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Solubility and Dissolution Enhancement of Lornoxicam by Surface Solid Dispersion Technique

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Abstract:

Lornoxicam (LOX), a non-steroidal anti-inflammatory drug (NSAID), is characterized by its crystalline powder form, which ranges from orange to yellow and exhibits poor solubility in water. This study aims to enhance the solubility and dissolution rate of LOX through the application of surface solid dispersion (SSD) techniques, utilizing hydrophilic-water insoluble carriers, including Aerosil 200, Croscarmellose Sodium (CCS), Sodium Starch Glycolate (SSG), Crospovidone (CP), and Avicel® PH101. To identify the most effective drug-carrier interaction, SSD formulations of LOX were developed by kneading the drug with various carriers in different weight ratios (1:1, 1:3, 1:5). The formulations were subsequently evaluated based on yield, drug content, water solubility, in vitro release in phosphate buffer saline (pH 7.4), powder X-ray diffraction (PXRD), and Fourier Transform Infrared Spectroscopy (FTIR). The results indicated that most of the SSD formulations significantly enhanced LOX solubility. Notably, Crospovidone demonstrated the most pronounced effect, achieving a high yield (98%), substantial drug content (95.2%), and a 147.6-fold increase in solubility compared to the pure drug, alongside an improved dissolution rate. The transformation of LOX into an amorphous form was confirmed by the absence of sharp crystalline peaks in Differential Scanning Calorimetry (DSC) and Powder X-ray Diffraction PXRD analyses, with no chemical interaction observed between the drug and the carrier. Thus, the SSD approach proved to be a successful strategy for improving LOX's solubility and dissolution rate.

Keywords: Hydrophilic insoluble carriers, **Dissolution rate, kneading method, Lornoxicam, Surface Solid Dispersion**

Introduction

Lornoxicam (LOX) a nonsteroidal anti-inflammatory drug (NSAID) oxicam class-alongside piroxicam and meloxicam-demonstrates significant anti-inflammatory, analgesic, and antipyretic properties [(1)] Chemically, Lornoxicam is identified as (3E)-6-chloro-3-[hydroxy(pyridine-2-ylamino) methylene]-2-methyl-2,3-dihydro-4H-thieno[2,3-e] [1,2] thiazin-4-one 1,1-dioxide, as shown in figure (1). [(2)] It is widely prescribed for the treatment of both acute and chronic pain conditions, including osteoarthritis, rheumatoid arthritis, and postoperative pain. The pharmacological action of lornoxicam is primarily attributed to its inhibition of cyclooxygenase (COX) enzymes, specifically COX-1 and COX-2.

These enzymes play a crucial role in the biosynthesis of prostaglandins, which are key mediators in processes such as inflammation, pain, and fever. By inhibiting prostaglandin synthesis, lornoxicam effectively alleviates pain and reduces inflammation. [(3,4)] Prostaglandins, which are produced through the conversion of arachidonic acid via the COX-1 and COX-2 pathways, contribute to the development of postoperative macular oedema. During surgical procedures, particularly in ocular surgeries, the synthesis of COX-2 is upregulated, leading to increased prostaglandin production and subsequent inflammation. The use of NSAIDs to inhibit prostaglandin synthesis can therefore reduce macular edema. Although the COX-2 pathway is a primary contributor to surgical inflammation in the eye, topical NSAIDs such as Lornoxicam that inhibit both COX-1 and COX-2 are often employed postoperatively to reduce inflammation. [(5)] COX and nuclear factor-kappa B (NF-kB) are activated by ultraviolet B (UVB) radiation, with COX inhibitors protection against UVB-induced skin damage., lornoxicam administered intraperitoneally at a dosage of 0.4 mg/kg has been shown to significantly reduce corneal opacity and ameliorate ultrastructural damage caused by radiation. [(6)]

