Chinese Journal of Health Management
Volume 20 Issue 5, Year of Publication 2026, Page 1109-1117 | DoI-10.564220/1674-0815.2026.138

ISSN: 1674-0815

Chinese Journal of Health Management

Chinese Medical Association

Novel Formulation and Assessment of Multi-Component Herbal Transdermal Foot Patch

Dr. Swati Jogdand[1]*, Ragini Jaiswal[2], Nandini Faye[3], Mansi Pandit[4], Pravin Gavhane [5], Sushant Tanpure[6], Swapnali Girme[7], Rutuja Mule [8], Dr. Hemalata Wadkar [9]

[1]*CAYMET's Siddhant college of Pharmacy, Sudumbare, Pune, Maharashtra, India, 0000-0003-2251-7599
[2]CAYMET's Siddhant college of Pharmacy, Sudumbare, Pune, Maharashtra, India, 0009-0003-2754-7006
[3]CAYMET's Siddhant college of Pharmacy, Sudumbare, Pune, Maharashtra, India, 0009-0009-3029-3178
[4]CAYMET's Siddhant college of Pharmacy, Sudumbare, Pune, Maharashtra, India, 0009-0000-2962-4595
[5]CAYMET's Siddhant college of Pharmacy, Sudumbare, Pune, Maharashtra, India, 0009-0000-3059-6122
[6]CAYMET's Siddhant college of Pharmacy, Sudumbare, Pune, Maharashtra, India, 0009-0006-4781-9322
[7]CAYMET's Siddhant college of Pharmacy, Sudumbare, Pune, Maharashtra, India, 0009-0007-2015-2465
[8]CAYMET's Siddhant college of Pharmacy, Sudumbare, Pune, Maharashtra, India, 0009-0003-6029-5373
[9]Abhinav Education Society's college of Pharmacy, Narhe, Pune, Maharashtra, India, 0009-0000-6668-0932.

Article Information
Received: 13-04-2026
Revised: 04-05-2026
Accepted: 21-05-2026
Published: 08-06-2026

Keywords
Transdermal foot patch, turmeric, lavender, tourmaline, ascorbic acid, corn starch, non-invasive drug delivery, powder-in-pouch system, controlled release, in-vitro evaluation

ABSTRACT:

Background: The rapidly evolving landscape of pharmaceutical development has seen rising interest in non-invasive drug delivery systems that merge traditional herbal medicine with modern technology. This study details the formulation and evaluation of a novel herbal foot patch designed to utilize the unique, porous structure of the plantar skin area. By targeting this site, the transdermal system aims to bypass first-pass hepatic metabolism, offering a controlled-release mechanism that simultaneously supports systemic detoxification and provides localized pain relief. Ultimately, this approach highlights how integrating bio-minerals and plant-based actives can yield sustainable, patient-friendly alternatives to conventional systemic drug delivery routes. **Materials and Methods:** The formulation of this transdermal system utilizes a precise combination of bioactive materials and structural agents organized into a powder-in-pouch design. The active components include turmeric, incorporated for its potent anti-inflammatory and antioxidant properties, and tourmaline, a silicate mineral added to emit far-infrared radiation to improve local microcirculation and skin permeability. Ascorbic acid (Vitamin C) is included to stabilize the formulation and brighten the skin, while dried lavender flower powder acts as both a natural sedative and an aromatic stabilizer to enhance patient compliance. To ensure structural integrity, cornstarch is

utilized as a natural polymer matrix and a moisture-absorbing base. Following formulation, the patches are subjected to physicochemical characterization methods to evaluate their thickness, weight uniformity, pH compatibility, and potential drug-polymer interactions. **Results:** The transdermal patch underwent in-vitro evaluation that includes measurements of its thickness, folding endurance, weight uniformity, percentage of moisture content, pH, and estimated curcumin content. Among the three patches, formulation F2 demonstrated the best properties of the transdermal patch. **Conclusion:** The results obtained from the study demonstrated that a transdermal patch containing a combination of turmeric, lavender, tourmaline, ascorbic acid and corn starch can be effectively made with the reservoir system powder-in-pouch method.

