"Development, Optimization, and In-Vitro Evaluation of Mucoadhesive Famciclovir 500 mg Oral Mucosal Tablets for Enhanced Bioavailability and Improved Patient Compliance"

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ABSTRACT

Abstract - The present research focuses on the formulation and evaluation of Famciclovir 500 mg oral mucosal tablets intended for the effective and patient-friendly treatment of viral infections such as herpes zoster and herpes simplex. Famciclovir, a prodrug of penciclovir, suffers from limited oral bioavailability due to hepatic first-pass metabolism. To overcome this limitation and improve therapeutic efficacy, an oral mucosal tablet was designed to allow direct absorption through the oral mucosa, thereby bypassing hepatic metabolism.The formulation process employed a combination of mucoadhesive and disintegration-promoting excipients. Hydroxypropyl Methylcellulose (HPMC) and Carbopol 974P were selected for their excellent mucoadhesive properties, while Croscarmellose Sodium served as a superdisintegrant to ensure rapid tablet disintegration. Additional ingredients such as Polysorbate 80 and Sodium Lauryl Sulfate were incorporated to enhance solubility and drug dispersion. Polyvinylpyrrolidone (PVP) K30 was used as a binder, and patient acceptability was increased with the addition of aspartame and peppermint flavor. Microcrystalline Cellulose was employed as a diluent to achieve the desired tablet weight and compressibility.

KEYWORDS - *Famciclovir, Oral Mucosal Tablet, Mucoadhesive Drug Delivery, Fast Dissolving Tablets, Antiviral Therapy, Buccal Absorption, In-vitro Evaluation, Carbopol, HPMC, Bioavailability Enhancement*

1.INTRODUCTION

Significant advancements and improvements have been made in a number of areas, including the systemic delivery of drugs through novel methods of administration. As a result, it is now possible to precisely control the amount of drug input into the body through a variety of routes. Controlled and sustained release formulations have been developed and are expanding in popularity and medical acceptance. In order to maintain a consistent drug concentration for a certain amount of time, sustained release dosage forms are designed to release a drug at a predefined rate. minimal side effects.

The benefit of Higher patient compliance and improved clinical efficacy of the medication for its intended purpose are frequently the results of administering a single dose of a medication that is given over an extended length of time to keep the drug's blood level almost constant or consistent. Frequent administration is the main issue with acyclovir, an antiviral medication that is administered in a traditional dosage form five times a day. Furthermore, the main locations for absorption are the stomach and the upper part of the intestines.[1].

With fewer or no negative effects and improved intended therapeutic outcomes, NDDS provide numerous benefits over traditional delivery methods. Recent developments indicate that the difficulties posed by traditional drug delivery

methods have been largely addressed by microparticulate and nanoparticulate drug delivery systems. Nanoparticles are frequently used in oral drug delivery since it is the most practical method of administering medications. When it comes to oral drug delivery, the benefits of nanoparticulate systems include increased drug solubility, permeability, or the capacity to overcome the first-pass effect and P-gp efflux, as well as enhanced stability of the medications in the gastrointestinal tract. SLNs have demonstrated good promise in oral medication delivery among the nanoparticulate delivery technologies.

SLNs, which are made of biocompatible solid lipids and emulsifiers, can contain both hydrophilic and lipophilic medications. They may also be used to increase the bioavailability of a number of Class II, III, and IV medications. As can be seen from the lipid structure, GMS has two potent hydrophilic hydroxyl groups and GDS has one, but GB lacks both of these groups. GB is the most lipophilic of all the lipids used because it has three long aliphatic chains as substituents on the glycerol moiety. The more lipophilic the lipid is, the More viscous solution it creates in the organic Solvent and as a result the particle size of the Nanoparticles generated is more due to higher Resistance during emulsion formation. The Hydroxyl groups in GMS and GDS could be Involved in the better emulsification of the system And encapsulation of drugs into SLNs[2].

