RESEARCH ARTICLE

Design, Development and Evaluation of Aspirin Transdermal Patch Using *Cetamacrogol 1000*

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KEYWORDS:

Aspirin, Cetamacrogol, NSAIDS

ABSTRACT:

Aspirin is a widely used analgesic, antipyretic, and anti-inflammatory drug, but its oral administration is associated with gastrointestinal side effects . To overcome these challenges, transdermal patches offer a promising alternative for controlled drug delivery. This study focuses on the formulation and evaluation of aspirin transdermal patches using cetomacrogol 1000 as a polymer. The patches were prepared using the solvent casting method and evaluated for thickness, folding endurance, weight uniformity , in vitro drug release, and skin permeability of the prepared transdermal patch is analysed using UV Spectroscopy. The results indicate that the transdermal system provides a steady release of aspirin, potentially reducing side effects and improving patient compliance.

INTRODUCTION:

Aspirin (Acetylsalicylic Acid) is a widely used nonsteroidal anti-inflammatory drug (NSAID) with analgesic, antipyretic, anti-inflammatory, and antiplatelet properties. It was the first NSAID discovered and remains a key medication for managing pain, fever, and inflammation. Additionally, its ability to inhibit platelet aggregation makes it essential in preventing and treating cardiovascular diseases such as ischemic stroke and myocardial infarction.

Aspirin works by irreversibly inhibiting cyclooxygenase-1 (COX-1) and modifying cyclooxygenase-2 (COX-2), enzymes responsible for prostaglandin and thromboxane synthesis. By inhibiting COX-1, aspirin reduces the production of prostaglandins that protect the stomach lining, leading to its anti-inflammatory and analgesic effects while also causing gastrointestinal side effects. It also blocks thromboxane A2 production in platelets, preventing platelet aggregation and reducing the risk of blood clots, making it effective for cardiovascular protection. Additionally, aspirin promotes anti-inflammatory lipid mediators called aspirin-triggered lipoxins, contributing to its therapeutic benefits.

Aspirin causes gastrointestinal (GI) side effects by irreversibly inhibiting cyclooxygenase-1 (COX-1), which reduces the production of protective prostaglandins in the stomach lining. This leads to increased gastric acid secretion, decreased mucus production, and reduced bicarbonate secretion, making the mucosa more vulnerable to damage. As

a result, prolonged aspirin use can cause gastritis, ulcers, and an increased risk of GI bleeding.

However, its oral administration is associated with gastrointestinal side effects and first-pass metabolism, reducing its bioavailability. Transdermal drug delivery offers an alternative route that bypasses the gastrointestinal tract, providing a controlled and sustained release of aspirin. Aspirin transdermal patches aim to enhance patient compliance, minimize side effects, and ensure consistent therapeutic levels in the bloodstream. This innovative approach has the potential to improve aspirin's efficacy in pain management and cardiovascular protection.

Cetamacrogol is a non-ionic surfactant acts as an emulsifier and penetration enhancer in transdermal patches. It helps in stabilizing the drug formulation, improving drug solubility, and enhancing skin absorption for effective transdermal delivery. Its non-irritant nature makes it suitable for prolonged skin contact.

Hydroxypropyl Methylcellulose (HPMC) is used in transdermal patches as a film-forming agent, matrix polymer, and penetration enhancer. It helps in controlled drug release, improves adhesion to the skin, and maintains patch flexibility. Its biocompatibility and moisture-retaining properties make it ideal for sustained drug delivery through the skin.

Polyethylene glycol (PEG) is commonly used in transdermal patches as a plasticizer and also penetration enhancer. It helps to improve drug solubility and skin penetration, ensuring effective drug delivery through the skin. PEG's ability to modify the patch's mechanical properties also enhances flexibility and adhesion.

APPARATUS:

Beaker, petridish, magnetic stirrer, measuring cylinder, cutting tools

CHEMICALS:

Aspirin(activeingredient),Cetamacrogol 1000(Copolymer),PEG400(Plasticizer),HPMC(Polymer),Distilled water,Ethanol(Cosolvent).

EQUIPMENTS:

Magnetic stirrer(For mixing), UV Spectroscopy(For absorbance), Franz diffusion cell(For permeation), Dissolution tester(For drug release).

