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Research article on transdermal anti-inflammatory patches of *Curcuma amada*

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Abstract
Curcuma amada, a member of the Zingiberaceae family of ginger plants, is sometimes referred to as mango ginger or ambehaldi. Anti-inflammatory drugs can be locally delivered by transdermal patches, which may lessen systemic adverse effects. Controlled release: Over an extended length of time, patches can sustain therapeutic levels by releasing the active components in a controlled manner. Pain relief: The anti-inflammatory and antioxidant qualities of *Curcuma amada* and curcumin may help reduce pain and inflammation. Transdermal patches may offer a continuous release of the active ingredients of *Curcuma amada*, guaranteeing a longlasting therapeutic benefit. Increased bioavailability: Transdermal administration may increase the chemicals in *Curcuma amada*'s bioavailability, which could result in increased efficacy. Targeted delivery: For targeted treatment, patches might be made to target particular body parts, such the skin or joints.

Keywords: Curcuminoids, anti-inflammatory transdermal patch, anti-bacterial, anti-fungal, pain relief

Introduction
This plant is a perennial, rhizomatous, aromatic herb that belongs to the Zingiberaceae family, which includes 70 to 80 species of both annual and perennial rhizomatous herbs. The genus is widely distributed across the tropical regions of Asia, Africa, and Australia, with its origins traced back to the Indo-Malayan area. The plant can grow up to one meter in height, featuring radical leaves that are long, oblong, and lanceolate in shape, arranged in a tuft-like manner and attached by petioles. Typically, a single plant produces five to six pairs of leaves. The rhizomes of mango ginger are fleshy, buff-colored, measuring between 3 to 5 cm in length and 2 to 4 cm in width, and are characterized by internodes and nodes. At the nodes of the rhizome, rough leaves are arranged in a circular pattern, giving the appearance of concentric growth rings marked by surface scars. The roots exhibit a branched structure with sympodial branching and possess a flavor reminiscent of raw mango, accompanied by a strong taste.

Transdermal Patch
A transdermal patch is a medicinal adhesive patch applied to the skin that delivers a controlled dosage of medication into the body at a specified release rate through the skin and into the bloodstream. Presently, the most widely used transdermal device consists primarily of patches, which are constructed from semi-permeable membranes. Commonly referred to as 'transdermal patches' or 'skin patches,' transdermal drug delivery systems (TDDS) are designed to administer a therapeutically effective quantity of medication through a patient's skin and into their bloodstream.

Fig 1: Plant Profile

Vernacular Names *C. amada* Roxb.

- **English:** Mango ginger,
- **Sanskrit:** Amrardrakam, Karpuraharida,
- **Hindi:** Amahaldi,
- **Malyalam:** Mangainchi,
- **Tamil:** Mankayinci
- **Telugu:** Mamidi Allam

The systematic position of the plant *C. amada* is as follows

- **Kingdom:** Plantae
- **Sub-kingdom:** Phanerogamae
- **Division:** Spermatophyta
- **Series:** Epigynae
- **Order:** Scitaminales
- **Family:** Zingiberaceae Genus
- **Curcuma Species:** *C. amada* Roxb.

Chemical components

proximity of edible rhizomes an important part in determining their nutritional value and nutraceutical quality. It was discovered that the mango ginger rhizome is a rich source of starch and fiber.

Volatile Constituent

Numerous studies have been conducted on the composition of volatile oil derived from mango ginger. The characteristic mango flavor is primarily due to the presence of car-3-ene and cis-ocimene among the 68 volatile aroma compounds found in the essential oil extracted from the rhizome of mango ginger [Dutt and Tayal]; Golap and Bandyopadhyaya; Rao *et al*. The mango ginger plant (A), its rhizomes (B), and the thin section of the rhizome (C) are illustrated. 740 RS Policegoudra, SM Aradhya, and L Singh J. Biosci.