Lornoxicam gel was given topically to rats' skin following burn induction; it demonstrated better anti-inflammatory action than Feldene® gel. Higher in vivo skin penetration mixed micelles of

lornoxicam gel on rats were shown to have superior analgesic and anti-inflammatory properties while maintaining non-irritating. [7]Despite its clinical efficacy, the therapeutic potential of lornoxicam is constrained by its poor water solubility, it is classified as a Class II drug under the Biopharmaceutics Classification System (BCS), denoting its low solubility and high permeability.[8,9] This limitation has prompted extensive research into formulation strategies aimed at improving the drug's solubility, dissolution rate, and bioavailability including solid dispersion (SD) and surface solid dispersion (SSD) nanocrystal, bilosomes, self-emulsifying system etc.[7,10]

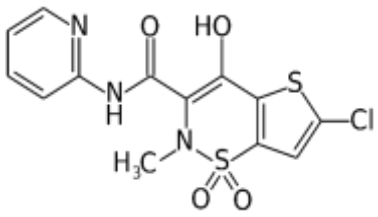

Figure 1. Chemical Structure of Lornoxicam. **(11)**

Solid dispersion is a technique in which the drug is uniformly dispersed within a solid carrier matrix, typically at the molecular level. This method enhances the solubility and dissolution rate of poorly water-soluble drugs by significantly reducing particle size and increasing surface area. Additionally, solid dispersions can stabilize the drug in its amorphous form, preventing crystallization and thus improving bioavailability, with the potential for controlled release. [12] Surface solid dispersion (SSD) differs from traditional solid dispersion in that the drug is predominantly adsorbed onto the surface of a solid carrier. This method enhances dissolution by maximizing the surface area of the drug exposed to the dissolution medium, resulting in a rapid release. SSDs are often easier to produce, as they involve simpler processes, such as the adsorption of the drug onto the carrier surface. This technique can also improve the wettability of the drug, further increasing dissolution. [13]

Both solid dispersions and SSDs aim to enhance the dissolution rate and bioavailability of poorly water-soluble drugs. While solid dispersions achieve this by reducing particle size and increasing surface area through uniform distribution within the carrier, SSDs focus on optimizing the drug's surface exposure to the dissolution medium and improving wettability and rapid release. [14,15] Surface solid dispersions are often used when a high dissolution rate is needed, especially for drugs that require rapid onset of action. Drugs can be deposited on the surface of some materials using SSD, which can change the drug's dissolution and solubility properties. Drugs dissolve more quickly when they are deposited on an inert carrier's surface because the medication's particle size is smaller. [16] SSD a technique for dispersing solids over an inert carrier while performing and precipitating them such as hydrophilic-water insoluble carriers, such as Aerosol 200, Croscarmellose Sodium (CCS), Sodium Starch Glycolate (SSG), Crospovidone (CP) and Avicel® PH101. The solid dispersion method solves issues with product handling, particularly when creating tablets by using water-soluble carriers.

By depositing the medication, this method lowers the drug's particle size by applying it to the surface of an inert carrier, and facilitates its quick breakdown. The carriers upon contact with water, they rapidly breakdown, liberating the drug particles into the surrounding medium. The mechanisms that lead to greater dissolution in surface solid dispersion (SSD). [17,18] The choice of method for preparing surface-solid dispersions depends on factors such as the drug's thermal stability, solubility, the nature of the carrier, and the desired characteristics of the final product. Each method has its own set of advantages and limitations, and the selection is often based on optimizing the drug's dissolution profile and the feasibility of large-scale production such as kneading, solvent evaporation, fusion, microwave etc. [19,20] In contrast, SD involves a uniform dispersion of the drug within a solid matrix, which may not achieve the same level of surface contact, potentially leading to slower dissolution, the drug is dispersed throughout the carrier matrix rather than being concentrated on the surface. The SSD process is typically less complex and more efficient than the preparation of traditional SDs.