INTRODUCTION:

Increased exposure to environmental contaminants and lifestyle-related stress has led to growing interest in detoxification and wellness-based therapeutic systems. A detoxifying patch is disclosed that is preferably applied to the soles of the feet as a therapeutic treatment to remove toxins from the body and increase blood circulation. The accumulation of heavy metals, chemicals and other toxins in the body interferes with its ability to absorb essential minerals and vitamins from foods. Many natural healthcare practitioners believe that these toxins travel down through the body towards the foot. Additionally, circulation of blood and lymphatic fluids reaches its furthest point in the soles of the feet before returning back up in the higher portions of the body. Therefore, there is a need for a device and method to remove harmful toxins from the body and improve circulation, preferably from the soles of the feet.[1]

Detox foot pads contain ingredients based on natural ancient recipes and they aim to purify the body through the skin of the feet.[2] Transdermal drug delivery systems are topically administered medicaments in the form of patches that deliver the drug for systemic effects at a predetermined controlled rate. A transdermal drug delivery device, which may be of an active or passive design, provides an alternative route for administering medication. These devices allow pharmaceuticals to be delivered across the skin barrier.[3] A drug is applied in a relatively high dosage to the inside of a patch, which is worn on the skin for an extended period of time. Through a diffusion process, the drug enters the bloodstream directly through the skin. Since there is high concentration on the patch and low concentration in the blood, the drug will keep diffusing into the blood for a long period of time, maintaining a constant concentration of drug in the blood flow. The best mixture is about fifty percent of the drug being each hydrophilic and lipophilic, because lipid-soluble substances readily pass through the intercellular lipid bilayers of the cell membranes whereas water-soluble drugs face limiting steps in transdermal drug delivery. Sweat ducts are paths of entry, but they are considered rather insignificant.[4]

This study aims to develop a herbal transdermal patch that combines traditional remedies with modern delivery methods for effective, non-invasive detoxification. Turmeric, tourmaline, lavender oil, corn starch and ascorbic acid offer valuable therapeutic benefits, especially in traditional medicine. Turmeric is known for its anti-inflammatory, antioxidant, and anticancer properties, making it useful for relieving pain and swelling.[5]

Among formulations, the transdermal patch is the most extensively utilized for detoxification applications, with gradual improvement in design and application over the decades. The advantages of a drug administered through a transdermal patch include a uniform rate of drug release over an extended period of time[6] and avoidance of first-pass metabolism in the liver or GIT, thereby increasing bioavailability.[7] Transdermal patches are mostly composed of natural ingredients obtained from a variety of natural sources, underscoring the importance of natural herbs and the advantages of transdermal patches for local effect in detoxification.[8]

MATERIALS AND METHODS

Materials:

Turmeric (Curcuma longa):

Figure 1: Turmeric

Turmeric (Curcuma longa Linn.) is a perennial flowering plant belonging to the Zingiberaceae family and is native

to Southeast Asia. The biological source of turmeric consists of the dried rhizomes of Curcuma longa, which have been widely used in traditional systems of medicine such as Ayurveda and Chinese medicine for centuries. Turmeric is commonly known by several regional names, including Haldi in Hindi, Manjal in Tamil, and Turmer in French. Historically, turmeric has been valued for its medicinal, culinary, and cosmetic applications due to its strong anti-inflammatory and antioxidant properties.[9] Turmeric contains numerous bioactive compounds, of which curcumin is the principal active constituent responsible for most of its therapeutic effects. In addition to curcumin, turmeric also contains dimethoxycurcumin, bisdemethoxycurcumin, volatile oils, proteins, starch, sugars, and resins.[10] The volatile oil fraction includes compounds such as turmerone, atlantone and zingiberene, which contribute to turmeric's aroma and biological activities. Curcumin has been extensively studied for its antioxidant, anti-inflammatory, antimicrobial, anticancer and hepatoprotective properties.[11]

Lavender (Lavandula angustifolia)

