EJPMR, 2026, 13(6), 513-520 **Research Article** **Impact Factor: 8.158**

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

ISSN (O): 2394-3211
ISSN (P): 3051-2573
Coden USA: EJPMAG

FORMULATION AND EVALUATION OF TRANSDERMAL PATCHES FOR WOUND HEALING

Khushi Kumari* Sr. Praveen Kumar

Translam Institute of Pharmaceutical Education and Research, Meerut, U.P.

***Corresponding Author: Khushi Kumari**

Translam Institute of Pharmaceutical Education and Research, Meerut, U.P.

DOI: https://doi.org/10.5281/zenodo.20525292

How to cite this Article: Khushi Kumari* Sr. Praveen Kumar. (2026). Formulation And Evaluation of Transdermal Patches For Wound Healing. European Journal of Pharmaceuticaland Medical Research, 13(6), 513–520.

Article Received on 05/05/2026 **Article Revised on 25/05/2026** **Article Published on 03/06/2026**

ABSTRACT

The present study aimed to formulate and evaluate Mupirocin-loaded transdermal patches for wound healing applications using the solvent casting method. Transdermal drug delivery systems provide several advantages such as controlled drug release, improved patient compliance, reduced dosing frequency, and enhanced therapeutic efficacy. In the present work, Mupirocin was selected as the model antimicrobial drug, while polymers such as Polyvinyl Alcohol (PVA) and Gelatin were used for patch preparation along with suitable plasticizers and permeation enhancers. Preformulation studies including determination of λmax, calibration curve, and FTIR compatibility studies were performed prior to formulation development. The λmax of Mupirocin was found at 226 nm, and the calibration curve showed good linearity within the selected concentration range. FTIR studies confirmed the absence of any significant interaction between the drug and excipients. A total of eight formulations (F1–F8) were prepared and evaluated for various physicochemical parameters such as thickness, weight variation, pH, folding endurance, moisture retention, water vapour transmission rate (WVTR), drug content uniformity, skin irritation, and stability studies. The prepared patches showed uniform thickness, acceptable weight variation, good flexibility, and satisfactory moisture transmission properties. Drug content uniformity confirmed homogeneous distribution of Mupirocin within the polymeric matrix. Most formulations exhibited good skin compatibility with minimal irritation. Stability studies performed under room temperature and accelerated conditions demonstrated that the formulations remained stable with acceptable drug retention over a period of three months. Among all formulations, formulation F5 showed comparatively better physicochemical properties, higher mechanical strength, acceptable WVTR, and improved stability. The results of the present investigation suggest that Mupirocin-loaded transdermal patches may serve as a promising and effective drug delivery system for wound healing by providing sustained drug release and improved therapeutic performance.

KEYWORDS: Mupirocin; Transdermal patches; Wound healing; Solvent casting method; Controlled drug delivery; Gelatin; Polyvinyl alcohol (PVA); FTIR study; Stability study; Skin irritation study.

1. INTRODUCTION

Wound healing is a complex and dynamic biological process involving a series of coordinated events such as hemostasis, inflammation, proliferation, and tissue remodeling. Proper wound management is essential to restore the integrity and function of damaged tissues and to prevent microbial infections and chronic complications. However, conventional wound treatment methods such as creams, ointments, and oral medications often suffer from limitations including poor drug penetration, frequent application, low patient compliance, and reduced therapeutic efficacy. Therefore, the development of advanced drug delivery systems for wound care has become an important area of pharmaceutical research.

Transdermal patches have emerged as a promising and innovative approach for wound healing therapy due to their ability to provide controlled and sustained drug release directly through the skin. These patches are designed to deliver therapeutic agents at a predetermined rate over an extended period, thereby maintaining effective drug concentration at the wound site. Transdermal systems offer several advantages such as improved bioavailability, reduced dosing frequency, enhanced patient compliance, minimized systemic side

effects, and protection of the wound from external contamination.

The formulation of transdermal patches for wound healing generally involves the incorporation of bioactive compounds, antimicrobial agents, anti-inflammatory drugs, herbal extracts, or growth-promoting substances into a suitable polymeric matrix. Polymers such as Hydroxypropyl Methylcellulose (HPMC), Polyvinyl Alcohol (PVA), Polyvinyl Pyrrolidone (PVP), and Carbopol are commonly used for patch preparation because of their biocompatibility, flexibility, and film-forming properties. The selection of suitable polymers and plasticizers plays a crucial role in determining the mechanical strength, drug release behavior, adhesiveness, and overall performance of the patch.

