Formulation And Evaluation of Orllay Disintegrating Tablets of Piroxicam with Different Coformers

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***Abstract*—Orally disintegrating tablets (ODTs) are a patient-friendly solid dosage form designed to disintegrate rapidly in the oral cavity without the need for water. Piroxicam is a potent non-steroidal anti-inflammatory drug (NSAID) used in the management of pain and inflammation; however, its poor aqueous solubility may limit its dissolution and oral bioavailability. The present research was aimed at formulating and evaluating orally disintegrating tablets of piroxicam using different pharmaceutical coformers to improve its physicochemical and dissolution characteristics. Piroxicam cocrystals were prepared with selected coformers using a suitable cocrystal preparation technique and subsequently incorporated into ODT formulations. The prepared formulations were evaluated for pre-compression parameters, weight variation, hardness, friability, drug content, wetting time, water absorption ratio, in-vitro disintegration time, and in-vitro dissolution studies. Drug–coformer interactions and physicochemical characteristics were further investigated using analytical techniques such as Fourier-transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), and X-ray diffraction (XRD). The optimized formulation demonstrated satisfactory tablet characteristics, rapid disintegration, and improved drug dissolution compared with pure piroxicam. The study indicates that the use of suitable coformers in piroxicam ODTs can be a promising approach for enhancing dissolution and developing a rapidly disintegrating dosage form with improved patient convenience and potential therapeutic performance.**

***Index Terms*—Piroxicam; Orally disintegrating tablets; Pharmaceutical cocrystals; Coformers; Solubility enhancement; Dissolution; FTIR; DSC; NSAID.**

I. INTRODUCTION

Orally disintegrating tablets (ODTs) are an advanced solid oral dosage form that rapidly disintegrates or dissolves in the mouth, usually within a short period, without the need for water. These dosage forms have gained significant importance because of their ease of administration, improved patient compliance, and convenience for pediatric, geriatric, and dysphagic patients. ODTs also offer advantages such as rapid onset of action, ease of handling, portability, and improved acceptance among patients who experience difficulty in swallowing conventional tablets. The development of ODTs has therefore become an important area of pharmaceutical formulation research, particularly for drugs intended for immediate therapeutic action.

Piroxicam is a widely used non-steroidal anti-inflammatory drug (NSAID) belonging to the oxicam class and is commonly prescribed for the treatment of rheumatoid arthritis, osteoarthritis, musculoskeletal disorders, postoperative pain, and other inflammatory conditions. It exhibits potent analgesic and anti-inflammatory activity by inhibiting cyclooxygenase enzymes involved in prostaglandin synthesis. Despite its therapeutic effectiveness, piroxicam possesses poor aqueous solubility, which results in a relatively slow dissolution rate in gastrointestinal fluids. Since dissolution is a critical factor influencing the absorption of poorly soluble drugs, enhancing the dissolution characteristics of piroxicam remains an important formulation challenge.

Various approaches have been investigated to improve the solubility and dissolution of poorly water-soluble drugs, including particle size reduction, solid dispersions, inclusion complexes, lipid-based formulations, and pharmaceutical cocrystals. Among these strategies, cocrystal technology has emerged as a promising approach for modifying the

physicochemical properties of an active pharmaceutical ingredient without altering its pharmacological activity. Pharmaceutical cocrystals are crystalline materials composed of an API and one or more pharmaceutically acceptable coformers in a definite stoichiometric ratio, held together through non-covalent intermolecular interactions such as hydrogen bonding. The selection of an appropriate coformer can influence crystal packing, molecular arrangement, solubility, stability, and dissolution behavior of the drug.

The incorporation of different coformers with piroxicam provides an opportunity to improve its pharmaceutical performance by modifying its crystal structure and intermolecular interactions. Coformers containing functional groups capable of hydrogen bond formation may facilitate the development of stable cocrystals and enhance the wettability and dissolution properties of piroxicam. These modifications may subsequently contribute to improved formulation characteristics when the cocrystals are incorporated into orally disintegrating tablets. Therefore, the combination of cocrystal technology and ODT formulation represents a rational strategy for developing an effective dosage form for poorly soluble drugs.