Figure 2: Lavender Powder

Lavender (Lavandula angustifolia), a highly prized flowering plant belonging to the mint family (Lamiaceae), is native to the mountainous regions of the Mediterranean. Historically, this species has been utilized across diverse cultural eras for its applications in traditional medicine, cosmetics, perfumery, and culinary arts. Known historically and taxonomically by several synonyms—including Lavandula officinalis, true lavender, and English lavender—the plant remains a cornerstone of modern ethnopharmacological research. Mechanistically, while historically used as a crude botanical preparation, modern processing relies heavily on optimized steam distillation or hydro-distillation of the fresh flowers to yield high-quality essential oils or concentrated lavender powder.[12] Beyond its traditional geographical habitat, modern agronomic cultivation of L. angustifolia has expanded globally to meet industrial demand across temperate zones, where environmental variables such as soil composition and UV exposure heavily influence its secondary metabolite yields.[13] The therapeutic efficacy and distinct aroma profile of lavender are dictated by its intricate secondary metabolite matrix, comprising more than one hundred volatile compounds. Chromatographic and spectroscopic profiles show that the primary chemical constituents are the monoterpenes linalool and linalyl acetate, which together frequently constitute over 60% of the total volatile fraction.[14] Linalool is the major bioactive agent tied to the sedative and calming effects of the botanical, whereas linalyl acetate contributes to the characteristic floral fragrance profile and acts synergistically to provide anti-inflammatory and therapeutic qualities.[15]

Ascorbic acid (Vitamin C)

Figure 3: Ascorbic Acid Powder

L-ascorbic acid, universally recognized as Vitamin C, is a vital water-soluble micronutrient primarily obtained from biological sources such as citrus fruits (e.g., oranges, lemons, and grapefruits) and their expressed juices. Historically, the identification of citrus juices as a preventative remedy for scurvy marked a milestone in nutritional science, eventually leading to the isolation and characterization of ascorbic acid in the early 20th century. In modern industrial and pharmaceutical manufacturing, while citrus extracts remain valued as natural matrices, high-purity L-ascorbic acid, sodium ascorbate, and calcium ascorbate are predominantly synthesized through chemical or biosynthetic fermentation processes (such as the Reichstein process) utilizing D-glucose as a starting substrate.[16] These mineral salts—sodium and calcium ascorbate—serve as buffered, less acidic

alternatives that minimize gastrointestinal irritation while maintaining bioavailability and therapeutic efficacy comparable to the parent compound.[17] In addition to its anti-inflammatory actions—which operate by suppressing pro-inflammatory nuclear transcription factors such as NF-kB to reduce erythema—ascorbic acid acts as an effective topical de-pigmenting agent.[17]

Tourmaline

Figure 4: Tourmaline Powder

Tourmaline possesses unique non-centrosymmetric crystal structures that give rise to distinct pyroelectric and piezoelectric properties. When subjected to mechanical stress or temperature fluctuations, the mineral develops a transient localized electric polarization, generating micro-currents and emitting far-infrared (FIR) radiation alongside negative air ions.[18] In alternative medicine and holistic therapies, these properties are traditionally leveraged for protective purposes, such as serving as a buffer to capture perceived negative ambient energies. From a conventional physiological standpoint, modern researchers evaluate tourmaline-functionalized textiles and ceramics for their subtle biophysical interactions. Evidence suggests that the far-infrared emissions and negative ions generated by tourmaline particles can promote localized microcirculation, accelerate tissue repair, and modestly stimulate metabolic pathways by reducing oxidative stress and inducing mild thermal effects in subcutaneous tissues.[19]

Corn starch

Figure 5: Corn Starch Powder

Methods:

The herbal transdermal foot patch was prepared using the standardized reservoir-type powder-in-pouch method, a controlled drug delivery approach designed to provide uniform dosing, sustained release and enhanced stability of active constituents. In this system, the active herbal reservoir containing turmeric (Curcuma longa), corn starch (Zea mays), lavender (Lavandula angustifolia), ascorbic acid, and tourmaline powder was enclosed within a semi-permeable non-woven pouch and attached to a hypoallergenic adhesive backing membrane. Initially, all raw materials were individually sieved through a pharmaceutical-grade mesh sieve to obtain a uniform particle size distribution, eliminate aggregates, and improve blend homogeneity, which is essential for consistent transdermal diffusion and dose uniformity.[21]

Chinese Journal of Health Management
Volume 20 Issue 5, Year of Publication 2026, Page 1109-1117 | DoI-10.564220/1674-0815.2026.138