The rapid dissolution characteristics of SSD contribute to a faster onset of therapeutic action. This is particularly beneficial in the treatment of acute pain, where lornoxicam is frequently employed. The method of simply adsorbing the drug onto a carrier surface often requires fewer steps and lower energy inputs, making it a more straightforward and potentially cost-effective approach to drug formulation. [18,21] The objective of this study is to enhance the solubility, dissolution rate, and rapid onset of action of a drug by developing a novel dosage form with improved properties, including prolonged drug retention and minimized systemic absorption, compared to conventional formulations such as diclofenac sodium eye drops. [22,23]

Materials and Methods

Materials

Lornoxicam, Aerosil200, and Crospovidone where They were obtained from Henan Grange Biotechnology Co., Ltd. Croscarmellose sodium, Sodium starch glycolate (SSG), and Avicel®PH101purchased from Shanghai Ruiz Heng Chemical Technology.

Preparation of physical mixture (PM)

A physical combination was developed for the best SSD formula recipe by using a spatula to combine the particles in a glass mortar in a geometric way. After that, it was passed through sieve number 60 and stored for subsequent use. [5]

Preparation of surface solid dispersion (SSD) of lornoxicam

Kneading method was applied to SSD preparation. 200 mg of LOX and several carrier ratios were combined in a mortar and let sit for duration of five minutes. The mixture was made into a paste by gradually adding only a small amount of a solvent mixture (ethanol, tri ethanol amine) (1:0.5), and kneading it for 30 minutes. The dried substance was ground into powder and passed through a sieve with a specific mesh size of 60, and then put in a desiccator with the addition of silica as a drying agent. [24,25,26]

Table1. Composition of different Lornoxicam SSD formula

Formula number	LOX: carriers W/W ratio	LOX	Crospovidone CP	Croscarmellose sodium CCS	Aerosil200	Sodium starch glycolate SSG	Avicel® PH 101
SSD1	1:1	200mg	200mg				
SSD2	1:1	200mg		200mg			
SSD3	1:1	200mg			200mg		
SSD4	1:1	200mg				200mg	
SSD5	1:1	200mg					200mg
SSD6	1:3	200mg	600mg				
SSD7	1:3	200mg		600mg			
SSD8	1:3	200mg			600mg		
SSD9	1:3	200mg				600mg	
SSD10	1:3	200mg					600mg
SSD11	1:5	200mg	1000mg				
SSD12	1:5	200mg		1000mg			
SSD13	1:5	200mg			1000mg		
SSD14	1:5	200mg				1000mg	
SSD15	1:5	200mg					1000mg

Saturation Solubility

Saturation solubility was tested in water at 25°C; an excess of the LOX, SSD of LOX was mixed with 10 milliliters of distilled water and placed in separated stoppered vials. After mixing for five minutes, the vials were kept in a water bath shaker at 25±1°C for 72hrs to reach equilibria, the samples were centrifuged for 15 minutes at 3000 rpm, the supernatants were filtered via a membrane (0.45 µm Millipore filter). The amount of LOX in the water was evaluated by UV spectrophotometer absorbance at 375nm. [27,28]

Determination of percentage yield

Calculating the yield percentage the equation was used to calculate. [29]

$$\boldsymbol{Yeild\ Percentage} = \frac{\textbf{Weight of SSDs}}{\textbf{Weight of drug+weight of carrier}} \times \mathbf{100.}$$ [26]

Determination of drug content

Using UV spectroscopy, the content of drug of Lornoxicam in surface solid dispersions was observed. An accurate weight of 4 mg of Lornoxicam was diluted with 50 mL of a solvent mixture (ethanol, tri ethanol amine) (1:0.5). The mixture was sonicated for 10 minutes, and 1 milliliter of the solution was extracted. After diluting it to 10 mL with the solvent mixture, the absorbance at 384 nm was measured. [3] The concentration of Lornoxicam was measured using a calibration curve in a solvent mixture.

$$\boldsymbol{Drug\ content} = \frac{\boldsymbol{Practical\ drug\ content}}{\boldsymbol{Theorical\ drug\ content}} \times \mathbf{100.}$$ [30]

