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Herbal and Natural Remedies for Relieving Burning Feet Syndrome: A Review

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Abstract: *Burning feet syndrome (BFS) is a distressing condition in which the soles and sometimes the whole foot feel hot, tingling or painful, often worse at night. It is not a disease in itself but a symptom of many underlying problems, including diabetes, vitamin B12 deficiency, peripheral neuropathy, fungal infection, and long standing on hot or wet surfaces. Dry and cracked skin of the feet (heel fissures) commonly accompanies it and adds to discomfort and the risk of infection. Medical diagnosis of the cause is the first step, but many patients also seek simple, low-cost and natural measures for relief. This review brings together the available information on herbal and natural remedies for burning feet and related foot problems, with special attention to neem (Azadirachta indica), tulsi (Ocimum sanctum) and aloe vera (Aloe barbadensis). It discusses the causes and mechanisms of burning sensation, the traditional and reported activities of these plants, the herbal dosage forms used so far (creams, patches, films), and a proposed solid, flexible herbal foot pad prepared by solvent casting with PVA, HPMC and glycerin. Methods of standardisation, evaluation and stability testing are summarised. The literature on herbal foot care is mostly limited to creams and a few patches, and clinical evidence for relief of burning feet specifically is lacking. Well-designed laboratory and clinical studies are therefore needed.*

Keywords: burning feet syndrome, herbal remedies, neem, tulsi, aloe vera, foot pad, transdermal film, heel fissures

I. INTRODUCTION

The feet carry the full weight of the body and are exposed to heat, moisture, dust, friction and footwear for many hours every day. It is therefore not surprising that foot complaints such as burning sensation, itching, dryness, cracked heels, fungal infection and odour are very common, especially among people who walk barefoot, stand for long hours, or work in wet and dusty surroundings [1,2]. Burning feet syndrome is one of the most troublesome of these complaints. Patients describe a hot, burning, tingling or “pins and needles” feeling in the soles, which may extend to the toes and ankles and is often worse in the evening or at night, disturbing sleep and daily activity.

Herbal medicines are therapeutic and cosmetic products obtained from plants. They are widely used because they are easily available, relatively inexpensive and generally well tolerated, and materials such as neem, tulsi and aloe vera have a long history of use in Ayurveda for the care of the skin [3,6]. Many people use cooling pastes, oils, foot soaks and leaf preparations at home to ease burning feet. However, scientific information on these remedies is scattered, and few products are standardised or evaluated.

The aim of this review is (i) to describe burning feet syndrome and its causes in brief, (ii) to collect the reported information on herbal and natural remedies for burning feet and for dry, cracked and infected skin of the sole, (iii) to discuss the dosage forms used for herbal foot care, and (iv) to describe a proposed herbal foot pad containing neem, tulsi and aloe vera and the way in which such a pad can be evaluated.

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II. BURNING FEET SYNDROME: CAUSES AND MECHANISM

2.1 Definition and common causes

Burning feet syndrome is a symptom complex rather than a single disease. The burning sensation arises when the nerves of the feet, particularly the small sensory fibres that carry pain and temperature, are irritated or damaged, or when the skin and its blood supply are disturbed. The commonly recognised causes are summarised in Table 1. Burning feet can arise from causes such as diabetes or vitamin B12 deficiency, which need medical diagnosis.

Table 1. Common causes of burning sensation in the feet

Group	Examples
Metabolic and nutritional	Diabetes (diabetic neuropathy), vitamin B12 and other B-vitamin deficiency, thyroid disorders
Nerve related	Peripheral neuropathy, nerve compression (for example tarsal tunnel), alcohol-related neuropathy
Drug and toxin related	Some chemotherapy drugs and other medicines, heavy metals
Kidney and systemic disease	Chronic kidney disease and other long-standing illnesses
Skin and infection	Fungal infection (athlete's foot), dry skin, heel fissures, contact dermatitis
Local and environmental	Prolonged standing, hot or wet conditions, tight or non-breathable footwear, menopause-related heat

In many patients no single cause is found. For this reason the first step is always medical assessment, and herbal or natural products should be seen as supportive foot care and not as a replacement for treatment of an underlying disease.

2.2 Mechanism of the burning sensation

The exact mechanism differs with the cause. In neuropathic burning, damaged small nerve fibres become hyperexcitable and send abnormal pain signals, so that normal warmth is felt as burning. In metabolic conditions such as diabetes, high blood sugar, oxidative stress and inflammation are believed to contribute to nerve damage. In skin-related burning, a broken skin barrier (cracks and fissures) exposes nerve endings, allows water loss and lets bacteria and fungi enter, producing pain, inflammation and itching. These mechanisms suggest three targets for supportive foot care: reduction of inflammation and oxidative stress, control of microbial growth, and restoration of moisture and barrier function of the skin.

