



# FORMULATION AND EVALUATION OF HERBAL TRANSDERMAL PATCHES FOR THE TREATMENT OF WOUND HEALING

1. Astha Patil , 2. Charvi Chaudhari, 3.Sneh Sonkamble.

1. Student ,2. Student ,3. Professor.

1.MET's Institute of Pharmacy, Nashik.

2.MET's Institute of Pharmacy, Nashik.

3.MET's Institute of Pharmacy, Nashik.

**Abstract:** Herbal medicine has gained significant attention in modern healthcare due to its natural origin, therapeutic potential, affordability, and minimal side effects. Medicinal plants contain various bioactive constituents such as flavonoids, alkaloids, tannins, terpenoids, and glycosides that exhibit pharmacological activities including antimicrobial, anti-inflammatory, antioxidant, analgesic, and wound healing properties. Wound healing is a complex physiological process involving hemostasis, inflammation, proliferation, and remodeling phases, requiring effective therapeutic approaches to accelerate tissue repair and prevent complications. Transdermal Drug Delivery Systems (TDDS) have emerged as an advanced and patient-friendly approach for controlled and sustained drug delivery through the skin. These systems improve bioavailability, reduce dosing frequency, avoid first-pass metabolism, and enhance patient compliance. Among various TDDS approaches, transdermal patches have become highly effective dosage forms due to their ability to provide prolonged drug release, painless administration, and targeted therapeutic action. Herbal-based transdermal patches combine the benefits of herbal medicines with modern drug delivery technology, offering a promising strategy for wound management and other therapeutic applications. Their enhanced safety profile, biocompatibility, and sustained drug release characteristics make them a valuable alternative to conventional dosage forms in pharmaceutical and clinical practice.

**Index Terms** – Herbal medicines, wound healing, transdermal drug delivery system, transdermal patches.

## I. INTRODUCTION

### Herbal medicine

Herbal medicines have been used for centuries as natural remedies for the treatment and prevention of various diseases. Medicinal plants contain several bioactive constituents such as flavonoids, alkaloids, tannins, terpenoids, glycosides, steroids, and phenolic compounds which possess important pharmacological activities including antimicrobial, anti-inflammatory, antioxidant, analgesic, anticancer, and wound healing properties. Due to their natural origin, affordability, easy availability, biocompatibility, and reduced side effects, herbal formulations are gaining increasing importance in modern healthcare systems. Traditional systems of medicine such as Ayurveda, Siddha, and Unani have extensively utilized

medicinal plants for maintaining health and treating disorders. In recent years, scientific advancements in pharmaceutical technology have encouraged the development of novel herbal therapeutic systems including creams, gels, ointments, films, microspheres, nanoparticles, and transdermal patches for effective drug delivery. Herbal formulations provide controlled and sustained release of active constituents, improve therapeutic effectiveness, enhance patient compliance, and reduce dosing frequency. In addition, herbal medicines are considered eco-friendly and safer alternatives to synthetic drugs. Continuous research and technological advancements are contributing significantly to the development of standardized, effective, and innovative herbal therapeutic products for various clinical applications.[1,5]

## Wound Healing

Wound healing is a complex and dynamic physiological process through which the body repairs damaged tissues and restores the structural and functional integrity of the skin after injury. The process involves a coordinated sequence of biological and biochemical events including hemostasis, inflammation, proliferation, and remodeling. Immediately after injury, the hemostasis phase begins with vasoconstriction and clot formation to prevent blood loss. This is followed by the inflammatory phase in which neutrophils and macrophages remove microorganisms, damaged tissues, and cellular debris from the wound site. During the proliferative phase, fibroblast proliferation, collagen synthesis, angiogenesis, and epithelialization occur, resulting in granulation tissue formation and wound contraction. Finally, in the remodeling phase, collagen fibers reorganize and mature to restore tissue strength and function. Various factors such as microbial infection, diabetes, oxidative stress, malnutrition, poor blood circulation, aging, and environmental conditions can delay wound healing and increase the risk of complications. Therefore, effective wound management requires therapeutic agents possessing antimicrobial, anti-inflammatory, antioxidant, and tissue regenerative properties. Herbal medicines have shown significant potential in wound care due to their ability to accelerate tissue repair, promote collagen synthesis, reduce inflammation, and enhance epithelialization.[2,15]

