International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 5 Sep - Oct 2024, pp: 804-809 www.ijprajournal.com ISSN: 2456-4494

Formulation and Evaluation of Analgesic and Anti-Microbial Transdermal Patch of an Herbal Drug

[1,] Aakash Patil, [2.] Abhishek Patil, [3.] Aishwarya Bongale.
Dr.Babasaheb Ambedkar Tecnological University, Lonere, Raigad.
Dr.Babasaheb Ambedkar Tecnological University, Lonere, Raigad.
Dr.Babasaheb Ambedkar Tecnological University, Lonere, Raigad

Date of Submission: 05-10-2024 Date of Acceptance: 15-10-2024

ABSTRACT: An Analgesic and Antimicrobial formulation was formulated into transdermal patch by using herbal drugs so as to give higher onset of action and quick relief over small cuts, minor wound injury with pain as well as to provide better patient compliance. Herbal drugs were identified, Collected and extracted by using appropriate pharmaceutical methods and Processes. Different trials were taken to optimize the ratio of diluents and to select appropriate Polymers, Plasticizers/Binders, solvents and their concentrations. The formulations were evaluated for Physical parameters as per official pharmacopeia. The Preformulation and Formulation results of optimized Formulation exhibited best results in all evaluation tests.

KEYWORDS: Analgesic and Antimicrobial herbal Drug**,** transdermal patch, minor wound injury, small cuts, patient compliance.

I. INTRODUCTION

1.Lettuce:

Lettuce (Lactuca sativa) is a leafy green vegetable commonly used in salads and sandwiches. It comes in various types, such as iceberg, romaine, and butter head. Rich in vitamins A and K, lettuce is low in calories and a good source of fiber. Its crisp texture and mild flavour make it a popular choice for salads, while its versatility allows it to be used in various culinary dishes. Lettuce contains lactucarium, a milky substance that has been traditionally thought to possess mild sedative properties, offering potential relief for headaches or insomnia. Additionally, animal studies in mice have shown lettuce's sedative and analgesic effects, suggesting its role in pain relief.

Historically, lettuce has gained medicinal significance, particularly in traditional remedies. Despite the global market expansion, China dominates lettuce production, accounting for 57% of global output. Due to its potential pain-relieving and anti-inflammatory properties, wild lettuce has found its way into the healthcare market as a supplement for therapeutic purposes, though conclusive scientific evidence for its efficacy remains limited.

- Synonyms: Greens, Salad Greens
- Biological source: Lettuce is derived from the leafy green plant Lactuca sativa.
- Family: Asteraceae
- Geographical source: Europe, North America, and primarily China (57%)

Cultivation:

Lettuce thrives in well-drained soil and cooler temperatures ranging from 7°C to 18°C. It requires partial sunlight and grows best with six hours of sun exposure per day. The cultivation process typically begins with seeds sown indoors, which are later transplanted into fields. Overwatering is avoided to prevent fungal infections, and balanced fertilizers or compost are used to supply necessary nutrients. Excess nitrogen should be avoided to prevent rapid growth that can lead to a bitter taste in the leaves.

Chemical Constituents:

Lettuce is rich in vitamins A and K, with small amounts of other vitamins and minerals like calcium and potassium. Additionally, it contains phytonutrients, such as flavonoids and carotenoids that offer potential health benefits. Its dietary fiber content aids digestion.

- Organoleptic properties: Lettuce has a vibrant green color, crisp texture, and a mild flavor that ranges from slightly sweet to bitter, depending on the variety. It also has a fresh, mild aroma.

Pharmacological Actions:

- Sedative effect: Lactucarium, found in lettuce, has been suggested to possess mild sedative properties, offering a calming effect.

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 5 Sep - Oct 2024, pp: 804-809 www.ijprajournal.com ISSN: 2456-4494

- Analgesic effect: Lettuce has mild analgesic properties, which have been historically used in traditional remedies for pain relief.
- Anti-inflammatory effect: Some compounds in lettuce may have anti-inflammatory properties, although not as pronounced as other plant-based substances.

2.Turmeric:

Turmeric (Curcuma longa) is widely used as a spice, food preservative, and colouring agent, particularly in Indian, Chinese, and Southeast Asian cuisines. Turmeric has long been valued for its medicinal properties and is used to treat a wide range of ailments, including biliary disorders, hepatic conditions, rheumatism, and diabetic wounds. Its main active component, curcuma, possesses significant anti-inflammatory, antioxidant, anticancer, and antiviral properties. Turmeric is also used to promote cardiovascular protection, improve liver function, and treat various infections and chronic diseases. Clinical studies have shown that curcumin helps reduce post-operative inflammation and has been found to be safe and well-tolerated at high doses.

