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Research Paper

Formulation And Evaluation of Herbal Foot Care Stick Containing *Cinnamomum Verum* and *Juglans Regia*

Rahana P. V.^{*1}, Anjana K. K², Fathimath Hadiya B.³, Fathimathu Rushda C.⁴, Liyana P⁵.

¹Associate professor, Crescent college of pharmaceutical sciences, Kannur, Kerala, India

²³⁴⁵Crescent college of pharmaceutical sciences, Kannur, Kerala, India

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ABSTRACT

The study involves the formulation and evaluation of a Herbal foot care stick using Cinnamon (*Cinnamomum verum*) and Walnut (*Juglans regia*) to manage cracked heels, dryness and microbial infections. Phytochemical screening confirmed the presence of beneficial constituents such as flavonoids, glycosides, terpenoids and phenolic compounds. Five formulations (F1–F5) were prepared and evaluated for Physical characteristics, pH, spreadability, antioxidant activity and antimicrobial effect, melting point, stability studies. Among them, formulation F3 showed the best properties, including good consistency, suitable pH, effective spreadability, better antioxidant activity and notable inhibition of *E.coli*. The results conclude that the herbal foot care stick is safe, stable and effective for routine foot care

INTRODUCTION

Cosmetics are defined as articles intended to be rubbed, poured, sprinkled or sprayed on, or introduced into, or otherwise applied to, the human body or any part thereof for cleansing, beautifying, promoting attractiveness or altering the appearance and includes any article intended for use as a component of cosmetic.^[1]

The word 'cosmetic' is derived from a Greek word - kosmetikos that means adornment and preparation. Cosmetics refer to all of the products

used to care for and clean the human skin and make it more beautiful. The intentions of using cosmetic product is to maintain the body in a good condition, protect it from the effect of the environment and aging process, change the appearance and make the body smell nicer. Cosmetic products are widely used by every socio economic class of human beings to cleanse, perfume, protect and change the appearance of the skin.^[2] Herbal Cosmetics, referred as Products, are formulated, using various permissible cosmetic

***Corresponding Author:** Rahana P. V.

Address: Associate professor, Crescent college of pharmaceutical sciences, Kannur, Kerala, India

Email ✉: Pvrahana0211@gmail.com

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ingredients to form the base in which one or more herbal ingredients are used to provide defined cosmetic benefits only, shall be called as “Herbal Cosmetics”.^[3]

FOOT SKIN

The skin of the foot is a highly specialized structure designed to support body weight and enable functions such as standing, walking and running. It is particularly thick on the plantar surface (sole) in order to resist continuous friction and pressure. The outermost layer of the foot, known as the epidermis, consists of tightly packed keratinized cells that act as a protective barrier against external damage, microorganisms and dehydration. The stratum corneum of the heel is the thickest in the entire human body and is responsible for providing mechanical strength. Beneath the epidermis lies the stratum lucidum, a layer found only in thick skin such as that of the feet and hands, which contributes to the smooth and tough structure of the sole. Unlike other areas of skin, the plantar region does not contain sebaceous glands or hair follicles, which is why dryness and cracking of heels are common. However, the area is rich in sweat glands that help maintain temperature regulation and moisture

levels in the skin. Deeper to the epidermis is the dermis, which is composed of collagen and elastic fibers that give the skin strength, flexibility and durability. This layer contains blood vessels that nourish the outer layers and assist in wound healing. It also houses numerous sensory receptors, making the foot highly sensitive to pressure, vibration and pain. These sensations help maintain balance and alert the body to potential injuries while walking. The deepest layer of the foot skin called the hypodermis or subcutaneous layer, contains thick fatty tissue that serves as a shock absorber. This padding is especially prominent in the heel region and helps protect underlying bones and joints from impact forces experienced during movement.