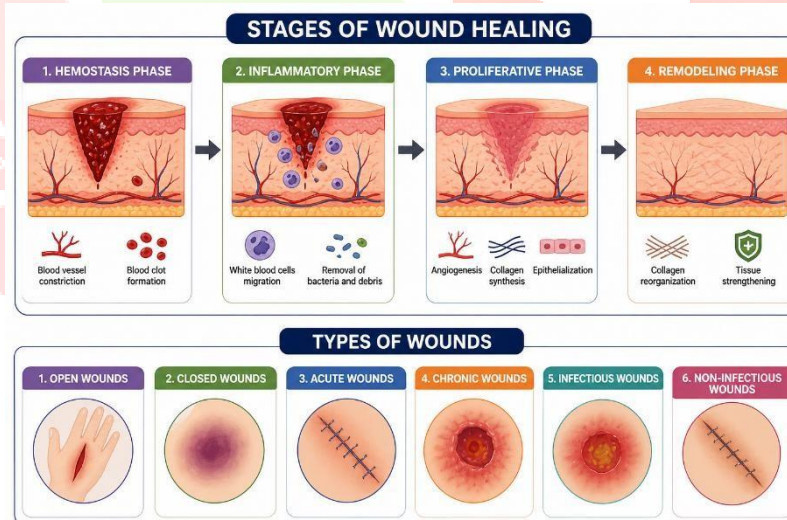
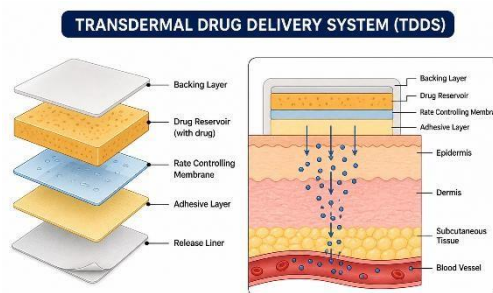


Fig No. 1. Wound Healing

## Transdermal Drug Delivery System

A Transdermal Drug Delivery System (TDDS) is a specialized and advanced drug delivery approach in which therapeutic agents are administered through the skin to achieve systemic effects at a controlled and predetermined rate. In TDDS, drug molecules penetrate through different layers of the skin and enter systemic circulation without passing through the gastrointestinal tract. The skin acts as a protective barrier; however, suitable drug molecules with appropriate molecular weight and lipophilicity can effectively permeate through the epidermal layers. Transdermal drug delivery systems have gained considerable attention in modern pharmaceutical research due to their ability to improve therapeutic effectiveness and patient compliance. TDDS offers several advantages such as non-invasive administration, prolonged drug release, reduced dosing frequency, avoidance of hepatic first-pass

metabolism, minimized gastrointestinal side effects, and maintenance of steady plasma drug concentration. A typical TDDS consists of components such as a backing membrane, drug reservoir, adhesive layer, release liner, and permeation enhancers which facilitate drug absorption through the skin. The effectiveness of transdermal delivery depends on various factors including skin permeability, physicochemical properties of the drug, patch design, and formulation characteristics. Due to continuous advancements in pharmaceutical technology and biomaterials, TDDS has become an important area of research for controlled and targeted drug delivery applications.[5]



**Fig No. 2 Transdermal drug delivery system**

### Transdermal Patches

Transdermal patches are medicated adhesive dosage forms designed to deliver therapeutic agents through the skin into systemic circulation at a controlled and sustained rate. These patches provide a convenient, painless, and non-invasive method of drug administration and are widely used in modern pharmaceutical applications for prolonged therapeutic action. Transdermal patches consist of several important components including a backing layer, drug reservoir or matrix, adhesive layer, release liner, and permeation enhancer. The backing layer protects the formulation from environmental factors, while the adhesive layer ensures proper attachment of the patch to the skin surface. Permeation enhancers improve drug penetration through the stratum corneum and increase bioavailability. Compared to conventional dosage forms such as tablets and injections, transdermal patches offer numerous advantages including improved patient compliance, reduced dosing frequency, controlled drug release, avoidance of first-pass metabolism, minimized gastrointestinal irritation, and maintenance of steady plasma drug levels. Furthermore, transdermal patches can improve the stability of active pharmaceutical ingredients and reduce fluctuations in drug concentration. Recent advancements in polymer science, nanotechnology, and pharmaceutical biomaterials have significantly enhanced the development of novel transdermal patches for various therapeutic applications including pain management, hormonal therapy, cardiovascular disorders, and wound healing. Herbal transdermal patches have also gained increasing importance due to their natural origin, enhanced safety profile, and therapeutic effectiveness in skin and wound care applications.[5,7,8,11]