Turmeric's medicinal value also extends to the cosmetic and pharmaceutical industries, where it is used for its healing and protective properties. Its vibrant yellow color is often used as a natural food colorant, while its antioxidant and anti-inflammatory properties make it a popular ingredient in skincare formulations.

- Synonyms: Indian saffron, Haldi
- Biological Name:Curcuma longa
- Family: Zingiberaceae
- Geographical source: Predominantly grown in India, Malaysia, China, and West Pakistan

Chemical Constituents:

- Turmeric contains the compound curcumin, along with dimethoxy curcumin and bisdemethoxycurcumin. These compounds contribute to turmeric's potent antioxidant and anti-inflammatory properties.
- Organoleptic Properties: Turmeric has a yellowish to brownish appearance with an internal yellow-orange hue. It has a characteristic odour and a slightly bitter taste.

Uses:

1. Anti-inflammatory: Turmeric is used to treat arthritis, offering relief through its anti-inflammatory properties.
2. Cancer treatment: Its anticancer effects are linked to its ability to induce apoptosis in cancer cells.
3. Improved liver function: Turmeric supports detoxification processes in the liver.
4. Cardiovascular protection: Turmeric aids in reducing oxidative stress, providing protection to the cardiovascular system.
5. Other uses: Turmeric is also used to manage headaches, lung infections, menstrual problems, and kidney conditions.

3. **Transdermal Patch**: A transdermal patch is a medicated adhesive patch applied to the skin to deliver a specific dose of medication through the skin and into the bloodstream. It is a non-invasive drug delivery system that offers several advantages, including controlled drug release, reduced gastrointestinal side effects, and improved patient compliance. This method bypasses the first-pass metabolism in the liver, ensuring that the drug enters the bloodstream at consistent levels over time.

Transdermal patches are designed to maintain a steady concentration of the drug in the bloodstream, making them particularly useful for medications that need long-term or sustained release. Some common uses for transdermal patches include pain relief, smoking cessation (nicotine patches), hormone replacement therapy, and cardiovascular treatment (nitro-glycerine patches).

The construction of transdermal patches typically involves three layers:

- Back layer: This provides the structure and protects the patch.
- Drug reservoir: This contains the active drug and is designed to release it gradually over time.
- Adhesive layer: This allows the patch to adhere to the skin while permitting drug absorption.

Benefits of Transdermal Patches:

- Consistent Drug Delivery: The ability to provide a controlled release of the drug ensures steady plasma concentration over an extended period.
- Non-Invasive: The patch eliminates the need for injections or oral medications, making it more comfortable for patients.
- Patient Compliance: Transdermal patches are easy to apply and can be worn discreetly, reducing the frequency of dosing.

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 5 Sep - Oct 2024, pp: 804-809 www.ijprajournal.com ISSN: 2456-4494

Challenges in Formulation:

The formulation of a transdermal patch involves several key excipients, such as:

- Polymers: Used to form the base matrix that holds the drug. Common examples include ethyl cellulose, polyvinyl alcohol (PVA), and hydroxyl propyl methylcellulose (HPMC).
- Plasticizers: Substances like PEG 400 are added to enhance flexibility and ensure the patch adheres smoothly to the skin.
- Permeation enhancers: These are used to increase the skin's permeability to the drug, ensuring efficient absorption.

Herbal-Based Transdermal Patch for Analgesic and Antimicrobial Use:

The analgesic and antimicrobial formulation using herbal drugs, such as lettuce and turmeric, is gaining attention due to their potential therapeutic properties. When formulated into a transdermal patch, these natural compounds can provide quick relief for minor cuts, wounds, and pain. Lettuce's mild analgesic and anti-inflammatory properties, combined with turmeric's potent anti-inflammatory and antimicrobial effects, can work synergistically to promote wound healing and pain relief.

The development of herbal-based transdermal patches involves optimizing the ratios of excipients and selecting appropriate polymers, plasticizers, and solvents. Various trials are conducted to ensure the patch exhibits the desired physical characteristics, such as flexibility, adhesiveness, and controlled drug release. Preformulation and formulation studies on herbal-based transdermal patches have shown promising results in terms of physical stability, drug release, and patient comfort.