Overall, the unique structure of foot skin ensures effective protection, cushioning and support to the body. However, because it is constantly exposed to stress and lacks natural oil secretion, it is prone to common conditions such as callus formation, fissures, blisters and fungal infections. Proper foot care, including hydration and hygiene is essential to maintain healthy skin and prevent discomfort or disease. The specialized anatomy of the foot skin highlights its vital role in mobility, stability and overall quality of life.^[4]

Foot skin has 3 main layers:

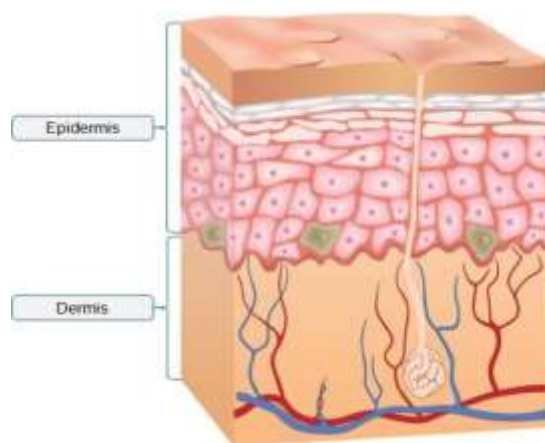


Figure1: Structure of Foot Skin

HERBAL FOOTCARE STICK

A herbal foot care stick is a convenient topical formulation designed to nourish, protect and repair the skin of the feet using natural plant-derived

ingredients. Since the skin of the heel and sole is the thickest and usually prone to dryness, cracks, callus formation and fungal infections due to absence of oil glands. The formulation aims to provide intense moisturization and restorative action. This type of product typically contains herbal oils, plant extracts, waxes and natural emollients that create a protective barrier to prevent water loss and soften hardened skin. The herbal constituents often possess anti-bacterial, anti-fungal and anti-inflammatory properties that help maintain healthy feet, reduce odour and support healing of minor wounds and fissures. Herbal foot care sticks are easy to apply due to their solid stick form and allow targeted application without the need for direct hand contact making them hygienic and travel-friendly. They offer a combined effect of hydration, soothing and antimicrobial protection. The presence of waxes such as beeswax helps in providing the product its solid consistency and enhances its adherence to the skin, which is beneficial for long-lasting moisture retention. Regular application of a herbal foot care stick improves the texture, smoothness and elasticity of foot skin, preventing cracking and discomfort while restoring overall foot health.^[8]

Since the product is based on natural herbal ingredients, it reduces the risk of irritation and side effects associated with synthetic chemicals, making it suitable for long-term personal care. Due to increasing preference for natural cosmetics and easy-to-use solid formulations, herbal foot care sticks are gaining importance in both cosmetic and therapeutic foot care. Their role becomes essential in maintaining soft, healthy and well-protected feet in daily life.

The herbal foot care stick formulated with cinnamon extract and walnut works by deeply moisturizing, protecting and repairing the thick and dry skin of the feet. Cinnamon contains active compounds such as cinnamaldehyde, polyphenols

and essential oils that show strong antibacterial, antifungal and anti-inflammatory properties. When applied to the heel and sole, cinnamon extract helps to inhibit the growth of common foot pathogens including fungi responsible for athlete's foot and bad odour. Its mild warming effect improves local blood circulation, which enhances nutrient supply to the damaged tissues and promotes faster skin regeneration and healing of cracks and calluses. Cinnamon also supports exfoliation of dead cells, helping to smoothen rough surfaces on pressure areas of the feet.^{[7][8]}

Walnut contributes nourishment in the form of omega-3 fatty acids, proteins, vitamins (E & B complex) and minerals that restore the skin barrier and help retain moisture in the stratum corneum. The presence of antioxidant compounds protects the skin from oxidative stress caused by friction and environmental exposure. Walnut has natural emollient and softening action, which reduces dryness, prevents fissure formation and improves the overall elasticity of the heel pad. When both cinnamon and walnut ingredients penetrate the skin, they synergistically provide hydration, antimicrobial protection and rejuvenation. Additionally, waxes and lipids in the stick form a protective occlusive layer, reducing water loss and shielding the skin from further mechanical damage. With consistent application, this formulation leads to visibly softer, smoother and healthier feet with reduced cracking, pain and infection risks.^[7]

Advantages

- Made from natural herbal ingredients, reducing the risk of irritation and side effects.
- Cinnamon provides strong antibacterial and antifungal action, preventing foot infections and odour.
- Improves blood circulation in heel and sole, promoting faster healing of cracks.



- Walnut offers deep moisturization due to omega fatty acids and vitamin E.
- Helps restore the skin barrier and prevents dryness and fissure formation.
- Antioxidants in walnut protect the skin from damage and support regeneration.
- Stick form allows clean, easy and targeted application without using hands.
- Forms a protective film over the skin to retain moisture for a longer time.
- Reduces callus formation and softens rough skin.^[7]

MATERIALS AND METHODS

Materials

Methyl Paraben (Loba Chemie, Mumbai), Beeswax (Oxford Lab, Maharashtra), Castor Oil (Isochem Laboratory, Kochi), Paraffin Wax (Finar Ltd Ahmedabad), Cetosteryl Alcohol (Loba Chemie Mumbai).