Figure 6: Formulation

The accurately weighed ingredients were then blended geometrically in a stainless-steel blender to achieve a homogeneous powder matrix. Turmeric and corn starch were incorporated for their anti-inflammatory, antioxidant, and circulation-enhancing properties, while lavender contributed soothing and aromatherapeutic effects. Ascorbic acid functioned as an antioxidant stabilizer to prevent oxidative degradation of phytoconstituents, whereas tourmaline powder was included for its reported far-infrared emission and ionizing effects that may support local blood circulation and enhance transdermal permeation. The prepared blend was subjected to blend-uniformity analysis by sampling different regions of the mixture to ensure consistent composition and minimize dose variation.[23] A predetermined quantity of the homogeneous powder blend was then filled into pre-cut semi-permeable pouch fabrics to form the drug reservoir compartment. The pouches were sealed using heat-sealing or ultrasonic-sealing techniques to prevent leakage, maintain structural integrity, and protect the formulation from environmental contamination and moisture.[22] Subsequently, the sealed pouch reservoir was fixed onto a medical-grade pressure-sensitive adhesive backing membrane, followed by application of a protective peel-off release liner. Finally, the prepared patches were individually packaged in moisture-resistant aluminium foil pouches and labelled appropriately to protect the formulation from humidity, oxidation, and photodegradation during storage.[24]

A total of three transdermal patches were formulated with variable amounts of each component. The complete composition of each transdermal patch is shown in Table 1.

Table 1: Composition of Transdermal Patch

Formulation Code	Turmeric (gm)	Lavender (gm)	Vitamin C (gm)	Tourmaline (gm)	Corn Starch (gm)
F1	0.40	1.20	0.60	1.0	0.80
F2	0.40	2.0	0.60	0.60	0.40
F3	0.20	2.80	0.40	0.40	0.20

Figure 7: Transdermal Patches Formulated (F1, F2, F3)

Physicochemical evaluation of transdermal patch[8]

Physical appearance: The patches were evaluated for colour, odour, texture and appearance. The prepared patches underwent visual inspection, assessing attributes such as colour, clarity, flexibility, and smoothness.

Thickness: The thickness of the formulated patch was measured at three different points using a digital vernier caliper and the average thickness was determined from these readings. The standard deviation was calculated to

ensure uniformity in the thickness of the prepared patch.

Figure 8: Thickness

Weight uniformity: The prepared patch was cut into three 1 × 1 cm³ sections and each section was weighed using a digital balance. The average weight was then calculated.

Figure 9: Weight Uniformity

Surface pH: To determine the surface pH of the patch, 1 × 1 cm³ sections were cut from three different areas of the patch and placed in 0.5 mL of distilled water and allowed to swell for 1 hour. The surface pH was then measured using a digital pH meter and the average pH value was calculated.

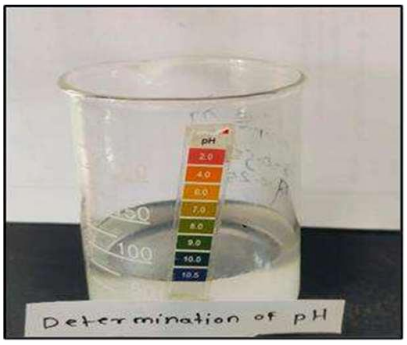

Figure 10: Surface pH

Percentage of moisture content: The patches were accurately weighed and then placed inside a desiccator containing anhydrous calcium chloride. After 3 days, the patches were removed from the desiccator and reweighed. The moisture content (%) of the transdermal patches was then calculated using the formula:
% Moisture content = [(Initial weight − Final weight) / Initial weight] × 100

Figure 11: Moisture Content

Folding endurance: The efficacy of the plasticizer was evaluated using a folding endurance test. This involved manually folding the prepared patches repeatedly at the same spot until they broke. The number of times each transdermal patch could be folded at the same position without breaking was recorded as the folding endurance.

Figure 12: Folding Endurance

Estimation of content in the transdermal patch: A 1 × 1 cm^2 section of the patch was placed in a 10 mL test tube, and 10 mL of methanol was added. The mixture was shaken for 2 hours and then left to stand overnight. Afterward, the solution was filtered using filter paper. From the filtered solution, 1 mL was transferred into a 10 mL volumetric flask and diluted to the mark with methanol. The absorbance was measured at 425 nm using a UV spectrometer and the concentration was calculated using a slope value of 0.1228.

