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Formulation and Evaluation of Potato Extract Transdermal Patch

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ABSTRACT:
Novel herbal drug delivery system opens new Wister's for delivery of herbal drugs at right place At right concentration, for height right period of time. Transdermal drug delivery System (TDDS) also known as patches Synthetic medications, which are presently offered as transdermal patches, are a mainstay of treatment for numerous disorders. Traditional medicine is a centuries-old practise that is once again gaining popularity. Therefore, herbal products can be applied as transdermal patches to treat a variety of illnesses, patches are dosage forms designed to deliver a therapeutically effective amount of drug across a patient Skin. This system is one the very effective ways of delivering drug to the body. Potatoes (Solanum tuberosum) contain several bioactive compounds that have medicinal properties. While not commonly considered an herbal drug, potatoes have been studied for their health benefits due to their rich content of alkaloids, phenolic compounds, and glycoalkaloids like solanine and chaconine. Potato peel, often discarded as waste, is a rich source of bioactive compounds such as phenolic acids, flavonoids, glycoalkaloids, dietary fiber, vitamin C, potassium, and iron, making it valuable for medicinal and therapeutic applications. Potato peel is not just waste but a valuable natural source of antioxidants, antimicrobial agents, anti-inflammatory compounds, and gastroprotective properties. It has promising applications in medicine, pharmaceuticals, and functional foods. The objective and aim of the transdermal drug delivery system is topically administered drug in the form of patches that is delivering the drug in the body through the skin for systemic effect at a predetermined time period The herbal drugs can be utilized in a better form with enhanced efficacy by incorporating them in modern dosage forms. This can be achieved by designing novel drug delivery systems for herbal constituents.

Key-words-Transdermal, patches, potato peel, Solanum tuberosum, Topical, Drug delivery. Etc.

I. INTRODUCTION:

Transdermal drug delivery systems (TDDS), also known as "patches," are dosage forms designed to deliver a therapeutically effective amount of drug across a patient's skin Several TDDS containing drugs such as clonidine, estradiol, fentanyl, nicotine, nitroglycerine, oxybutynin and scopolamine are available in the United States. In the Drug Quality Reporting System (DORS), the United States Food and Dione (FDA) has received numerous reports of "adhesion lacking for transdermal drug delivery systems. In the past few decades' considerable attention has been focused on the development of Novel drug delivery system (NDDS) for herbal drug. The novel carriers should ideally fulfil two prerequisites. Firstly, it should deliver the drug at a rate directed by the needs of the body over the period of treatment secondly, it should channel the active entity of herbal drag to the she of action. Conventional dosage forms including prolonged-release dosage form are unable to meet none of these in Phytoformulation research, developing nano dosage Forms (polymeric nanoparticles and nanocapsules, liposomes, solid lipid nanoparticles. Phytosomes and nano emulsion etc.) have a number of advantages, for herbal drugs, Including enhancement of solubility and bioavailability protection from toxicity enhancement. Of pharmacological activity, enhancement of stability Improving. Tissue macrophages distribution, Sustained delivery, protection from physical and chemical degradation, etc. Thus, the rans sized novel drug delivery system of herbal drugs have a potential Future For enhancing the activity and overcoming problems associated with plant medicines. Liposomes, which are biodegradable and essentially non-toxic vehicles, can encapsulate both hydrophilic and hydrophobic, material [1]. The application of novel approaches Can also Improve the efficacy of herbal cosmetic formulations on the human body [2].

Transdermal drug delivery systems (TDDS) have gained significant attention due to their ability to provide controlled and sustained

