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Formulation and Evaluation of Transdermal Patch Containing *Carica papaya* Leaf Extract for Wound Healing

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Highlights

• Herbal transdermal patch containing papaya leaf extract was successfully formulated.

• Phytochemical screening confirmed the presence of alkaloids, tannins, flavonoids and glycosides.

• Solvent casting method was used for preparation of transdermal patches.

• Formulation F1 showed optimum physicochemical properties and stability.

• The developed patch demonstrated potential for wound healing therapy.

ABSTRACT

Leaves of Carica papaya contain several bioactive phytochemicals known for antimicrobial, antioxidant, and wound-healing activities. The objective of the present study was to formulate and evaluate a herbal transdermal patch containing papaya leaf extract for wound healing applications.Papaya leaves were collected, shade dried, powdered, and extracted using ethanol through the maceration method. The extract was subjected to preliminary phytochemical screening. Transdermal patches were prepared using the solvent casting method with hydroxypropyl methylcellulose (HPMC) and methylcellulose as polymers. Oleic acid was used as a penetration enhancer, polyethylene glycol (PEG) as plasticizer, and vitamin E as stabilizer.The prepared patches were evaluated for physicochemical parameters including weight variation, thickness, pH, moisture content, and skin irritation. Phytochemical analysis confirmed the presence of alkaloids, tannins, flavonoids, and glycosides. Among the four formulations prepared (F1–F4), formulation F1 exhibited better stability, acceptable pH, and optimum moisture content compared with other formulations.The results indicate that papaya leaf extract-loaded transdermal patches may be a promising herbal drug delivery system for wound healing applications.

Keywords: Transdermal drug delivery system, wound healing, herbal patch, papaya leaf extract, phytochemical screening

1. INTRODUCTION

Wounds are physical injuries that result in disruption of skin integrity and require proper healing for restoration of tissue function. Wound healing is a complex physiological process consisting of inflammatory, proliferative, and remodeling phases. Effective wound treatment requires prevention of microbial infection and promotion of tissue regeneration.

Medicinal plants have been widely used in traditional medicine due to their therapeutic efficacy and lower side effects. Among them, Carica papaya has attracted significant scientific interest because of its rich phytochemical profile and therapeutic properties.

Papaya leaves contain various bioactive compounds such as papain, chymopapain, flavonoids, phenolic compounds, and alkaloids that exhibit antimicrobial, antioxidant, and anti-inflammatory activities. These compounds contribute to tissue repair and accelerate wound healing.

Conventional drug delivery routes such as oral administration and injections often face limitations including first-pass metabolism, poor patient compliance, and drug degradation in the gastrointestinal tract. The Transdermal Drug Delivery System (TDDS) has emerged as a promising alternative approach for systemic drug delivery.

Transdermal patches offer several advantages including controlled drug release, improved bioavailability, reduced dosing frequency, and enhanced patient compliance. Therefore, incorporation of herbal extracts into transdermal patches represents an innovative strategy for wound management.

The present study aimed to formulate and evaluate transdermal patches containing papaya leaf extract and investigate their physicochemical properties.

2. Materials and Methods

2.1 Plant Material

Fresh leaves of Carica papaya were collected and washed thoroughly with distilled water to remove dust and impurities. The leaves were shade dried for seven days and pulverized into fine powder using a blender.

2.2 Preparation of Extract

Extraction of papaya leaf powder was performed by the maceration method. Approximately 500 g of powdered leaves were soaked in 96% ethanol for 72 hours with intermittent stirring. The extract was filtered using Whatman No.1 filter paper and concentrated using a rotary evaporator to obtain a thick extract.

2.3 Phytochemical Screening

Preliminary phytochemical tests were carried out to detect the presence of various secondary metabolites:

- Alkaloids: Mayer's and Wagner's tests
- Tannins: Ferric chloride test
- Flavonoids: Sodium hydroxide test
- Glycosides: Fehling's test

2.4 Preparation of Transdermal Patch

Transdermal patches were prepared using the solvent casting technique. HPMC and methylcellulose were dissolved in ethanol to form a polymer matrix. Oleic acid was added as a penetration enhancer and PEG as a plasticizer.

The ethanolic extract of papaya leaves was incorporated into the polymeric solution and mixed thoroughly to obtain a homogeneous mixture. The solution was poured into a petri dish and allowed to dry at room temperature to form thin films.

2.5 Formulation Composition

Table no:-1 Formulation Composition

Component	F1	F2	F3	F4
Papaya Extract	0.5	0.5	0.5	0.5
HPMC	2.5	2.0	1.5	3.0
Methylcellulose	1	1.5	2	0.5
Vitamin E	0.2	0.2	0.2	0.2
Oleic Acid	0.3	0.3	0.3	0.3
PEG	0.5	0.5	0.5	0.5
Ethanol	Q.S	Q.S	Q.S	Q.S

3. Evaluation of Transdermal Patches

3.1 Weight Uniformity

Ten patches were randomly selected and individually weighed using a digital balance. The average weight and standard deviation were calculated.

3.2 Thickness

Patch thickness was measured using a micrometer screw gauge at different points.

3.3 Surface pH

The surface pH of the patches was determined by placing the patch in contact with distilled water and measuring using a digital pH meter.

3.4 Moisture Content

Moisture content was determined using a desiccator containing calcium chloride.

$$[\% \text{ Moisture} = \frac{\text{Initial Weight - Final Weight}}{\text{Initial Weight}} \times 100]$$

3.5 Skin Irritation Test

Patches were applied to the skin surface and observed for redness, swelling, or irritation.

4. Results

4.1 Phytochemical Screening

Table no:-2 Phytochemical Screening

Test	Observation	Inference
Tannin Test	Black precipitate	Present
Flavonoid Test	Crimson color	Present
Glycoside Test	Brick red color	Present
Alkaloid Test	Turbid precipitate	Present

4.2 Physicochemical Evaluation

Table no:-3 Physicochemical Evaluation

Parameter	F1	F2	F3	F4
Patch Weight	77 mg	68 mg	65 mg	80 mg
Thickness	0.1 mm	0.1 mm	0.1 mm	0.1 mm
pH	5.7	5.3	5.1	5.5
Moisture Content	4.4%	4.0%	3.0%	3.5%
Skin Irritation	Non-irritant	Non-irritant	Non-irritant	Non-irritant
Stability	Stable	Stable	Unstable	Stable

Fig no:- 0.1 Irritancy Test

5. Discussion

Phytochemical screening confirmed the presence of alkaloids, flavonoids, tannins, and glycosides in papaya leaf extract. These compounds are known for antimicrobial, antioxidant, and anti-inflammatory activities which play a crucial role in wound healing.

The prepared transdermal patches exhibited acceptable physicochemical properties including uniform thickness, suitable pH, and low moisture content. Among the developed formulations, F1 demonstrated the most desirable characteristics in terms of stability and weight uniformity.

The results suggest that papaya leaf extract can be effectively incorporated into transdermal patches using the solvent casting method. Such herbal patches may provide a controlled and sustained release of bioactive compounds for wound healing therapy.

6. Conclusion

The present study successfully formulated and evaluated transdermal patches containing papaya leaf extract using the solvent casting technique. Phytochemical screening revealed the presence of important bioactive compounds responsible for wound healing activity.

Among the prepared formulations, F1 showed optimal physicochemical properties and stability. The findings suggest that papaya leaf extract-loaded transdermal patches could serve as a potential herbal therapeutic system for wound healing. Further in vivo and clinical investigations are recommended to confirm its therapeutic efficacy.

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