PROCEDURE:

1.PREPARATION OF DRUG SOLUTION:

Weigh accurately 0.1g of aspirin and 0.1g of cetamacrogol1000 (polymer) dissolve in 2ml of ethanol and mix well, until the clear solution is formed

2.PREPARATION OF POLYMER SOLUTION

Take 1g of HPMC (Hydroxy propyl methyl cellulose) and dissolve the polymer solution in 40ml of distilled water with continuous stirring for 2-5mins.

3.MIXING THE SOLUTION:

The above drug solution was mixed with the polymer solution and add a suitable plasticizer (polyethylene glycol 400) and mix well using magnetic stirrer for 1 hour to enhances the uniform drug distribution.

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4.CASTING THE SOLUTION:

Take a clean petridish, pour the prepared solution onto the petridish and spread it evenly and ensure the uniform thickness.

5.DRYING THE PATCH:

Allow the patch to dry at room temperature for 24 hours.

6.PEELING THE PATCH:

After drying carefully peel off the patch from the casting petridish

CONSTRUCTION OF STANDARD CURVE OF ASPIRIN:

0.1g of aspirin was dissolve in 50ml ethanol and then make up the volume with 100ml of ethanol. From this stock solution a series of 1ml, 2ml,3ml,4ml and 5ml was taken in a 10ml standard flask and volume made up to 10ml using ethanol. Then the absorbance was determined using UV spectrophotometer at 270nm.

TABULATION:

TABLE 1: STANDARD CURVE OF ASPIRIN

CONCENTRATION(µg/ml)	ABSORBANCE
0	0
10	0.128
20	0.242
30	0.463
40	0.572
50	0.675

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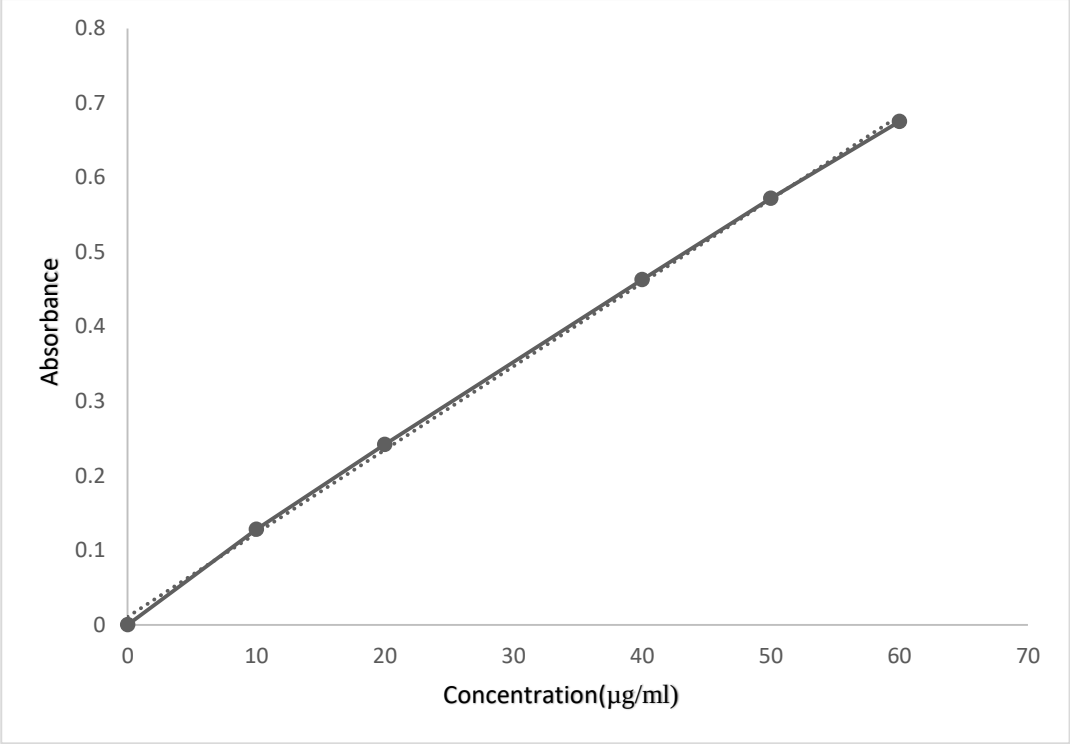

FIGURE 1: STANDARD CURVE OF ASPIRIN

PREPARATION OF PHOSPHATE BUFFER

1) PH 7.4, Phosphate buffer:

Dissolve 2.38g of disodium hydrogen phosphate, 0.19g of potassium dihydrogen phosphate and 8.0g of sodium chloride in sufficient water to produce 1000ml.