Proposed Attributes

1. **Organic components:** Leveraging the inherent anti-inflammatory and antioxidant characteristics of *Curcuma amada*.
2. **Transdermal administration:** Facilitating prolonged release and precise delivery of active ingredients.
3. **User-friendly:** Offering a practical and non-invasive method to enjoy the advantages of *Curcuma amada*.

Potential Applications

1. **Arthritis management:** Providing relief from arthritis symptoms.
2. **Sports injuries:** Aiding in recovery from sports injuries.
3. **Skincare:** Promoting healthy and youthful-looking skin.

Evelopment and Production

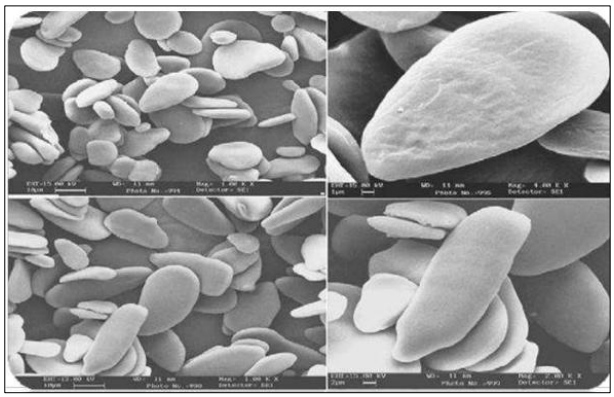
1. **Patch design:** Designing patches that are comfortable, breathable, and easy to use.
2. **Active compound extraction:** Extracting and incorporating the active compounds of *Curcuma amada* into the patches.
3. **Quality control:** Ensuring the quality and efficacy of the patches through rigorous testing and quality control measures.

Phenolic content

The amount of phenol in mango and ginger extracts The free phenolic acids (figure 4) found in mango ginger are as follows: small amounts of syringic (4%, 30 mg/g) and p-coumaric acids (2%, 15 mg/g), followed by gallic (10%, 75 mg/g), cinnamic (7%, 52.5 mg/g), and protocatechuic (7%, 52.5 mg/g) acids.

Additionally, it contains bound phenolic compounds such as gallic acid (1%, 11.5 mg/g), gentisic acid (1%, 4.9 mg/g), caffeic acid (4%, 30.7 mg/g), p-coumaric acid (11%, 95 mg/g), ferulic acid (47%, 391.5 mg/g), and cinnamonic acid (29%, 237 mg/g).

Accumulation pattern of biological compounds during development



Above Starch granule in mango ginger rhizome in this figure Perhaps it was a biological necessity for mango and ginger rhizomes to produce compounds with multifunctional activity to combat a wide range of abiotic and underground organisms. Difurocumenonol proved to be one such compound with multifunctional properties found in mango ginger. A distinct pattern of accumulation of phytochemicals and difurocumenonol was demonstrated along with Other visual parameters of ginger mango are given the best time to harvest mango ginger rhizomes,They are endowed with phytochemicals that provide various medicinal properties as mentioned above. Biosynthesis and accumulation pattern of diflocumenonol, Phenol and protein concentrations are maximum in rhizomes at 150-180 days of age. High concentrations of bioactive substance Compounds and other stock components are of great importance and play an important role as biomarkers for determining quality indicators of C.Amada rhizomes for use in the food and pharmaceutical industries

Raw-Mango Flavor

Spices' aroma and flavor qualities are what determine much of its worth. The commonly known as *C. amada* in the nations of South Asia,mango ginger, is because of its distinct uncooked mango. Numerous efforts have been undertaken to determine the evaporative scent elements that give mangos their distinct scent. The Bandyopadhyay and Gholap (1984) detected three terpene hydrocarbons in an approximate manner. For example, α-pinene, car-3-ene, and cis-ocimene, and proposed that while α-pinene contributes to the distinctive mango flavor, the latter two components the scent. to be the main chemicals in that have an impact on volatile oils from amada, suggesting that the aroma of mango Ginger is made up of a variety of substances that affect character.

Extraction of curcuminoids from curcumin amada (Ambihalad)

Material - Ethanol, Powder of *Curcuma amada*

Sample preparation

Sourcing: Raw *Curcuma amada* is procured from the market.