In the present study, orally disintegrating tablets of piroxicam with different coformers were formulated and evaluated to investigate their suitability as rapidly disintegrating solid dosage forms. The prepared formulations were assessed for important pre-compression and post-compression parameters including flow properties, weight variation, hardness, friability, drug content, wetting time, water absorption ratio, disintegration time, and in-vitro dissolution. Furthermore, analytical characterization techniques such as Fourier Transform Infrared Spectroscopy (FTIR) and Differential Scanning Calorimetry (DSC) may be employed to study the physicochemical characteristics and confirm changes associated with cocrystal formation. The overall objective of this research is to evaluate the influence of different coformers on the formulation performance of piroxicam ODTs and identify a formulation with desirable tablet quality and enhanced dissolution characteristics, thereby contributing to the development of improved patient-friendly oral drug delivery system.

II. MATERIALS AND METHODS

2.1 Materials

Drug: Piroxicam.

Coformers: Mefenamic acid and Ibuprofen.

Excipients: Superdisintegrant, diluent, binder, lubricant, glidant, and sweetening agent.

Other chemicals: Potassium dihydrogen phosphate, sodium hydroxide, distilled water, and other analytical-grade reagents.

- FTIR Instrument
- DSC Instrument

2.2 Preparation of Piroxicam Cocrystals

- Accurately weigh piroxicam and selected coformer in the required ratio.
- Transfer both into a clean mortar.
- Triturate thoroughly using the dry grinding method.
- Continue grinding for a predetermined time to promote drug–coformer interaction.
- Pass the prepared cocrystal powder through a suitable sieve.
- Store in a desiccator until further use.

2.21. Preformulation Studies

- Determine the appearance and solubility of piroxicam and coformers.
- Perform drug–excipient compatibility studies.
- Analyze pure drug, coformers, physical mixtures, and cocrystals using FTIR.

2.22. Formulation of Orally Disintegrating Tablets

- Prepare different formulations using piroxicam cocrystals.
- Accurately weigh all ingredients.
- Pass ingredients through a suitable sieve.
- Mix drug/cocrystal with diluent and superdisintegrant uniformly.
- Add glidant and lubricant at the final stage.
- Mix gently to obtain a uniform powder blend.
- Compress the blend using a suitable tablet compression machine.

2.23. Evaluation of Powder Blend

- Angle of repose.
- Bulk density.
- Tapped density.

- Carr's compressibility index.
- Hausner's ratio.

2.24. Evaluation of Tablets

- Appearance.
- Weight variation.
- Hardness.
- Friability.
- Drug content.
- Wetting time.
- Water absorption ratio.
- In-vitro disintegration time.
- In-vitro dissolution study.

2.25. Wetting Time

- Place tissue paper in a Petri dish containing distilled water.
- Place the tablet on the wetted tissue paper.
- Record the time required for complete wetting of the tablet.

2.26.Water Absorption Ratio

- Weigh the tablet before wetting.
- Allow the tablet to absorb water completely.
- Weigh the wet tablet.
- Calculate the water absorption ratio.

2.27.Disintegration Test

- Determine disintegration time using a suitable disintegration apparatus.
- Record the time required for complete disintegration.
- The ODT should preferably disintegrate within 30 seconds.

2.28. In-vitro Dissolution Study

- Perform dissolution using a suitable USP dissolution apparatus.
- Maintain the dissolution medium at 37 ± 0.5°C.
- Withdraw samples at predetermined intervals up to 30 minutes.
- Replace each withdrawn sample with an equal volume of fresh medium.
- Analyze samples spectrophotometrically.
- Calculate percentage drug release and plot the dissolution profile.