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drug release while bypassing first-pass metabolism. Potatoes (Solanum tuberosum) contain several bioactive compounds that have medicinal Properties. While not commonly considered an herbal drug, potatoes have been studied for Their health benefits due to their rich content of alkaloids, phenolic compounds, and Glycoalkaloids like solanine and chaconine. Potato peel, often discarded as waste, is a rich Source of bioactive compounds such as phenolic acids, flavonoids, glycoalkaloids, dietary Fiber, vitamin C, potassium, and iron, making it valuable for medicinal and therapeutic Applications. Potato peel is not just waste but a valuable natural source of antioxidants, Antimicrobial agents, anti-inflammatory compounds, and gastroprotective properties. It has Promising applications in medicine, pharmaceuticals, and functional foods. Among various natural polymers explored for TDDS, potato peel-a rich source of starch, antioxidants, and bioactive compounds-offers an eco-friendly and cost-Effective alternative for the formulation of herbal transdermal patches. Potato peels contain starch, polyphenols, and glycoalkaloids, which provide film-forming, antioxidant, and antimicrobial properties. These characteristics make them a suitable natural polymer for developing biodegradable and skin-friendly transdermal patches. By incorporating herbal extracts with therapeutic potential, such patches can be used for wound healing, pain relief, or other medicinal applications. [3]. Potato peel extracts exhibit antibacterial and antifungal effects against E. coli, Salmonella, And Staphylococcus aureus. Traditionally used as a natural dressing for burns and wounds Due to its antimicrobial and cooling properties.[4].Potato peels contain phenolic compounds (e.g., chlorogenic acid, catechins) that neutralize Free radicals, reducing oxidative stress and preventing cellular damage. Helps in preventing Aging-related diseases, cancer, and neurodegenerative disorders[5].The polyphenols in potato peel reduce inflammation, making it beneficial for arthritis, Chronic pain, and digestive disorders. [6]. Some studies suggest that potato peel extracts help regulate blood sugar levels and improve Insulin sensitivity, making it beneficial for diabetes management. Potato peel extract helps in treating gastric ulcers by reducing stomach acidity and Inflammation. Its high fiber content promotes gut health and digestion[7].

Herbal drugs are becoming more popular in the modern Variety world for their application to cure of diseases with less toxic effects and better therapeutic imitations effects However, of herbal extracts/plant actives like instability in highly acidic ph. Metabolism etc. Has led to drug levels below therapeutic concentration in the blood resulting in less or no therapeutic effect. Incorporation of novel ‘drug delivery technology to herbal or plant actives minimizes the drug degradation or presystemic metabolism and serious side effect by accumulation of drugs to the non targeted areas and improves the ease of administration in the paediatric and geriatric patients [8]. Herbs and herbal drugs have created interest among the people by its clinically proven effects in different health problem. Herbal drug therapy for skin disorders has been Utilized for many years. Even our biologically dose primitives, the apes, make herbal Selfmedication [9]. Now ‘days about 74% of drugs are taken orally and are found not to be as valuable as most wanted. To advance such character’s transdermal drug delivery System was emerged. With the creation of current time of pharmaceutical dosage forms, transdermal drug delivery system (TDDS) recognized itself as an important part of novel drug delivery systems Trans-dermal dosage forms, still a costly alternative to conventional formulations, are becoming popular because of their exclusive advantages. Improved bioavailability, controlled absorption, extra uniform plasma levels, painless and reduced side effects easy application and Flexibility of terminating drug administration by simply removing the patch to the skin are some of the potential advantages of transdermal drug deliveryth[10].TDDs TDDs does not involve passage through the gastro-intestinal tract; therefore, there is no less due to first-pass metabolism, and drugs can be delivered without interference Form PH, enzymes, and intestinal bacteria. In addition, TDDS can be used to control drug release according to usage restrictions, thereby Contributing to the high persistence of this method. Most Importantly, because TDDS is a non-invasive administration method and involves minimal pain and burden on the patient, drugs can be safely and conveniently administered to children of the elderly [11, 12].

II. ANATOMY AND PHYSLOGY OF SKIN :

Skin is the most extensive organ of the body covering under area of about 2m2 on in an average human adult. This multi-layered organ receives approximately one third of all blood circulating through the body. With thickness of only a millimeter, the skin separates the underlying

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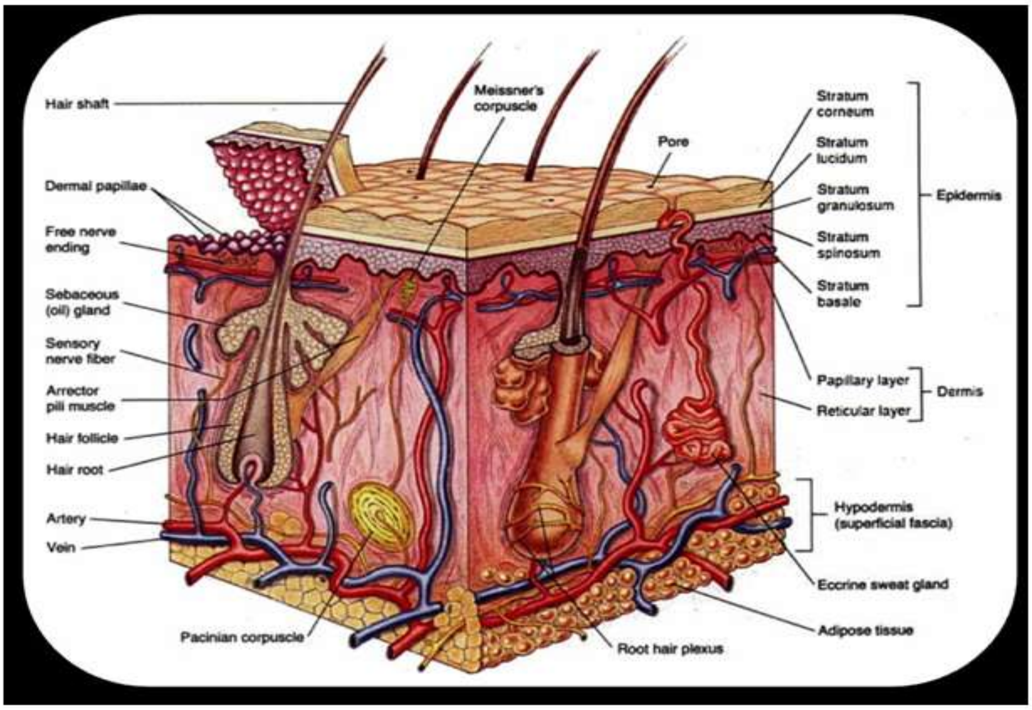
blood circulation network from outside environment.