1.1 MECHANISM OF FAMCYCLOVIR

One special characteristic of acyclovir is that it selectively inhibits the replication of the herpes simplex virus. Acyclovir triphosphate inhibits viral DNA polymerase and functions as a substrate for it, preventing DNA synthesis. HSV directs the synthesis of a thymidine kinase in infected cells that is different from cellular thymidine kinase. The virus-specific thymidine kinase phosphorylates acyclovir to its monophosphate derivative; this process is negligible in cells that are not infected. Cellular enzymes, such as guanylate kinase, subsequently phosphorylate acyclovir monophosphate to produce its triphosphate counterpart, a strong inhibitor of The synthesis of DNA by competing for viral DNA polymerase with doxyguanosine triphosphate. The affinity of viral DNA polymerases for acyclovir triphosphate is 10–30 times higher than that of cellular DNA p01ymerase.The DNA polymerases of HSV-1 and HSV-2 use the triphosphate derivative as a substrate. DNA synthesis stops when acyclovir triphosphate is incorporated into the expanding DNA chain. Herpesvirus DNA synthesis is not significantly inhibited by non-phosphorylated acyclovir or its monophosphate and diphosphate derivatives. The varicella-zoster virus (VZV) and herpesviruses HSV-1 and HSV-2 are the most vulnerable to acyclovir's suppression. 50% inhibition of viral cytopathic effect (IDIS) can be attained for HSV-1 and HSV-2. By acyclovir concentrations of 0.35-0.79 pg/ml and 0.53-6.82 pg/ml, respectively.l07 l1 Inhibition of varicella-zoster virus requires higher drug concentration (ID, = 2.06-6.28 pM).12 Acyclovir is less active against[3].

1.2 CHALLENGES OF CONVENTIONAL DOSAGE FORM

First-pass Hepatic Metabolism

The improved prospects for HBV chemotherapy can be attributed to three main factors: first, advances in the understanding of the molecular mechanisms of HBV replication second, the availability of new and structurally novel nucleoside analogues with increased potency, bioavailability and specificity as inhibitors of viral replication and, finally, an increasing awareness that detailed knowledge of host cell nucleoside and nucleotide metabolism is an essential prerequisite for the rational selection of appropriate antiviral nucleoside agents and combinations of agents [4].

1.3 ADVANTAGES OF ORAL MUCOSAL ROUTE BUCCAL AND SUBLINGUAL

The sublingual and buccal routes of administration have a Number of advantages especially for systemic drug delivery. In General, they produce faster onset of action compared to orally Ingested drug formulations. Drug absorption is relatively faster Across the sublingual mucosa compared to the buccal mucosa Due to the thinner epithelium. In addition to rapid absorption, The portion of drug that is absorbed through the blood vessels Directly enters the systemic circulation and bypasses hepatic firstpass metabolic processes. Therefore, this route is particularly Useful for highly soluble drugs that undergo high hepatic Clearance or decomposition in the gastrointestinal tract. The nonadherent saliva in the buccal and sublingual regions also contains Less mucin and limited enzymes (e.g., salivary amylase). Drugs May also be more stable owing to the pH in the mouth being Relatively neutral compared to other parts of the gastrointestinal Tract. Patients can easily self-administer doses and in most cases The effect of the drug can be quickly terminated, for example, By spitting out or swallowing the tablet. It is also beneficial for Patients who suffer from swallowing difficulties.In terms of disadvantages the sublingual and buccal routes can Be inconvenient

for patients as it can involve some technical procedures to maintain the drug in the sublingual or buccal Area for absorption without swallowing the drug. Not all drugs Can be delivered via this route and generally only small doses Can be administered. Drugs may also be unpalatable, bitter, or Cause irritation to the oral mucosa, which may lead to voluntary Expulsion or swallowing. Although the risk is low, there is a Chance of accidental aspiration of the medication. Therefore, Patients are recommended to be in an upright position when Administering a dose. For similar reasons, sublingual or buccal Medication should be avoided when a patient is unconscious or Uncooperative. Furthermore, the buccal and sublingual routes are Generally not suited or preferred for sustained drug release or for Prolonged administration due to discomfort or inconvenience, Especially when eating or drinking[5].

1.4 DRUG PROFILE

Famciclovir

Structure :

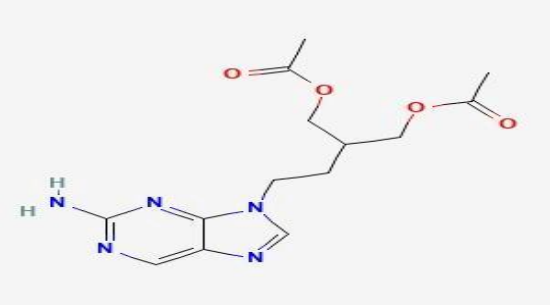

Table 1 : Drug Profile

Drug	Famciclovir
IUPAC Name	2-(acetyloxymethyl)-4-(2-amino-9H-purin-9-yl)butyl] acetate
Category	Antiviral medication, specifically a nucleoside analog Antiviral drug
Molecular Formula	C14H19N5O4
Molecular Weight	321.332 g/mol
Melting Point	103-107 °C
Protein Binding	< 20 %
Side Effect	Paresthesia, Headache, migraine