2.29.FTIR Study

Record FTIR spectra of:

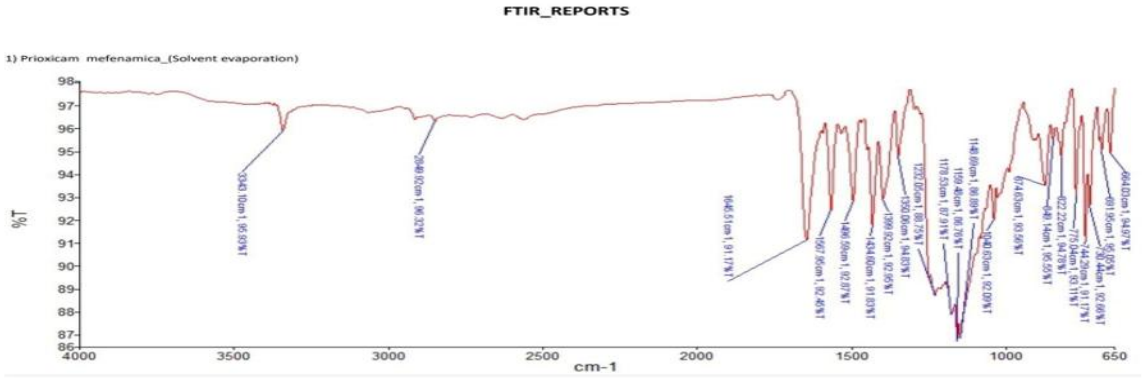
- Pure piroxicam.
- Coformers.
- Physical mixtures.
- Prepared cocrystals.
- Compare characteristic functional-group peaks to identify possible drug–coformer interactions.

2.2.0.DSC Study

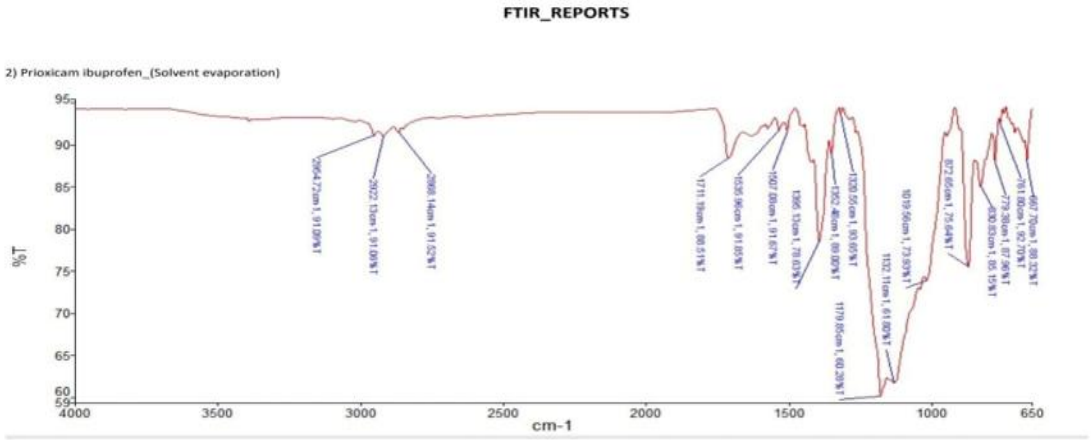
- Perform DSC analysis of piroxicam, coformers, physical mixtures, and cocrystals.
- Compare melting points and thermal transitions.
- Evaluate changes in thermal behavior indicating possible cocrystal formation.

2.2.1.FTIR Analysis

- FTIR spectra of piroxicam, coformers, physical mixtures, and cocrystals were recorded.
- Characteristic peaks were compared for shifts or changes.
- Drug–coformer interactions were assessed.



