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FORMULATION AND EVALUATION OF ANTIMICROBIAL ACTIVITY OF TRANSDERMAL PATCHES BY USING *MUSA PARADISIACA*

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ABSTRACT

In this study, efforts are made to develop a formulation of transdermal patches with the use of Musa paradisiaca extracts as primary pharmaceutically active components to test its possible antimicrobial activity. The agricultural waste, which is rich in bioactive compounds, served as a natural source of medication. In preparing these transdermal patches, hydroxypropyl methylcellulose (HPMC), as well as Carbopol, served as film-gelling polymers. Propylene glycol, on the other hand, worked as plasticizers along with glycerin, which acted as enhancements. Methanol served as a solvent. The prepared transdermal patches were tested for different physiochemical parameters such as organoleptic test, surface pH, thickness, and folding endurance as a measure of their suitability for transdermal delivery. Antimicrobial potential was taken as the main evaluating criterion, which was tested against specific microorganisms to measure the potency of the Musa paradisiaca extract through a transdermal delivery system. This research attempts to explore the feasibility of using Musa paradisiaca skin transdermal patches as an eco-friendly alternative delivery method of antimicrobial compounds. Further research is recommended to improve the formulation of the delivery system and investigate the release kinetics as a means

of establishing the feasibility of using Musa paradisiaca as a pharmaceutical compound.

KEYWORDS: *Musa paradisiaca*, antimicrobial activity.

1. INTRODUCTION

Transdermal patches are effective drug delivery systems that provide controlled release of medication through the skin and improve patient convenience. Natural materials are increasingly preferred in such systems due to their safety and environmental benefits *Musa paradisiaca* extract contains various bioactive compounds with proven antimicrobial activity, making it suitable for topical applications. In this study, *Musa paradisiaca* extract is used as the active antimicrobial agent in a transdermal patch. HPMC and Carbopol are selected as film-forming polymers to ensure strength and controlled drug release, while glycerin and propylene glycol act as plasticizers and penetration enhancers. Ethanol is used to aid uniform mixing and enhance skin permeation. This formulation aims to develop a safe, effective, and eco-friendly antimicrobial transdermal patch.

2. MATERIALS AND METHODS

A) *MUSA PARADISIACA (PLANTAIN)*

Description: These bananas are gigantic herb having a cylindrical shape along with 30 cm long. They are large and thick skinned, depending up on the ripening of banana it shows green, yellow, brown colors.

Uses: Antimicrobial, antifungal effect, anti-inflammatory properties, anti-oxidant action.

CHEMICAL INGREDIENTS

B) HPMC (HYDROXYPROPYL METHYLCELLULOSE)

Description: HPMC is also referred to as Hypromellose which is a hydrophilic partially synthesized polymers made from organic cellulose. Although it may function as a thickening adhesive, emulsifying agents and film former, it is used as a versatile ingredient in numerous sectors. It is also used for food and pharmaceutical goods.

Uses: Film-forming polymer, Controlled drug release, enhances patch stability, Improves adhesion.

C) CARBOPOL - 940

Description: Carbopol 940 is a cross-linking polyacrylate polymer that works well as a gelling, thickening, and stabilizing ingredient in pharmaceutical, cosmetic, and personal care

products. It is a puffy white powder that, when treated with a base, swells and disperses in either alcoholic or water solutions to produce transparent gels and lotions. It is commonly found in products including serums, lotions, Sanitizers for hands, and hair gels.

Uses: Increases thickness and consistency of the formulation, helps improve drug penetration through the skin, enhances the physical stability and integrity of the patch.

D) PROPYLENE GLYCOL

Description: A synthetic organic chemical, propylene glycol, also known as (PG) is a transparent, colorless, odorless, moderately viscous fluid with a hint of sweetness. In terms of science, it is an alcohol (more precisely, a diol, also known as or 1,2-propanediol) that is miscible with a variety of solvents and easily absorbs water.

Uses: Humectant, plasticizer, enhance patient comfort

E) GLYCEROL

Description: It is a common triol compound that has a three-carbon backbone. It is a viscous, sweet-tasting, colorless, and odorless liquid. Glycerol is hygroscopic and miscible with water due to its three hydroxyl groups.

Uses: stabilize formulation, permeation enhancer, improves patch adhesion

F) METHANOL

Description: The most basic alcohol is methanol, sometimes referred to as wood alcohol or methyl alcohol. It is combustible, colorless, light, and volatile.