2) PH 6.8, Phosphate buffer:

Dissolve 2.0g of disodium hydrogen phosphate,1.0g of potassium dihydrogen phosphate and 8.5g of sodium chloride in 900ml of water.

COMPOSITION OF ASPIRIN PATCH

Table 2: Formulation of aspirin transdermal patch

INGREDIENTS	F1	F2	F3	F4	F5	F6	F7
Aspirin	0.1g	0.1g	0.1g	0.1g	0.1g	0.1g	0.1g
Cetamacrogol1000	1g	0.6g	0.6g	0.9g	0.3g	0.6g	0.1g
Polyethylene glycol	2ml	2ml	1ml	1ml	1ml	2ml	1ml

Propylene glycol	1ml	1ml	0	0	0	0	0
Ethanol	2ml	2ml	2ml	2ml	2ml	2ml	2ml
HPMC [E15]	0.5g	0.2g	0.2g	0.5g	0.5g	0.5g	1g
Distilled water	20ml	10ml	10ml	7ml	7ml	7ml	40ml

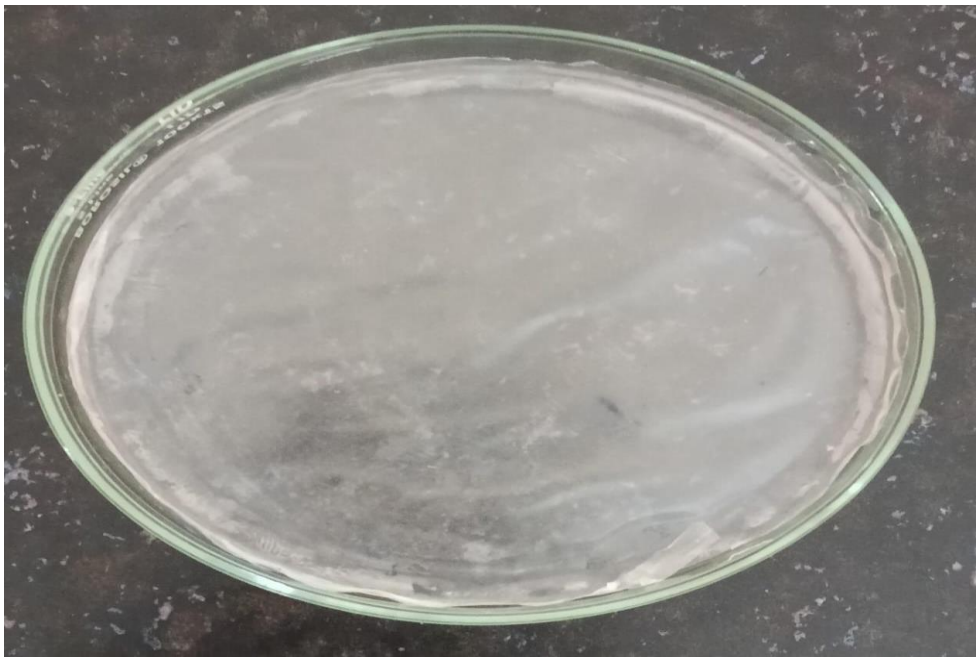

FIGURE 2: TRANSDERMAL PATCH OF ASPIRIN

REMARKS:

F1- Patch is not formed till 5 days, remains a gel

F2- Patch is not formed but remains as a gel

F3- Patch is formed but remains as a gel

F4- Patch is formed with weak film

F5- Patch is formed with air bubbles

F6- Patch is formed with large vacuoles

F7- Patch is fully formed with no air bubbles

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RESULT:

Aspirin transdermal patch is prepared by solvent casting method. 0.1g of aspirin and 0.1g of cetamacrogol1000 was dissolved in 2ml of ethanol and 1ml of polyethylene glycol was added mixed well using stirrer. And 1g of HPMC was dissolved in 40ml of distilled water. The above two solution was mixed well and transferred to petridish and keep it drying for 24hours, the patch was obtained

EVALUATION PARAMETERS OF PATCH

1. FOLDING ENDURANCE:

Folding endurance is determined by gradually folding a strip of patch/ film in the same position until it breaks or folds up to 300 times. The folding endurance of a patch is determined by the number of times it can be folded without breaking. The folding endurance helps to determine the flexibility of the transdermal patch.

