International Journal of Agriculture and Animal Production
ISSN: 2799-0907
Vol: 04, No. 06, Oct-Nov 2024
http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.46.25.44

Formulation, Development and Evaluation of Herbal Transdermal Patches from Leaf Extract of Thespesia Populnea Linn. for Anti- Inflammatory Activity

Mrunal K. Shirsat[1], Mahesh M. Thakare[2], Kalyani V. Amale[3], Aishwarya U. Kulkarni[4*], Sandhya K. Shinde[5]

[1]Principal, RMP'S Bhalchandra College of Pharmacy, Pune, India.
[2,3]Associate Professor, RMP's Bhalchandra College of Pharmacy, Pune, India.
[4,5]B. Pharmacy (Final Year), RMP's Bhalchandra College of Pharmacy, Pune, India.*

Corresponding Email: [4]aishwaryakulkarni2002@gmail.com*

Received: 03 June 2024 **Accepted:** 20 August 2024 **Published:** 05 October 2024

Abstract: ***The Thespesia Populnea Linn are large trees belonging to the Malvaceae family. It is a tiny, evergreen tree with a broad, heavy crown and a short, frequently twisted stem that grows to an average height of 6 to 10 metres [20 to 33 feet]. It features yellow hibiscus-like flowers and glossy green, heart shaped leaves. Thespesia populnea has a wide variety of active chemical ingredients, traditional applications, photochemistry, and pharmacology for drug development research. The plant contain a broad variety of biologically active substances, including sugars, antioxidants, tannins, sesquiterpenoids, flavonoids, alkanes, and essential oils. It is known that different plant parts, such as the roots, bark, leaves, flowers, and fruits, have distinct pharmacological characteristics such as anti-diarrheal, anti-microbial, anti-diabetic, memory boosting antibacterial and antioxidant, anti-inflammatory, wound healing activity.***

One non-invasive way to administer medication is via transdermal patches. It's an adhesive patch that works by putting a predetermined amount of medicine under the skin and into the body's bloodstream. Transdermal medication delivery has a number of benefits over conventional delivery methods, including the ability to avoid first-pass metabolism and the harmful acidic environment of the stomach that arises when pharmaceuticals are taken orally. It is also more patient-friendly. The patches were assessed using physicochemical criteria, including pH, flatness, moisture absorption, drug content, thickness, folding endurance, physical appearance, weight uniformity, moisture content, and an in-vitro drug release and stability study.

Keywords: ***Thespesia Populnea L., Herbal Transdermal Patch, Alcoholic Leaf Extract, Anti- Inflammatory Activity, Triterpenoid, Steroid.***

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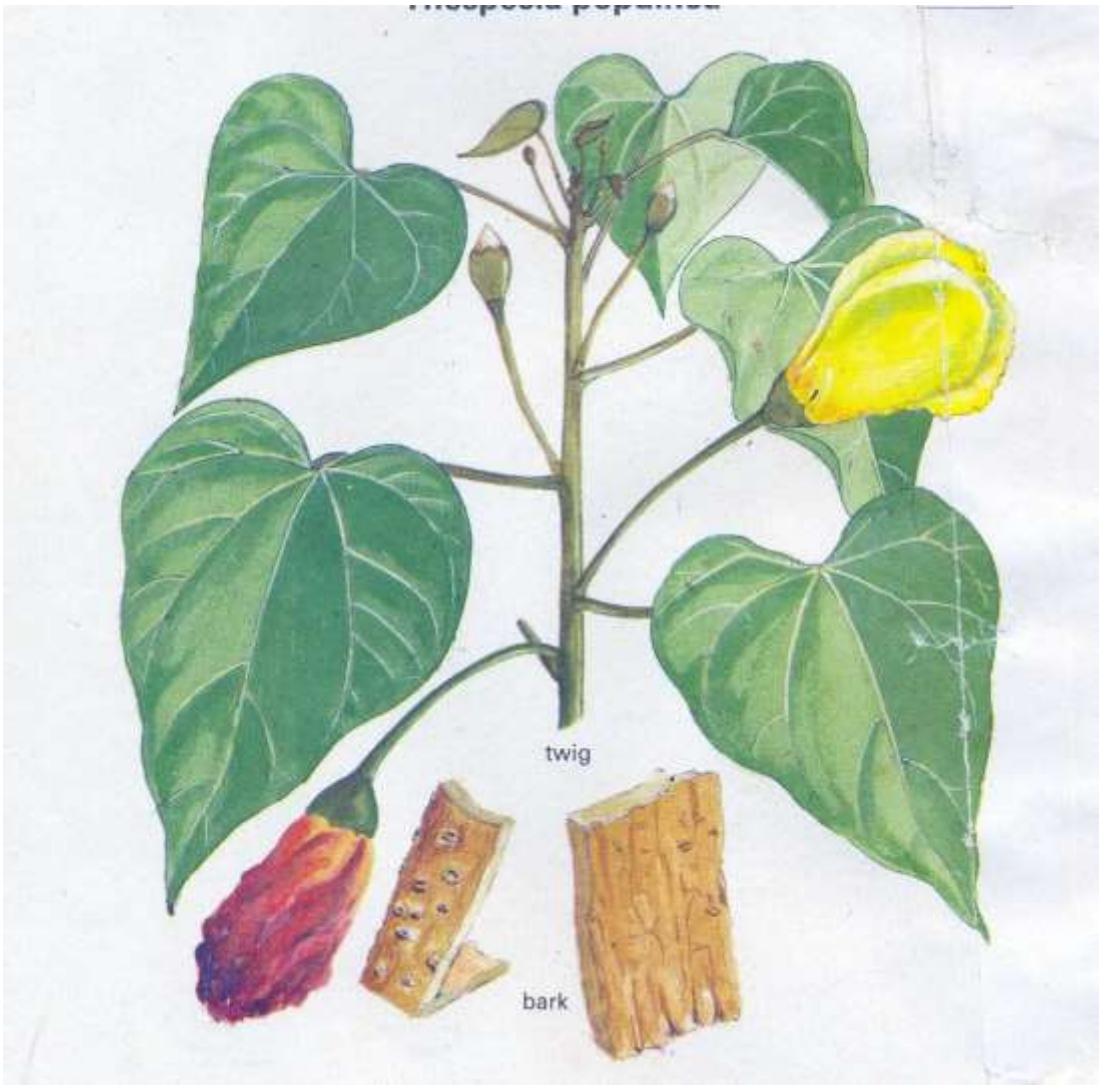