Methods

Plants Used:

a) Cinnamon (*Cinnamomum verum*)

Cinnamomum verum, commonly known as True Cinnamon or Ceylon Cinnamon belongs to the family Lauraceae. It is a small evergreen tree native to Sri Lanka and Southern India. The bark of the plant is widely used in traditional and modern systems of medicine. It possess numerous therapeutic properties such as antibacterial, antifungal, antioxidant^[5] and anti-inflammatory effects due to the presence of active constituents like Cinnamaldehyde, Eugenol and Cinnamic acid. These properties make cinnamon a valuable ingredient in cosmetic and pharmaceutical formulations aimed at promoting skin health and protection. It is commonly used as spices and widely cultivated for its aromaticity.^[9]

b) Walnut (*Juglans regia*)

Juglans regia, commonly known as Walnut belongs to the family Juglandaceae. It is a large deciduous tree native to Central Asia and the Himalayan regions. The fruit (nut) and oil extracted from walnuts are rich in polyunsaturated fatty acids, tocopherols, phenolic compounds and essential vitamins. These components are responsible for its moisturizing, nourishing and antioxidant properties. In cosmetic applications, walnut oil and powder are used to soften rough skin, prevent dryness and provide gentle exfoliation, making it suitable for foot-care preparations.^[9]

Collection of Bark and Seeds.

The cinnamon bark and walnut seeds were procured from a local herbal raw material supplier. Both raw materials were authenticated and examined for quality. The collected plant materials were cleaned, shade-dried and finely powdered using a mechanical grinder. The powders were stored in airtight containers for further use in the formulation.^[9]

Preparation of Herbal Extracts.

The Cinnamon extract were prepared by weighing 10g of dried bark, powdered mechanically and soaked in 100ml of ethanol overnight. After 24hrs the extract were filtered using funnel and filter paper and used for the preparation of herbal foot care stick. The walnut milk extract was prepared by weighing 10g of walnut kernels, which were cleaned and soaked in 100ml of warm distilled water for 8-10hrs. The soaked kernels were then blended mechanically into a smooth mixture and filtered through a muslin cloth to obtain the milk extract. The filtrate (walnut milk) was stored in an airtight container and used for the preparation of herbal foot care stick.^[10]





Figure no.2: Extract of Cinnamon and Walnut

Formulation of Herbal Foot care stick

The herbal foot care stick was formulated using a conventional Hot fusion method. Initially, Beeswax and paraffin wax were placed in a china dish and melted on a water bath at 60-65°C until a clear, homogeneous oil phase was obtained. Castor

oil was then incorporated slowly into the molten wax base with gentle stirring and heating was continued to maintain uniformity. Cinnamon extract and walnut milk were mixed separately in a glass beaker, followed by the addition of Cetostearyl alcohol to aid proper dispersion of the active ingredients. This mixture was gradually added to the molten base under continuous stirring. Methyl paraben was introduced into the formulation at approximately 60°C and mixed thoroughly. The resulting molten mass was finally poured into stick moulds at 55-60°C and allowed to cool and solidify at room temperature, yielding a uniform herbal foot care stick suitable for topical application.^[10]

The herbal foot care stick was prepared by the following ingredients given in the table no.1

Table no.1:Formula for the preparation of herbal foot care stick

Ingredients	F1	F2	F3	F4	F5
Beeswax	0.5 g	0.5 g	1 g	1.5 g	2 g
Castor oil	2.5 ml	3.5 ml	3 ml	3.5 ml	3.5 ml
Paraffin	0.5 g	0.5 g	0.5 g	0.5 g	0.5g
Cinnamon extract	2 ml	2 ml	2 ml	2 ml	2 ml
Walnut milk	2 ml	2 ml	2 ml	2 ml	2 ml
Cetostearyl alcohol	0.5 g	0.5 g	0.5 g	0.5 g	0.5 g
Methyl paraben	0.5 g	0.5 g	0.5 g	0.5 g	0.5 g



Figure no. 3: Formulated footcare stick

4. Phytochemical Screening of the extract.

The ethanolic extract of *Cinnamomum verum* and *Juglans regia* milk was subjected to the following qualitative test to reveal the presence of carbohydrates, alkaloids, glycosides, flavonoids, terpenoids, phenolic compounds, tannins and saponins.^{[11][13]}

i. Test for Alkaloids

- To 0.1ml of Mayer's reagent, 0.5ml of extract solution was added and mixed in a test tube and looked for any precipitates. A pale-yellow precipitate indicates the presence of alkaloids.