Trituration: The raw material is triturated (ground or crushed) using a mortar and pestle. Powder formation: The triturated material is then converted into a fine powder.

Fig 2: Powder of *Curcuma amada*

Curcuminoids from curcumin amada

The 100gm powder of curcumin amada is placed in a thimble-shaped filter paper which is then kept in a glass cylinder. This cylinder is provided with a siphon tube and an inlet tube. A water condenser is attached to the cylinder at the top. This entire assembly is fitted into the neck of a round bottom flask containing the solvent (Ethanol) The flask is heated in a heating mental. The solvent vapors reach the cylinder through the inlet tube and conduce on passing upward into the condenser. The condensed solvent comes in contact with the crude organic substance and dissolves it. As soon as the solution reaches the top end of the siphon tube. In this way, a continuous supply of solvent vapors is maintained in the cylinder, and the dissolved organic compound flows back into the flask. Finally, the heating is stopped and the solution in the flask is distilled to recover the solvent, While the organic compound is left behind.

Soxhlet Extraction Unit

Soxhlet extraction is a laboratory technique used to extract bioactive compounds from solid materials using a solvent.

Equipment

Soxhlet apparatus (extractor, condenser, and flask), Solvent (e.g., ethanol, hexane), Sample material (e.g., plant material).

Table 1: Procedure -Formulation of transdermal anti - inflammatory herbal patches of *Curcuma amada*

Sr. No.	Ingredient	Quantity for 1 patch	Role
1.	Curcuminoids	0.2gm	Anti – inflammatory
2.	Gelatin	4gm	Solidifying Agent or gelling agent
3.	Cucumber gel	2gm	soothing, hydrating, cooling properties
4.	Hpmc	2gm	Stabilizer
5.	Menthol	1ml	Topical agent to prevent skin infections
6.	Hot water	20ml	Pain alleviator

Methods for preparation of transdermal patch

Curcuminoids was used as an active pharmaceutical ingredient. Extracted curcuminoids from *Curcuma amada* and glycerine used as a hydrating agent, Polymer was slowly dissolved in an ethanol solvent. The curcuminoids was dispersed uniformly in the viscous solution with a stirring. Add glycerine in a viscous solution. The resulting viscous solution poured in a petri plate covered. The petri plate was left undistributed at a room temperature for a 24 hours. The patch was obtained intact slowly lifting from the petri plate

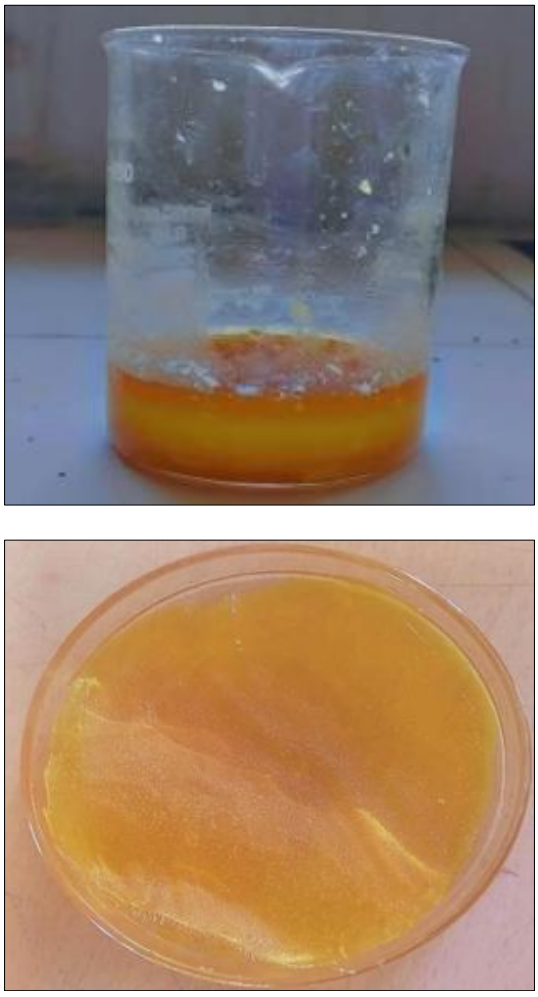


Fig 3: Prepared patch of *Curcuma amada*

Evaluation Parameters

A. Physicochemical evaluation

Thickness

The thickness of the drug prepared patches is measured by the digital travelling microscope dial/ screw gauge at different points of patch and determines the average thickness and standard deviation for the same to ensure the thickness of the prepared patch**.**