2. THICKNESS:

The transdermal patch's thickness is measured using a traveling microscope, dial gauge, screw gauge, or a micrometer at three different points on the patch; the patch's thickness is then calculated as the average of the three measurements; a uniformity of thick patch will have the same thickness. Calculations can be made for the thickness variation both inside and between patches.

3. WEIGHT UNIFORMITY:

The patches are dried at 60.C before being weighed. By cutting and weighing a 1cm2 piece of three patches. The weight homogeneity of a transdermal patch is assessed and the weight variance is then estimated. By taking the mean of the three values, the patches weight is calculated. The weight of an individual must not significantly depart from the average weight.

4. DISSOLUTION STUDIES:

Utilizing an Indian Pharmacopeia (IP), the equipment is made to have 50rpm and 37.C, in vitro release is assessed, which is then submerged in a dissolution medium that contains 900ml of phosphate buffer with a PH of 7.4. For different intervals a sample were taken out and an equivalent drug release is calculated by UV spectroscopy.

TABULATION:

TABLE 3: TABULATION FOR DISSOLUTION STUDY

TIME (mins)	ABSORBANCE	CONCENTRATION(µg/ml)	%DRUG RELEASE
0	0.0256	2.28	23.2%
15	0.0458	4.08	41.2%
30	0.0596	5.32	54.1%
45	0.0745	6.65	67.7%
60	0.0954	8.51	86.6%
75	0.0110	9.82	100%

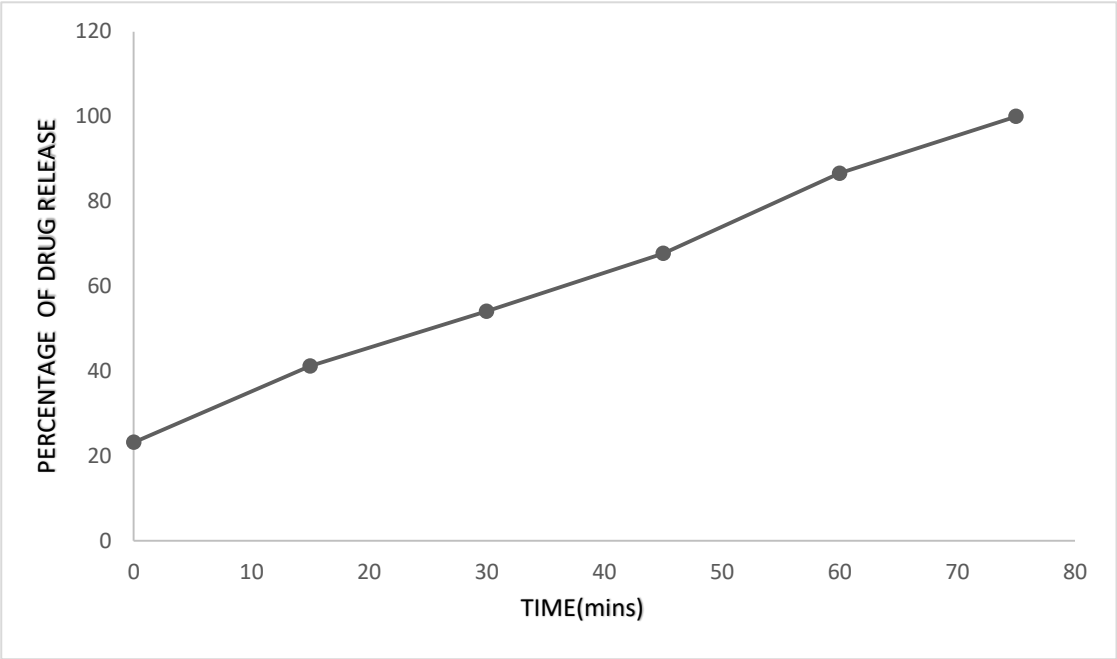

FIGURE 3: GRAPHICAL REPRESTENTATION OF ASPIRIN DRUG RELEASE

5. INVITRO SKIN PERMEATION STUDY:

Franz diffusion cell was used to perform this study. The transdermal patch was fixed in between the two compartments which was donor compartment and receptor compartment. Receptor compartment had capacity 20ml and it was filled with PH 6.8 phosphate buffer. This set up was mounted on stirrer. The receptor compartment which was filled with phosphate buffer solution was stirred with magnetic stirrer. The samples were taken out at different time intervals and drug content was measured by spectrophotometer. After each sample withdrawal, the equal volume of buffer solution was replaced every time.