- Equal volume of Dragendroff's reagent and extract solution was mixed on a clean test tube. Formation of orange, brown precipitate shows the presence of alkaloids.

ii. Test for Carbohydrate

- Molisch test

2ml of extract was added into the test tube and few drops of Molisch reagent was added to extract. To this 2ml of concentrated H₂SO₄ was dropped out from the walls of test tube. Formations of a violet colour ring at the junction of two liquids indicates the presence of carbohydrate.

- Fehling's test

1ml of the extract was boiled with 1ml each of Fehling solution A and B on water bath. Appearance of a red or brick precipitate indicates the presence of sugar.

iii. Test for Glycosides

- Legal test

A small quantity of extract was heated with dilute HCl to the hydroxylate 2ml of pyridine and 2ml of sodium nitroprusside solution was added. Formation of pink red colour indicates the presence of glycosides.

- Borntrager's test

A small portion of the extract was boiled with dil.H₂SO₄ and filtered while hot. The filtrate was cooled and 5ml of solvent ether was added and shaken well. Ether layer was separated and treated with equal volume of ammonia solution. Rose pink in the ammonical layer shows the presence of anthraquinone glycoside.

iv. Test for Saponins

- Foam test

A few ml of extract was mixed with 20ml of distilled water in a 100ml measuring cylinder

and shaken for 15mins. 1cm of foam indicate the presence of saponins. About 3ml of extract solution was mixed with lead sub acetate solution. Formation of precipitate indicates the presence of saponin.

v. Test for Flavonoids

- One drop of extract was caught on a filter paper and was exposed to ammonia. Yellow spots show the presence of flavonoids.
- Extract was treated with a few drops of lead acetate solution. Formation of yellow colour precipitate indicates the presence of flavonoids.

vi. Test for Tannins and Phenolic compounds

- To 1ml of Gelatin solution add 10% NaCl and 1ml extract, precipitation occurs if tannins are present.
- To 2ml of aqueous solution of the extract, 0.5ml of ferric chloride solution was added. Blue colour indicated the presence of phenolic compounds.

vii. Test for Proteins and Amino acids

- Xanthoproteic test

The extract was treated with few drops of concentrated nitric acid solution. Formation of yellow colour indicates the presence of protein.

- Ninhydrin test

To the extract 0.25% of Ninhydrin reagent was added and boiled for few minutes. Formation of blue colour indicates the presence of amino acids.

viii. Test for Terpenoid

- 2.0ml of chloroform was added with the 5 ml aqueous plant extract and evaporated on the water bath and then boiled with 3 ml of H₂SO₄ concentrated. A grey colour formed which showed the entity of terpenoids.^{[11][13]}



EVALUATION OF HERBAL FOOT CARE STICK

t= time taken in seconds

To evaluate the prepared formulation, Various evaluation test are performed to determine the physiochemical parameters.

i. Physical Appearance:

Visual inspection of the herbal foot care stick was performed. The colour, odour and homogeneity of the herbal foot care stick were checked.

ii. Determination of the pH:

In 100 ml of petroleum ether, 1g of herbal foot care stick was mixed. The pH of the mixture was examined using a previously standardized digital pH metre.^[14]

iii. Spreadability:

The spreadability was expressed in terms of time in seconds taken by two slides to slip off from the foot care stick, placed in between the slides, under certain load. Lesser the time taken for separation of the two slides better the spreadability. Good spreadability ranges from 5 to 7cm. Two sets of glass slides of standard dimension were taken. Then one slide of suitable dimension was taken and the stick formulation was placed on that slide. Then the other slide was placed on top of the formulation. Then a weight or certain load was placed on the upper slide so that the stick formulation between the two slides was pressed uniformly to form a thin layer. The excess of formulation adhering to the slides was scrapped off. The upper slide was allowed to slip off freely by the force of weight placed over it. The time taken by the slide to slip off was noted.^[17]