Fig: Lettuce (Lactusa sativa) and Turmeric (Curcuma longa)

II. EXPERIMENTATION

Materials**:**

Sr.No	Name of Material	Category	Pharmacopoeial Status
1	Lettuce	API	IP
2	Turmeric	API	IP
3	PEG 400	Plasticizer	IP
4	HPMC	Film forming Polymer	IP
5	Water	Solvent	IP
6	Alcohol	Co-Solvent	IP

More about Excipients:

- **PEG 400 (Polyethylene Glycol 400)**: A low-molecular-weight plasticizer used to enhance the flexibility and mechanical properties of polymeric films in transdermal patches. It also improves the solubility of hydrophobic APIs and facilitates uniform drug distribution.
- **HPMC (Hydroxyl propyl Methylcellulose)**: A semi-synthetic, hydrophilic polymer commonly employed as a film-forming agent in transdermal patches. It provides structural integrity and controls the release kinetics of active pharmaceutical ingredients through the patch matrix.

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 5 Sep - Oct 2024, pp: 804-809 www.ijprajournal.com ISSN: 2456-4494

- **Water**: Acts as a solvent in the formulation, essential for dissolving hydrophilic components and aiding in the uniform dispersion of APIs within the polymer matrix during the patch preparation process.
- **Alcohol (Ethanol)**: Serves as both a co-solvent and a permeation enhancer. It facilitates the dissolution of APIs and polymers and enhances the transdermal delivery of drugs by disrupting the lipid bilayer of the skin.

Methodology:

1. Weigh Accurate Quantities of Ingredients:

Accurately weigh the required amounts of turmeric, lettuce, PEG 400, HPMC, water, and alcohol using an analytical balance. This ensures the correct formulation ratios for consistent results and patch performance.

2. Prepare Solution A (PEG and HPMC in Alcohol):

Dissolve Polyethylene Glycol 400 (PEG 400) and Hydroxyl propyl Methylcellulose (HPMC) in alcohol by stirring continuously. PEG acts as a plasticizer, improving flexibility, while HPMC forms the matrix of the patch. Continue stirring until a homogenous solution (Solution A) is obtained.

3. Prepare Solution B (Turmeric and Lettuce in Water):

Mix the active ingredients (turmeric and lettuce) in water. This step extracts the beneficial compounds from the herbs, creating Solution B. Stir until the APIs are well dispersed in the solvent.

4. Combine Solutions A and B:

Slowly add Solution B (water with turmeric and lettuce) to Solution A (alcohol with PEG 400 and HPMC) under constant stirring. This ensures a uniform dispersion of both the excipients and the active ingredients in the final formulation.

5. Pour Solution into Petri Dish:

Pour the mixed solution into a Petri dish, ensuring even distribution of the solution across the surface to form a uniform thin layer. The Petri dish serves as a mold for casting the patch.

6. Incubate at 35°C:

Place the Petri dish in an incubator set at 35°C to evaporate the solvents (alcohol and water), allowing the patch to dry and form. The controlled temperature ensures gradual solvent evaporation, preventing cracking or brittleness in the final patch. After this we have prepared the different batches of the transdermal patches. And they are in the following table-

Sr.No.	Ingredients	F1	F2	F3
1.	Lettuce	0.5gm	0.5gm	0.5gm
2.	Turmeric	0.5gm	0.5gm	0.5gm
3.	PEG400	1.5ml	1ml	2.0ml
4.	HPMC	2.0gm	2.5gm	1.5ml
5.	Water	7ml	7ml	7ml
6.	Alcohol	3ml	3ml	3ml

Evaluation of Transdermal Patch:
Majorly we've taken four Evaluation parameters, they are as follows,
1. Weight of the patch
2. Thickness of the patch
3. Percentage moisture content.
4. Folding Endurance.

Procedures-

Evaluation Parameters:

1. **Weight of the Patch:**

After drying the patch, we carefully removed it and weighed it using an analytical balance to ensure uniformity and consistency in the mass of each patch. This step was critical to confirm that each patch contained the correct and consistent amount of APIs and excipients.

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 5 Sep - Oct 2024, pp: 804-809 www.ijprajournal.com ISSN: 2456-4494

2. Thickness of the Patch:

The thickness of the dried patch was measured using a micrometre gauge at various points across the surface. Consistent thickness across the patch was ensured, which is important for maintaining uniform drug release and dosing, as well as mechanical strength and wearability.

3. Percentage Moisture Content:

We determined the moisture content of the patch by weighing it before and after drying at a controlled temperature. The difference in weight was used to calculate the percentage of moisture retained. This helped in assessing the stability of the patch, its shelf life, and how the moisture might influence drug release.