Skin composed of three main layers:
1.Epidermis
2.Dermis
3.Hypodermis

1.Epidermis

It is the squamous, stratified, keratinized epithelial layer (20-200 µm thick). It can produce yellow and brown black pigment melanin which contributes colour, and absorb UV light. Microscopic sections of the epidermis show two main parts: the Stratum Corneum (SC) and the stratum germinativum. The stratum corneum is the outer most Horney, very thin layer and consists of compacted flattened, dehydrated, keratinized cells in stratified layer. It can resist over 80% of skin permeability. It also consists of nearly non-permeable cornified cells called corneocytes. Keratinized layer of skin is responsible for keeping water in the body and other harmful chemicals out which making skin natural barrier for infection.

Stratum Lucidum is the additional thin layer of keratinized cells which are located beneath the corneum, Mainly present on the palm of hand and on feet soles.

Stratum Granulosum, is a layer where keratinization begins. In this layer, lamellar granules appear and merge with the cell membrane, and these cells release glycophospholipids into intercellular space that forms the main constitute of the water permeability barrier.

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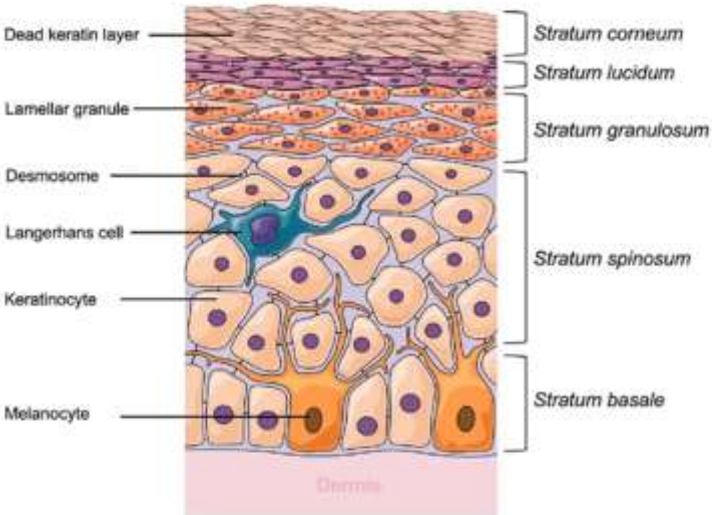

Stratum Spinosum, the spinous cell layer of the skin composed of keratinocytes with a characteristic "prickly appearance due to the presence of desmosomes, important structural filament called cytokeratin.
Stratum Basaleis a continuous single layer consists of columnar epithelial cells also called basal layer or stratum germinativum. It consist of Melanocytes, Langerhan and Merked cells [13].

2.Dermis:

It is composed of connective tissues connected tightly to epidermis by a basement membrane. It consists of hair follicles, sweat glands, sebaceous gland, lymphatic vessels, and blood vessels. The blood vessel in dermis provides nourishment and waste removal from its own cells. It is responsible for biochemical and biological degradation of material transported across lo. Beneath the dermis, the fibrous tissue opens out and merges with the fat-containing subcutaneous tissue [14].