Spreadability = $\frac{ml}{t}$

Where, m= standard weight which is placed over the upper slide (100g)

l= length moved by the slide

iv. Melting Point

Determination of melting point is important as it is an indication of the limit of safe storage. The melting point of formulated foot care stick was determined by Capillary tube method. The capillary tube and thermometer was fitted in a Burette and is immersed in beaker containing Paraffin wax and is then gently heated. The product in the test tube was slowly melted, The temperature at this point was observed. Melting point of each formulation was determined.^[11]



Figure no. 4: Melting point apparatus

v. DPPh Assay for Antioxidant study:

The DPPh (2,2-diphenyl-1-picrylhydrazyl) assay is a widely used method for evaluating the antioxidant activity of plant extracts, compounds and foods. The assay measures the ability of antioxidants to scavenge the stable free radical DPPh, which is a stable nitrogen-centered radical with a deep purple colour. The reduction of DPPh by an antioxidant results in a colour change from purple to yellow, which can be measured spectrophotometrically at 517 nm. The DPPh assay is a simple, rapid and sensitive method for assessing antioxidant activity, making it a popular choice for screening and evaluating the antioxidant potential of various samples

To evaluate the antioxidant property using DPPH assay, follow steps are followed;

- Prepare DPPH Solution: To prepare 100 ml of 0.1 μ M, Dissolve 0.0034 g(3.94 mg)in 100 ml ethanol.
- Preparation of standard ascorbic acid: Dissolve 10 mg Ascorbic acid in 10 ml ethanol. Prepare serial dilutions for standard curve(50,100,150mg/ml).
- Prepare Sample: Prepare a series of concentrations of the sample (50,100,150mg) in ethanol.
- Mix DPPH and Sample & Test: Mix 3 ml of DPPH solution with 1,1.5,2 ml of sample And Test solution.
- Make up to 10 ml in a standard flask.
- Incubate: Incubate the mixture in the dark for 30 minutes.
- Measure Absorbance: Measure the absorbance at 517 nm using a spectrophotometer.
- Calculate IC₅₀: Calculate the IC₅₀ value, which is the concentration of sample required to scavenge 50% of DPPH radicals.

Formula:

$$\% \text{ Inhibition} = (A_0 - A_1) / A_0 \times 100$$

A₀ = Absorbance of DPPH solution without sample

A₁ =Absorbance of DPPH solution with sample.^{[12][17]}

vii. Microbial study:

The antimicrobial efficiency of optimized formulation (F3) was studied using *Escherichia*

coli. The inhibitory effect of formulation on the studied microorganisms was evaluated using Agar well diffusion method. All the glass wares required to conduct the test were sterilized by dry heat method using hot air oven. Nutrient agar medium was prepared and sterilized by autoclaving under aseptic conditions. Nutrient agar medium was inoculated with 0.1ml of fresh overnight nutrient broth culture of bacterium in flasks and poured into sterile petri plates. Allow them to solidify. After solidification cups were made on each plate with the help of sterile borer of 6mm diameter and poured appropriate amount of formulation to the cup. Incubate the plates for 24hrs at 37°C. After the incubation period, the plates were examined for inhibition of bacterial growth around the wells. The plates were examined for inhibition of bacterial growth around the wells. Alcohol was used as the control, while ciprofloxacin served as the standard antimicrobial agent. The plates were then incubated at 37°C for 24 hours. After the incubation period, the plates were observed for the presence of zones of inhibition around the wells, indicating antimicrobial activity of the formulation.^[18]

RESULTS

Preliminary phytochemical screening

Preliminary phytochemical screening was evaluated and the results are given in the table no. 2

Table no.2:Preliminary Phytochemical Screening

Phytochemicals	Results (Cinnamon extract)	Results (Walnut milk)
Alkaloids	-	-
Carbohydrates	+	+
Glycosides	+	+
Saponins	-	-
Flavanoids	+	+
Proteins and Aminoacids	-	+
Terpenoids	+	+



+ present,-absent

The following evaluation test were performed on formulated Herbal footcare stick.

i. Physical Appearance:

The colour ,odour of the formulated herbal foot care stick were inspected and determined.

Table no.3:Table showing characteristics of formulation

Formulation	Colour	Odour
F1	Light Brown	Pleasant aromatic
F2	Light Brown	Pleasant aromatic
F3	Pale Brown	Pleasant aromatic
F4	Creamy White	Pleasant aromatic
F5	Creamy White	Pleasant aromatic

The homogeneity of the formulated foot care stick was judged by the visual appearance and touch. The appearance and touch of the foot care stick was good.