Thespesia Populnea plant

1. INTRODUCTION

Thespesia populnea, a member of the Malvaceae family, is a significant tree species native to tropical and coastal regions of India. This evergreen tree, characterized by a short, often twisted stem and a broad, heavy crown, typically reaches heights ranging from 6 to 10 meters. Its distinctive yellow hibiscus-like flowers and glossy green, heart-shaped leaves contribute to its ornamental value. Remarkably, Thespesia populnea exhibits a wide geographical distribution, extending from the east coast of Africa to the southernmost parts of Asia, and encompassing the islands of Melanesia, Micronesia, and Polynesia. This broad range underscores its adaptability to diverse tropical and coastal environments. Beyond its aesthetic appeal, Thespesia populnea holds cultural and ecological significance, serving various purposes including traditional medicine and wood utilization. Its presence contributes to biodiversity and ecosystem stability in coastal areas, rendering it a vital component of

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numerous ecosystems[1]. *Thespesia populnea* is a botanical resource rich in bioactive compounds distributed throughout its various plant parts. These compounds, encompassing diverse chemical classes such as alkaloids, flavonoids, carbohydrates, phytosterols, tannins, saponins, proteins and aminoacids, terpenes, phenols and essential oils, exhibit significant pharmacological activities. Notably, different plant components including roots, bark, leaves, flowers, and fruits demonstrate distinct pharmacological profiles, including anti-diarrheal, anti-microbial, antidiabetic, memory- enhancing, antibacterial, antioxidant, anti-inflammatory, and wound-healing properties. The multifaceted chemical composition and pharmacological efficacy of *Thespesia populnea* underline its potential as a valuable resource for drug discovery and development research[2].

Fig.1.1 Thespesia Populnea Linn

Fig.1.2 Flowers leaves and fruits, seed

Historical Claims

Bark and fruits have stronger curative qualities. The herb is astringent, cooling, depurative, anti- inflammatory, haemostatic, anti-diarrheal, and Anti-bacterial. It is beneficial in dermatopathy such as scabies, psoriasis, ringworm, leprosy, arthritis, ulcer, cholera, diabetes, dispsia, cough, asthma. The Ayurvedic Pharmacopoeia of India suggests Prameha, Raktapitta, Raktavikra, Yoni Roga, Daha, Trsa, Vrana, Sotha, Balavisarpa, Pama, Khandu,

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Dadru, and Medoroga. It is beneficial in cases of dysentery, piles, diabetes, and hemorrhoids. It heals ulcers, itching, scabies, and other infections of the skin, as well as urinary tract infections. Leaves are effective in joint pain. Externally, the fruits and leaves are used to treat scabies, psoriasis, and other skin problems.

1.1 Introduction of Transdermal Patches -

Transdermal patches represent a method for administering medication through the skin into the systemic circulation. The FDA approved the first ever transdermal patch product in 1981 was the scopolamine patch, marketed under the brand name Transderm Scop. Presently, transdermal systems are commercially available for delivering various medications, including fentanyl for chronic pain, clonidine and nitroglycerin for cardiovascular ailments, scopolamine for motion sickness, and nicotine for smoking cessation. These patches are particularly advantageous for drugs with short biological half-lives, facilitating continuous delivery and mitigating pulsatile systemic exposure, thereby enabling controlled and sustained pharmacological action[3].