TABULATION:

TABLE 4: TABULATION FOR PERMEATION STUDY

TIME (mins)	ABSORBANCE	CONCENTRATION(µg/ml)	%DRUG PERMEATED
20	0.0386	3.44	33.3%
40	0.0563	5.02	50.2%
60	0.0897	8.00	77.6%
80	0.0940	8.39	81.4%
100	0.1154	10.3	100%

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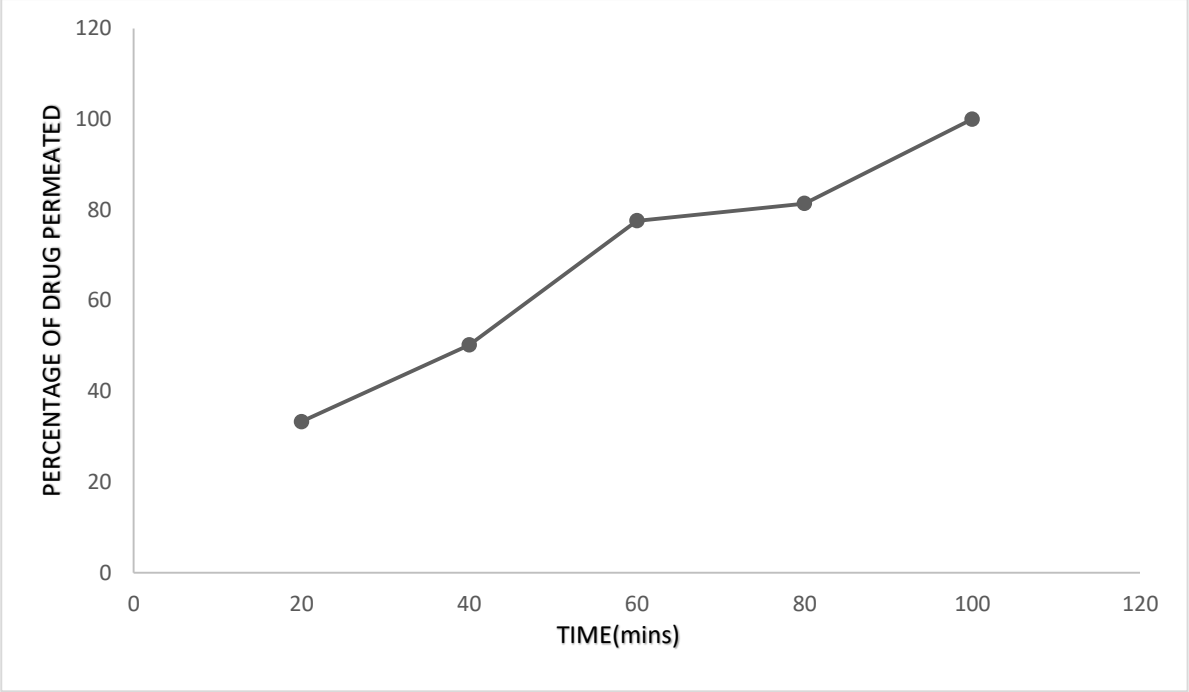

FIGURE 4: GRAPHICAL REPRESENTATION OF ASPIRIN PERMEATION STUDY

RESULTS AND DISCUSSION:

In this study we have taken an effort to formulate and evaluate the transdermal patch containing aspirin to decrease the gastric bleeding and ulcer.Different formulation of aspirin transdermal patch was prepared based on the solvent casting method.The formulation F7 was selected as an optimized formulation for aspirin transdermal patch.

In this present work, transdermal patch has been prepared to reduce the gastric bleeding and ulcer of gastrointestinal tract and also to reduce NSAID side effects. From the result of the present experimental investigations, it may be concluded that the formulation of aspirin transdermal patch shows better folding endurance, thickness, drug release and permeation studies.So it can concluded that the result of the current study indicates that transdermal patch can be developed as an alternative to conventional dosage forms to enhance the bioavailability and biocompatibility

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