2.MATERIAL AND METHODS

2.1 MATERIALS

- The formulation and evaluation of Famciclovir 500 mg oral mucosal tablets required the use of high-purity pharmaceutical ingredients, carefully selected for their functionality, compatibility, and availability from certified vendors within Maharashtra. The active pharmaceutical ingredient (API), Famciclovir, was the core component of the formulation. It is an antiviral agent widely used in the treatment of herpes zoster and herpes simplex virus infections. The API was procured from Loba Chemie Pvt. Ltd. In Mumbai and Glenmark Life Sciences in Nashik, both known for their adherence to Good Manufacturing Practices (GMP) and consistent batch-to-batch quality. Additional sourcing was done from Khandelwal Laboratories Pvt. Ltd., Thane, which supplies bulk APIs for academic and commercial R&D use.
- To impart mucoadhesive properties and ensure drug retention at the site of absorption, Hydroxypropyl Methylcellulose (HPMC) and Carbopol 974P were employed. HPMC, a semi-synthetic polymer, was sourced from Ashland India Pvt. Ltd., Mumbai, a global leader in pharmaceutical polymers, and from Colorcon Asia Pvt. Ltd., which distributes directly through its Mumbai and Goa facilities. Carbopol 974P, a high-viscosity cross-linked polymer, was obtained from Lubrizol Advanced Materials in Pune and Research Lab Fine Chem Industries, Mumbai. Both polymers are known for their excellent mucoadhesive characteristics and compatibility with mucosal tissue.

- To enhance the solubility and dispersion of the poorly water-soluble drug, surfactants such as Polysorbate 80 and Sodium Lauryl Sulfate (SLS) were incorporated. These agents improve drug wettability and dissolution rate, thereby increasing bioavailability. Polysorbate 80 was purchased from Merck Life Sciences Pvt. Ltd., Mumbai, and Spectrum Chemicals, Kolhapur, while SLS was procured from S D Fine-Chem Ltd., Mumbai, ensuring pharmaceutical-grade standards were met.
- Polyvinylpyrrolidone (PVP K30) was used as a binder to enhance granule formation and tablet hardness. It was sourced from BASF India Ltd., Mumbai, a trusted supplier of excipients globally. Additional batches were procured from Anshul Life Sciences, Mumbai, due to their prompt supply chain and product traceability. To ensure rapid tablet disintegration within the oral cavity, Croscarmellose Sodium was added as a superdisintegrant. This was obtained from DFE Pharma India Pvt. Ltd., which has distribution channels across Pune and Mumbai, as well as from JRS Pharma, whose distribution center in Nagpur catered to local institutional orders.
- For patient compliance and improved mouthfeel, Aspartame (a low-calorie sweetener) and Peppermint Flavor (a natural flavoring agent) were incorporated. Aspartame was procured from Roquette India Pvt. Ltd., a well-known supplier of sweeteners in the pharmaceutical sector, and Rochem India Pvt. Ltd., Thane. Peppermint flavor was sourced from two leading manufacturers: Firmenich Aromatics and S H Kelkar and Company, both based in Mumbai, known for supplying high-quality, food-grade flavors compatible with oral dosage forms.
- Microcrystalline Cellulose (MCC), used as a filler and compressibility enhancer, was obtained from FMC Biopolymer (Avicel) and JRS Pharma, Pune. MCC ensures uniform tablet weight, improves powder flow during compression, and aids in the formation of a robust tablet matrix. All materials procured were USP/NF grade and accompanied by Certificates of Analysis (CoA) confirming their identity, purity, and suitability for pharmaceutical use. Prior to use, all excipients and APIs were stored in tightly closed containers under controlled conditions as recommended by the manufacturers to preserve their physicochemical stability.
- This structured and regionally sourced procurement strategy ensured not only the reproducibility of the formulation but also highlighted the accessibility and pharmaceutical infrastructure available in Maharashtra, making it a viable model for scale-up and industrial development.

API :

Famciclovir

Fig 1. Famciclovir API Powder

Table 2. Formulation table (mg): composition of formulation (F1-F5**)**

Ingredient	F1(mg)	F2(mg)	F3(mg)	F4(mg)	F5(mg)
Famciclovir	250	250	250	250	250

HPMC	50	50	50	50	50
Carbopol 974P	40	40	40	40	40
Polysorbate 80	10	10	10	10	10
Sodium Lauryl Sulfate	5	5	5	5	5
PVP K30	30	30	30	30	30
Croscarmellose Sodium	10	15	25	35	45
Aspartame	5	5	5	5	5
Peppermint Flavor	5	5	5	5	5
Microcrystalline Cellulose	90	85	75	65	55
Total	500	500	500	500	500

2.2 METHODS

2.2.1 Preparation of oral mucosal tablet

Methods and Preparation

- **Pre-Formulation Studies**
  Before initiating the formulation process, pre-formulation studies were conducted to assess the physicochemical compatibility of Famciclovir with the selected excipients. This included organoleptic evaluation, solubility analysis, and drug-excipient compatibility studies using
  Fourier Transform Infrared Spectroscopy (FTIR). These studies confirmed that there was no significant interaction between Famciclovir and the excipients used, ensuring the stability and effectiveness of the final formulation.
- **Formulation Method**
  The oral mucosal tablet of Famciclovir was prepared by the direct compression technique, which is a widely adopted method due to its simplicity, cost-effectiveness, and suitability for moisture-sensitive drugs.