## II. PLANT PROFILE

### 2.1 *Tridax procumbens*

**Table 1. *Tridax procumbens* taxonomy**

Kingdom	Plantae
Phylum	Magnoliophyta
Class	Magnoliopsida
Order	Asterales
Family	Asteraceae
Genus	<i>Tridax</i>
Species	<i>Procumbens</i>



**Fig No. 3. *Tridax Procumbens***

#### 2.1.1. Phytoconstituents present in *Tridax Procumbens* leaves :

Flavonoids, alkaloids, tannins, saponins, terpenoids, steroids, phenolic compounds, carotenoids, glycosides, essential oils, fatty acids, and phytosterols.

#### 2.1.2. Pharmacological activities of *Tridax Procumbens* :

Healing, antimicrobial, anti-inflammatory, antioxidant, antidiabetic, hepatoprotective, anticancer, immunomodulatory, and antihypertensive activities

#### 2.1.3. Role of *Tridax Procumbens* in wound healing :

*Tridax procumbens* possesses significant wound healing potential due to the presence of bioactive compounds such as flavonoids, alkaloids, tannins, terpenoids, and phenolic compounds. These phytoconstituents contribute to multiple therapeutic actions that support the wound healing process. The plant exhibits strong antimicrobial activity against various bacteria and fungi, which helps prevent wound infection and supports faster healing. Its anti-inflammatory properties help reduce swelling, redness, and pain at the wound site by minimizing inflammatory responses. In addition, the antioxidant activity of the

plant protects tissues from oxidative stress and cellular damage caused by free radicals. It also promotes collagen synthesis and fibroblast proliferation, which are essential for tissue repair and wound contraction. It enhances granulation tissue formation and accelerates epithelialization, thereby improving the overall healing rate. Due to these combined properties, the plant is widely used in herbal formulations intended for wound management and skin repair.[3,6,12]

## 2.2. Glycyrrhiza Glabra

**Table 2. Glycyrrhiza Glabra taxonomy**

Kingdom	Plantae
Phylum	Magnoliophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Genus	Glycyrrhiza
Species	Glabra



**Fig No. 4. Glycyrrhiza Glabra**

### 2.2.1. Phytoconstituents present in Glycyrrhiza Glabra leaves :

Glycyrrhizin, flavonoids, saponins, tannins, alkaloids, terpenoids, phenolic compounds, coumarins, steroids, and essential oils.

### 2.2.2. Pharmacological activities of Glycyrrhiza Glabra :

Pharmacological activities include anti-inflammatory, antioxidant, antimicrobial, antidiabetic, hepatoprotective, antiulcer, expectorant, immunomodulatory, anticancer, and wound healing activities.

### 2.2.3. Role of Glycyrrhiza Glabra in wound healing :

The root of the plant contains several active phytoconstituents such as glycyrrhizin, flavonoids, saponins, tannins, and phenolic compounds that contribute to its medicinal value. It exhibits potent anti-inflammatory activity, which helps reduce inflammation and irritation at the wound site. Its antimicrobial

properties help inhibit the growth of pathogenic microorganisms and protect the wound from infection. The antioxidant compounds present in the plant neutralize free radicals and reduce oxidative stress, thereby supporting healthy tissue regeneration. The plant also possesses soothing and moisturizing properties that help maintain a favorable environment for wound healing. It promotes tissue repair and enhances skin regeneration by stimulating cellular activity and improving blood circulation around the affected area. Furthermore, its bioactive compounds help reduce scar formation and support faster recovery of damaged tissues. Due to its antimicrobial, anti-inflammatory, antioxidant, and tissue regenerative properties. [1,2,4,15]