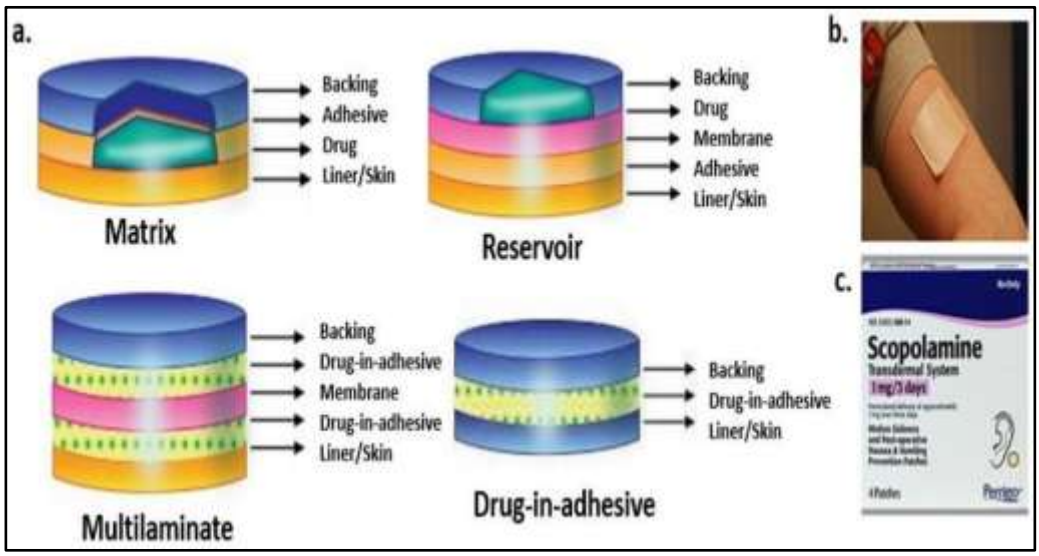

Fig.1.3 Different Types of Transdermal Patches [First TDDS]

Transdermal patches and medicated plasters are prominent extended-release dosage forms. Despite their significance, regulatory agencies frequently receive reports on insufficient in vivo adhesion, which directly impacts therapeutic efficacy and safety. When characterizing the adhesive properties of patches, it is essential to consider three key parameters: tack, shear adhesion, and peel adhesion. Tack denotes the ability to form an immediate bond under light pressure, shear adhesion measures resistance to flow, and peel adhesion quantifies the force required for patch removal. These factors are pivotal for evaluating the performance and reliability of transdermal patches and medicated plasters in clinical applications[4].

1.2 Anatomy of Skin:

The skin, constituting the body's largest organ, encompasses approximately 16% of the

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average individual's total body mass and presents a vast surface area of 1.7 m^2. Its fundamental function resides in serving as a protective barrier against various external threats, including pathogens, ultraviolet (UV) radiation, chemical agents, allergens, and excessive water loss, thereby effectively segregating the internal milieu from the external environment. Three primary sections make up skin: (1) the outermost layer, called the epidermis, which contains the stratum corneum;
(2) the intermediate layer, called the dermis; and (3) the innermost layer, called the hypodermis[5,12].

1. Epidermis- The epidermis, which is the skin's outermost layer, varies in thickness, measuring about 0.8 mm on the soles of the feet and palms of the hands. The viable epidermis, which is made up of multilayered regions of epithelial cells, is frequently referred to as the epidermal layers beneath the stratum corneum. Approximately 95% of the cells in the epidermis are keratinocytes; melanocytes, Langerhans cells, and Merkel cells are among the other cells in the epidermal layers[6]. The majority of the cells in the stratum corneum are made up of 20% lipid and 70% insoluble keratins.
The microscopic section of epidermis shows,
-Stratum corneum
-Stratum lucidium
-Stratum granulosum
-Stratum spinosum
-Strarum basale

2. Dermis- The skin's strength and elasticity are provided by the elastin and collagenous fibers, which make up 70% of the dermis's 2-3 mm thickness[7]. Both the dermis and the epidermis receive nourishment from blood vessels located in the dermis. The dermis layer also contains nerves, lymphatic vessels, and macrophages.

3. Hypodermis- The layer directly beneath the dermis is called the subcutis, or hypodermis in histology. A significant number of fat cells make up the elastic layer known as the subcutis, which acts as a shock absorber for blood vessels and nerve endings. This layer has an average thickness of 4 to 9 mm. The actual thickness, however, varies depending on the body region and from person to person[8].
Drug penetration through the intact skin can occur via the transepidermal and transappendegeal pathways. The stratum corneum, a multilayered, multicellular barrier with a diverse architectural style, is traversed by molecules as part of the transepidermal pathway. Intercellular or intracellular transepidermal penetration are other names for it[9].

Drug Delivery Routes across Human Skin
Drug molecules can penetrate by three pathways:
1. Sweat ducts
2. Hair follicles
3. Sebaceous glands

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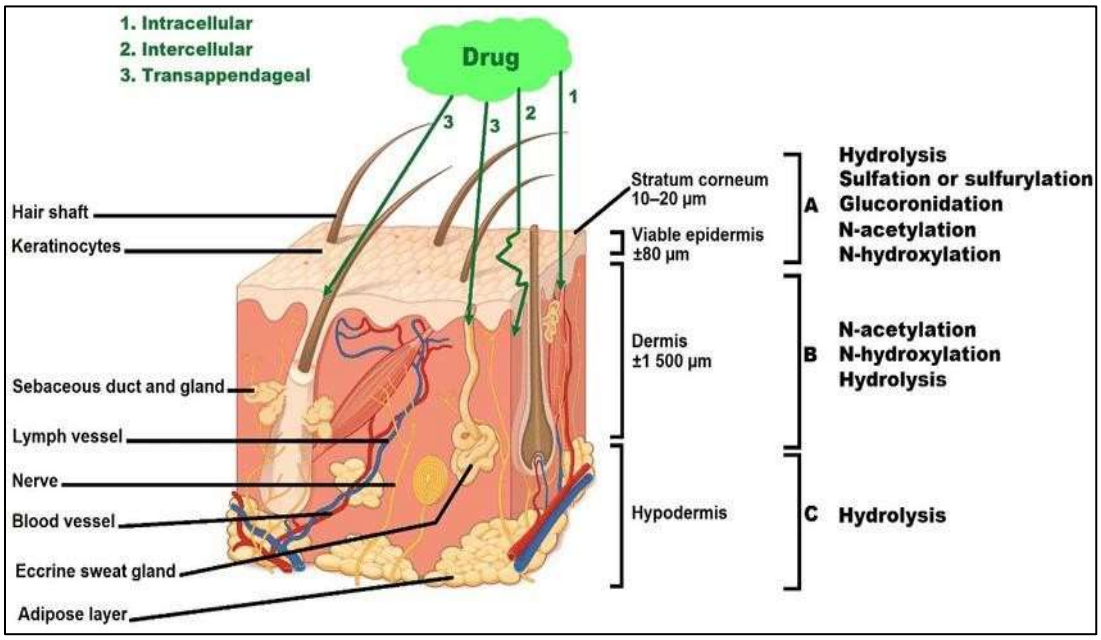