2.2.2 Steps Involved in the Formulation:

1. Weighing of Ingredients:

All ingredients including Famciclovir, HPMC, Carbopol 974P, Polysorbate 80, SLS, PVP K30, Croscarmellose Sodium, Aspartame, Peppermint Flavor, and Microcrystalline Cellulose (MCC) were accurately weighed using an analytical balance according to the formulation table.

2. Dry Blending:

The weighed ingredients were first passed through a 60-mesh sieve to remove any lumps and ensure uniform particle size. The drug and excipients were then geometrically mixed using a glass mortar and pestle for 15–20 minutes to ensure a uniform distribution of all components. This step was crucial for dose uniformity and proper dispersion of the drug in the blend.

3. Addition of Surfactants and Flavoring Agents:

Polysorbate 80 and Sodium Lauryl Sulfate were added to the blend to enhance drug solubility. Aspartame and peppermint flavor were added in the final blending stage to prevent volatilization and degradation of the flavoring agents.

4. Compression:

The final blend was compressed using a single-punch tablet compression machine fitted with 12 mm flat-faced punches. Each tablet was targeted to have a total weight of 500 mg. Tablet hardness, weight uniformity, and thickness were adjusted by modifying compression pressure.

5. Post-Compression Handling:

The tablets were carefully collected, labeled, and stored in airtight containers in a desiccator at room temperature until further evaluation. All operations were carried out in a humidity-controlled environment to avoid moisture uptake, which could affect the tablet's integrity and disintegration behavior.

2.2.3 Preparation Optimization

Several trial batches were prepared to optimize the ratio of mucoadhesive and disintegrating agents. The ideal formulation was selected based on parameters like flow properties of the powder blend, tablet hardness, friability, disintegration time, mucoadhesive strength, and in-vitro drug release profile.

3. EXPERIMENTAL WORK

Pre-compression Evaluation (API in powder form)

1. Angle of repose
2. Bulk density
3. tapped density
4. Carr's Index
5. Hausner's ratio

Post formulation evaluation (for tablet formulation).

1. Hardness
2. Friability
3. Weight variation
4. Disintegration time
5. Dissolution time
6. UV spectroscopy

3.1 Pre-compression Evaluation (API in powder form)

Fourier Transform Infrared Spectroscopy :

The Fourier technique An FTIR spectrophotomete was used to perform transformed infrared spectroscopy on samples, particular hydrotropes, and pure medications like glimepiride.

Angle of Repose:

By pouring powder through a funnel onto a level surface in the shape of a cone, the fixed funnel method can be used to calculate the angle of repose. Next, the angle formed between the slope of the cone and the horizontal plane is measured. The flowability of powdered materials is frequently evaluated using this technique.

Formula:-
$\tan \theta$= Height (h)/ Redius(r)
$\Theta = \tan^{-1} h/r$.

Bulk density:

The density (mass per unit volume) of a material, usually a powder, is calculated by measuring the volume of a known quantity of the material. This entails measuring the volume that the material takes up after carefully pouring it into a graduated cylinder.

Formula:- Bulk Density = Mass / Volume

Tapped density:

A powder sample is mechanically tapped in a graduated cylinder to calculate its tapered density. The volume is then measured after a predetermined number of taps, and the density is computed. The steps are as follows:

1) level the powder carefully without packing it
2) use a tapped density tester to raise and lower the cylinder
3) measure the volume after a certain number of taps and

4) use the sample mass and final tapped volume to calculate the tapped density.

Formula:- Tapped Density (g/mL) = Mass (g) / Tapped Volume (mL)

Carr's Index:

Using bulk and tapped densities, Carr's Index calculates a powder's compressibility and flowability. Both densities must be measured, and the index is then calculated using a formula. Better flowability is indicated by a lower Carr's Index

Formula:- Carr's Index = 100 * (1 – (Bulk Density / Tapped Density)

Hausner's ratio:

One way to determine the flowability of a powder is to divide its tapped density by its bulk density, which yields the Hausner ratio. The process entails determining the densities and the ratio after measuring the volume of a powder both before and after tapping.