Recent advancements in wound healing research have focused on the incorporation of natural products and nanoparticles into transdermal patches to enhance therapeutic efficacy. Herbal extracts possessing antimicrobial, antioxidant, and anti-inflammatory properties have gained considerable attention due to their safety and effectiveness in accelerating tissue regeneration. Similarly, nanoparticle-loaded patches improve drug permeation and provide enhanced antimicrobial activity against wound-causing pathogens.

Evaluation of transdermal patches is an important step to ensure their quality, safety, and effectiveness. Various physicochemical and biological parameters such as thickness, weight variation, folding endurance, moisture content, tensile strength, drug content uniformity, in-vitro drug release, skin permeation studies, and wound healing activity are assessed during formulation development. These evaluations help in optimizing the formulation and ensuring consistent therapeutic performance.

Considering the increasing demand for effective wound care systems, the present study focuses on the formulation and evaluation of transdermal patches for wound healing. The study aims to develop a stable, effective, and patient-friendly transdermal delivery system capable of promoting rapid wound healing and improving therapeutic outcomes.

2. MATERIAL AND METHODS

2.1 Preparation of Standard Stock Solution

Accurately weighed 10 mg of Mupirocin using a SHIMADZU AX200 analytical balance and dissolved in methanol. The solution was transferred into a 100 ml volumetric flask and the volume was adjusted with methanol to obtain a stock solution of 100 µg/ml. The solution was sonicated for 15 minutes for complete dissolution. Further, 2 ml of the stock solution was diluted up to 10 ml with methanol to prepare a working solution of 20 µg/ml. The solution was analyzed using a SHIMADZU 1700 UV/Visible spectrophotometer in the range of 200–400 nm to determine λmax.

2.1 Development of Calibration Curve

Aliquots of 0.2–2 ml from the stock solution were transferred into 10 ml volumetric flasks and diluted with methanol to obtain concentrations of 5–25 µg/ml. The absorbance of each solution was measured at 250 nm using a UV spectrophotometer. A calibration curve was plotted between concentration and absorbance.

2.2 Formulation of Transdermal Patches

Mupirocin transdermal patches were prepared by solvent casting method. The drug was dissolved in methanol, while polymers were dissolved in distilled water. Both solutions were mixed under continuous stirring at 37 ± 0.5°C. Plasticizer and other excipients were added gradually to obtain a uniform mixture. The prepared solution was poured into petri dishes and dried by slow solvent evaporation. Dried films were cut into 2 × 2 cm² patches and stored in a desiccator.

2.3 Evaluation parameters

2.3.1 General Appearance

The prepared patches were visually inspected for colour, smoothness, flexibility, clarity, and presence of imperfections such as air bubbles or cracks.

2.3.2 Thickness Measurement

The thickness of randomly selected patches was measured at different points using a screw gauge and the average thickness was calculated.

2.3.3 Uniformity of Weight

Individual patches were weighed using a digital balance and the average weight was determined to evaluate uniformity.

2.3.4 pH Determination

The pH of the patch surface was determined using a calibrated pH meter to ensure compatibility with skin pH and avoid irritation.

2.3.5 Water Vapour Transmission Rate (WVTR)

The patch was fixed over a cup containing calcium chloride and placed in controlled humidity conditions. The weight change was recorded after a fixed time interval and WVTR was calculated.

2.3.6 Moisture Content

The patches were weighed and kept in a desiccator containing fused calcium chloride for 24 hours. After drying, the patches were reweighed and percentage moisture content was calculated.

2.3.7 Folding Endurance

Folding endurance was determined by repeatedly folding the same patch at one place until it cracked. The number of folds required to break the patch was recorded.

3.3.8 Drug Content Determination

A known area of patch was dissolved in phosphate buffer pH 7.4 and stirred continuously for complete extraction

of drug. The solution was filtered and analyzed spectrophotometrically at 250 nm.

2.3.9 In-Vitro Drug Release Study

Drug release from transdermal patches was studied using a Franz diffusion cell with dialysis membrane. Samples were withdrawn at predetermined intervals and analyzed at 250 nm using UV spectrophotometer.

2.3.10 Skin Irritation Study

The skin irritation study was carried out on healthy rabbits by applying test and control patches on shaved skin. The skin was observed for erythema, oedema, or irritation after 24 hours.

2.3.11 Stability Study

The prepared patches were packed properly and stored under room temperature and accelerated conditions for three months. Samples were evaluated periodically for physical appearance, drug content, moisture content, and drug release behavior.