2.3 Dry skin and heel fissures

The skin of the sole has a thick stratum corneum and few sebaceous glands, so it dries easily and cracks when it loses moisture [1,2]. Cracks in the heel (fissures) are painful, may bleed, and can become infected. Creams and ointments are the usual treatment, and most herbal products for this purpose are creams [2,3]. These facts matter for burning feet because dry, inflamed and infected skin is a common companion of the complaint and a common reason for burning and itching of the soles.

III. CONVENTIONAL MANAGEMENT IN BRIEF

Treatment of burning feet depends on the cause. Control of blood sugar in diabetes, correction of vitamin deficiency, change of an offending drug, treatment of fungal infection, and medicines for neuropathic pain are decided by a physician. Simple supportive measures are widely advised: keeping the feet clean and dry, wearing breathable footwear and cotton socks, avoiding long standing on hot surfaces, cool water soaks, and regular moisturising of dry skin. Herbal and natural remedies are mostly used within these supportive measures, and a patient with persistent, severe or spreading symptoms, numbness, wounds, or known diabetes should consult a doctor and not rely on home remedies alone.

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IV. HERBAL AND NATURAL REMEDIES

4.1 Overview

Plants are used for burning feet and foot care in three broad ways: as cooling and soothing applications (pastes, gels and soaks), as antimicrobial agents against the organisms that infect cracked skin, and as emollients that soften dry skin. Many of the plants mentioned in the literature contain polyphenols, flavonoids, volatile oils and polysaccharides, which are reported to have antioxidant, anti-inflammatory, antimicrobial or moisturising activity. Table 2 lists the plants that appear in the studies reviewed here, together with their reported use.

Table 2. Plants reported for heel fissures and foot care in the reviewed studies

Plant	Form studied	Reported purpose / finding	Ref.
Neem (*Azadirachta indica*)	Cream with Hedychium and aloe; antiseptic cream	Microbiologically safe; no microbial growth seen	[3,6]
Tulsi (*Ocimum sanctum*)	Antiseptic cream with neem and aloe	Stable; no growth of *E. coli* and yeast	[6]
Aloe vera (*Aloe barbadensis*)	Heel crack cream; polyherbal cream; antiseptic cream	Moisturising, soothing; good spreadability, no irritation	[2,3,6]
Black turmeric, vetiver, green tea	Polyherbal heel fissure cream	pH 6.5, good spreadability and washability, no irritation	[2]
Hedychium spicatum	Crack cream	Safe and suitable for cracked skin	[3]
Datura metel seeds with mustard oil	Transdermal patch for cracked heels	Formulation F5 best; clinical study still needed	[1]
Hibiscus rosa-sinensis	Transdermal film	Films evaluated, diffusion studied over 24 h	[4]

Several of these plants, for example vetiver (khus), are traditionally regarded as “cooling” in Indian systems of medicine, which is the reason they are popular for burning sensations. It should be noted, however, that the reviewed studies tested them mainly for heel fissures, skin safety and microbial growth. None of the studies reviewed here tested relief of burning feet itself in patients.

4.2 Neem (*Azadirachta indica* A. Juss., family Meliaceae)

Neem is traditionally used for skin diseases. Its leaves contain nimbin, nimbidin, azadirachtin, quercetin and other flavonoids and tannins, and the literature describes antibacterial, antifungal, anti-inflammatory and antioxidant activity of neem and its bioactive constituents [13]. These properties are useful in the foot, where cracked skin can be infected by bacteria and fungi. Neem has been included together with *Hedychium spicatum* and aloe vera in a crack cream that was found microbiologically safe [3], and with tulsi and aloe vera in an antiseptic cream [6]. The part used is the leaf, which is available fresh and cheaply throughout Maharashtra.

4.3 Tulsi (*Ocimum sanctum* L., family Lamiaceae)

Tulsi leaf contains a volatile oil rich in eugenol, together with ursolic acid, flavonoids and tannins, and antimicrobial and antioxidant effects have been reported [8]. Eugenol is a phenolic compound with well-known antiseptic properties and is the main reason tulsi is chosen for antimicrobial preparations. In the antiseptic cream prepared with neem, tulsi and aloe vera, no growth of *E. coli* and yeast was seen and the cream was stable without phase separation [6].