Uses: Casting solvent, enhance drug uniformity

3. METHODOLOGY

Collection and Processing of *Musa paradisiaca* Peel

Fresh, healthy, and ripe *Musa paradisiaca* fruits were selected, and the peels were separated from the pulp and collected in clean containers. The peels were washed thoroughly with running water to remove adhering impurities and allowed to drain. The cleaned peels were cut into uniform pieces (2–5 cm) and dried in a hot air oven at 60–70 °C for 4–12 h. The dried material was pulverized to obtain a fine powder and stored in airtight containers until further use.

Extraction of *Musa paradisiaca* Peel

Approximately 10–25 g of the powdered peel was subjected to Soxhlet extraction using a

suitable solvent. The sample was placed in an extraction thimble and extracted with 150–250 mL of solvent for 6–8 h, allowing multiple extraction cycles. After completion of extraction, the solvent was concentrated by evaporation using a rotary evaporator or water bath to obtain a semi-solid extract, which was stored in airtight containers at room temperature.

Preparation of Antimicrobial Transdermal Patches

Accurately weighed quantities of hydroxypropyl methylcellulose (HPMC) and Carbopol were dispersed separately in ethanol and allowed to swell. The polymer dispersions were combined and stirred using a magnetic stirrer to obtain a uniform viscous solution. The *Musa paradisiaca* peel extract was dissolved separately and incorporated gradually into the polymeric mixture under continuous stirring. Propylene glycol and glycerin were added as plasticizers and permeation enhancers. The final homogeneous solution was poured onto a leveled Petri dish and dried in a hot air oven at 70 °C for 18–24 h. After drying, the former transdermal films were carefully peeled off.

4. FORMULATION

INGREDIENTS	F1	F2	F3
Drug	1.5ml	2.5ml	3.5ml
HPMC	0.5 g	0.5ml	0.5ml
Carbopol	0.25g	0.15ml	0.15ml
Propylene glycol	0.5ml	0.6ml	0.4ml
Glycerin	0.5ml	0.4ml	0.6ml
Water	10ml	10ml	10ml
Ethanol	10ml	10ml	10ml

5. EVALUATION AND RESULTS

A) Organoleptic evaluation

Table no. 3.

SL.NO	CHARACTERISTIC	OBSERVATION
1.	Color	Pale yellow
2.	Odor	Characteristic odor
3.	Texture	Smooth texture

B) pH

The pH of the transdermal patch for the formulation F1, F2, F3 was found to be 5.04, 5.05 and 5.03. respectively the pH of the ideal transdermal patch's ranges between 4.5 and 6.5 which is close to the natural pH of the skin.

C) Thickness of the transdermal patch

The thickness of the transdermal patches of the for the formulations F1, F2, F3 was found to be 0.19mm, 0.20 mm and 0.22mm.

SL No.	PATCHES	THICKNESS
1.	F1	0.19mm
2.	F2	0.20mm
3.	F3	0.22mm

D) Folding endurance

This test is conducted to evaluate the flexibility and mechanical resistance of the transdermal patch to ensure the patch can with stand normal wear and handling during use and the folding endurance value of the formulations F1 is 321, F2 is 325 and F3 is 327. an ideal endurance value is generally considered to be greater than 300.

E) Antimicrobial activity

Zone of Inhibition – Antimicrobial Activity of Musa paradisiaca

The antimicrobial activity of Musa paradisiaca extract was evaluated against *Escherichia coli*. Agar plates inoculated with E. coli were prepared and introduced with Musa paradisiaca extracts obtained using distilled water, ethanol, and methanol. The extracts were placed onto the agar plates using sterile discs, and the plates were incubated at 37°C for 24-48 hours. Following incubation, the diameter of the inhibition zone around the extract was measured in millimeters. The formation of a visible clear area surrounding the Musa paradisiaca extract indicated the inhibition of microbial growth, attributed to the presence of bioactive phytochemicals. The results were recorded, with larger zones signifying greater antimicrobial activity in the F3 formulation.

6. DICUSSION

The objective of the present study was to formulate and evaluate a transdermal patch incorporating Musa paradisiaca extract. The prepared patches exhibited acceptable physicochemical and mechanical characteristics required for an ideal transdermal system, including a smooth surface and satisfactory folding endurance. The pH values of the formulated transdermal patches (F1, F2, and F3) were found to be 5.04, 5.05, and 5.03, respectively. These values fall within the acceptable pH range for transdermal formulations (4.5–6.5), which closely corresponds to the natural pH of the skin and therefore minimizes the potential for skin irritation. The findings of this study indicates that F3 formulation exhibits significant antimicrobial activity, suggesting its potential application as a natural and effective drug delivery system. The antimicrobial efficacy of the patch against Escherichia coli was evaluated using zone of inhibition.

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