3. RESULTS AND DISCUSSION

3.1 Calibration curve of Mupirocin

Table 1: Calibration curve of Mupirocin at 226nm.

Concentration (µg/mL)	Absorbance
2	0.12
4	0.24
6	0.36
8	0.48
10	0.6

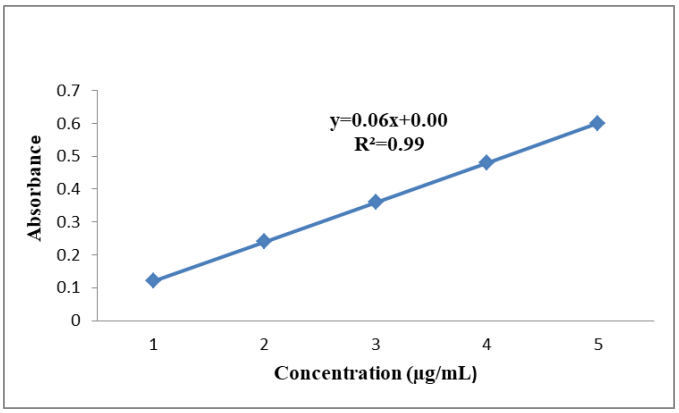

Figure 1: Calibration curve of Mupirocin in phosphate buffer at 226nm.

3.2 Compatibility by FTIR study

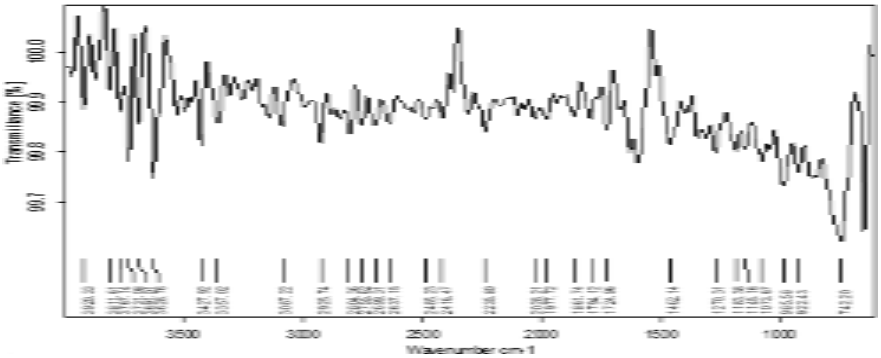

Figure 2: Mupirocin + Gelatin compatibility study.

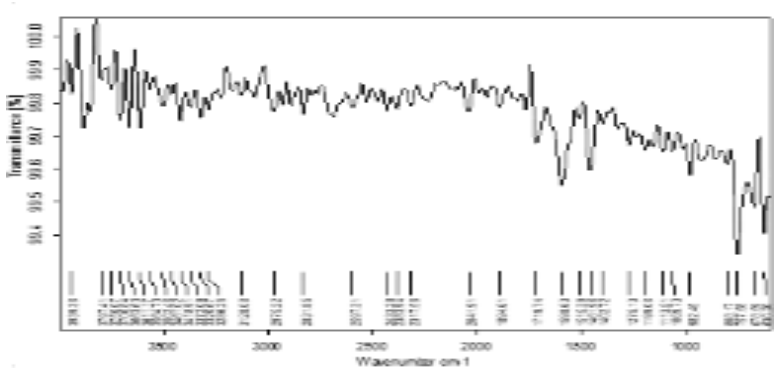

Figure 3: Mupirocin + PVP compatibility study.

Table 2: drug and excipient compatibility study.

Drug + Excipient	Ratio	Observation		
		Colour change	Cake formulation	Liquefication
Mupirocin + PVP	1:1	No	No	No
Mupirocin + Gelatin	1:1	No	No	No
Mupirocin + Gelatin + PVP	1:1:1	No	No	No

3.3 Evaluation parameter of Mupirocin loaded Transdermal patches

3.3.1 Thickness and weight variation test

Table 3: Thickness and weight variation test.

Formulation code	Thickness (nm)	Weight (g)
F1	0.58	1.07
F2	0.62	1.02
F3	0.59	1.05
F4	0.63	1.02
F5	0.55	1.03
F6	0.59	1.08
F7	0.57	1.02
F8	0.62	1.01

3.3.2 WVTR test

Table 4: Water Vapor Transmission Rate (WVTR) test.

