectively. Anti-bacterial activity of 5-10 days old leaf extracts (100 mg/mL) showed the significant results against Escherichia coli (15.67 ± 1.58 mm), Staphylococcus aureus (12.67 ± 1.76 mm) compared to extracts from other ages. This group extract also revealed anticoagulant activity with longer Prothrombin time (PT) lasting for 26.153 ± 1.6(s). As a result, 5-10 days-old leaf extract was conducted for antibacterial serum formulation. After 14 days of preservation in different conditions, serum preserved in cold temperature 2-8oC (NT1) showed S. aureus resistant activity (15.23 ± 0.76 mm) more slightly effective than the one in room temperature 30-32oC (NT2) as 11.17 ± 0.62 mm, which initially stated the significance of temperature on antibacterial activity of final serum product during preservation.

Tutik Wuryandari (et.al)2022 reported that Moringa oleifera, known as moringa, is reported to have a high source of natural antioxidants, especially vitamin E. The formulation of purified Moringa leaf extract is needed so that the vitamin E content in it is more maximal. This study aimed to determine the levels of vitamin E in extracts after purification, physical property test of emulgel with variations in extract concentration and vitamin E levels in emulsions. The study was started from the extraction using maceration method with petroleum ether solvent, followed by extract purification using column chromatography with n-hexane solvent. The results of the purified extract were then formulated into emulgel with three concentrations of 3% (F1), 6% (F2) and 9% (F3). Emulgel was then evaluated for physical characteristics (pH, viscosity, adhesion, dispersion and stability). Determination of vitamin E levels was carried out on purified extract samples and on each formula. The results of non-specific standardization of extracts included ash content, acidic insoluble ash content were higher than those of

Indonesian Herbal Pharmacopoeia literature and drying losses were lower compared to literature. Specific standardization of extracts was the content of vitamin E in 1.40% PE extract and 8.02% purified extract. In the test of emulgel physical characteristics, an increase in the concentration of the extract caused an increase in viscosity and decreased emulgel dispersion power. Whereas, tthe pH and sticky power remained the same. Storage hds an effect on decreasing the physical characteristics of emulsions especially on adhesion. Increased extracts also caused an increase in the levels of vitamin E in the purified extract of moringa leaf emulgel.

Adinath Ware (et.al)2025 Study that This research involves preparing a topical herbal gel using Moringa oleifera leaf extract and examining its potential as a natural antimicrobial product. The leaves were processed through maceration to obtain an extract containing important phytochemicals such as flavonoids, phenolic compounds, tannins, and alkaloids. These constituents are known to provide antibacterial, antioxidant, and soothing effects on the skin. The extracted material was incorporated into a carbopol gel base and evaluated for physical characteristics, including colour, consistency, pH, spreadability, and ease of washing. Phytochemical analysis verified the presence of key secondary metabolites, and antimicrobial testing showed that the gel produced a noticeable zone of inhibition against Staphylococcus aureus, indicating beneficial antibacterial activity. The prepared gel displayed acceptable pH for skin use, a smooth texture, uniform appearance, and good spreading behaviour. Overall, the findings suggest that Moringa oleifera extract can be effectively formulated into a topical gel and may serve as a promising herbal alternative for skincare and microbial protection.

Agitha Casanova Capah (et.al)2026 reported that Moringa oleifera leaves have attracted considerable interest as a natural source of bioactive compounds for cosmetic applications because of their antioxidant and antimicrobial properties. This study aimed to develop and evaluate a gel serum containing M. oleifera leaf extract as a natural skincare formulation with desirable physicochemical properties and storage stability. The leaves were extracted by maceration using 96% ethanol, and the resulting extract was subjected to qualitative phytochemical screening before

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incorporation into a gel serum formulation containing glycerin, butylene glycol, hyaluronic acid, and niacinamide. The formulated gel serum was evaluated for its organoleptic characteristics, homogeneity, pH, viscosity, and physical stability under storage at 25°C and 40°C for one month. Phytochemical screening confirmed the presence of flavonoids, steroids, tannins, and saponins, whereas alkaloids were not detected. The developed gel serum exhibited a homogeneous appearance, a skin-compatible pH of 5.35, and viscosities of 420 and 303 mPa·s at 30 and 60 rpm, respectively, while maintaining good physical stability under both storage conditions. These findings suggest that M. oleifera leaf extract is a promising natural bioactive ingredient for stable and multifunctional serum formulations and warrants further investigation regarding long-term stability, skin compatibility, and clinical efficacy.