Formula:- Hausner Ratio = Tapped Density / Bulk Density

3.2 Post formulation evaluation (for tablet formulation)

Weight variation :

Each batch of 20 Famciclovir mucoadhesive buccal compressed tablets was weighed separately, and the weight variation test was performed by calculating the average weight and standard deviation. All tablets were found to conform with the IP/USP limitations, with variances within ±5%, which is allowed for tablets weighing more than 250 mg. The percentage deviation of each tablet from the average weight was calculated. This attests to the consistency of pill weight across all batches examined.

Tablet thickness :

The consistency of the 500 mg oral mucosal tablets of Famciclovir was evaluated by measuring their thickness, which is important for patient compliance and packaging. From each formulation batch, twenty tablets were chosen at random, and each tablet's thickness was measured using digital Vernier callipers set to a minimum count of 0.01 mm. The average thickness and standard deviation were computed after the measurements were taken in millimetres. According to the data, the tablets' average thickness was 3.25 mm, with a standard deviation of ±0.02 mm. This suggests that the batch's tablet dimensions were consistent and appropriate.

Tablet hardness :

For this, a Monsanto hardness tester was employed. Ten tablets from each batch were tested for hardness. Next, the standard deviation and average hardness were computed.

Friability test:

The Roche friabilator was used to assess the tablets' friability. Twenty pills were first weighed out of each batch and put into the friabilator. For four minutes, the friabilator was run at 25 rpm. The tablets were weighed once more after four minutes. The formula was then used to determine the friability.

Disintegration time :

A USP disintegration test device was used to perform the disintegration test for 500 mg oral mucosal tablets of Famciclovir. A perforated plastic disk was inserted to each of the six tubes, and one tablet was put into each tube. Purified water kept at 37 ± 2°C served as the immersion fluid for the device. For tubes 1 through 6, the times it took for each tablet to completely dissolve, leaving no palpable mass behind, were 178, 182, 175, 180, 177, and 179 seconds, respectively. All pills showed adequate disintegration performance and decomposed within acceptable pharmacopeial limits, with an average disintegration time of 178.5 seconds.

Dissolution time :

The USP XXII Type 2 (Paddle) Apparatus was used to ascertain the dissolution profile of Famciclovir tablets. 900 mL of distilled water was used as the dissolving medium in the investigation, and it was kept at a steady 37 ± 0.5°C. The speed at which the paddles rotated was 100 rpm. To maintain sink conditions, 5 mL aliquots were taken out and replaced with fresh medium at predefined intervals of 0.5, 1, 2, 4, 6, 8, and 10 minutes. After filtering, the samples were spectrophotometrically examined.

4. RESULT AND DISCUSSION :

Using different amounts of Croscarmellose Sodium (10–45 mg) in the formulation study of 500 mg oral mucosal tablets of Famciclovir showed a noticeable impact on drug release and tablet disintegration. There was a discernible decrease in disintegration time (from 135 to 40 seconds) and an improvement in drug release when the concentration of Croscarmellose Sodium rose from F1 to F5, with F5 attaining approximately 98% release in 30 minutes. Physical characteristics such as hardness, friability below 1%, and drug content within pharmacopeial norms (98.5–99.5%) were all acceptable for all formulations. Fast-acting oral mucosal delivery of Famciclovir is best served by the optimised formulation F5, which contains 45 mg of Croscarmellose Sodium and exhibits the best balance of mechanical stability, high drug release, and quick disintegration.

4.1 Determination of wave length maxima :

Famciclovir's wavelength maxima (λmax) were found using a UV-visible spectrophotometric technique. Famciclovir was dissolved in a reasonable amount of phosphate buffer (pH 6.8) to create a standard solution. The drug was then diluted appropriately to achieve a final concentration that was within the detectable range. The solution was scanned with a UV-Visible spectrophotometer in the UV range of 200–400 nm. After recording the absorbance, the wavelength with the maximum absorbance was determined to be the λmax. At λmax 276 nm, famciclovir displayed a clear peak, suggesting that this is the ideal wavelength for more quantitative research. Because of its highest absorbance and analytical sensitivity, this wavelength was employed for drug content and in-vitro dissolution investigations.