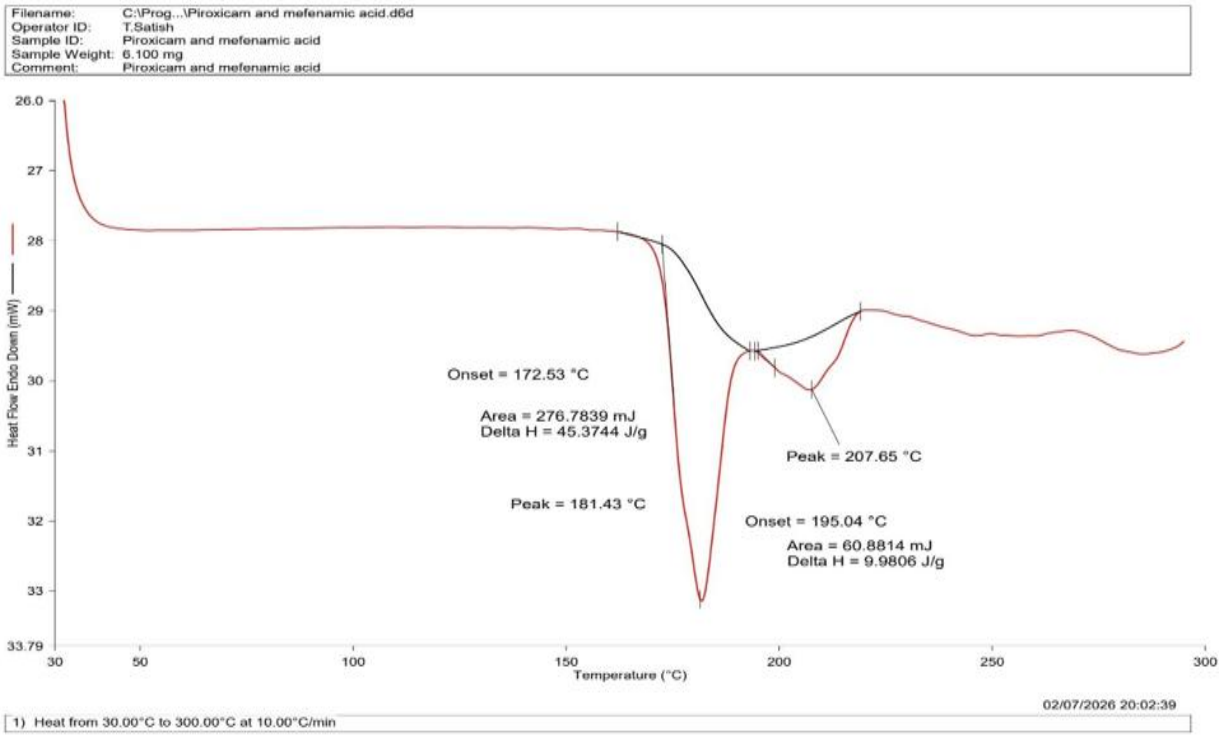
Piroxicam-mefenamic acid



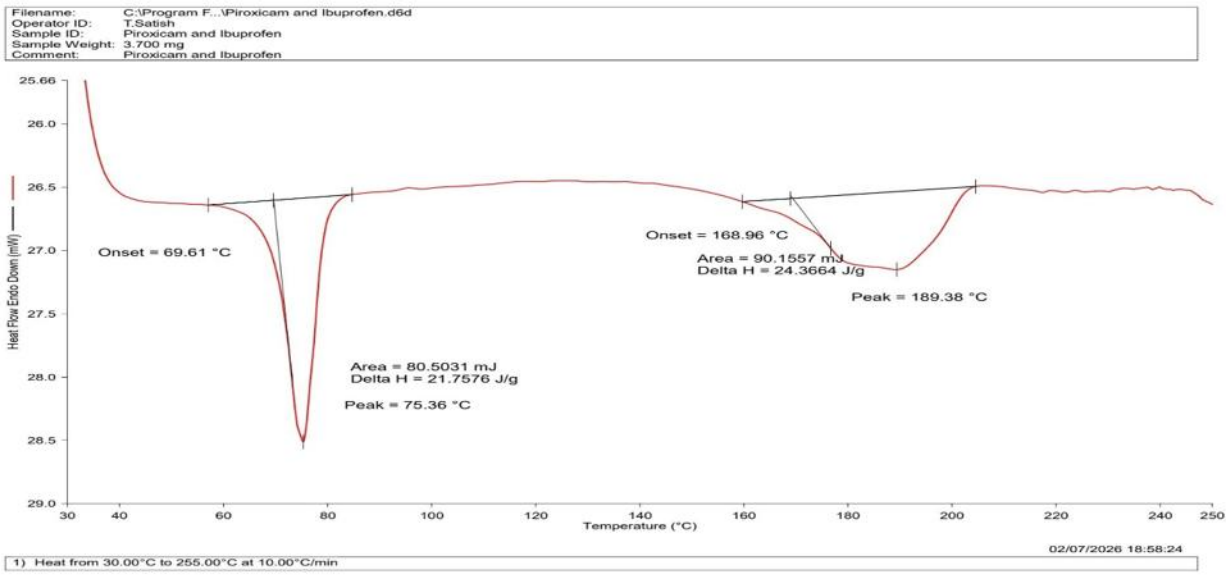
Piroxicam-ibuprofen

2.2.2. DSC Analysis

- DSC thermograms of piroxicam, coformers, physical mixtures, and cocrystals were recorded.
- Melting points and thermal transitions were compared.
- Changes in endothermic peaks were evaluated for cocrystal formation.



Piroxicam-mefenamic acid



Piroxicam-Ibuprofen

III. RESULTS

The cocrystals were obtained in 1:1 ratio with sodium acetate. The analysis of Infrared explicitly indicated the shifting of characteristic bands of piroxicam. The FTIR and DSC pattern denoted the crystallinity of cocrystals and noteworthy difference in 2θ value of intense peaks. Differential scanning calorimetry spectra of cocrystals indicated altered endotherms corresponding to melting point. The pH solubility profile of piroxicam showed sigmoidal curve, which authenticated the pKa-dependent solubility. Piroxicam cocrystals also exhibited a similar pH-solubility profile. The cocrystals exhibited faster dissolution rate owing to cocrystallization as evident from 30% increase in the extent of dissolution. The orodispersible tablets of piroxicam cocrystals were successfully prepared by direct compression method using crospovidone as superdisintegrant with improved disintegration time (30 sec) and dissolution rate.

IV. CONCLUSION