Formulation code	Weight of cup at 1st hour (W1) (g)	Weight of cup at 1st hour (W2) (g)	Transmission area (s) (cm^2)	WVRT (g/m^2×100)
F1	45.0	45.6	2.63	20.62
F2	45.0	45.5	2.63	12.78
F3	45.0	45.4	2.63	16.79
F4	45.0	45.7	2.63	24.95
F5	45.0	45..3	2.63	8.75
F6	45.0	45.6	2.63	16.97
F7	45.0	45.4	2.63	20.69
F8	45.0	45.7	2.63	25.38

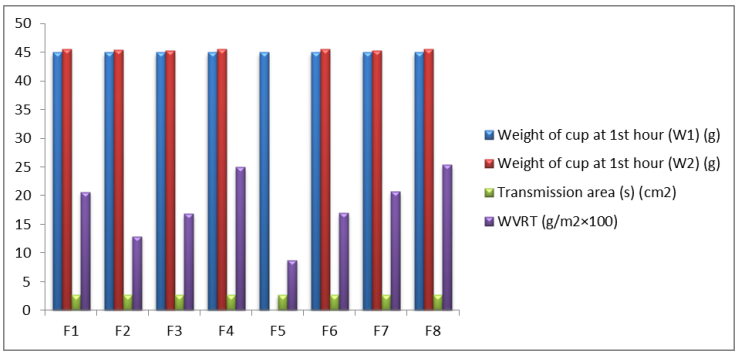

Figure 4: Results of WVTR test.

3.3.3 Moisture retention test

Table 5: Outcomes of Moisture retention.

Time (hr)	Covered patches Initial weight (g)	Covered patches Initial weight (g)	Uncovered patches Initial weight (g)	Uncovered patches Initial weight (g)
0	1.06	1.07	1.06	1.07
4	1.06	0.99	1.06	0.96
8	1.06	0.94	1.06	0.88
12	1.06	0.96	1.06	0.85
16	1.06	0.92	1.06	0.84

3.3.4 Folding Endurance examination

Table 6: Results of Folding Endurance examination.

Formulation code	Number of folds before damage
F1	80
F2	72
F3	81
F4	73
F5	97
F6	73
F7	88
F8	89

3.3.5 pH examination

Table 7: Results of optimized pH.

Formulation code	pH Value
F1	5.3
F2	5.5
F3	5.3
F4	5.6
F5	5.1
F6	5.8
F7	5.2
F8	5.3

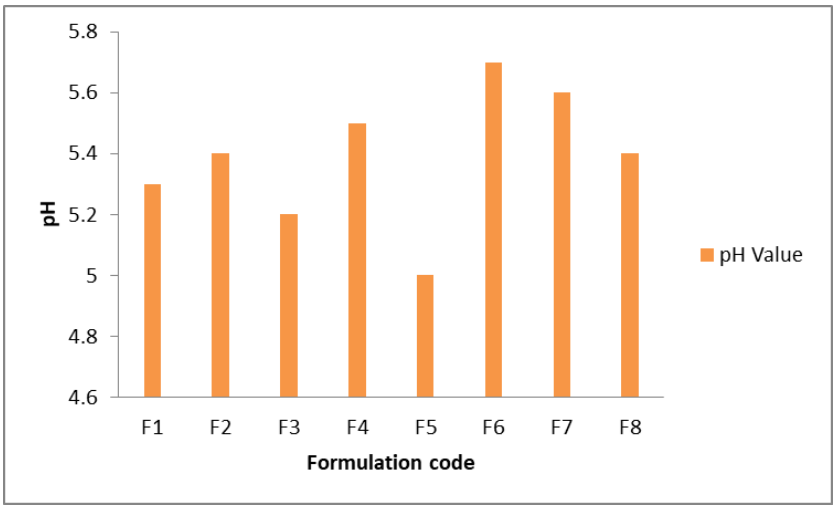

Figure 5: Results of optimized pH.

3.3.6 Drug content uniformity examination

Table 8: Outcomes of Drug content uniformity examination.