Figure 13: Drug Content Test

RESULTS AND DISCUSSION

The goal of the study was to develop a transdermal patch using the reservoir powder-in-pouch method. A total of three formulations of herbal foot patches were prepared and evaluated, namely F1, F2, and F3, for their physicochemical and mechanical characteristics. The prepared patches showed satisfactory uniformity in all

evaluation parameters including thickness, weight variation, surface pH, moisture content, and folding endurance. The obtained results indicated that the formulated patches possessed acceptable properties for transdermal application.[25] The results are depicted in Table 2.

Table 2: Physicochemical Evaluation of Transdermal Patch

Sr. No.	Evaluation Parameter	F1	F2	F3
1	Thickness (mm)	0.51 ± 0.01	0.50 ± 0.01	0.52 ± 0.01
2	Weight Variation (mg)	4.02 ± 0.02	3.98 ± 0.02	4.01 ± 0.02
3	Surface pH	6.4	6.6	6.5
4	Percentage of Moisture Content (%)	9.95 ± 0.05	9.55 ± 0.05	9.48 ± 0.05
5	Folding Endurance	> 185	> 192	> 178

The thickness of the prepared patches was found to be in the range of 0.50 ± 0.01 mm to 0.52 ± 0.01 mm, indicating uniform distribution of the formulation throughout the patches. Among all formulations, F2 showed the lowest thickness (0.50 ± 0.01 mm), suggesting better uniformity and flexibility compared to F1 and F3.[26] The weight variation test demonstrated minimal difference among the formulations, confirming accurate mixing and proper casting of the patches. The values obtained were 4.02 ± 0.02 mg for F1, 3.98 ± 0.02 mg for F2, and 4.01 ± 0.02 mg for F3. The F2 formulation exhibited the most uniform weight variation, indicating better consistency during formulation preparation.[27]

Surface pH values of all formulations were found to be near neutral, ranging from 6.4 to 6.6, which indicates compatibility with skin and a lower possibility of irritation upon application. The F2 patch showed a pH of 6.6, considered highly suitable for topical and transdermal use.[28] Moisture content analysis revealed values between 9.48 ± 0.05% and 9.95 ± 0.05%. Among all formulations, F2 exhibited an optimum moisture content of 9.55 ± 0.05%, which may contribute to better stability, flexibility, and moisture absorption capacity of the patch. Excessive moisture may reduce stability, while insufficient moisture can make the patch brittle; therefore, F2 demonstrated balanced characteristics.[29]

Folding endurance studies indicated good mechanical strength for all formulations. The values were found to be greater than 185, 192, and 178 for F1, F2, and F3 respectively. The F2 patch showed the highest folding endurance (> 192), indicating superior flexibility and resistance to breaking during handling and application. This confirms that F2 possessed the best mechanical properties among all the prepared formulations.[30]

CONCLUSION:

The present study concluded that all three formulated herbal foot patches (F1, F2, and F3) showed satisfactory physicochemical and mechanical properties suitable for transdermal application. Among all formulations, F2 was found to be the optimized formulation due to its uniform thickness, minimum weight variation, near-neutral surface pH, optimum moisture content, and highest folding endurance. These results indicate that the F2 patch possesses better stability, flexibility, skin compatibility, and mechanical strength compared to F1 and F3. Therefore, F2 can be considered the best formulation for the development of effective herbal foot patches for transdermal use.

ACKNOWLEDGEMENT:

We thank Siddhant College of Pharmacy for providing the facility and resources.

REFERENCES:

1. Cabados, R. H. (2011). Detoxifying patch (U.S. Patent Application Publication No. US20110064787A1). United States Patent and Trademark Office.
2. Stasko, M., & Zyta, A. (2014). DetoxPad detoxifying action or placebo. Biotransformations for Pharmaceutical and Cosmetic Industry Conference, Warsaw, Poland.
3. Aquil M, Ali A, Sultana Y, Najmi AK. Fabrication and evaluation of polymeric films for transdermal delivery of pinacidil. Pharmazie. 2004;59:631-635.
4. Arabi H, Hashemi SA, Ajdari N. Preparation of a transdermal delivery system and effect of membrane type for scopolamine drug. Iranian Polymer J. 2002;11(4):245-249.
5. Raundal DE, Shinde AD, Sonawane KS, Deore NP, Deore AR, Deshmukh YH. A review on turmeric: Curcuma longa. International Journal of Pharmaceutical Research and Applications. 2023;8(1):1577-1582.
6. Sabbagh F, Kim BS. Recent advances in polymeric transdermal drug delivery systems. J Control Release. 2022;341:132-146.
7. Pastore MN, Kalia YN, Horstmann M, Roberts MS. Transdermal patches: History, development and pharmacology. Br J Pharmacol. 2015;172(9):2179-2209.