Comparative in vitro dissolution analysis of pure LOX and SSD

The release of LOX pure powder and SSD formulas was determined utilizing a USP dissolution test device type II, filled with 500 ml of 7.4 pH phosphate buffer saline as dissolution media due to closely mimics the natural PH of human tears and ocular fluids, this makes it a suitable medium for simulating the conditions in the eye, conducted at 34±0.5 °C and 150 rpm paddle. Using 34°C is essential to mimic the ocular surface

temperature at around 34-35 °C, slightly lower than body temperature at 37°C.

The 150 rpm is chosen to replicate the natural tear fluid movement, ensuring proper dissolution without excessive shear that could disturb the formula structure. These conditions provide a realistic dissolution experiment. [31,32,33] Both the LOX SSD Formulas and pure LOX powder were subjected to the test for dissolution, which comprised—the addition of 4 mg of LOX and LOX SSD weight corresponding to 4 mg of pure LOX. At specific intervals of 5, 10, 15, 30, 45, and 60 minutes, 5 ml of the sample were collected, and it was substituted with exactly the same quantity of fresh dissolution media. After the materials were filtered, spectrophotometric analysis was performed. at 375 nm. [28] The drug release percentage was plotted against time to create the drug dissolution profile. [34]

Selection of the optimum dispersion

The best SSD formulas were based on the higher saturation solubility and percent yield and release.

Differential scanning calorimetry (DSC)

The DSC data were acquired using a DSC-60 plus Shimadzu instrument. The carrier, Lornoxicam, and its physical mixture were accurately weighed and prepared in tightly sealed aluminum pans under a flow of nitrogen gas (100 mL/min) until a stable heat range of 25–300°C was reached. [11]

Powder X-ray diffraction (PXRD) analysis

Powder XRD was used to analyze the drug's crystalline nature in order to find any changes or possible polymorphisms that would have an impact on the drug's solubility in the SSD formulation. The X-ray diffraction graph of Lornoxicam, the carrier, its physical mixing, and the optimal SSD was obtained using the X-ray diffractometer. The scanning speed across a 2θ range of 5–80° was 5°/min. [35,36]

Fourier transform infrared (FTIR)

The (FT-IR) spectrum were acquired using a Shimadzu FT-IR spectrometer. Using KBr, an infrared transparent matrix, the samples were suitably ground and triturated at a 1:5 ratio (sample: KBr). To make the KBr discs, the powders were mixed under hydraulic pressure for five minutes at a pressure range of five tons between the values are 4500 and 400 cm^{-1}, with a resolution of 4 cm^{-1}. [37,38]

Statistical analysis

The dissolution profiles were analyzed using a similarity factor (f2) to determine statistical significance. Quantitative data analysis the dissolution profiles were validated using statistical analysis similarity factor (f2). The value of this component ranges from 50 to 100. When the f2 > 50 (50-100), the two dissolution profiles are deemed to be similar. However, if the f2< 50, it indicates that the comparison profiles are not similar, using the DD Solver. The equation was used to define the similarity factor (f2). [39]

$$F2 = 50x\ log\left[1 + \frac{1}{n}\sum_{t=1}^{n}[R_t - T_t]^2\right]^{-0.5} \times 100$$

(n) is the representation of the total number of dissolution time points. As a percentage at time (t), the reference and test dissolution values are (Rt, Tt), respectively. The remaining results are evaluated using the one- way ANOVA (SPSS version 25) and t- test, with a significance level set at a P-value <0.05. [40]

Results and Discussion

Saturation Solubility

As seen in Table1, surface solid dispersion (SSDs) formulas containing LOX demonstrated a considerable improvement in their water solubility relative to the pure lornoxicam, with a significant $p<0.05$ one-way ANOVA test. [13] The reduction in particle size leads to an increase in the surface area available for contact between drug particles and the solvent, thereby enhancing the interaction at the interface and promoting faster dissolution. [41] The type of carrier used, along with the drug, significantly influences this enhancement. As shown in Table 2, the solubility of lornoxicam (LOX) was notably improved when the drug-to-carrier w/w ratio was 1:1. This improvement was increased when the ratio increased from 1:1 to 1:5 ($p < 0.05$) for all carriers tested. At higher carrier ratios, more LOX was dispersed over the carrier's surface, which enhanced wettability and solubility[42].