4.4 Aloe vera (*Aloe barbadensis* Miller, family Asphodelaceae)

The gel from the inner leaf is a well-known moisturising and soothing material for dry skin. It contains polysaccharides, vitamins, amino acids and small amounts of anthraquinones, and the exact content depends on the source. Aloe gel has been used in herbal creams for heel cracks [2,3] and in the antiseptic cream mentioned above [6]. It contributes water and soothing material that soften dry skin, and it is generally regarded as cooling when applied, which suits the complaint of hot, burning soles.

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4.5 Other natural measures

Besides plant extracts, simple natural measures are used at home: soaking the feet in cool water, applying plain coconut or sesame oil to soften the skin, and applying cooling pastes. These measures are low in cost and low in risk for most people, but they are not standardised, and their effect on burning feet has not been tested in controlled studies in the literature reviewed here.

4.6 Variability and quality of herbal materials

Herbal materials are natural products, so their composition changes with the species, the part used, the place and time of collection, drying and storage. For this reason the WHO has published methods for the quality control of herbal materials, and the Indian Pharmacopoeia gives standards and methods of analysis [7,9]. Any serious herbal product should therefore start with authentication of the plant, and tests such as foreign matter, loss on drying, total ash, acid-insoluble ash and water-soluble and alcohol-soluble extractive values [7,9,10].

V. DOSAGE FORMS FOR HERBAL FOOT CARE

5.1 Existing forms

The forms used for herbal foot care are compared in Table 3. Creams and ointments are the most common. They are easy to apply but are rubbed off by socks, footwear and walking. Herbal patches and films have also been developed, and they stay in place and give controlled contact with the skin [1,4]. Foot soaks and powders give only a short contact time and a temporary effect.

Table 3. Comparison of dosage forms for herbal foot care

Dosage form	Description	Remarks
Cream / ointment [2,3]	Semisolid preparation rubbed on the skin	Easy to apply; rubs off with socks and walking
Herbal patch / film [1,4]	Thin polymer film containing the herbal extract	Stays in place; controlled contact with skin
Foot pad (proposed)	Flexible polymer pad containing herbal extracts, applied to the sole or heel	Protects the area and keeps it moist; no mess
Foot soak / powder	Herbal powder or liquid for bathing the feet	Short contact time; temporary effect

5.2 Herbal patches and films in the literature

Sahane et al. developed a herbal transdermal patch for cracked heels using *Datura metel* seeds and mustard oil. Six patches (F1 to F6) were prepared with PVA and PVP by the solvent casting method and were evaluated for organoleptic properties, thickness, surface pH, swelling index, moisture content, folding endurance and tackiness. Formulation F5 was the best, and the authors state that clinical evaluation is still needed [1]. Dhanalakshmi et al. fabricated a herbal transdermal film from the aqueous extract of *Hibiscus rosa-sinensis* using two polymers, and evaluated appearance, weight uniformity, thickness, folding endurance, moisture content, surface pH and tensile strength, with diffusion across a rat membrane studied over 24 hours [4]. Himaja et al. prepared methotrexate patches using HPMC and PVP in nine solvent-cast formulations with ethanol and glycerine; formulation F9 was best and the patches were flexible and smooth [5]. Although the last study used a drug and not a herb, it shows the usefulness of HPMC and glycerine for casting smooth and flexible films.

5.3 Herbal creams in the literature

Khan et al. formulated a polyherbal cream for heel fissures containing extracts and essential oils of black turmeric, vetiver, aloe vera and green tea; the cream had a pH of 6.5, good spreadability and washability, and did not cause irritation in the test performed [2]. Patil et al. prepared a crack cream from *Hedychium spicatum*, *Aloe barbadensis* and

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Azadirachta indica that passed microbiological safety tests [3]. Shah prepared a herbal antiseptic cream of neem, tulsi and aloe vera that was stable, showed no phase separation, and showed no growth of *E. coli* and yeast [6].

5.4 Drawbacks of existing forms

Most herbal products for cracked heels are creams, which are removed by friction from socks, footwear and walking.
Many marketed herbal foot products do not state the quantity of the herb or the quality of the plant material.
The reported herbal patch for cracked heels uses a single seed and oil [1], while many herbal creams are not evaluated for film properties.
Reported studies often do not compare the product with a marketed product and may not study stability [1,2].