8. Gowda MH, Lalitha C, Niharika CP, Preethi GB. Herbal transdermal patch for wound healing: Formulation and in-vitro evaluation. Journal of Medicinal Plants Studies. 2025;13(2):144-148.
9. Prasad S, Aggarwal BB. Turmeric, the golden spice: From traditional medicine to modern medicine.
10. Raundal DE, Shinde AD, Sonawane KS, Deore NP, Deore AR, Deshmukh YH. A review on turmeric: Curcuma longa. International Journal of Pharmaceutical Research and Applications. 2023;8(1):1577-1582.
11. Gupta SC, Patchva S, Koh W, Aggarwal BB. Discovery of curcumin, component of golden spice, and its miraculous biological activities.
12. Donelli D, Antonelli M, Bellinazzi C, Gensini GF, Firenzuoli F. Effects of lavender on anxiety: A systematic review and meta-analysis. Phytomedicine. 2019;65:153099.
13. Chambali M, Algristian H. Lavender essential oil as an adjuvant therapy for anxiety disorders. Journal of Health Literacy and Qualitative Research. 2024;5(1):38-45.
14. Da Porto C, Decorti D, Kikic I. Flavour composition of Lavandula angustifolia Miller essential oils. Journal of Essential Oil Research. 2009;21(5):412-416.
15. Lizarraga-Valderrama LR. Effects of essential oils on central nervous system disorders. Advances in Experimental Medicine and Biology. 2021;1321:101-115.
16. Carr AC, Maggini S. Vitamin C and immune function. Nutrients. 2017;9(11):1211.
17. Mohan SA, Kumar P, Dev S. Phytochemical profiles and dermatological efficacy of citrus-derived L-ascorbic acid in modern skincare. Journal of Cosmetic Dermatology and Bioresources. 2024;8(2):204-211.
18. Yoo JM, Kim JH, Chang SB. Piezoelectric and pyroelectric characterization of functionalized polymer composites containing tourmaline mineral powders. Journal of Applied Polymer Science. 2014;131(12):40411-40419.
19. Aakelayen S, Yoon JH, Kim HS. Evaluation of the holistic and physiological impacts of mineral-infused substrates on human metabolic parameters. Journal of Alternative and Complementary Materials. 2020;18(3):142-151.
20. Slapik M, Thompson C, Garrard C. What are the health benefits of cornstarch? Everyday Health: Nutrients and Supplements. 2025;14(2):112-119.
21. Gowda MH, Lalitha C, Niharika CP, Preethi GB. Herbal transdermal patch for wound healing: Formulation and in-vitro evaluation. Journal of Medicinal Plants Studies. 2025;13(2):144-148.
22. Reddy P. Transdermal drug delivery systems [Master's thesis, University of KwaZulu-Natal]. 2015.
23. United States Pharmacopeia (USP). Uniformity of Dosage Units. 2023.
24. Banker GS, Rhodes CT. Modern Pharmaceutics. 2002.
25. Patel R, Shah M, Desai N. Development and evaluation of herbal transdermal patches. International Journal of Pharmaceutical Sciences. 2021;13(4):210-218.
26. Sharma P, Gupta S. Physicochemical evaluation of transdermal therapeutic systems. Asian Journal of Pharmaceutics. 2020;14(2):155-162.
27. Kumar A, Singh V, Yadav R. Formulation and characterization of herbal patches for topical delivery. Journal of Drug Delivery Research. 2019;8(3):98-104.
28. Rao K, Mehta P, Kulkarni A. Surface pH and skin compatibility studies of herbal formulations. International Research Journal of Pharmacy. 2022;11(5):44-49.
29. Singh T, Verma N. Moisture uptake and stability analysis of herbal transdermal films. World Journal of Pharmaceutical Research. 2021;10(7):1220-1228.
30. Joshi D, Patil R, Kapse S. Mechanical evaluation of medicated transdermal patches. Journal of Pharmaceutical Innovation. 2020;9(1):65-72.