3.Hypodermis:

The hypodermis or subcutaneous fat tissue supports the dermis and epidermis. It serves as a fat storage area. This layer helps to regulate temperature, provides nutritional support and mechanically protection. It carries principal blood vessels and nerves to skin and may contain sensory pressure organs. For transdermal drug delivery, drug has to penetrate through all these three layers and reach into systemic circulation while in case of topical drug delivery only penetration through stratum corneum is essential and then retention of drug in skin layers is desired [15].

III. DRUG PROFILE POTATO PEEL

Potatoes (Solanum tuberosum) contain several bioactive compounds that have medicinal properties. While not commonly considered an herbal drug, potatoes have been studied for their health benefits due to their rich content of alkaloids, phenolic compounds, and glycoalkaloids like solanine and chaconine. Potato peel, often discarded as waste, is a rich source of bioactive compounds such as phenolic acids, flavonoids, glycoalkaloids, dietary fiber, vitamin C, potassium, and iron, making it valuable for medicinal and therapeutic applications. Potato peel is not just waste but a valuable natural source of antioxidants, antimicrobial agents, anti-inflammatory compounds, and gastroprotective properties. It has promising applications in medicine, pharmaceuticals, and functional foods.

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Scientific classification	
Kingdom	Plantae
Subkingdom	Viridaeplantae
Division	Tracheophyte
Subdivision	Spermatophytina
Class	Magnoliopsida
Order	Solanales
Family	Solanacceae
Genus	Solanum
Species	*Solanum tuberosum L.*

IV. MEDICINAL PROPERTIES OF POTATO PEEL:

1. Antimicrobial & Wound Healing Activity:

Potato peel extracts exhibit antibacterial and antifungal effects against E. coli, Salmonella, and Staphylococcus aureus. Traditionally used as a natural dressing for burns and wounds due to its antimicrobial and cooling properties.

2. Antioxidant Properties:

Potato peels contain phenolic compounds (e.g., chlorogenic acid, catechins) that neutralize free radicals, reducing oxidative stress and preventing cellular damage. Helps in preventing aging-related diseases, cancer, and neurodegenerative disorders.

3. Anti-Inflammatory Effects:

The polyphenols in potato peel reduce inflammation, making it beneficial for arthritis, chronic pain, and digestive disorders.

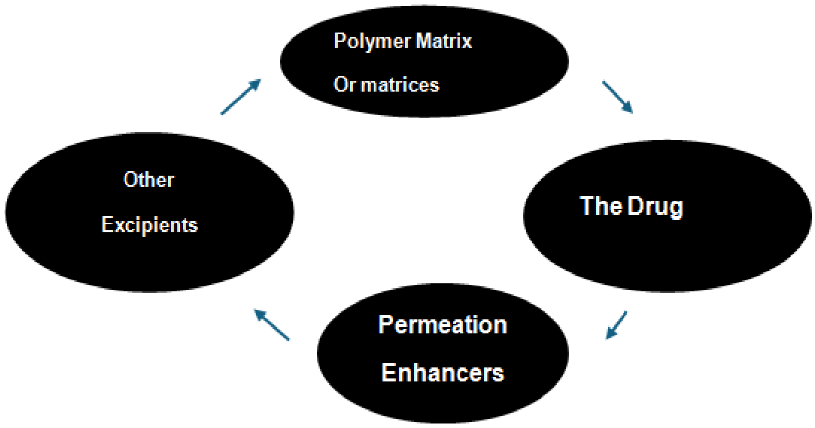
4. Anti-Diabetic Potential:

Some studies suggest that potato peel extracts help regulate blood sugar levels and improve insulin sensitivity, making it beneficial for diabetes management.

5. Gastroprotective & Anti-Ulcer Properties:

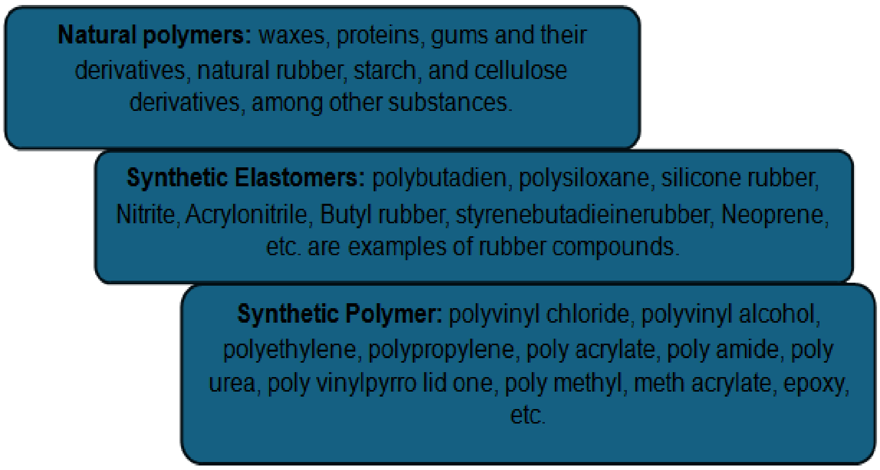
Potato peel extract helps in treating gastric ulcers by reducing stomach acidity and inflammation. Its high fiber content promotes gut health and digestion.