Fig.1.4 Transverse section of skin showing routes of penetration 1. Through the sweat ducts; 2. Directly across the stratum corneum; 3. Via the hair follicles [10].

1.3 The Main Components of Transdermal Patch Contain as Following:

1. Polymer Matrix- The polymer matrix constitutes the fundamental component of Transdermal Drug Delivery Systems (TDDS), dictating the controlled release of medication. Polymers selected for TDDS applications must adhere to stringent criteria, including biocompatibility, chemical inertness, cost-effectiveness, and stability over extended storage periods. Among the polymers commonly employed are natural substances such as waxes, gums, zein, gelatin, and cellulose derivatives as well as synthetic counterparts like polyvinylpyrrolidone, polyethylene, polypropylene, polyvinyl alcohol, polyvinyl chloride, and polymethylmethacrylate. Additionally, elastomeric materials find widespread application. These polymers are pivotal in modulating drug release kinetics, thereby ensuring the efficacy, safety, and reliability of transdermal drug delivery systems in pharmaceutical research and development.

2. Drug- with proper pharmacology and physical chemistry, the transdermal route is a very attractive choice. Transdermal patches provide a lot of benefits for medications with short half- lives, limited therapeutic windows, or high first pass metabolism such as nitroglycerine, fenatyl, etc.

3. Permeation Enhancers- are compounds utilized to augment the permeability of the stratum corneum, facilitating higher concentrations of therapeutic medications. They are categorized into three types: two-component systems, lipophilic solvents, and surface-active agents. For instance, dimethyl sulfoxide (DMSO) is a widely used permeation enhancer.

4. Adhesive Layer- This layer is responsible for adhering the patch to the skin. It should have proper adhesive properties to ensure the patch stays in place during wear but can be easily removed without causing skin irritation.

5. Backing Laminates- in transdermal patches serve as the outermost layer and play a

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crucial role in providing structural integrity and flexibility to the patch. These backing materials should possess high adaptability or low modulus to conform to the contours of the skin and ensure comfortable wear. Common materials used for backing laminates include polyethylene and vinyl, which exhibit the desired properties of flexibility.

6. Other excipients like plasticizers and solvents[10]- TDD is a painless systemic drug delivery technique that involves putting a drug formulation to healthy, undamaged skin[11,12]. The medication enters the body through the stratum corneum at first, and then moves through the deeper layers of the epidermis and dermis without building up in the dermal layer. The dermal microcirculation allows the medication to be absorbed systemically once it reaches the dermal layer [13,14]. TDD is superior to other traditional drug delivery methods in several ways[15,16]. It can offer a non-invasive substitute for parenteral methods, hence avoiding problems like needle fear. Drug pharmacokinetic profiles are less peaks and more homogeneous, which reduces the possibility of harmful side effects. Because TDD circumvents pre-systemic metabolism, bioavailability is enhanced[6].

A transdermal patch for the prolonged, three-day administration of scopolamine to treat motion sickness was the first to be licensed for systemic distribution in 1979[17,18]. The nitroglycerin patch was another transdermal patch created in 1985. A membrane that regulates the rate of ethylene vinyl acetate is used in the patch created by Gale and Berggren (1985). When it comes to helping people stop smoking, the nicotine patch is arguably the most popular and well-known transdermal patch. Numerous further uses have been researched during the last 30 years. These days, medications applied by transdermal patches include scopolamine, estrogen (to prevent osteoporosis after menopause and to ease undesirable menopausal symptoms), nitroglycerin (to treat angina), lidocaine (to treat herpes zoster pain), and other medications[19].

Since TDDS have far more readily regulated and targeted effects than oral administration, they are a more effective drug delivery method. Since its inception, transdermal drug delivery has provided numerous advantages, such as noninvasiveness, extended therapeutic effect, decreased side effects, fewer dose frequency, enhanced bioavailability due to bypassing hepatic first-pass metabolism, and increased patient compliance. Since the skin is the largest organ in the body, transdermal distribution is a more targeted and selective delivery approach because medicinal chemicals that are difficult to administer orally can more easily be absorbed through the broad exposed surface of the tissue[20]. Transdermal patches come in three primary varieties: the single-layer/multi-layer drug-in- adhesive transdermal patch, where the medication is integrated into the adhesive; the second form, known as matrix transdermal patches, includes a separate drug-containing layer that is thought of as a drug reservoir; and the third type has a drug layer that consists of a semi-solid matrix that contains a drug solution or suspension[19].