VI. THE HERBAL FOOT PAD: A PROPOSED APPROACH

6.1 Concept

A foot pad, as proposed here, is a thin, flexible, solid film made from film-forming polymers into which herbal extracts, the moisturising aloe gel and a plasticiser are incorporated. It is applied to the sole or heel, keeps the herbal material in contact with the skin for a longer time, protects the cracked area, and does not need to be rubbed in like a cream. Polyvinyl alcohol (PVA) forms a strong, clear, flexible film, and hydroxypropyl methylcellulose (HPMC) forms a smooth film and controls swelling; PVA, PVP and HPMC have been used in solvent-cast herbal and drug patches [1,4,5]. Glycerin is the plasticiser and also acts as a humectant.
The pad has four functional layers: a backing layer that protects the matrix and keeps the pad in place, a herbal polymer matrix (PVA/HPMC, glycerin, neem, tulsi, aloe) that holds and releases the herbal constituents, a skin-contact surface that adheres the pad to the sole, and the skin of the sole or heel as the site of action.

Table 4. Components of the proposed foot pad

Component	Role	Examples
Film-forming polymer	Forms the flexible matrix of the pad	PVA, HPMC [1,5]
Plasticiser / humectant	Gives flexibility and keeps the film moist	Glycerin [5]
Herbal extracts	Antimicrobial, antioxidant, soothing action	Neem and tulsi extract
Moisturising agent	Softens dry, cracked skin	Aloe vera gel
Solvent	Dissolves the polymers; evaporates on drying	Purified water, ethanol

6.2 Method of preparation

The solvent casting method is selected because it is simple, needs only ordinary laboratory equipment and does not expose the herbal constituents to high temperature [1,5]. Hot melt casting is not suitable for heat-sensitive herbal constituents, and compression moulding needs special equipment. The steps are:
Neem and tulsi leaves are washed, shade dried, powdered and extracted with ethanol and water by maceration or hot extraction; the extract is filtered and concentrated. Aloe vera gel is collected from the leaf, homogenised and filtered through muslin cloth.
PVA is dispersed in hot water (about 80 °C) with stirring until a clear solution is obtained and cooled.
HPMC is dispersed separately in water and hydrated overnight; the two polymer solutions are then mixed.
Glycerin, neem extract, tulsi extract and aloe gel are added slowly with continuous stirring, and the volume is adjusted with water.
The mixture is kept aside to remove air bubbles and is poured into a levelled glass mould or Petri dish.
It is dried in a hot air oven at about 40 to 50 °C until the film is formed, cut to size and stored in an airtight, light-resistant pack.
The solvent, the polymer ratio, the quantity of plasticiser and the drying temperature all affect the thickness, flexibility and appearance of the film, and these variables are therefore kept constant or varied in a planned way during the batches [5].

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6.3 Suggested formulation batches

Three batches (F1 to F3) are proposed in which the ratio of PVA to HPMC is varied, while glycerin and the herbal ingredients are kept constant so that the effect of the polymers can be seen clearly.

Table 5. Composition of the proposed batches (per 100 mL of casting mixture)

Ingredient	F1	F2	F3	Function
PVA (g)	4	3	2	Polymer
HPMC (g)	1	2	3	Polymer
Glycerin (mL)	2	2	2	Plasticiser
Neem extract (mL)	5	5	5	Antimicrobial
Tulsi extract (mL)	5	5	5	Antimicrobial, antioxidant
Aloe vera gel (g)	5	5	5	Moisturising
Purified water	q.s. to 100 mL	q.s. to 100 mL	q.s. to 100 mL	Solvent

The exact quantities may be changed after preliminary trials.

6.4 Advantages and disadvantages

Advantages: the pad stays in contact with the skin for a long time and protects the cracked area from dust and friction; it keeps the skin moist because of aloe gel and glycerin [2,3]; neem and tulsi give antimicrobial and antioxidant action [6,8,13]; it is clean and easy to apply and remove; and the method of preparation is simple and low in cost, with a fixed dose in each pad [1,5].

Disadvantages: the pad may not stay in place during long walking and may need a cover such as a sock; herbal extracts vary in composition, so the quality of the pad depends on the quality of the herbs [7]; aqueous herbal pads are liable to microbial growth and loss of flexibility on storage, so stability has to be studied [12]; and some persons may be sensitive to herbal ingredients, so an irritation test is necessary.

VII. EVALUATION OF HERBAL FOOT PADS

The parameters used to evaluate herbal patches and films in the literature are grouped in Table 6 [1,4,5].