V. BASIC COMPONENTS OF TRANSDERMAL DRUG DELIVERY SYSTEMS



5.1.Polymer matrix or matrices

The polymer regulates the drug diffusion from the apparatus. These polymers may be suitable for transdermal devices



5.2..The drug

The drugs should be carefully selected in order to design a system that delivers drugs through the skin accurately. The factors that follow are some of a drug's preferable characteristics for trans dermal distribution.

❖ **PHYSICO-CHEMICAL PROPERTIES**

The drug's molecular weight should be under about 1000 Daltons.

The drug needs to be able to bind to both hydrophilic and lipophilic phases. Extreme partitioning properties do not favor the effective administration of drugs via the skin.

The drug melting point needs to be low.

In addition to these characteristics, the treatment should be powerful, have a brief half life, and not irritate enhance

5.3.Permeation enhancers

These substances change the skin's ability to act as a barrier to the flow of a desired penetrant, hence increasing skin permeability. These can be organized neatly under these main headings.

5.4.Solvents

These substances may improve penetration by fluidizing lipids or sapping the polar route. Examples include the water alcohols like methanol and ethanol, alkyl methyl sulfoxides like dimethyl sulfoxide, dimethyl acetamide, and dimethyl formamide, pyrrolidones like 2pyrrolidone, N-methyl, 2-pyrrolidone; and laurocapram (Azone).

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5.5.Surfactants

These chemicals are thought to improve the transport of hydrophilic medicines along polar pathways. A surfactant's capacity to change penetration depends on the hydrocarbon chain length and the polar head group.

1.Anionic Surfactants: such as Dioctyl Succinate, Sodium Lauryl Sulphate, Deco decyl Methyl Sulfoxide, etc. Pluronic F127, Pluronic F68, and other nonionic surfactants.

2.Bile Salts: Sodium deoxycholate, Sodium Tauro glycocholate, and Sodium MS taurocholataci

3.Binary system: The heterogeneous multilaminate pathway and the continuous paths appear to be made accessible by these systems. For instance, 1, 4-butanediolinoleic acid and propylene glycol-oleic acid.

5.6.Miscellaneous Chemicals

These include calcium thioglycolate, anti-anticholinergic agents, N, N-dimethyl-toluamide, urea, and a keratolytic and hydrating agent.Although some possible permeability enhancers are currently being developed, there is little information on their efficacy. Eucalyptus oil, di-o-methyl-Bcyclodextrin, and soybean casein are a few of **excipien**

5.7.other excipients

5.7.1.Adhesives

All transdermal devices have previously been secured to the skin using a pressure-sensitive adhesive that can be applied to the device's face, within its back, and along its periphery.

The following requirements should be met by both adhesive systems.

- Should aggressively stick to the skin, then be thoroughly removed.
- Skin should not be left with an impermeable film.
- Should not cause skin irritation or sensitization.

5.7.2.Backing membrane

Backing membranes are adaptable and offer a strong attachment to the drug reservoir. They also accept printing and stop the medication from escaping the form of administration through the top.

VI. MATERIAL AND METHODS

6.1.Material

Table 1(28)

❖ **List of chemicals**

Chemical Name	Uses
Pectin	Thickening agents (polymer)
Carbopol	Mucoadhesive effect
DMSO	Permeation enhancer
Glycerin	Plasticizer
Oleic acid	Increase absorption of drug
Tween80	Surfactant

Table 2(29)

❖ **List of equipment**

➢ Name of Equipment	➢ Name of manufacturer	➢ Purpose
Dessicator	-	Moisture content studies
Digital vernier caliper	-	Patch thickness studies
Electronic balance	Sartorius, Germany	Weighing purpose
Digital pH meter	Elicit Ltd, AP, India	Surface pH study
Filter paper	-	Filtration
MagneticStirrer	ROTEK, W. Vengola, Kerala, India	Diffusion studies
UV spectrophotometer	Shimadzu 1700,Japan	Determination of Absorption Maxima and concentration of active substances