The pH of the prepared formulations were determined using digital pH meter and the pH of the prepared formulations are shown in the table no.4,the pH of these formulations are compatible with Foot skin, thus cause no irritation.

ii. Determination of pH

Table no.4:pH of formulations

Formulation	pH
F1	6.7
F2	6.8
F3	6.5
F4	6.7
F5	7.1

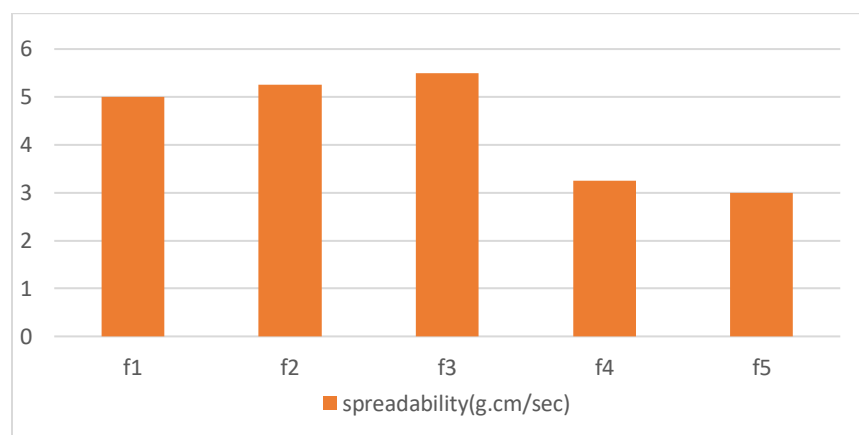
iv.Spreadability

Spreadability of the formulated herbal foot care stick were determined by using the Slip and Drag

method. The time taken for the movement of upper slide is given in the following table no.5

Table no.5: Spreadability of formulations

Formulation	Spreadability (g.cm/sec)
F1	5
F2	5.25
F3	5.5
F4	3.25
F5	3



Satisfactory spreadability of formulated herbal foot care stick was found to be F3.

vi. Melting point

Melting point of all the footcare stick formulations was found in between 47-59°C. Thus all the formulation possess typical stick property. Moderate melting property of stick prevents its melting during storage and promotes ease of application on the foot. The melting point results were depicted in table no 6.

Table no.6: Melting point of formulations

Formulation	F1	F2	F3	F4	F5
Melting Point(°C)	47° C	50° C	57° C	58.4° C	59° C

Table no.7 percentage inhibition

SAMPLE	ABSORBANCE	% INHIBITION
T1	0.050	40%
T2	0.0499	40.60%
T3	0.047	44.05%
T4	0.047	44.05%
T5	0.046	45.24%
T6	0.045	46.43%
S1	0.020	75%
S2	0.015	81.25%
S3	0.010	93.75%
Control	0.084	0%

T₁= Test Sample 1
T₂= Test Sample 2

v. Antioxidant study

The DPPH method measures the ability of a compound scavenge free radicals. The ability of antioxidants is related to the ability of compound components to donate electrons or hydrogen. A molecule can donate electron or hydrogen will react to DPPH. The mechanism will change the colour solution from purple to yellow. We got a yellow coloured solution while adding DPPH solution and the percentage inhibition found to be shown in table no.6 Antioxidant activity is the ability of a compound or an extract to inhibit oxidation reaction which can be expressed by the presentation of DPPH absorption. Extract exhibit percentage inhibition that they possess a good antioxidant activity from the table no.7

T₃= Test Sample 3
T₄= Test Sample 4

T₅= Test Sample 5

T₆= Test Sample 6

S₁=Standard Sample 1

S₂=Standard Sample 2

S₃=Standard Sample 3

Selection of best formulation

Out of the five formulations prepared, one formulation is selected as the best formulation based on the following evaluation parameters

- pH
- Spreadability
- Melting point



Figure no.5: Microbial Test for the Formulation F3 **Figure no.6: Microbial test of control and standard**

- DPPH assay

Formulation F3 was selected as the best formulation which showed a pH 6.5, spreadability of 5.5g.cm/sec and showed a better antioxidant activity.

The selected formulation F3 was then evaluated for antibacterial activity.

vii. Antimicrobial study

The Antimicrobial study of herbal foot care stick was done using *E.coli*. The Best formulation F₃ was studied and it showed a satisfactory antimicrobial property.