Crospovidone, in particular, demonstrated superior solubility enhancement, increasing solubility by a factor of 147.6 compared to other carriers, especially at the drug-to-carrier ratio of 1:5. This can be attributed to Crospovidone ability to reduce particle size and improve wettability through its swelling and wicking mechanisms, as well as its deposition on the solid dispersion surface.[14,41,43] Crospovidone is a super disintegrant characterized by a small particle size (20-50 microns) and a porous, cross-linked structure that increases its specific surface area, typically around 2-3 m^2/g.[44] In comparison, other super disintegrants, such as croscarmellose sodium, have a slightly larger particle size (50-60 microns) and a lower surface area (approximately 0.5-1 m^2/g). Sodium starch glycolate, another super disintegrant, has a larger particle size, ranging from 20-100 microns. Avicel PH101, a commonly used diluent and binder, has an average particle size of about 50 microns and a relatively low surface area, typically less than 1 m^2/g. [26,45,46] Aerosil 200, with

particles less than 12 nm in size, has an extremely high specific surface area of approximately 200 m^2/g. However, despite its high surface area, Aerosil 200 is not specifically designed to enhance drug dissolution like Crospovidone. [47] Crospovidone smaller particle size, porous structure, and higher specific surface area compared to other excipients like croscarmellose sodium, sodium starch glycolate, and Avicel PH101 make it particularly effective for promoting rapid drug release and disintegration in pharmaceutical formulations.

[41] As the concentration of carrier increases, a greater amount of surface area becomes accessible for the adsorption of drug crystals. This leads to a reduction in particle size and an improvement in the solubility and dissolution of the drug. [13,41] Due to linear carriers, there is no significant difference between Aerosil 200 and Avicel®PH101 regarding solubility improvement ($p>0.05$), with enhancements of 104 and 100-fold, respectively, the solubility did not increase despite the considerable surface area of Aerosil 200 (<12 nm), indicating that other factors may also impact solubility such as particle size and type of polymer. [26,48,49] Sodium starch glycolate (SSG) makes LOX 50.2 times more soluble. [18] There is a significant difference between the drug: carrier ratios of 1:1, 1:5 $p<0.05$, and there is no significant difference between the drug-to-carrier ratios of 1:1 and 1:3, based on the results obtained from one-way ANOVA (SPSS version 25). Therefore, the best formulation is SSD11, which showed a P-value < 0.05 compared to other polymers at the same 1:5 ratio.

Drug Content and Percentage yield of SSDs.

Table 2 indicates that all SSD formulations evaluated had appropriate drug content ranging from 90 to 99% w/w, which was consistent with USP standards (90–110%). The synthesized formulations were distributed uniformly, according to these findings. [50]

Table 2 displays the SSD formulations achieved a high yield % which range from 90 to 99%, saturation solubility and drug content The results obtained show the suitability of the kneading method. [26]

Table 2. Saturation Solubility, folds, drug content and percent of yield of LOX SSDs