### III. MATERIALS AND METHOD

#### 3.1 Materials :

- A) Plant sample (extract)
- B) Instruments – Weighing balance, electric stirrer, desiccator, pH meter.
- C) Apparatus – Beaker, measuring cylinder, glass rod, soxhlet apparatus, funnel, petri dish.
- D) Ingredients –

**Table 4. List of Ingredients**

Sr. No.	Formulation Ingredient	Quantity
1	Tridax procumbens extract	5 ml
2	Glycyrrhiza glabra extract	5 ml
3	Polyethylene glycol - 400	2.5 ml
4	Propylene glycol	2.5 ml
5	HPMC	5 gm
6	Chloroform	8 ml
7	Methanol	4 ml

#### 3.2 Method

##### 3.2.1. Procedure for preparation of herbal plant extract :

##### A) Tridax Procumbens Extract

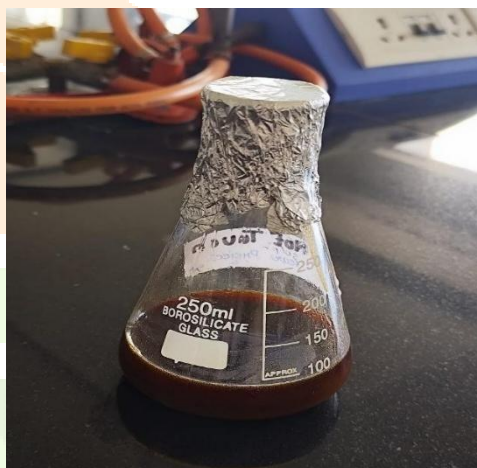
The leaves of *Tridax procumbens* were collected and shade-dried. The dried leaves were then coarsely powdered and kept in well- closed container. About 40g of powdered leaves were packed in Soxhlet apparatus. The extraction was carried out using ethanol as the solvent. The temperature was maintained between 40–70°C for 24 hours. The collected extract was then concentrated by evaporating the ethanol. Thus, the crude extract of *Tridax procumbens* was obtained. [13,14]



**Fig No. 5. Tridax Procubens extract**

### **B) Glycyrrhiza Glabra Extract**

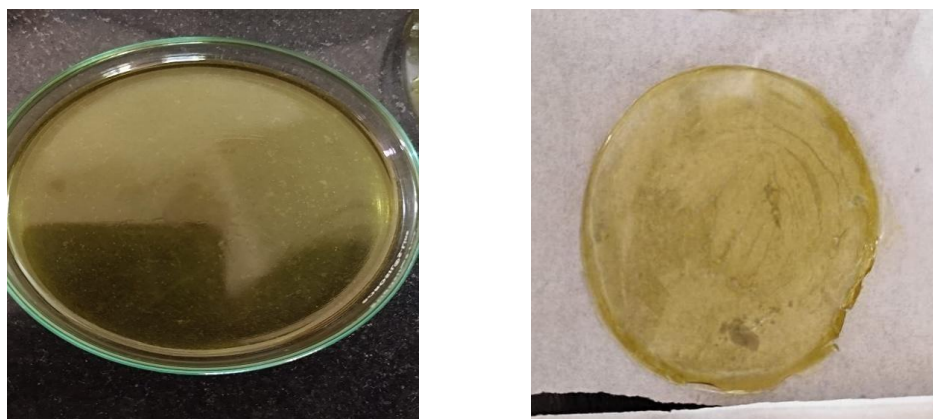
100 g of the licorice powder was placed in a beaker and 1000 ml of ethanol 70% was added and mixed thoroughly. The mixture was left at room temperature for 3 days. The extract was then filtered using Whatman (No.10) filter paper.[910]



**Fig No. 6. Glycyrrhiza Glabra Extract**

#### **3.2.2. Preparation for formulation of transdermal patches :**

- 1) Initially the required ingredients, for the formulation were weighed.
- 2) Then, chloroform and methanol were added to the beaker and mixed properly using an magnetic stirrer.
- 3) Next, propylene glycol and polyethylene glycol were added, and the mixture was stirred continuously using an magnetic stirrer.
- 4) Each medicinal plant extract i.e., tridax procumbens extract and glycyrrhiza glabra extract was added with constant stirring for 10-15 minutes.
- 5) Then, HPMC was added with constant stirring using an magnetic stirrer. HPMC was added at a rate of 1g at intervals of 1 minute.
- 6) After a period of 10-15 minutes, when the formulation becomes viscous, it was poured into glass petri plates.
- 7) Then, the petri plates were placed in a hot air oven at 50°C for a certain period to allow evaporation of solvent.