Formulation code	Drug content uniformity (%)
F1	93.10
F2	91.02
F3	92.89
F4	94.72
F5	97.92
F6	96.30
F7	92.87
F8	95.82

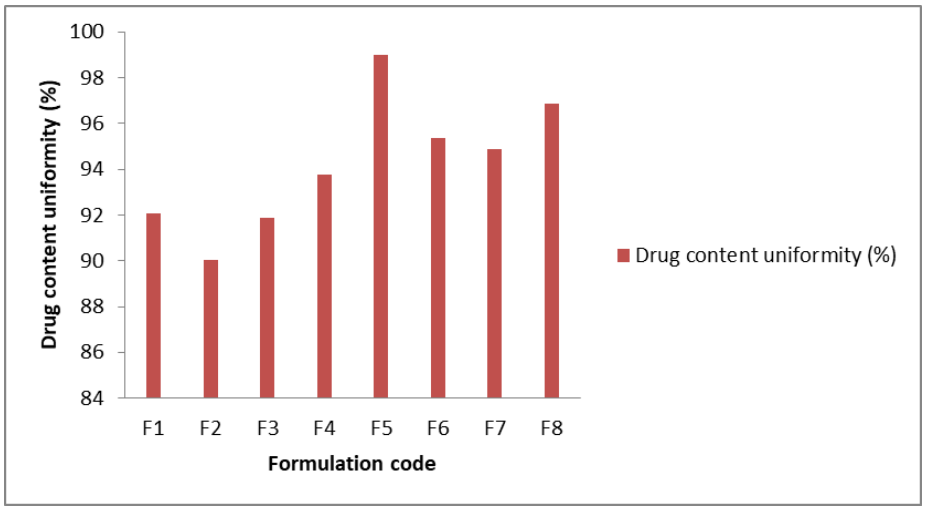

Figure 6: Drug content uniformity examination.

3.3.7 Skin irritation Examination

Table 9: Skin irritation Examination.

Formulation code	Skin Reaction severity
F1	None
F2	Mild
F3	None
F4	None
F5	None
F6	None
F7	Severe
F8	Mild

3.3.8 Stability study

Table 10: stability study of Mupirocin loaded transdermal patches formulation F1 to F8 at 25°C/60% RH.

Time (Days)	Condition	% Active drug remaining							
		F1	F2	F3	F4	F5	F6	F7	F8
0	25°C/60% RH	100	100	100	100	100	100	100	100
30		97	95	96	95	98	95	96	94
60		97	96	95	96	99	95	94	93
90		95	93	92	94	97	93	94	92

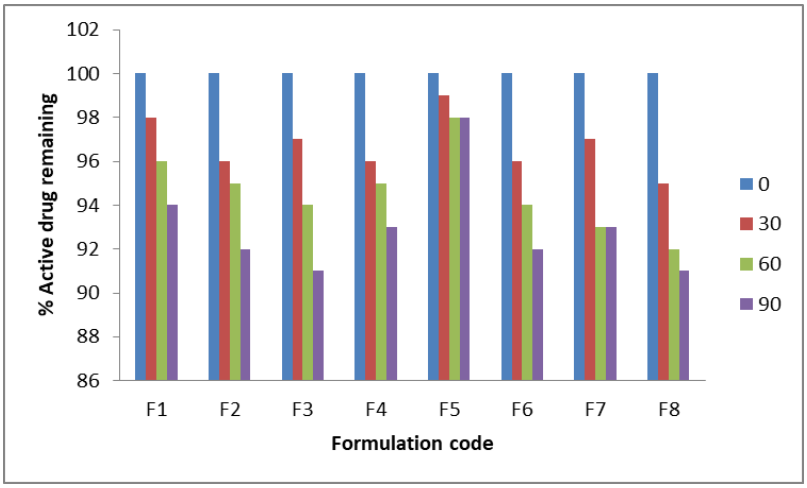

Figure 7: Stability study of Mupirocin loaded transdermal patches formulation F1 to F8 at 25°C/60% RH.

Table 11: Stability study of Mupirocin loaded transdermal patches formulation F1 to F8 at 40°C/75% RH.

Time (Days)	Condition	% Active drug remaining							
		F1	F2	F3	F4	F5	F6	F7	F8
0	40°C/75% RH	100	100	100	100	100	100	100	100
30		98	96	97	96	98	96	97	95
60		97	95	94	95	97	94	96	95
90		93	93	95	96	97	94	93	92