III. AIM & OBJECTIVE

AIM

To Prepare Formulation And Evaluation Of Moringa Oleifera Extract Serum Gel

OBJECTIVES

- To prepare and incorporate Moringa oleifera leaf extract into a suitable serum gel formulation.
- To evaluate the physicochemical properties of the formulated serum gel, including pH, viscosity, homogeneity, colour, odour, and appearance.
- To assess the spreadability, extrudability, and consistency of the prepared serum gel.
- To evaluate the compatibility of the leaf extract with the selected excipients used in the formulation.
- To assess the stability of the formulated serum gel under different storage conditions by monitoring changes in its physical appearance, pH, viscosity, and other relevant parameters.
- To determine the overall quality, uniformity, and suitability of the formulated serum gel for topical application.

IV. NEED OF STUDY

- Develop a suitable serum gel formulation incorporating Moringa oleifera leaf extract.
- Evaluate the physicochemical properties of the prepared formulation to establish its quality and uniformity.
- Assess the stability of the serum gel under selected storage conditions by monitoring changes in its physical appearance, pH, viscosity, and other relevant parameters.
- Identify a suitable formulation that maintains acceptable physical characteristics throughout the study period.
- Generate preliminary data to support further research and development of plant-based topical skincare formulations.

V. PLAN OF WORK

1. Literature Review

Review the available scientific literature on Moringa oleifera, its phytochemical constituents, potential topical applications, serum gel formulations, and stability studies.

2. Collection and Preparation of Leaf Extract

Collect and authenticate Moringa oleifera leaves, wash and dry them, prepare the powdered material, and extract the phytoconstituents using a suitable extraction method.

3. Formulation Development

Select suitable excipients, such as a gelling agent, humectant, preservative, and other necessary ingredients, and incorporate the leaf extract to prepare the serum gel.

4. Physicochemical Characterization

Evaluate the prepared serum gel for colour, odour, appearance, pH, homogeneity, viscosity, consistency, spreadability, and extrudability, as applicable.

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5. Stability Assessment

Store the formulation under selected storage conditions and periodically evaluate changes in appearance, pH, viscosity, homogeneity, and other relevant parameters.

6. Data Collection and Analysis

Record the results of the physicochemical tests and stability study, compare the observations across formulations and storage intervals, and identify the formulation with the most acceptable characteristics.

7. Conclusion and Report Preparation

Interpret the findings, draw conclusions regarding the formulation's physicochemical quality and observed stability, and prepare the final research report.

VI. MATERIAL AND METHODS

INGREDIENTS

Sr.No	Ingredients
1	Cold Pressed Moringa Oil (base)
2	Rosehip Oil
3	Aloe Vera Distillate / Rose Water
4	Glycerin
5	Vitamin E Oil
6	Preservative (if you want to sell)

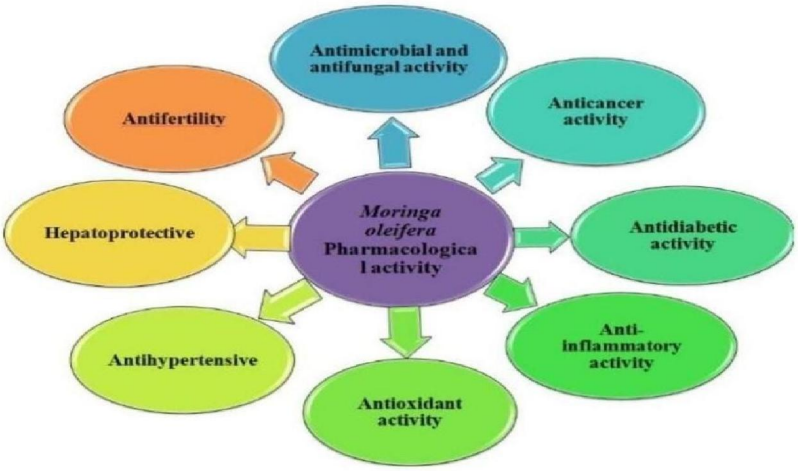
Drug Profile

Moringa oleifera (Drumstick Tree / Miracle Tree)

Biological Profile

Taxonomic Category	Classification
Scientific Name	Moringa oleifera Lam.
Common Name	Drumstick tree, Miracle tree, Horseradish tree
Vernacular Names	Hindi: Sahjan; Tamil: Murungai; Telugu: Munaga
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Brassicales
Family	Moringaceae
Genus	Moringa
Species	Oleifera
Part Used (Present Study)	Leaves
Distribution	Native to sub-Himalayan tracts; widely cultivated in tropical and subtropical regions of Asia, Africa, and Latin America
Flowering Season	Throughout the year (primarily January to March)

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Pharmacological Activities Of Moringa Oleifera