**Fig No. 7. Formation of Patches**

#### IV. EVALUATION PARAMETERS

1. Organoleptic characteristics.
2. Surface pH determination.
3. Measurement of thickness of patch.
4. Percentage moisture content.
5. Folding resistance.
6. Phytochemical screening of Tridax Procumbens leaf extract.
7. Phytochemical screening of Glycyrrhiza Glabra leaf extract.

##### 4.1. Organoleptic characteristics :

In this the organoleptic properties were studied like colour, odour, appearance, and etc.

Colour: The Colour of patches was evaluated to be light greenish yellow.

Texture: The texture of the formulated patches was evaluated to be smooth and uniform.

Appearance: The Appearance of the Formulated patches was translucent.

Odour: The Odour of the Formulated Patches was evaluated to be Herbal extract like.

##### 4.2. Surface ph determination :

In this evaluation test the Ph of the surface of transdermal patches was evaluated using Ph Meter.

##### 4.3. Measurement of thickness of patch :

The thickness of formulated transdermal patches were evaluated using vernier caliper. This thickness was evaluated by measuring the average thickness from three sites of the patch.

##### 4.4. Percentage moisture content:

The % Moisture content was studied using Desiccator. Initially the individual patches were weighed and then kept in the desiccator containing activated silica at the Room temperature for time period of 24 hours. Then afterwards the Patches were reweighed.

$$\% \text{ MOISTURE CONTENT} = [\text{INITIAL WEGHT} - \text{FINAL WEIGHT} / \text{INITIAL WEIGHT}] \times 100$$

##### 4.5 Folding resistance :

The patches of length 2×4cm were cut and folded multiple times at the same spot until it breaks. The number of folds before breaking determines the folding endurance.

#### 4.6. Phytochemical screening of *Tridax Procumbens* leaf extract :

In Phytochemical screening of *Tridax Procumbens* extract the chemical test named as Alkaline reagent test , Wagner test, Test for tannins were performed.

##### 4.6.1. Requirement for Phytochemical analysis :

Test tube, test tube holder, spatula weighing balance.

##### 4.6.2. Reagents used : Sodium Hydroxide

Wagner's Reagent

1% Lead Acetate

##### A) Test for Flavonoid :

Alkaline reagent test - A small quantity of plant extract was taken in a test tube, a few drops of sodium hydroxide solution were added, and the formation of an intense yellow color was observed.

##### B) Test for Alkaloids :

Wagner Test - A small quantity of plant extract was taken in a test tube, a few drops of Wagner's reagent, to determine the presence of alkaloids.

##### C) Test for Tannins :

2 ml extract was taken in a test tube, a few drops of 1% lead acetate were added, to determine the presence of tannins.

#### 4.7. Phytochemical screening of *Glycyrrhiza glabra* extract :

In Phytochemical screening of *Glycyrrhiza Glabra* Extract the Chemical tests like Fehling's test, Test for flavanoids, Test for saponins were Performed.

##### 4.7.1. Requirement for Phytochemical analysis :

Test tube, test tube holder, spatula weighing balance.

##### 4.7.2. Reagents used :

Fehling's solution A

Fehling's solution B

Concentrated Sulphuric Acid

##### A) Fehling's test :

A small amount of extract was kept on the water bath, to which fehling solution A and B were added.

##### B) Test for Flavonoids :

With sulphuric acid – 1ml of extract was taken the test tube and few drops of concentrated sulphuric acid along the sides of test tube were added.

##### C) Test for Saponins :

Foam test – 1ml of extract was taken in a test tube and 5 ml of water was added to it , the test tube was shaken vigorously for 2-3 minutes and allowed it to stand for 10-15 minutes.