- The research successfully demonstrated the formulation and Evaluation of Piroxicam-mefenamic acid, piroxicam-ibuprofen Orally Disintegrating Tablets (ODTs) utilizing the principles of Pharmaceutical co-crystallization.The crystal lattice was Successfully modified without altering the therapeutic Structure of the active drug. The Piroxicam cocrystals showed Greater dissolution than the pure drug.
- The solid-state characterization using Differential Scanning Calorimetry (DSC) confirmed successful co-crystal formation,Evident from the distinct shifts in the characteristic Endothermic melting peaks of pure Piroxicam. Furthermore, The DSC thermograms verified excellent drug-excipient Compatibility, proving that the developed co-crystals remained Chemically stable when mixed with superdisintegrants.
- The prepared ODTs exhibited excellent mechanical strength,Acceptable friability.Most co-crystal-infused tablets Achieved a highly accelerated salivary disintegration time Of under 30 seconds, accompanied by a significant Enhancement in the in-vitro drug dissolution rate compared To standard commercial formulations.
- Ultimately, this study proves that combining crystal Engineering (co-crystallization) with advanced oral drug Delivery systems (ODTs) provides a highly versatile, Synergistic approach. This optimized formulation Successfully bridges the gap between fast drug dissolution And rapid pain relief, offering a promising, fast-acting

Patient-compliant alternative for acute inflammatory and Pain management.

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