Fourier Transform Infrared Spectroscopy

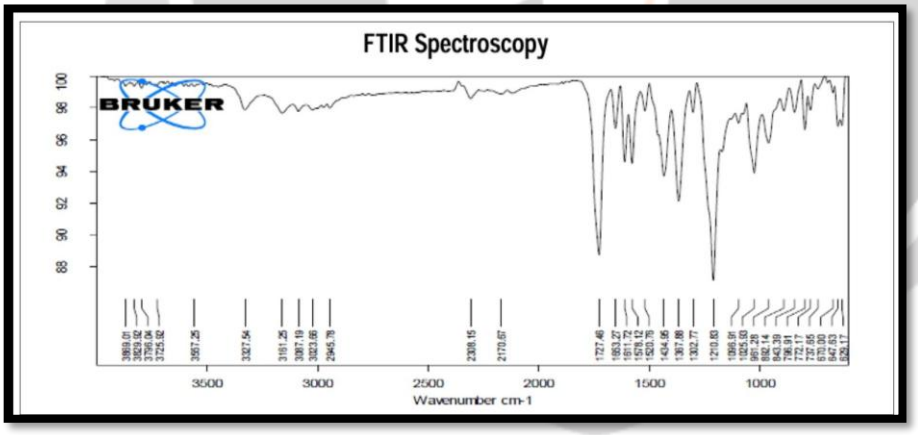

Fig2: FT-IR Spectrum of Drug sample (Famciclovir)

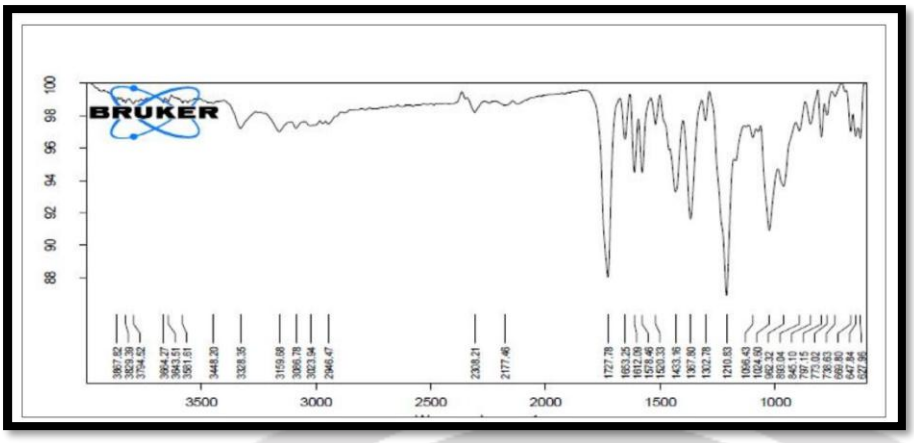

Fig3: FT-IR Spectrum of Reference (Famciclovir)

Table 3 : IR interpretation for Famciclovir

Frequency, cm-1	Bond
1210.83 cm-1	(C-O stretching)
1727.48 cm-1	(C=O stretching)
2308.15 cm-1	(O=C=O stretching)
961.28 cm-1	(C=C bending)
3227.54 cm-1	(O-H Stretching)

4.2 Angle of Repose :-

Using the following formula, the Angle of Repose was determined for five distinct formulations (F1 through F5): The angle of repose is a crucial parameter to evaluate the flow characteristics of powders or granules. Better flowability is indicated by lower angles, and poor flow is suggested by greater angles.

Table 4. Angle Of Repose

Formulation	Angle of Repose (°)
F1	14.04 ± 0.12
F2	15.95 ± 0.18
F3	18.43 ± 0.15
F4	21.80 ± 0.20
F5	26.57 ± 0.25

4.3 Bulk density :-

The flow and packing capabilities of the powder blends used to prepare the 500 mg oral mucosal tablets of Famciclovir were assessed by measuring the estimated bulk density (g/mL) of the different formulations (F1 to F5).

Table 5. Bulk density

Formulation	Estimated Bulk Density (g/mL)
F1	0.912 ± 0.01
F2	0.909 ± 0.01
F3	0.904 ± 0.01
F4	0.898 ± 0.01
F5	0.893 ± 0.01

4.4 Tapped density :-

0.625 ± 0.008 g/cm³ (F1) to 0.645 ± 0.012 g/cm³ (F5) were the tapped density readings. All of the formulations showed a progressive increase in tapped density, which may have been caused by compositional modifications like higher binder or filler content, which improved particle packing and decreased inter-particulate voids.

Table 6. Tapped Density

Formulation	Tapped Density (g/cm³)
F1	0.625 ± 0.008
F2	0.630 ± 0.007
F3	0.635 ± 0.009
F4	0.640 ± 0.010
F5	0.645 0.012

4.5 Carr's Index :-

The Carr's Index was calculated for all formulations to assess the flow qualities of the powder mixes. The findings are as follows: Carr's Index (also known as the Compressibility Index) is a useful measure for determining the flowability of powder mixes. According to USP guidelines, a Carr's Index value between 16 and 21% indicates fair flow characteristics.