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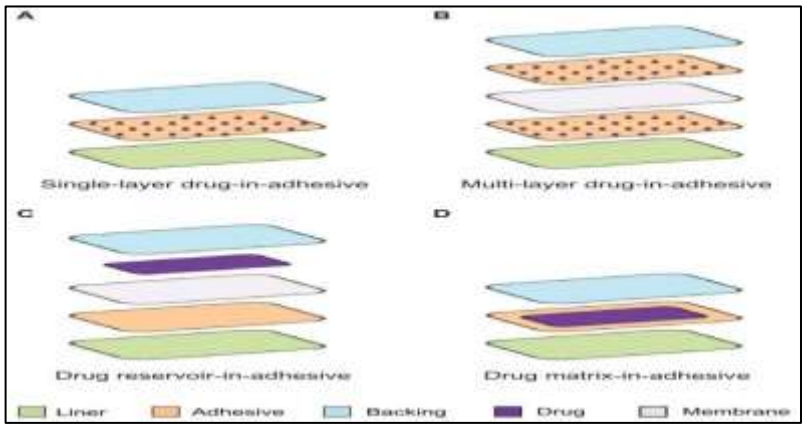

Fig.1.5 Representation of different types of patches (Di Stefano et al., 2012)

Advantages -

1. It is convenient method and requires only once weekly application. Such a simple dosing regimen can aid in patient adherence to drug therapy.
2. Transdermal drug delivery can be used as an alternative route of administration to accommodate patients who cannot tolerate oral dosage forms.
3. It is of great advantage in patients who are nauseated or unconscious.
4. Drugs that cause gastrointestinal upset can be good candidates for transdermal delivery because this method avoids direct effects on the stomach and intestine.
5. Drugs that are degraded by the enzymes and acids in the gastrointestinal system may also be good targets.
6. First pass metabolism, an additional limitation to oral drug delivery, can be avoided with transdermal administration.
7. Drugs that require relatively consistent plasma levels are very good candidates for transdermal drug delivery.

Limitation-

1. TDDS cannot deliver ionic drugs.
2. It cannot develop for drugs of large molecular size.
3. TDDS cannot deliver drugs in a pulsatile fashion.
4. TDDS cannot develop if the drug or formulation irritates the skin.

2. LITERATURE REVIEW

1] Review on pharmacological studies of Thespesia Populnea Linn by Mohini A. Phanse, Manohar J. Patil, Konde Abbulu- Plant profile and study of pharmacological activity.
2] In vitro anti-microbial activities and phytochemical analysis of crude leaf extracts of Thespesia Populnea (L) byNeethu S. Kumar & Neethu Simon - Extraction method of leaf.
3] Phytochemical, Pharmacological and Phytopharmaceutics Aspects of Thespesia Populnea (Linn.) Soland.: A Review by D. S. Chumbhale, A. A. Pawase, S. R. Chaudhari, C. D. Upasani- Introduction, pharmacological activity.

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4] Phytochemical characterization of leaf extracts of THESPESIA POPULNEA L. by Narendar Vankudothu,R. Chandrashekar, P. Jyothi Chiatanya, Ayesha sultana, Chekuri Sudhakar, N.Lakshmi Bhavani, S.Y.Anwar- Preliminary tests of leaf extract.
5] Review of literature: phytopharmacological studies on Thespesia Populnea. by Battu Ganga Rao, K. Jeevitha, Devarakonda Ramadevi, Heera Battu -Botanical description and chemical constituients with structure.
6] THESPESIA POPULNEA LINN: A REVIEW by S.Panchal Hiteksha and B.Shah Mamta- Method of extraction and evaluation.
7] Formulation and In– Vitro Evaluation of Transdermal Patches of Anti–Arthritic Ayurvedic Medicinal Plants by Pallavi S. Shelke and Pradnya N. Jagtap - Material and method, procedurefor formulation of transdermal patch.
8] Formulation and evaluation of transdermal patches of pantoprazole sodium by M. R. Shivalingam, Arul Balasubramanian, Kothai Ramalingam-Evaluation parameters.

Aim & Objective

2.1 Aim- Formulation, Development and Evaluation of Transdermal Patch of Thespesia Populnea linn. for anti-inflammatory activity.

2.2 The Objective of thhe Work

1. To make available herbal drug in advanced form mainly known as novel and sustain releasing drug.
2. To develop a novel topical formulation from extract of Thespesia Populnea Linn. leaves for the effective treatment rheumatoid arthritis(joint pain).
3. Collection and authentication of Thespesia Populnea Linn.
4. Study of phytochemicals parameters of leaf powder.
5. To carryout extraction process of leaves.
6. To prepare and evaluate herbal transdermal patch

Plan of work

1. Collection of part of herbal plant (i.e leaf)
2. Authentication of herbal plant
3. Solubility analysis
4. Preparation of herbal extract
5. Phytochemical screening
6. Formulation of dosage form (TDDS)
7. In vitro study (evaluation study/ parameter)
8. Result analysis

Plant Profile:

1. Botanical Name: T. Populnea Linn
2. Synonym: Hibiscus bacciferus, Hibiscus populneus
3. Common name: Portia tree, Bhendi tree, Seaside mahoe, Baru Baru
4. Family: Malvaceae
5. Order: Malvales

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6. Kingdom: Plantae
7. Genus: Thespesia
8. Sub-genus: T. Populnea

Fig.5.1 Thespesia populnea tree

9. Active Phytochemicals: Gossypol, quercetin, lupeol, Beta-sitosterol, Thespone, Mansonones D, E and F Populneol, Kaempferol, myricyl alcohol, daucosterol, stearic acid, and betulin.
10. Part used for Research: Leaves

Leaves - Leaves are heart-shaped, bright green, and vary in size from 10 to 20 cm long and 6-13cm wide. Young leaves- uncooked or cooked. They can be eaten raw as a vegetable or boiled and added to soups.