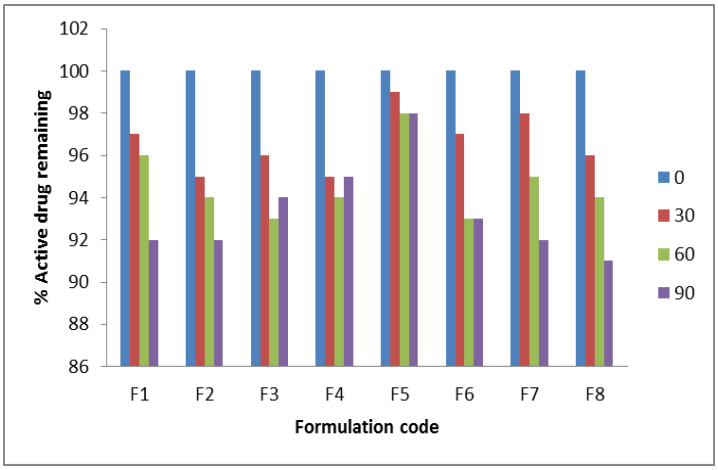

Figure 8: Stability study of Mupirocin loaded transdermal patches formulation F1 to F8 at 40°C/75% RH.

DISCUSSION

The calibration curve of Mupirocin in phosphate buffer at 226 nm showed a linear relationship between concentration and absorbance within the selected concentration range. The linearity confirmed that Beer-Lambert's law was obeyed, indicating the suitability of the developed UV spectrophotometric method for quantitative estimation of Mupirocin. The FTIR compatibility study revealed that there were no significant changes in the characteristic peaks of Mupirocin in the presence of Gelatin and PVP. This indicated the absence of chemical interaction between the drug and excipients. The physical observation study also showed no colour change, cake formation, or liquefaction, confirming good compatibility and stability of the formulation components. The thickness and weight variation results demonstrated uniformity among all formulations. The minor variations observed indicated proper distribution of polymer and drug throughout the patches. Uniform thickness and weight are important for consistent drug release and mechanical stability. The WVTR study showed that all formulations possessed acceptable moisture transmission properties. Formulations F4 and F8 exhibited comparatively higher WVTR values, indicating better permeability, whereas F5 showed lower WVTR. Appropriate WVTR is necessary to maintain patch integrity and prevent excessive moisture accumulation. The moisture retention study demonstrated gradual reduction in patch weight over time in both covered and uncovered conditions. Uncovered patches showed greater moisture loss compared to covered patches due to direct exposure to the environment. The results suggested that the formulations possessed moderate moisture retention

capacity, which is beneficial for maintaining flexibility and stability. The folding endurance values indicated good flexibility and mechanical strength of the prepared patches. Formulations F5, F7, and F8 showed higher folding endurance, suggesting better elasticity and resistance to breakage during handling and application. The pH values of all formulations were found to be within the acceptable skin pH range. This indicated that the prepared transdermal patches are less likely to cause skin irritation and are suitable for topical application. Drug content analysis showed uniform distribution of Mupirocin in all formulations. The results confirmed the efficiency of the solvent casting method in achieving homogeneous incorporation of drug into the polymeric matrix. Most formulations showed no signs of skin irritation, indicating good skin compatibility. However, formulations F2 and F8 exhibited mild irritation, while F7 showed severe irritation. The findings suggested that excipient concentration and composition may influence skin tolerability. The stability studies conducted under both room temperature and accelerated conditions demonstrated that the formulations retained a high percentage of active drug over three months. Formulation F5 showed comparatively better stability with maximum drug retention, whereas slight degradation was observed in other formulations over time. Overall, the prepared transdermal patches exhibited acceptable physical and chemical stability during storage.

CONCLUSION

The present study successfully formulated and evaluated Mupirocin-loaded transdermal patches using the solvent casting method for wound healing applications. The prepared patches showed satisfactory physicochemical characteristics, including uniform thickness, acceptable weight variation, good flexibility, suitable moisture retention, and adequate water vapour transmission properties. The FTIR compatibility study confirmed the absence of any significant interaction between Mupirocin and the selected excipients, indicating good compatibility and stability of the formulation components. The prepared transdermal patches exhibited acceptable pH values close to skin pH, suggesting their suitability for topical application without causing significant irritation. Drug content uniformity studies confirmed homogeneous distribution of Mupirocin within the polymeric matrix. The skin irritation study demonstrated good biocompatibility for most formulations, while only a few formulations showed mild irritation. The stability studies carried out under both room temperature and accelerated conditions revealed that the formulations remained stable throughout the storage period with minimal loss of active drug content. Among all formulations, formulation F5 demonstrated better physicochemical properties, higher folding endurance, acceptable WVTR, good stability, and superior overall performance compared to other formulations. Overall, the developed Mupirocin-loaded transdermal patches can be considered a promising and effective drug delivery system for wound healing management, offering controlled drug release, improved patient compliance, and enhanced therapeutic efficacy.