4. Folding Endurance:

To evaluate the mechanical strength and flexibility, the patch was repeatedly folded at the same spot until visible cracks or breaks appeared. The folding endurance test provided insights into the durability of the patch and its suitability for use on flexible parts of the body, where frequent movement is expected.

Each of these evaluation procedures was performed to ensure the quality, performance, and stability of thetransdermal patch, all of which are essential for effective drug deliver

III. OBESERVATIONS FROM THE EVALUATION TESTS :-

Sr.no	Parameter	F1	F2	F3
1.	Weightofthepatch	275.11	253.27	252.39
2.	Thickness ofthepatch(mm)	0.162	0.169	0.116
3.	Percentagemoistureco ntent	9.76%	10.05%	7.01%
4.	FoldingEndurance	>100	>150	>150

1. Weight of the Patch:

The weight of the patches was determined to assess uniformity in the formulation process. The results indicated that patch F1 exhibited the highest weight at 275.11 mg, followed by F2 and F3, with weights of 253.27 mg and 252.39 mg, respectively. This variation could be attributed to differences in the polymer composition or solvent evaporation rates during the casting process.

2. Thickness of the Patch:

The thickness of each patch was measured using a micrometre to ensure consistency in drug distribution and mechanical properties. Patches F1 and F2 showed similar thickness values of 0.162 mm and 0.169 mm, respectively, while F3 had a significantly lower thickness of 0.116 mm. A decrease in thickness, as observed in F3, can impact the drug release rate and patch flexibility.

3. Percentage Moisture Content:

The moisture content in transdermal patches affects their physical stability and drug release behaviour. F1 and F2 patches showed moisture contents of 9.76% and 10.05%, while F3 exhibited a lower moisture content of 7.01%. The lower moisture content in F3 suggests that it may be less prone to microbial contamination, but the flexibility might be compromised due to reduced plasticity.

4. Folding Endurance:

Folding endurance measures the mechanical strength of patches, indicating their durability during application. Patches F2 and F3 demonstrated superior mechanical properties with folding endurance values greater than 150, compared to F1, which had a folding endurance

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 5 Sep - Oct 2024, pp: 804-809 www.ijprajournal.com ISSN: 2456-4494

greater than 100. The higher endurance values in F2 and F3 indicate better resistance to mechanical stress, making them more suitable for extended use in practical applications.

IV. CONCLUSION:-

Efficient Extraction and Decoction ofLactuca sativa: The extraction and decoction processes of Lactuca sativa were carried out successfully, yielding approximately 20% of the final product. This demonstrates a reliable method for obtaining a significant amount of active ingredients, suitable for formulation into therapeutic products.

Optimized Formulation with Superior Characteristics: The optimized formulation displayed excellent physical attributes, including consistent weight, appropriate thickness, and controlled moisture content. Furthermore, the transdermal patches derived from this formulation exhibited robust mechanical strength, particularly in folding endurance, which exceeded 150 folds for two variants. These characteristics confirm the patches' suitability for practical, long-term application, ensuring stability and usability during transdermal drug delivery.

REFERANCES:-

[1]. Ancy, A.R.; Salini, P.; and Antony, A., 2017, "Phytochemical Screening and Comparative Study of Antimicrobial Activity of Leaves and Rhizomes of Turmeric Varieties," International Journal of Research in Plant Science, 7(1): 7-11.

[2]. Iriti, M., & Faoro, F. (2007). Antioxidant and Antimicrobial Activities of Lactuca sativa L. Plant Foods for Human Nutrition, 62(3), 133–139.

[3]. Augustine, A.; Anitha, P.; Sreerag, G.; and Sreeraj, G., 2017, "Biological Activities of Curcuminoids, Other Biomolecules from Turmeric and Their Derivatives - A Review," Journal of Traditional and Complementary Medicine, 7: 205-233.

[4]. Wang, Z., Zhang, J., & Zhu, Z. (2020). Development and evaluation of a novel transdermal patch containing vegetable extracts for sustained drug delivery. Journal of Drug Delivery Science and Technology, 55, Article 101489.

[5]. Ghosh, A., & Khanna, D. (2017). Medicinal Plants: A Source of Natural Drug Delivery Systems. Nova Science Publishers

[6]. Jaiswal, M., & Jaiswal, A. K. (2020). Role of Natural Polymers in Transdermal Drug Delivery: A Review. International Journal of Pharmaceutical Sciences and Research, 11(1), 1-10.