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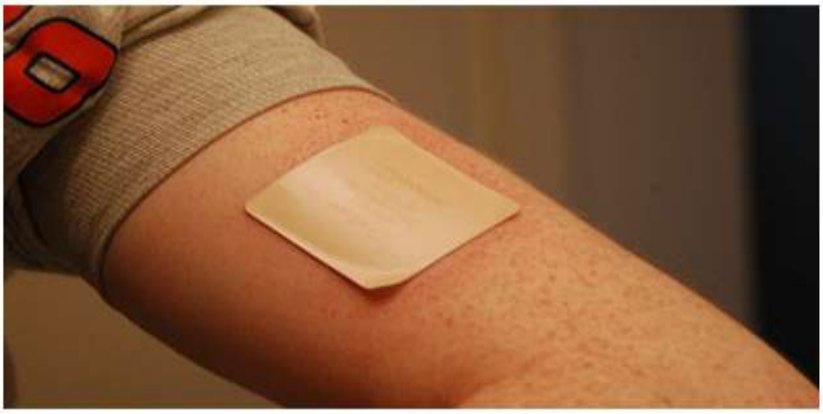


6.2 METHODS(30, 31)

6.2.1.Preformulation studies

It is one of the important prerequisite in development of any drug delivery system. Preformulation studies were performed on the drug, which included solubility ,melting point and compatibility studies.

A) Description

Potato peel was physically examined for colour and odour etc.

B) Solubility

Solubility of potato peel was determined in water, phosphate buffer 7.4, ethanol, DMSO, tetra hydro furan, etc.

C) Interaction Studies

Drug-polymer interaction study

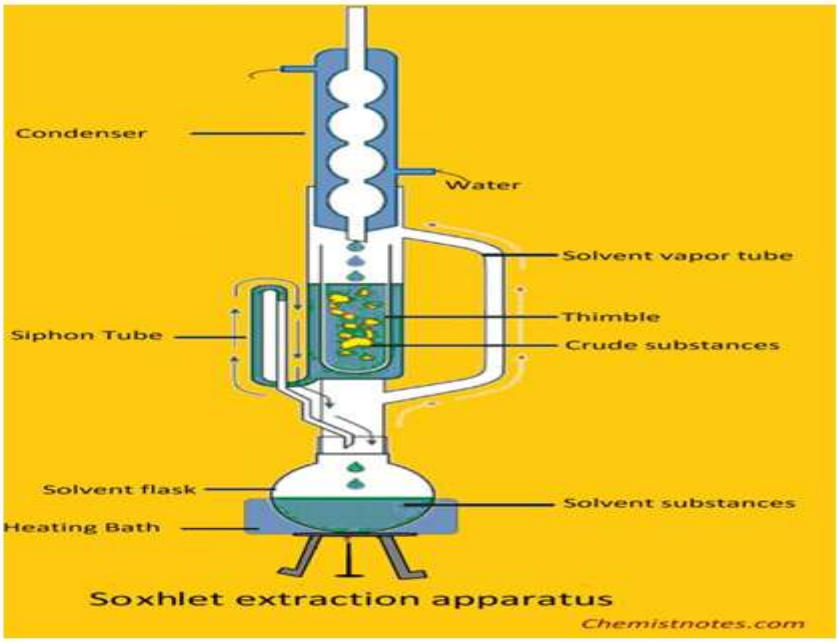
Interaction of drug with polymers was confirmed by UV-visible interaction studies. The pure drug along with polymer was subjected to UV-visible studies.

VII. PROCEDURE FOR FORMULATION

7.1.collection of drug[32]

Potato peel were collected, cleaned and washed properly. Then, Collect potato peel.

7.2.Extraction of potato peel



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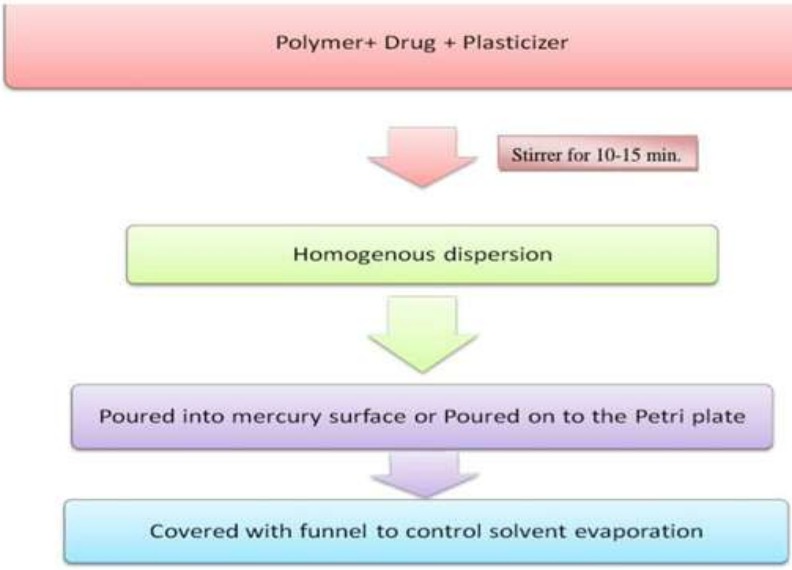
The potato peel were carefully transformed into coarse particles. Then, 15g of powdered form was carefully added to a soxhlet apparatus along with 95:5 ethanol and water for 10 hours. The substance was then carefully filtered out following extraction. Then, the quantifiable amount of drug obtained was used to make transdermal patches.