1. **Weight variation:** Weight 4 patches and then weight single patch. The variation in the weight is considered as the weight variation.
2. **Folding endurance:** Folding repeatedly at a same point until it breaks. The number of times it could be folded is its folding endurance value.
3. **Flatness:** One strip is cut from the center and two from each side end of the patches. The length of each strip is measured and variation in length is measured by constriction is equivalent to 100 percent flatness.
4. **Percentage of moisture content:** First take a weight of empty China dish and then poured a drug into a China dish and weight it. After that apply heat to China dish containing the drug and note the reading after burning the drug. The difference in the initial and final is the moisture content percent.

Fig 4: Porcelain with drug Incineration of drug

Fig 5: After incineration

Moisture Content

% moisture content= initial weight - final weight / final weight * 100
Empty porcelain = 50.39 gm
Porcelain with drug (Initial weight) =51.31 gm
After incineration (Final weight) = 50.87 gm
= 51.31 – 50.87
= 0.44
% moisture content = initial weight - final weight / final weight * 100
= 51.31 – 50.87 / 50.87 * 100
= 0.44 / 50.87 * 100
= 0.00864 * 100
= 0.864%
The percentage moisture content of the formulation was found to be 0.8%

Result of evaluation of curcuminoids

Table 2: Qualitative Test

Sr. No.	Parameter	Curcumin Amada
1.	Colour	Dark yellowish
2.	Odour	Raw mango odour or aromatic
3.	Solubility in cold water	Dissolve slightly and form suspension after vigorous shaking
4.	Solubility at 100 °C for 20min	Dissolve Slightly
5.	Solubility of curcuminoid suspension in cold alkali	The curcuminoids suspension forms yellow precipitate

Table 3: Observation table and indentification test

Sr. No.	Test	Observation
1	Ruthenium red Take 0.1gm of dried Curcuminods and 2ml of ruthenium red	Reddish brown colour
2	Phloroglucinol Take 0.1 gm of dried curcuminoids and 2ml of phloroglucinol	Orange red colour

Evaluation of transdermal patch

Table 4: Evaluation of CURCUMINOIDS transdermal patch

Formulation code	% Moisture content	% moisture uptake	Drug constant (mg)
F_1	6.15± 0.1	5.40± 0.2	36.15± 0.25
F_2	5.20± 0.1	5.10± 0.2	35.40± 0.25
F_3	4.45± 0.1	4.86± 0.2	30.64± 0.25

Conclusion

The development of transdermal curcumin patches using *Curcuma amada* holds significant promise for therapeutic applications, especially in areas requiring sustained anti-inflammatory or antioxidant effects. However, challenges related to skin permeability, stability, and formulation need to be addressed to fully unlock the potential of curcumin in transdermal therapy. Future research should focus on optimizing formulation techniques and testing for long-term

safety and efficacy in clinical settings. The patches were smooth, flexible, and transparent. Curcuminoids dissolves quite well in ethanol. Of the different batches, the weight fluctuation and thickness show that the solution is evenly distributed throughout the patches. Nonetheless, the strength and integrity of the patch were not negatively impacted by the moisture absorbed. Evaluation parameters like physical appearance, uniformity of weight, thickness of film. folding endurance, moisture content. moisture uptake, drug content F_1-F_3 were found to be satisfactory. From the given study, we conclude that transdermal anti-inflammatory herbal patches incorporating *Curcuma amada* extracts offer a promising approach for managing pain and inflammation.

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