Fig.5.2 Leaves of Medicinal Plant

Active Constituents in Leaf- Beta-Sitosterol, Lupenone, Quercetin, Lupeol, Rutin

11. General uses: -Anti-inflammatory,
-Anti-diarrheal,
-Anti-microbial,
-Antidiabetic,
-Memory boosting
-Antibacterial and

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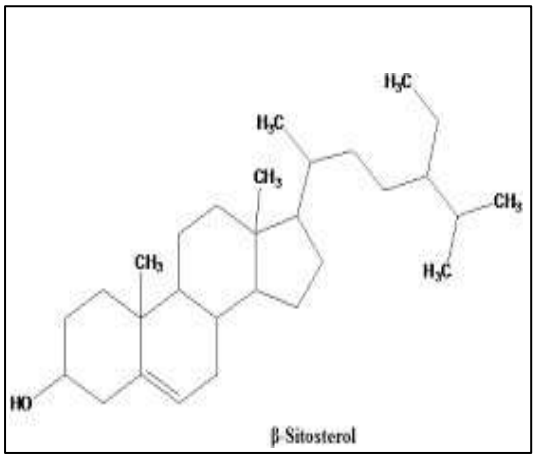
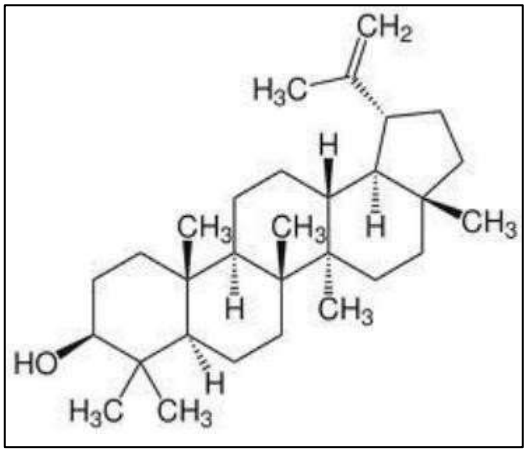
-Antioxidant,
-Wound healing activity.

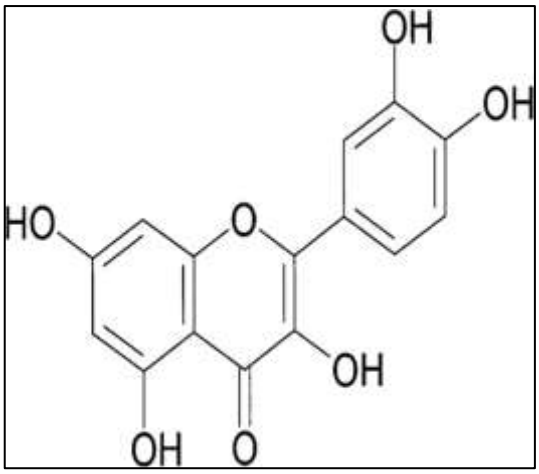
Chemical Constituents:



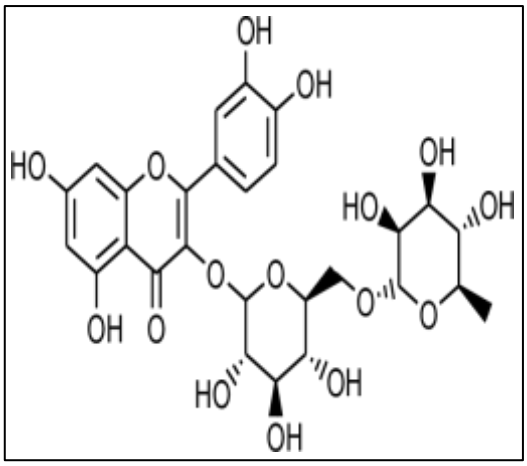
Beta-sitosterol



Lupeol



Quercetin



Rutin

Fig.5.3 Chemical Constituents

3. MATERIALS AND EQUIPMENTS:

Materials used are as following:
API- Lupenone, Lupeol, Beta-sitosterol, Rutin,Quercetin Chemicals:

1. Ethanol/ methanol/alcohol (for extraction)
2. Propylene glycol (plasticizer)
3. Glycerol
4. Polymers (polyvinyl alcohol, polyvinylpyrrolidone)
5. Permeation enhancer(dimethyl sulphoxide)

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Equipments needed are as following:

1. Soxhlet apparatus (round bottom flask, soxhlet tube, condenser),
2. Weighing balance,
3. Hot air oven,
4. Desiccator,
5. Verniercaliper/micrometer,
6. TLC Chromatography.
7. Double-beam UV- Visible spectrophotometer,
8. Dissolution apparatus.

Experimental Work:

1. **Collection of Plant:** The fully matured, fresh and healthy leaves of *T. populnea*(L) were collected from backwater area, opposite of our college, in Khanapur, dist-Pune. Leaves were thoroughly cleaned and good leaves were picked and dried under shade. Sufficient quantity of leaves were powdered in an electric grinder, sieved from 60# to obtain fine and coarse powder.