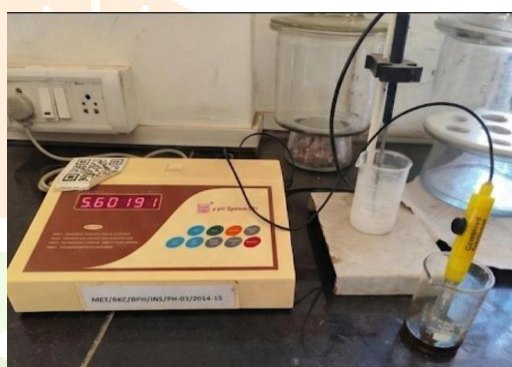
## 5. RESULT AND DISCUSSION

### 5.1 Results of Organoleptic characteristics

Sr. No.	Characteristics	Observation
1	Physical appearance	Translucent
2	Colour	Light greenish yellow
4	Odour	Herbal extract
5	Texture	Smooth, flexible

### 5.2 Surface pH Determination

The pH of formulated patches was found to be 5.6 .



**Fig No. 8 pH Determination**

### 5.3. Measurement of thickness of patch

The Thickness of formulated transdermal patches was evaluated to be 0.24 mm using vernier calliper. This Thickness was evaluated by measuring the average Thickness from three Sites of the patches.

### 5.4. Percentage Moisture Content

Here,

Initial weight = 0.6 gm and Final weight=0.57 gm so By Using the formula of % MC

%Moisture content=  $[0.6 - 0.57] / 0.6 \times 100 = 4.2 \%$

Hence, the % Moisture Content was evaluated to be 4.2 %

### 5.5. Folding Resistance

The patches of length 2×4cm were cut and folded multiple times at the same spot until it breaks. The folding resistance of formulated transdermal patches was found to be 141.

### 5.6. Phytochemical screening of *Tridax Procumbens* leaf extract :

The phytochemical screening of *Tridax Procumbens* extract revealed the presence of alkaloids, flavonoids, tannins.

Test	Observation	Inference	Result
A) Test for Flavonoid : Alkaline reagent test - Extract was treated with 10% NaOH solution.	Formation of intense yellow colour.	Presence of flavonoids.	+
B) Test for Alkaloids :  Wagner test – Filtrate treated with wagner's reagent.	Yellow colour precipitate.	Presence of alkaloids.	+
C) Test for Tannins :  2 ml extract was added to 1% lead acetate.	A yellowish precipitate.	Presence of tannins	+

+ :- Presence of  
constituents - :-  
Absence of  
constituents.

### 5.6. Phytochemical screening of *Glycyrrhiza Glabra* leaf extract :

The phytochemical screening of *Glycyrrhiza Glabra* extract revealed the presence of alkaloids, flavonoids, tannins.

Test	Observation	Inference	Result
A) Fehling's test : On the water bath, extract was kept to which fehling solution A and B were added.	Formation of brick red precipitate.	Presence of reducing sugars.	+
B) Test for Flavonoids : With sulphuric acid – 1ml of extract was taken the test tube and few drops of concentrated sulphuric acid along the sides of test tube were added.	Orange to red colour.	Presence of flavonoids.	+
C) Test for Saponins : Foam test – 1ml of extract was taken in a test tube and 5 ml of water was added to it , the test tube was shaken vigorously for 2-3 minutes and allowed it to stand for 10-15 minutes	Persistent foam formation.	Presence of saponins.	+

+ :- Presence of  
constituents. - :-  
Absence of  
constituents.



**Fig No. 9. Phytochemical screening of Tridax Procumbens plant extract**



**Fig No. 10. Phytochemical screening of Glycyrrhiza Glabra leaf extract**

## 6. Conclusion

This study focused on the formulation and evaluation of a herbal transdermal wound healing patch containing Tridax procumbens and Glycyrrhiza glabra. The developed formulation demonstrated satisfactory physicochemical properties and stability suitable for wound healing applications. The presence of bioactive phytoconstituents in both herbs contributed significantly to the wound healing activity due to their anti-inflammatory, antimicrobial, antioxidant, and tissue regenerative properties. Tridax procumbens was found to support rapid wound contraction and tissue repair, whereas Glycyrrhiza glabra enhanced the healing process by reducing inflammation and preventing microbial growth at the wound site. The combined herbal formulation showed a synergistic effect, resulting in improved wound healing potential with reduced chances of adverse effects compared to synthetic treatments. Hence, the formulated herbal transdermal patch may be considered a promising, safe, economical, and effective alternative for wound management. Herbal formulations are gaining significant importance in modern pharmaceutical research due to their natural origin, better patient compliance, reduced side effects, and therapeutic effectiveness. In the current study, the transdermal patch was successfully prepared and evaluated for various parameters such as physical appearance, thickness, flexibility, stability, moisture content, pH. The obtained results indicated that the formulated patch possessed suitable properties for wound healing applications. The herbal extracts incorporated in the formulation exhibited beneficial pharmacological activities including antimicrobial, anti-inflammatory, antioxidant, and tissue regenerative effects, which are essential for the wound healing process. The combination of both herbal drugs enhanced the overall therapeutic potential of the formulation. Therefore, the formulated herbal transdermal patch can be considered a promising and effective approach for wound management. Further advanced studies and clinical investigations may help in establishing its safety, efficacy, and future application in pharmaceutical and healthcare sectors.