Formula Number	(Drug: Carrier w:w ratio)	Carrier type	Saturation solubility mg/mL (Mean &SD)	Folds in solubility	Drug content. (w/w) (%) (Mean ±SD), n=3	Percentage yield (PY %)
Pure drug			0.014 ±0.0002			
SSD1	1:1	CP	0.4666 ±0.046	33.2	90.8%±0.739	97.7%
SSD2	1:1	CCS	0.069 ±0.00721	4.9	90.6%±1.9008	88.75%
SSD3	1:1	SSG	0.418 ±0.0176	29.8	92.9%±1.450	92.75%
SSD4	1:1	Aerosil200	0.455 ±0.0115	32.5	87.7%±0.718	93%
SSD5	1:1	Avicel® PH 101	0.458 ±0.02099	32.7	87.2%±1.193	92.5%
SSD6	1:3	CP	0.718 ±0.0276	51.2	92.8%±1.301	98%
SSD7	1:3	CCS	0.1493 ±0.0055	10.6	91.8%±2.07	93.5%
SSD8	1:3	SSG	0.539 ±0.03005	38.5	95.6%±1.0844	98%
SSD9	1:3	Aerosil200	0.6856 ±0.0215	48.9	91.8%±2.439	93%
SSD10	1:3	Avicel® PH 101	0.671 ±0.0140	47.9	91.5%±1.601	96%
SSD11	1:5	CP	2.0673 ±0.0916	147.6	95.2%±0.764	98.5%
SSD12	1:5	CCS	0.447 ±0.0166	31.9	94.06%±1.201	96.7%
SSD13	1:5	SSG	0.704 ±0.0185	50.2	95.8%±1.348	95%
SSD14	1:5	Aerosil200	1.456 ±0.0249	104	95.02%±1.062	92.5%
SSD15	1:5	Avicel® PH 101	1.4006 ±0.0249	100	95.2%±0.764	95.9%

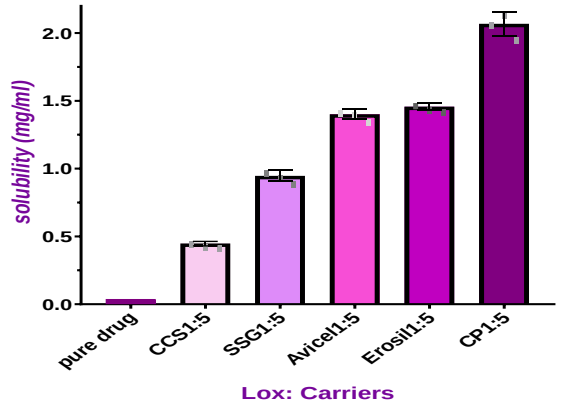

Figure 2. Saturation solubility of Lornoxicam.*Comparative in vitro dissolution analysis of pure and SSD LOX*

After 10 minutes, the pure LOX exhibited a release rate of 24.7%, as shown in Figure 3 and summarized in Table 3. In contrast, the LOX SSD formulations demonstrated significantly enhanced release profiles, with 73.8%, 74.4%, and 93.4% of their contents in just 10 minutes. SSD15, SSD13, and SSD11 also demonstrated in vitro release capability by accomplishing full LOX release in this short amount of time. The high and rapid release of lornoxicam formulations specially SSD11 at 10 minutes is due to Crospovidone rapid swelling and disintegration properties, which increase the surface area and wettability of the drug, thereby significantly enhancing its dissolution rate.[41,43,48] Using similarity factor f2, a measure used in pharmaceutical sciences to evaluate the similarity between two dissolution profiles, a comparison was made between the release patterns of the LOX formulations SSD and the LOX pure powder, which serves as a reference.[1]

The FDA states that when the f2 value ranges between 50 and 100 more than 50, the two dissolution profiles are deemed similar. The similarity factor value that is obtained is less than 50, as Table 3 illustrates. That suggests the prepared LOX SSD and the pure LOX powder are not similar when it comes to dissolution media. **[29,49]**

Table 3. Percent drug release after 10 min. and f2 similarity factor as compared the pure drug

Formula	Drug: carrier ratio	Carrier type	Drug release. (mg/ml) (%)	Similarity factor (f2)
Pure drug			24.7	
SSD11	1:5	CP	93.4	11.76
SSD12	1:5	CCS	73.5	20.57
SSD13	1:5	SSG	73.3	18.84
SSD14	1:5	Aerosil200	74.5	18.91
SSD15	1:5	Avicel® PH 101	73.8	19.86