Fig.7.1 Dry Leaves and Powdered leaves passed through sieve

2. **Authentication of Plant:** The plant material was taxonomically identified and authenticated by a noted botanist, Madhuri Pawar, Department of Botany, Botanical Survey of India, WRC, Pune. A specimen SSK01, AK01 were deposited in the form of herbarium sheet as following:

Fig.7.2 Herbarium sheet

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3. **Solubility Analysis:** After testing solubility of leaf powder in various solvents such as acetone, chloroform, water, alcohol and petroleum ether, it came to know that Thespesia Populnea leaf powder was more soluble in alcohol.

Fig.7.3 Solubility Analysis

4. **Preparation of Herbal Extract:**

50gm of coarse leaf powder was weighed and filled in thimble packet for soxhlet extraction in ethanol 95% as solvent. Extraction process was continued for 6hrs. Another method used for extraction was cold maceration. The leaf powder was macerated in petroleum ether by shaking for one time initially and keeping for 24hrs without disturbing it.

Fig.7.4 Extraction by Soxhlet technique(alcoholic) & Maceration(P.E.)

5. **Phytochemical screening: Table no.7.5a**

Sr. no.	Test for	Procedure	Observation	Inference
1.	Terpenoid	1ml of extract diss. in 1ml $CHCl_3$:1ml of acetic anhydride	Formation of reddish color	Presence of terpenoid

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		+ 2ml of conc.H_2SO_4.		
2.	Flavonoids	1ml of extract + few drops of dil.NaOH	Intense yellow color becomes colorless on addition of dil.acid	Presence of flavonoid
3	Phenols	2ml of extract + 2ml ferric chloride	Bluish green color	Presence of phenols
4.	Steroids	Libermann burchard's test	Bluish green color	Presence of steroid
5.	Tannins	5ml of extract + few drops of lead acetate	Yellow ppt form	Presence of tannins

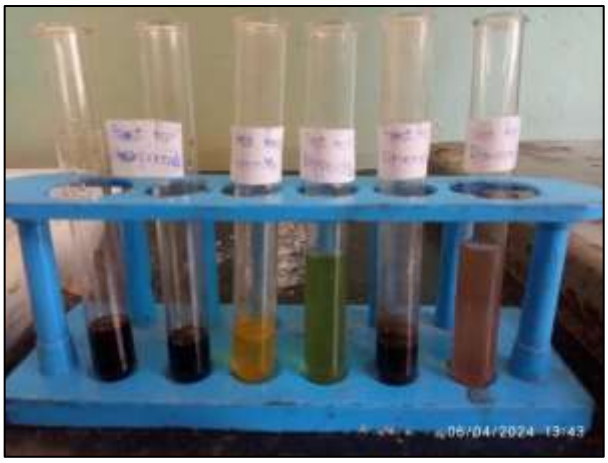

Fig.7.5b Phytochemical screening

6. Formulation of Herbal Transdermal Patch:

Method used for patch formulation is solvent casting method. Firstly 1gm of PVA & PVP (both are polymers) were weighed individually, then it was collected in beaker along with 10ml of dist. water, dissolve it completely on hot water bath and avoid bubble formation with the help of glass rod. After complete dissolution of polymer, remove it from water bath and allow it to reach 25ºC or to attain room temperature. Then add extract of leaf powder (drug). Continuous stirring is important in patch formulation to obtain homogenous mixture. Now we have to add propylene glycol(0.3ml) as plasticizer, glycerol(1ml). Next step for this to pour above solution into petri- plate with is covered with small quantity of glycerine as lubricant. Keep the petri-plate in hot air oven for 2-4hrs to remove air bubble and the keep it for 20hrs at room temperature by covering in with funnel to avoid rapid evaporation. Now we can remove patch from petri-plate with help of blade or any sharp and pointed substance.

Table No.7.6

Ingredients	**F1**	**F2**	**F3**
Drug Extract	0.3 gm	0.9 gm	1.5 gm
Polyvinyl Pyrrolidine [PVP]	1 gm	1 gm	1 gm
Polyvinyl Alcohol [PVA]	1 gm	1 gm	1 gm

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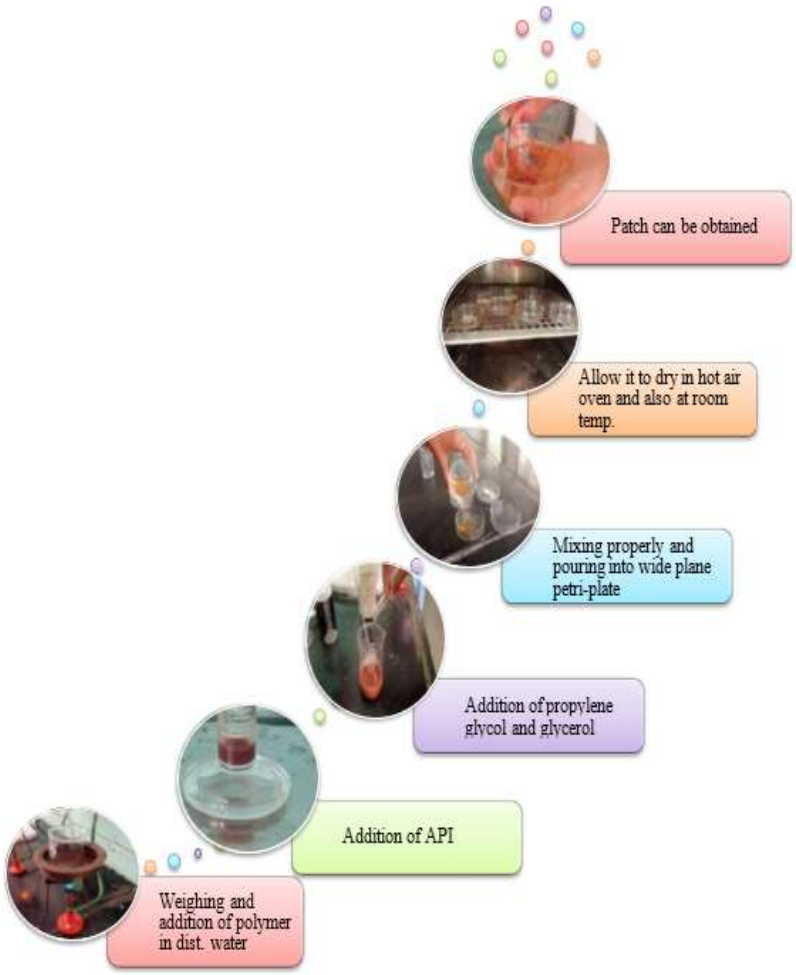
Propylene glycol	0.5 ml	0.5 ml	0.5 ml
Glycerol	0.5 ml	0.5 ml	0.5 ml
Distilled Water	10 ml	10 ml	10 ml