DISCUSSION

The present study demonstrates the successful formulation and evaluation of a herbal foot care stick containing *Cinnamomum verum* and *Juglans regia*. Phytochemical screening confirmed the presence of flavonoids, glycosides, terpenoids and phenolic compounds, which are known to contribute to antioxidant and antimicrobial activities. Among the five formulations, F3 exhibited optimal physicochemical properties, including acceptable pH close to skin neutrality, good homogeneity and satisfactory spreadability, making it suitable for topical application. The

antioxidant activity evaluated by the DPPH assay showed significant free radical scavenging ability, indicating the protective potential of the formulation against oxidative stress. Furthermore, the antimicrobial study against *Escherichia coli* confirmed the inhibitory effect of the optimized formulation, supporting the traditional use of cinnamon for microbial control. Overall, the findings suggest that the developed herbal foot care stick is stable, safe and effective for managing dry, cracked and infection-prone foot skin, highlighting its potential as a natural cosmetic foot care product.

CONCLUSION

The present investigation was aimed at formulating and evaluating a herbal foot care stick containing *Cinnamomum verum* and *Juglans regia* for the management of dry, cracked and infection-prone foot skin. Phytochemical screening of cinnamon extract and walnut milk revealed the presence of flavonoids, glycosides, terpenoids and phenolic compounds, which are well known for their antioxidant and antimicrobial activities.

The study concludes that a stable and effective herbal foot care stick containing *Cinnamomum verum* and *Juglans regia* can be successfully formulated using a simple and economical method. The best formulation (F3) exhibited desirable physicochemical properties, significant antioxidant activity and effective antimicrobial action. The presence of natural constituents supports its role in moisturizing the skin, preventing microbial infections and improving overall foot health. The pH of F3 was close to skin-neutral, indicating good skin compatibility and reduced risk of irritation upon topical application. Homogeneity and organoleptic properties such as colour and pleasant aromatic odour were satisfactory, suggesting uniform distribution of ingredients and consumer acceptability. Spreadability studies showed that F3 had appropriate consistency, enabling smooth and easy application on the foot surface. The antioxidant activity evaluated by the DPPH assay demonstrated notable free radical scavenging ability of the formulation, which can be attributed to the polyphenols and flavonoids present in cinnamon and walnut. The melting point of the formulations ranged between 47–59°C, indicating adequate thermal stability. This ensures that the foot care stick remains solid under normal storage conditions while allowing smooth application during use. Furthermore, the antimicrobial study against *Escherichia coli* showed clear inhibitory

activity, supporting the antimicrobial potential of cinnamon extract in preventing microbial infections commonly associated with cracked heels.

Overall, the evaluation results confirm that formulation F3 possesses balanced physical stability, efficacy and ease of application.

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REFERENCES

1. Dr.Aijas A.Sheikh , Dr.Subhash V.Deshmane , Dr.kKailash R. Biyani, Dr.Md.Rageeb Md.Usman; overview on cosmetics ; Text book of cosmetic science ;2019;page no .3.