7.3.Method of preparation(33)

Method of preparation of TDDS was summarized by modifying the earlier reported methods. The patches were prepared by solvent casting method. The polymer (for example PVP/HPMC) was taken in a beaker with a minimum quantity of the solvent. Then 2/3 of the solvent was mixed with the other polymers (for example PVA) and was added firstly with stirring at lower rpm and later at a higher speed. The plasticizer was added and homogeneously mixed and the drug was included with enduring agitation and the volume was made up. The films were cast onto a suitably designed and fabricated glass mould and then dried in oven at 40°C. The films were removed by using sharp blade by inserting along the edges of the film. The dried films were wrapped in butter paper and stored in a closed container away from light.



7.4.Formula :

Ingredients		Formulationcode			
	TP1	TP2	TP3	TP4	Category
potato peel(mg)	40	40	40	40	Drug
Pectin(mg)	240	320	-	-	Polymer
Carbopol(mg)	-	-	240	320	Polymer
DMSO(ml)	0.3	0.3	0.3	0.3	Excipient
Glycerin(ml)	0.3	0.3	0.3	0.3	Excipient
Water	q.s	q.s	q.s	q.s	Solvent

VIII. EVALUATION PARAMETERS

8.1.Thickness of the patch(34)

The thickness of the drug loaded patch is measured in different points using a digital micrometre and this determines the average thickness and standard deviation for the same to ensure the thickness of the prepared patch .

8.2.Weight uniformity(35)

The prepared patches are to be dried at 60°C for 4 h before testing. A specified area of patch is to be cut in different parts of the patch and weighed in digital balance. The average weight and standard deviation values are to be calculated from the individual weighs .

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8.3.Moisture content

The prepared films are weighed individually and kept in a desiccators containing calcium chloride at room temperature for 24 h. The films are weighed again after a specified interval until they show a constant weight. The percent moisture content is calculated using following formula

Moisture content initial weight-Final weight final weight 100

8.4.Percentage moisture uptake(36)

The weighed films are to be kept in a desiccator at room temperature for 24 hours containing saturated solution of potassium chloride in order to maintain 84% RH. After 24 hours the films are to be reweighed and determine the percentage moisture uptake from the below mentioned formula.

Percentage moisture uptake Final weight-initial weight/initial weight]100

8.5.Drug content(37)

A specified area of patch is to be dissolved in a suitable solvent in specific volume. Then, the solution is to be filtered through a filter medium and the drug content analyzed with the suitable method (UV or HPLC technique). Then, the average of three different samples is taken.

8.6.Formulation analysis

Evaluating the physical and chemical properties of the formulation, such as PH viscosity.

8.7.Stability studies(38)

Stability studies were conducted according to the international Conference on Harmonization (ICH) guidelines by storing the TDDS samples at 40 plus/minus 0.5 deg C and (75 plus/minus 51% RH for 6 months. The samples were withdrawn at 0, 30, 60, 90 and 180 days and analyzed suitably for the drug content .

IX. RESULTS AND DISCUSSION

9.1.Preformulation Studies

9. 1.1.Description

Potato peel was physically examined for colour and odor etc. It is a orange yellow powder, with characteristic odour.

9.1.2.Solubility

Potato peel was insoluble in water, poorly soluble in buffer solution pH 7.4, and soluble in ethanol, DMSO, and Tetrahydro furan (THF).

9.1. 3.interaction study

A) Drug-polymer interaction study in uv-visible

Interaction of drug with polymers was confirmed by carrying out UV-Visible interaction studies. The UV-Visible overlay spectrum of drug alone and drug with polymer were seen. It shows that there are no interactions found between the drug and polymers.