Instruments

1] Grinder mixer 2] Spectrophotometer

VIII. METHOD

- **Collection Of Plant material**
  Fresh leaves of Moringa oleifera were collected from a local botanical garden or agricultural farm. Seeds of Cajanus cajan were procured from a certified local market. Both plant materials were authenticated by a qualified botanist (or from a recognized herbarium such as the Botanical Survey of India). Voucher specimens were preserved in the Department of Pharmacognosy / Pharmacy for future reference.
- **preparation of Moringa oleifera Leaf Powder**
  Fresh moringa leaves were separated from the stems and washed thoroughly with running tap water followed by distilled water to remove dirt, dust, and surface contaminants.The washed leaves were spread in a single layer on clean muslin cloth and shadedried at room temperature (25–30°C) for 7–10 days to prevent degradation of heatsensitive phytoconstituents. The dried leaves were powdered using a mechanical grinder and passed through sieve mesh no. 60 (aperture size: 250 µm) to obtain a fine, uniform powder.The powder was stored in a clean, airtight glass container at room temperature, protected from light and moisture until use.
- **Alcholic Extraction**
  The leaves were extracted by maceration using 96% ethanol, and the resulting extract was subjected to qualitative phytochemical screening before incorporation into a gel serum formulation containing glycerin, butylene glycol, hyaluronic acid, and niacinamide. The formulated gel serum was evaluated for its organoleptic characteristics, homogeneity, pH, viscosity, and physical stability under storage at 25°C and 40°C for one month. Phytochemical screening confirmed the presence of flavonoids, steroids, tannins, and saponins, whereas alkaloids were not detected.

IX. PROCEDURE

Step 1 - Sterilize

Wash all bowls, bottles, dropper in hot water. Dry completely. No water should remain.

Step 2 - Mix Oils (Oil Phase)

In a glass beaker, take Moringa Oil + Rosehip Oil + Vitamin E Oil. Mix slowly with glass rod for 1 min.

Step 3 - Mix Water Phase

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In another bowl, take Aloe Distillate + Glycerin. Mix well.

Step 4 - Emulsify

Slowly pour water phase into oil phase while continuously stirring. Stir for 3-4 mins till it becomes slightly milky serum, not too thick.

Step 5 - pH Check

It should be 5.5 to 6.0. You can check with pH strip.

Step 6 – Bottle

Pour into 30ml dark glass dropper bottles using funnel. Close tight.

Step 7 – Storage

Label with date. Store in cool place. Shelf life = 6 months (12 months if you add preservative.

X. PHYTOCHEMICAL TESTS

- **Alkaloids (Mayer's Test):** Add a few drops of Mayer's reagent to the extract; a cream-colored precipitate indicates the presence of alkaloids.Flavonoids (Alkaline Reagent Test): Add a few drops of ethanol 70 % solution to the extract; an intense yellow color that confirms flavonoids.
- **Polyphenols (Ferric Chloride Test):** Add 1–2 drops of 5% ferric chloride solution to the extract; a deep blue or green color indicates the presence of polyphenols. Qualitative screening of Phytochemical Constituent of Moringa
- **Appearance and Texture:** Each formulation was visually inspected for color, consistency, and homogeneity by spreading a small amount on a glass slide.
- **PH Measurement**: The pH of each formulation was determined by dissolving 1 g of the sample in 100 mL of distilled water and measuring it using a calibrated digital pH meter.
- **Spreadability:** Spreadability was tested by placing a fixed quantity of the formulation between two glass slides and measuring the diameter after applying a standard weight for one minute.
- **Washability:** A small amount of the gel was applied on the skin and rinsed off un

XI. EXPEXTED OUT COME

1. The study entitled "Formulation, Physicochemical Characterization and Stability Assessment of a Moringa oleifera Leaf Extract Serum Gel" is expected to yield the following outcomes:
2. Successful Formulation: Development of a suitable serum gel incorporating Moringa oleifera leaf extract using appropriate excipients.
3. Physicochemical Characterization: Evaluation of important physicochemical parameters, including colour, odour, appearance, pH, viscosity, homogeneity, and consistency of the prepared serum gel.
4. Spreadability and Extrudability: Assessment of the ease of application, spreadability, and dispensing properties of the formulation.
5. Formulation Uniformity: Determination of the uniform distribution of the leaf extract within the serum gel to support consistent product quality.
6. Stability Assessment: Evaluation of the formulation under selected storage conditions to identify changes in physical appearance, pH, viscosity, and other relevant characteristics over time.
7. Identification of an Optimized Formulation: Selection of a formulation that demonstrates acceptable physicochemical properties and maintains its quality during the study period.
8. Potential for Topical Application: Generation of preliminary data regarding the suitability of the developed serum gel as a plant-based topical formulation.
9. Foundation for Further Research: The findings may support future investigations into the safety, efficacy, antioxidant activity, and potential skin benefits of Moringa oleifera leaf extract in topical preparations.

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• **Overall expected outcome:** The study is expected to produce a physically acceptable and sufficiently stable Moringa oleifera leaf extract serum gel, supported by physicochemical characterization and stability data. Its therapeutic effectiveness and safety would require further appropriate testing.

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