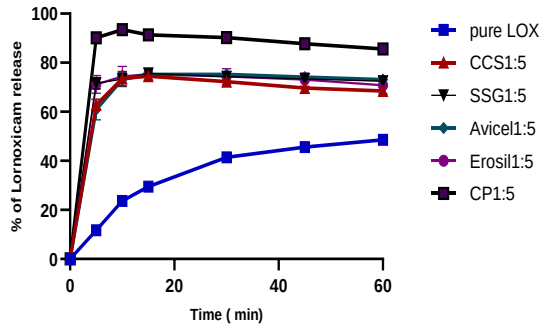

Figure 3. In-vitro release of pure Lornoxicam, SSD Formulas in 7.4 buffer saline at 150 rpm and 34°C. The results showed that SSD11, which contained Crospovidone, had the highest drug release within 10 min, with a similarity factor of less than 50 compared with pure Lornoxicam and other SSD formulas.

Selection of the optimum SDD

According to the results obtained and statistical analysis Crospovidone was the most suitable polymer SSD11 formula.

Differential scanning calorimetry (DSC)

Pure Lornoxicam (LOX) and a physical mixture of LOX with Crospovidone in a 1:5 ratio. Figure 4 illustrates the DSC curve for the selected formulation. The melting point of pure LOX typically ranges between 220°C and 230°C. In the DSC curve of pure LOX, an exothermic peak is observed at 228.6°C, likely associated with its crystallization. [6,11,27] Lornoxicam is physically mixed with Crospovidone, and the exothermic peak shifts to 213.8°C, alteration in the drug's crystallinity, possibly indicating a partial transition to an amorphous form. Additionally, the DSC curve for the LOX-Crospovidone mixture shows a

notable endothermic peak at 113°C, corresponding to Crospovidone glass transition temperature (Tg), is broad and less pronounced, likely due to the extensive cross-linking within the polymer. The glass transition temperature of Crospovidone is typically reported within the range of 130°C to 160°C. [2] However, the observed in the DSC curve, where the peak occurs at a lower temperature, could be attributed to various factors such as changes in the physical state of the sample, humidity that lower Tg or the influence of additives that modify the thermal properties of the system. When LOX is formulated as a surface solid dispersion (SSD) with Crospovidone using the kneading method, a broad peak is observed at 213.3°C. This shift indicates a change in the drug's physical state, likely representing a transition to an amorphous form disappearing of sharp peak. This alteration is consistent with forming an amorphous structure within the SSD, which can significantly influence the drug's thermal behavior and dissolution properties. [4,41]