Table 6. Evaluation parameters for the herbal foot pad

Group	Parameter	Method in brief	Ref.
Physical	Appearance	Colour, smoothness, transparency and uniformity observed	[1,5]
Physical	Thickness	Micrometer or vernier calliper at five places; average taken	[1,4]
Physical	Weight uniformity	Ten pads weighed; mean and standard deviation	[4]
Physical	Folding endurance	Number of folds at the same place before breaking	[1,4]
Physical	Tensile strength	Force at break divided by cross-sectional area	[4]
Moisture	Moisture content	Desiccator with calcium chloride for 24 h; re-weighed	[1,4]
Moisture	Moisture uptake	Gain in weight at high humidity	-
Moisture	Swelling index	Gain in weight in phosphate buffer pH 6.8	[1]
Skin related	Surface pH	pH meter on the moistened surface; ideally near skin pH (about 5 to 7)	[1,2,4]
Skin related	Tackiness	Thumb tack test	[1]
Activity	Phytochemical tests, total phenolic content	Standard reagents; Folin-Ciocalteu method with gallic acid	[10]
Activity	Antimicrobial activity	Agar well diffusion against *S. aureus*, *E. coli* and *C. albicans*	[6]
Safety	Skin irritation	Patch test on healthy volunteers after ethics committee approval	[2]

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Group	Parameter	Method in brief	Ref.
Stability	Storage study	25 ± 2 °C / 60 ± 5% RH and 40 ± 2 °C / 75 ± 5% RH for one month; checks at 0, 15 and 30 days	[12]

All determinations are carried out in triplicate, and results are expressed as mean ± standard deviation. The batches are compared with each other and with a marketed herbal foot pad, and the best batch is chosen on the basis of film properties and activity. A batch that shows a change in colour, loss of flexibility, brittleness or microbial growth during storage is considered unstable and the formula is modified.

VIII. CRITICAL DISCUSSION AND OBSERVATIONS FROM THE LITERATURE

The studies reviewed show the following points.

Herbal products for heel cracks are mostly creams [2,3], and the only solid patch for cracked heels found uses *Datura* seeds and mustard oil [1].

PVA, PVP and HPMC with glycerine as plasticiser and the solvent casting method are commonly used and give flexible, smooth films [1,4,5].

The usual evaluation of herbal films includes thickness, weight, folding endurance, moisture content, surface pH and, where relevant, tackiness and tensile strength [1,4].

Neem, aloe vera and tulsi have been used in herbal creams, and their combination was found to be stable and free of microbial growth [3,6].

Studies generally state that clinical or in-vivo evaluation is still needed [1].

A clear **research gap** emerges. The literature shows herbal creams for cracked heels and a few herbal patches and films, but a solid, flexible foot pad that combines neem, tulsi and aloe vera in a PVA/HPMC matrix, compared with a marketed foot pad and studied for stability, has not been found by the authors. More importantly, none of the reviewed studies measured relief of the burning sensation itself. Claims that herbal pads "relieve burning feet" therefore rest on the known soothing, antimicrobial and moisturising properties of the ingredients and not on direct evidence.

IX. SAFETY, LIMITATIONS AND PRECAUTIONS

Herbal does not automatically mean safe. Some people may develop allergy or irritation to plant extracts, polymers or preservatives, and a patch test should always be done before regular use. Aloe preparations made from the whole leaf can contain anthraquinones that may irritate the skin, so the clear inner gel should be used. Cracked or broken skin may absorb more of any applied material and is more prone to reaction. Herbal extracts vary between batches, and an unstandardised product may not give the same effect each time [7].

The work described in this review is laboratory based, so it cannot confirm relief of burning feet or healing of heel fissures in patients. Persons with diabetes, numbness, non-healing wounds, spreading redness or persistent burning should be examined by a doctor, since delayed diagnosis of the underlying cause can lead to serious complications.

X. FUTURE PROSPECTS

Future work may include assay of marker compounds such as eugenol and quercetin by HPTLC or HPLC for standardisation, studies of release of the herbal constituents from the pad, in-vivo and clinical studies with measurement of symptoms such as burning and pain scores, and the addition of other herbs such as turmeric or vetiver [2]. Comparison with marketed foot products, longer stability studies under ICH conditions [12], and ethical approval for human skin studies will make the evidence stronger. The same pad design may also be used as a base for other herbal ingredients.

XI. CONCLUSION

Burning feet syndrome is a common and troublesome symptom with many possible causes, and its proper management begins with medical diagnosis. Alongside this, herbal and natural remedies offer cooling, antimicrobial and

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moisturising care for the skin of the feet. Neem, tulsi and aloe vera are well known plants whose reported antimicrobial, antioxidant and soothing properties make them suitable choices for foot care [6,8,13]. Existing herbal foot products are mostly creams that are easily rubbed off, and a flexible herbal foot pad prepared by the simple solvent casting method with PVA, HPMC and glycerin is a promising alternative that remains in contact with the skin and gives a fixed amount of herb. Such a pad is expected to be smooth, flexible and stable with a skin-compatible pH and antimicrobial activity. However, direct evidence for relief of burning feet is still lacking, and carefully designed laboratory and clinical studies are needed before such products can be recommended with confidence.

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