## 7. References

1. Alsayed, A. Z., Mohammed, II. E., and Fahmy, A. A., 2005. Effect of licorice on wound healing in mbbits. The Egyptian Journal of Hospital Medicine, 20, pp. 58-65.
2. Assar, D. H., et al., 2021. Wound healing potential of licorice extract in rat model: Antioxidants, histopathological. immunohistochemical and gene expression evidences. Biomedicine & Pharmacotherapy.
3. Chaudhari, H. C., and Pati, K. P., A review on medicinal importance of Tridax procumbens Linn. Research & Reviews: Journal of Pharmacy and Pharmaceutical Sciences.
4. Chauhan, S., Gulati, N., and Nagiaich, U., 2018. Glycyrrhizic acid: extraction, screening and evaluation of anti-inflammatory property. Ars Pharmaceutica, 59(2), pp. 61-67.
5. Cheng, Y. C., Li, T. S., Su, H. L., Lee, P. C., and Wang, H. M. D., 2020. Transdermal delivery systems of natural products applied to skin therapy and care. Molecules, 25(21), pp. 5051.
6. Dattaray, D., 2022. Traditional uses and pharmacology of plant Tridax procumbens: A review. Systematic Reviews in Pharmacy, 13(7), pp. 476-482.
7. Gavali, S. S., Lawate, H. M., Hadke, A. H., Gaikwad, S. M., Jain, M. R., Suryawanshi, P. M., Jagtap, A. A., and Chaudhari. S. R., 2024. Formulation & evaluation of herbal transdermal patch of Centella asiatica & liquorice to study wound healing activity. International Journal of Pharmaceutical Sciences and Research. 15(12), pp. 3673-3678.
8. Gowda, H., Latha, M. C., Niharika, C. P., and Preethi, G. B., 2025. Herbal transdermal patch for wound healing: Formulation and in-vitro evaluation. Journal of Medicinal Plants Studies, 13(2), pp. 144-148.
9. Khandelwal K.R. Practical Pharmacognosy: Techniques and Experiments, Nirali Prakashan, p.125.
10. Khandelwal KR. Practical Pharmacognosy: Techniques and Experiments. Nirali Prakashan; p.153.
11. Patidar, B., Solanki, S., Jaiswal, M., and Kushwah, 1., 2024, Formulation and evaluation of herbal transdermal patches in treatment of wound healing. International Journal of Creative Research Thoughts (JCRT), 12(4), April 2024, pp. n241-n242.
12. Rani, S. S., Kumar, N. D., and Baru, C. R., 2022. Antifungal activity of acetone and ethanolic extract of leaves of Tridax procumbens. International Journal for Research Trends and Innovation, 7(9), pp. 652.
13. Redfern, J., Kinninmonth, M., Burdass, D., and Verran, J., 2014. Using Soxhlet ethanol extraction to produce and test plant material (essential oils) for their antimicrobial properties. Journal of Microbiology & Biology Education, 15(1), pp. 45-46.
14. Somnath, N., Komal, D., Selake, G., Meshram, S., and Padwal, P. N., 2024, A review on extraction, isolation and separation technique of alkaloids from Tridax procumbens. International Journal of Advanced Research in Science, Communication and Technology, 4(4), pp. 540.
15. Zabihi, M., et al., 2023. Impact of licorice root on the burn healing process: A double-blinded randomized controlled clinical trial. Complementary Therapies in Medicine. May 2023.