Table 7. Carr's Index:

Formulation	Carr's Index (%)
F1	20.00±0.45
F2	20.32±0.42
F3	20.31 ±0.41
F4	20.31 ±0.44
F5	20.31 0.45

4.6 Hausner's ratio :-

The powder blends' acceptable and passable flow qualities were shown by the Hausner's Ratio, which varied between 1.25 ± 0.01 and 1.26 ± 0.01 for formulations F1 through F5. While all values stayed within the permissible range of 1.25 to 1.5, formulas F1, F4, and F5 demonstrated somewhat better flow (1.25 ± 0.01) than F2 and F3 (1.26 ± 0.01). Values between 1.25 and 1.5 imply passable flow, whereas values below 1.25 indicate good flow, under standard flowability criteria. Good repeatability and homogeneous blending are demonstrated by the formulations' low standard deviation and minimum variation, which validates the powder blends' suitability for additional processing such direct compression.

Table 8. Hausner Ratio

Formulation	Hausner's Ratio

F1	1.25±0.01
F2	1.26±0.01
F3	1.26 ±0.01
F4	1.25 ± 0.01
F5	1.25 ± 0.01

4.7 Evaluation test of tablet (post formulation studies)

The formulation of Famciclovir 500 mg oral mucosal tablets (F1-F5) was created by altering the concentration of Croscarmellose Sodium as a superdisintegrant to assess its impact on tablet performance. All five formulations were tested for drug content, weight fluctuation, friability, disintegration time, and in vitro drug release. The drug content in all formulations varied from 98.5% to 99.5%, showing that the medication was evenly distributed throughout the tablets. Weight variance across all batches was within acceptable pharmacopeial limits, indicating constant tablet mass. Friability readings for all batches were less than 1%, indicating that the tablets had acceptable mechanical resistance. A substantial decrease in disintegration time was seen when the concentration of Croscarmellose Sodium increased. Formulation F5, which had the highest concentration (45 mg), disintegrated the fastest (70 ± 3 sec), whereas Formulation F1, which had the lowest concentration (10 mg), took the longest (135 ± 4 sec). The better disintegration rate with increasing amounts of the superdisintegrant was confirmed by the corresponding improvement in drug release at 30 minutes, which went from 78.4% in F1 to 98.7% in F5. With the quickest disintegration time and maximum drug release of any of them, F5 showed the most desirable profile. This suggests that 45 mg of Croscarmellose Sodium is the ideal amount for this formulation in order to guarantee a quick commencement of action through the oral mucosal route.

Table 9. Evaluation test of tablet (post formulation studies)

Formulation	Drug content (%)	Weight variation (mg)	Friability (%)	Hardness (Kg/cm²)	Disintegration time (min.)
F1	98.5±0.6	495±3.2	0.88±0.04	6.8	135±4
F2	99.1±0.4	505±4.1	0.82±0.05	6.4	120±3
F3	99.5±0.3	495±2.9	0.79±0.03	5.8	100±5
F4	99.3±0.2	495±3.5	0.76±0.02	5.2	85±4
F5	98.9±0.5	495±3.8	0.72±0.04	4.7	70±3

Table 10. In Vitro Dissolution Studies of Different Batches

Time Min	Pure Famciclovir %	Formulation 1 %	Formulation 2%	Formulation 3 %	Formulation 4 %	Formulation 5 %
5	10.2	18.4	22.6	28.7	34.2	40.5
10	18.5	30.1	38.7	45.8	55.4	63.9
15	26.8	45.7	55.4	62.9	73.3	81.5
20	35.1	61.3	70.2	79.6	85.7	92.4
30	48.7	78.2	86.3	91.8	96.4	98.9
45	62.3	91.4	95.8	97.6	99.2	99.6
60	75.4	97.6	98.9	99.1	99.8	100.0

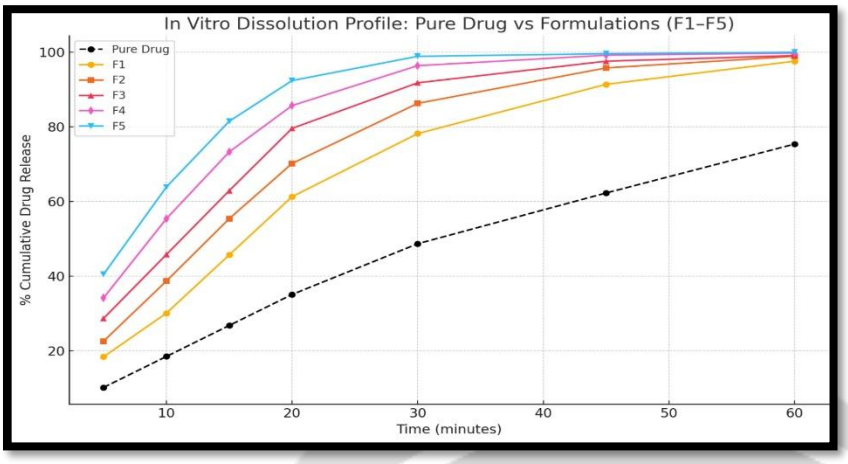

Fig 4: In Vitro Dissolution Data For Pure And Different Batches

5.CONCLUSION:

The present research focused on the formulation and evaluation of Famciclovir 500 mg oral mucosal tablets using varying concentrations of Croscarmellose Sodium (10 mg to 45 mg) to optimize disintegration and drug release characteristics. All formulations (F1 to F5) complied with pharmacopeial standards, showing acceptable weight variation (495 ± 2.9 mg to 505 ± 4.1 mg), friability well below 1% (0.88% to 0.72%), and consistent drug content ranging from 98.5% to 99.5%, confirming uniformity and mechanical stability across all batches.

A significant impact of the superdisintegrant concentration was observed on the disintegration and dissolution behavior of the tablets. The disintegration time decreased progressively with increasing levels of Croscarmellose Sodium—ranging from 135 ± 4 seconds in F1 to 70 ± 3 seconds in F5—while drug release at 30 minutes improved from 78.4 ± 1.8% to 98.7 ± 0.9%. These findings confirm that the superdisintegrant plays a critical role in enhancing the breakdown of the tablet matrix, thus promoting rapid drug release through the mucosal route.

Among the five batches, Formulation F5 exhibited superior overall performance, with the shortest disintegration time, highest drug release, and satisfactory mechanical and content uniformity parameters. This formulation is therefore considered the most suitable for fast-dissolving mucosal delivery of Famciclovir, offering potential advantages in the treatment of acute viral infections by ensuring rapid onset of action and improved patient compliance.

6.REFERENCE

1. Malvey, S., Kshirasagar, N., Vishnu, Y.V. and Srikanth, J., 2015. Formulation and evaluation of acyclovir orodispersible tablets using sublimation method. J en Pract, 3(208), p.2
2. Rawat, P.K., Tyagi, C.K., Shah, S.K. and Pandey, A.K., 2020. Formulation, characterization and in vitro evaluation of famciclovir loaded solid lipid nanoparticles for improved oral absorption. J Pharm Res Int, 32(29), pp.1-17.
3. Gnann Jr, J.W., Barton, N.H. and Whitley, R.J., 1983. Acyclovir: mechanism of action, pharmacokinetics, safety and clinical applications. Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy, 3(5), pp.275-283.
4. Shaw, T. and Locarnini, S.A., 1999. Preclinical aspects of lamivudine and famciclovir against hepatitis B virus. Journal of Viral Hepatitis, 6(2), pp.89-106.
5. Hua, S., 2019. Advances in nanoparticulate drug delivery approaches for sublingual and buccal administration. Frontiers in pharmacology, 10, p.1328.
6. Simpson, D. and Lyseng-Williamson, K.A., 2006. Famciclovir: a review of its use in herpes zoster and genital and orolabial herpes. Drugs, 66, pp.2397-2416.
7. Morishita, M. and Park, K., 2009. Biodrug Delivery Systems. DRUGS AND THE PHARMACEUTICAL SCIENCES, 194, p.194.
8. Patel, D. M., Patel, N. M., & Patel, M. M. (2007). Optimization of fast dissolving tablets of famotidine using simple lattice design. Pharma Science Monitor, 1(1), 1–11.

9. Hua, S., 2019. Advances in nanoparticulate drug delivery approaches for sublingual and buccal administration. Frontiers in pharmacology, 10, p.1328.
10. Ho, P.C.L., Boateng, J. and Bukhari, N.I., 2021. Advances in Nanoparticulate Drug Delivery Approaches for Sublingual. *Advances in Drug Formulation*, p.132863.

BIOGRAPHIES

I Gaurav Dattatray Shirsath dedicated final-year Bachelor of Pharmacy student with a keen interest in Drug Development, novel drug delivery systems and pharmaceutical formulation development. With a strong academic foundation and hands-on experience in formulation science, he has undertaken research focused on enhancing the therapeutic efficacy of antiviral drugs. My project on mucoadhesive Famciclovir tablets reflects his commitment to improving bioavailability and patient compliance through innovative drug delivery strategies. I aspires to contribute to the pharmaceutical industry by developing patient-centric formulations. I am also passionate about continuous learning and applying scientific principles to solve real-world healthcare challenges.