1. 2.Barnhart R. The Barnhart Dictionary of Etymology.H.W. Wilson Co.;1988.
2. 2.Barel AO,Paye M,Maibach HI. Handbook of cosmetic science and Technology.4th ed. CRC press; 2014. .
3. 4.Smith J,Kumar A,Lee P. Assessment of skin barrier function in plantar foot skin. J Dermatol Res.2023;15(2):85-92.`
4. 5.Amaral JS, Casal S, Seabra RM, Oliveira BP. Effects of roasting on hazelnut, almond and walnut oils antioxidant properties. Food Chem. 2006;97(2):227-234.
5. Debnath S, Niranjana Babu M, Kusuma G. Formulation and evaluation of herbal antimicrobial deodorant stick. Res J Topical Cosmet Sci. 2011;2(1):21–24..
6. Smita Kadam, Rohini Chavan, Surajkumar Chavan, Janhavi Chinchwade Formulation and Evaluation of Cinnamon and Walnut Foot Scrub International Journal for Research in Applied Science and Engineering Technology 12(9):1520-152
7. 8.Seyed Fazel Nabavi, Arianna Di Lorenzo, Morteza Izadi, Eduardo Sobarzo-Sanchez, Maria Daglia, and Seyed Mohammad Nabavi, Antibacterial effects of Cinnamon:
8. From Farm to Food, Cosmetic and Pharmaceutical industries, 2015; DOI:10.3390/nu7095359
9. Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. 50th ed. Pune: Nirali Prakashan; 2014.
10. Julianti E, Rajah KK, Fidrianny I. Antibacterial activity of ethanolic extract of cinnamon bark, honey, and their combination effects against acne-causing bacteria. Scientia Pharmaceutica. 2017;85(2):19. doi:10.3390/scipharm85020019.
11. Shaikh JR, Patil MK. Qualitative tests for preliminary phytochemical screening: An overview. Int J Chem Stud. 2020;8(2):603-8. doi:10.22271/chemi.2020.v8.i2i.8834.
12. Adamstone FB, Card LE. The effects of vitamin E deficiency on the testis of the male fowl (Gallus domesticus). Journal of Morphology. 1934 Sep;56(2):339-59.
13. 13.Shaikh JR, Patil MK. Qualitative tests for preliminary phytochemical screening: An overview. Int J Chem Stud. 2020;8(2):603-8. doi:10.22271/chemi.2020.v8.i2i.8834.
14. 14.Pagliari S, Forcella M, Lonati E, Sacco G, Romaniello F, Rovellini P, et al.
15. Antioxidant and anti-inflammatory effect of cinnamon (Cinnamomum verum J. Presl) bark extract after in vitro digestion simulation. Foods. 2023;12(3):452.
16. 15.Moreno EKG, de Macêdo IYL, Batista EA, Machado FB, Santos GR, Andrade DML, et al. Evaluation of antioxidant potential of commercial cinnamon samples and its vasculature effects. Oxid Med Cell Longev. 2022;2022:1992039
17. Rahman Gul,Syed Umer Jan,Syed Faridullah, Samiullah Sherani,and Nusrat Jahan:
18. Preliminary Phytochemical Screening, Quantitative Analysis of Alkaloids, and Antioxidant Activity of Crude Plant Extracts from Ephedra intermedia Indigenous to Balochistan, The Scientific World Journal. Vol. 2017, Article No. 5873648
19. 27. Vallimanalan B, Safeera KA, Athira VK, Anika K, Aswathy PN, Fasna M. Formulation and Evaluation of Facial Cleansing Stick. Int J Creat Res Thoughts (IJCRT). 2024 Jul;12
20. 18. Gajre V, Patel D, Patel S, Patel V, Patel D, Patel Y, Bhandari D. Formulation and Evaluation of Herbal Based Sunscreen Stick Containing Persea Americana Oil Extract. Int J Pharm Res Appl. 2025 Sep–Oct;10(5):142–151.
21. 19. Mirajkar R, Muttha K, Shaikh S, Mane S, Bikkad S. Formulation and Evaluation of an Antioxidant-Rich Foundation Stick Incorporating Aegle marmelos Fruit Extract.



- Int J Res Publ Rev (IJRPR). 2025 Apr;6(4):15509–15525. doi: 10.55248/gengpi.6.0425.1689.
22. 20. Gao P, Ding Y, Chen Z, Zhou Z, Zhong W, Hu C, He D, Wang X. Characteristics and antioxidant activity of walnut oil using various pretreatment and processing technologies. Foods. 2022 Jun 9;11(12):1698. doi:10.3390/foods11121698.
 23. 21. Panda H. Herbal Cosmetics: A Practical Book. NIIR; 2004
 24. 22. Yassine El Atki, Imane Aouam, Fatima El Kamari, Amal Taroq, Kaotar Nayme, Mohammed Timinouni, Badiaa Lyoussi, Abdelfattah Abdellaoui, Antibacterial activity of cinnamon essential oil and synergistics protection with antibiotic. J Adv Pharm Technol Res 2019;10:63- 7
 25. 23. Shital Kamathe, Vishnu Kangralkar, Nagesh. C, Pednekar Apurva, Pooja Balekundri, Patil Manasi and Preneet Anigol, Formulation and Evaluation of Polyherbal Foot Care Gel; DOI:10.20959/wjpr202412-32896
 26. 24. Yassine El Atki, Imane Aouam, Fatima El Kamari, Amal Taroq, Kaotar Nayme, Mohammed Timinouni, Badiaa Lyoussi, Abdelfattah Abdellaoui, Antibacterial activity of cinnamon essential oil and synergistics protection with antibiotic. J Adv Pharm Technol Res 2019;10:63- 7
 27. 25. Shital Kamathe, Vishnu Kangralkar, Nagesh. C, Pednekar Apurva, Pooja Balekundri, Patil Manasi and Preneet Anigol, Formulation and Evaluation of Polyherbal Foot Care Gel; DOI:10.20959/wjpr202412-32896

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