7. Evaluation Parameters Along with Result:

A) Organoleptic Evaluation- The physical appearance of developed patch was evaluated by using a naked-eye examination as follows:

Appearance- formulated in circular shape and cutted into desire shape and size Colour- brown, green and greenish brown

Clarity- transparent Flexibility- yes (flexible)

Smoothness- yes (smooth in texture)

International Journal of Agriculture and Animal Production
ISSN: 2799-0907
Vol: 04, No. 06, Oct-Nov 2024
http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.46.25.44

Fig.7.7A Formulated, developed transdermal patch

B) Thickness of Patch- A vernier caliper was used to measure the transdermal patches' thickness three times at different site of patch, and the mean value was calculated. It was found to be 0.5 mm

C) pH of Patch- Before using, the patch is swollen in 1ml of distilled water and allowed to sit at room temperature for two hours.. By using pH paper, it was came to know that pH of patch ranges from 5-
6.5 (similar to that of skin). It can also analysed by digital electrode.

Fig.7.7C pH paper dipped into solution

D) Percentage Moisture Content- After the patches were dried for 24 hours in a desiccator, their percent moisture content was calculated by weighing them. The formula for this calculation is as follows: % moisture content= (initial weight – final weight)/initial weight* 100% moisture content of our patch was 7.14%

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Fig.7.7D Desiccator used to remove moisture

E) Folding Endurance- The patches were repeatedly folded in the same spot even after they broke in order to test the fold endurance. The amount of times a patch can be folded in the same spot without breaking is known as its folding endurance. Our patch took avg 263 times folding to occur crack in patch.

Table No.7.7E

Formulation	1^{ST}	2^{ND}	Average
F1	261	265	263
F2	250	255	252.5
F3	262	264	263

F) Thumb Tack Test- This test is used to determine an adhesive's tack properties. The relative tack property is simply detected by pressing the thumb on the adhesive. It took around 2-2.5 sec to release from thumb.

G) Percentage Elongation Test- The length that follows the break in elongation is used to determine the percentage elongation, which can be calculated using the formula below.
% elongation= Increase in length/initial length* 100
% elongation of our patch was known to be 18.57%

4. RESULT

Based on phytochemical screening, terpenoids, flavanoids, tannins, polysaccharides, steroids, alkaloids, and phenols were shown to be present in ethyl alcohol extract. The primary

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mechanism by which anti-inflammatory drugs work is by inhibiting the cyclooxygenase enzyme, which is in charge of converting arachidonic acid into prostaglandins (PG). Inhibiting these lysosomal enzymes (Cyclooxygenase) or stabilizing the lysosomal membrane are the two ways that non-steroidal anti-inflammatory medications (NSAIDs) work. Moreover, the anti- inflammatory properties of the leaf extract's lupeone, lupeol, quercetin, and rutin content work as API. Based on a number of review papers and research articles, we may therefore conclude that leaf extract of *Thespesia Populnea* may prevent certain processes that either stimulate or improve the efflux of these intracellular components and act as anti-inflammatory agent.

Table no.8.1 Result of evaluation test

Sr. no.	Name of test	Inference
1	Organoleptic property: I. Appearance II. Colour III. Clarity IV. Flexibility V. Smoothness	Formulated in circular shape brown and green Transparent Flexible Smooth
2	Thickness	0.5mm
3	pH of patch	5-6.5
4	% moisture content	7.14%
5	Folding endurance	259.5
6	Thumb tack test	2-2.5sec
7	% elongation test	18.57%

5. SUMMARY AND CONCLUSION

Since medicinal plants contain active phytochemical substances which offer plants their diverse pharmacological action, they are a powerful source of health benefits for humans. Considering a review of the results, the current study concludes that the phytochemical screening of the leaf extracts of samples revealed variations in the phytochemical constituents with the presence or absence of specific components, *T. Populnea (L)* leaves are rich in phytochemical constituents.

It has come to the conclusion that creating new dosage forms for an older medication has inspired pharmaceutical scientists to create new dosage forms. Additionally, in order to improve the effectiveness of other medications, new dosage forms performance by delivering to the intended location, boosting absorption, lowering their dosage, etc. So that in response to the TDDS's many benefits, numerous studies are currently being conducted to integrate more recent herbal medications into the system.

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ISSN: 2799-0907
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