B) Drug-polymer interaction study FTIR

Interaction of drug with polymers was confirmed by carrying out IR interactions studies. The IR overlay spectrum of drug alone and drug with polymer were seen. It shows that there are no interactions found between the drug and polymers.

9.2.Evaluation of Transdermal patches

The prepared potato peel transdermal patches were evaluated as mentioned below.

1.Weight of the patch
2.Thickness of the patch
3.Percentage Moisture content
4.Percentage Moisture uptake
5.Percentage flatness
6.Folding endurance
7.Water vapour transmission rate

1. Weight of the patch

Three patches from each batch were taken and the weight of each patch was found by using an electronic balance. Then, the average weight of a single patch was determined

Table-1: Weight of Patch

Batch	Weight (mg)	Mean Weight (mg)
F1	263.40	275.11
	282.61	

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Batch	Weight (mg)	Mean Weight (mg)
	279.32	
F2	232.16	253.27
	259.23	
	268.41	
F3	248.39	252.39
	252.89	
	255.89	

2. Thickness of the patch

The thickness of the patch was assessed by using a screw gauge at different points of the patch. From each formulation, three randomly selected patches were used. The average value for the thickness of a single patch was determined.

Table-2: Weight of Patch

Batch	Thickness (mm)	Mean Thickness (mm)
F1	0.183	0.162
	0.161	
	0.142	
F2	0.171	0.169
	0.189	
	0.149	
F3	0.118	0.116
	0.121	
	0.108	

3. Percentage moisture content

The prepared films were weighed individually and kept in a desiccator containing fused calcium chloride at room temperature for 24 hours. The film was again weighed, and the percentage moisture content was calculated using the formula:

Percentage moisture content=(Initial weight−Final weightFinal weight)×100

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Table-III: Percentage Moisture Content

Sl No	Initial Weight (g)	Final Weight (g)	% Moisture Content
F1	1.8024	1.6422	9.76%
F2	1.6310	1.4820	10.05%
F3	1.4164	1.3236	7.01%

4. Percentage moisture uptake

The weighed films were kept in a desiccator at room temperature for 24 hours and then exposed to 84% relative humidity using a saturated solution of potassium chloride. Finally, the films were weighed, and the percentage moisture uptake was calculated using the formula:
Percentage moisture uptake=(Final weight−Initial weightInitial weight)×100

Table-IV: Percentage Moisture Uptake

Sl No	Initial Weight (g)	Final Weight (g)	% Moisture Uptake
1	1.2414	1.2821	3.28%
2	1.4629	1.4969	2.32%
3	1.1276	1.1623	3.08%

5. Percentage flatness

Longitudinal strips cut out from each film, one from the centre and two from either side. The length of each strip without applying additional pressure was measured, and the variation in length due to non-uniformity in flatness was measured by determining percent constitution equivalent to 100%.

Table-V: Percentage Flatness

Sl No	Initial Length (cm)	Final Length (cm)	% Flatness
F1	6.1	6.1	100
F2	6.3	6.35	99.99
F3	5.9	5.9	100

6. Folding Endurance

The number of times the films could be folded at the same place without breaking gave the value of folding endurance. It was expressed as a number of times. The patches were folded at the same place either to break the patches or to develop visible curves. It was done normally for the prepared

Table-VI: Folding Endurance

Serial Number	Thickness (mm)	Folding Endurance
F1	0.426	>100
F2	0.394	>150
F3	0.358	>150

7. Water vapor transmission

The film was fixed over the glass vial with an adhesive containing 1 g of fused calcium chloride as a desiccant. Then, the vial was placed in a desiccator containing a saturated solution of potassium chloride (relative humidity 84%). The vial was taken out periodically and weighed.

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Table-VII: Water Vapor Transmission (g/cm²/h)

Batches	24h	48h	72h	96h
P1	0.0006	0.0016	0.0027	0.0041
P2	0.0012	0.0026	0.0038	0.0049
P3	0.0009	0.0021	0.0033	0.0046

X. CONCLUSION

In this study different matrix type patches were prepared by varying polymer combination and polymer ratios. Potato peels were selected for present study. Both phytochemical and chemical test for performed for the selected plant parts. Methanolic extracts were prepared by soxhlation methods. By performing chemical evaluation the extracts showed positive response towards Alkaloids, glycosides, amino acids. The herbal transdermal patches were formulated and the prepared transdermal patches were evaluated and the results were found to be positive. Folding endurance results indicated that the patches would not break and would maintain their skin integrity with general skin folding when applied. The moisture uptake of the formulations was within the limits which could protect.

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