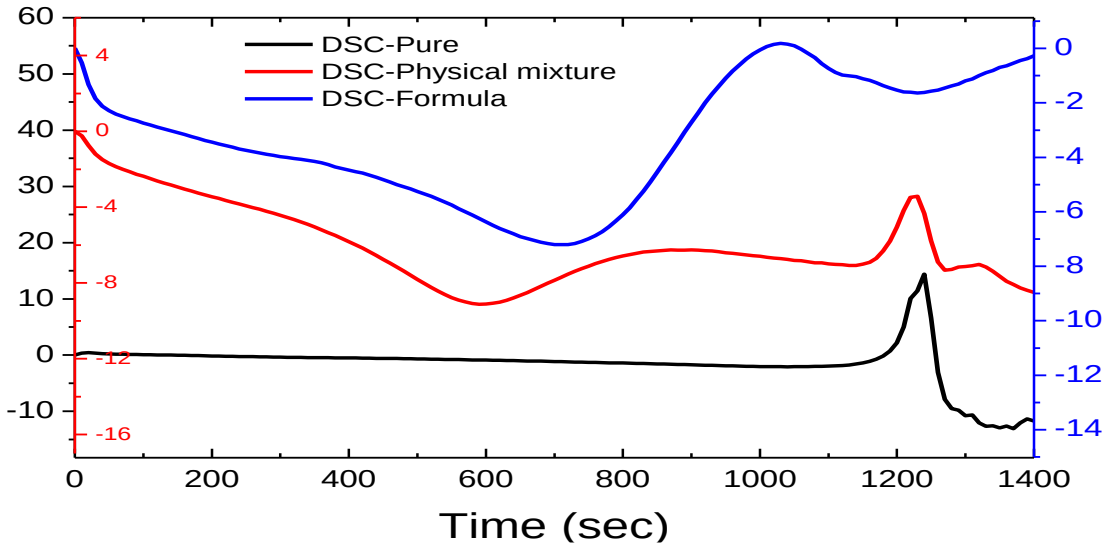

Figure 4. Differential scanning calorimetry (DSC) analysis of pure lornoxicam, a physical mixture, and the SSD11 formulation containing Crospovidone revealed that lornoxicam a transformation to an amorphous form, as evidenced by the disappearance of its characteristic crystalline peaks.

Powder X-ray diffraction (PXRD) analysis

Patterns of powder X-ray Diffraction (PXRD) for SSD formulas, physical mixture, and pure lornoxicam are shown in Figure5. The crystalline nature of lornoxicam is indicated by the notable peak in the XRD pattern of the drug and PM. Nevertheless, the absence of distinctive, sharp peaks in the SSD formulations demonstrated that lornoxicam had transformed into an amorphous form. [35,36]

Fourier transform infrared (FTIR)

The Fourier transform infrared (FTIR) spectrum of Lornoxicam the combination of different substances without any chemical reaction and the selected SSD11 were analyzed. The LOX exhibits peaks at specific wavenumbers, such as 3462.25 cm-1 OH stretching, 3100.96 cm-1 for NH stretching, 3066.26 cm-1 for CH aromatic stretching, 1645.95 cm-1 for C=N stretching, 1595.84 cm-1 for C=O stretching of amide, 1424.17 cm-1 for C=C stretching, 1082.83 cm-1 for S=O stretching, and 789.71 cm-1 for C-CL stretching. The peaks observed in the FTIR spectra of the final formula also indicated that there was no interaction between the bands. According to Figure 6, the reference shows no interaction between the Lox and polymer. [7,37,38]

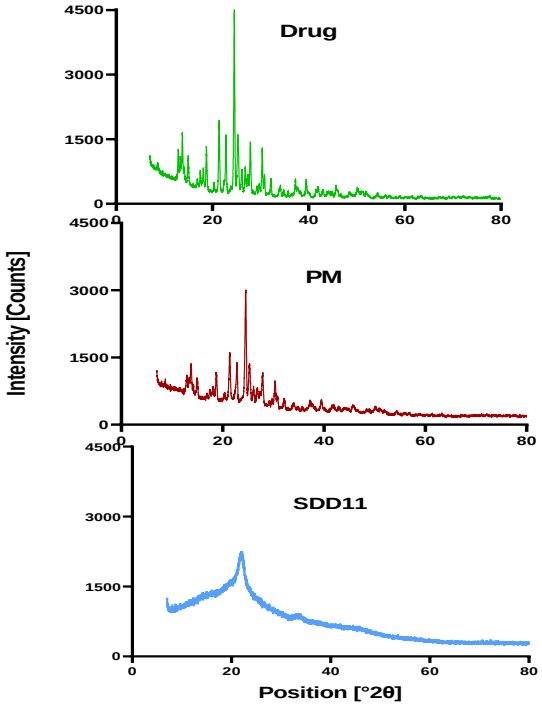

Figure5. Powder X-ray diffraction (PXRD) analysis of pure lornoxicam, a physical mixture, and the SSD11 formulation containing Crospovidone revealed that lornoxicam a transformation to an amorphous form, as evidenced by the disappearance of its characteristic crystalline peaks.

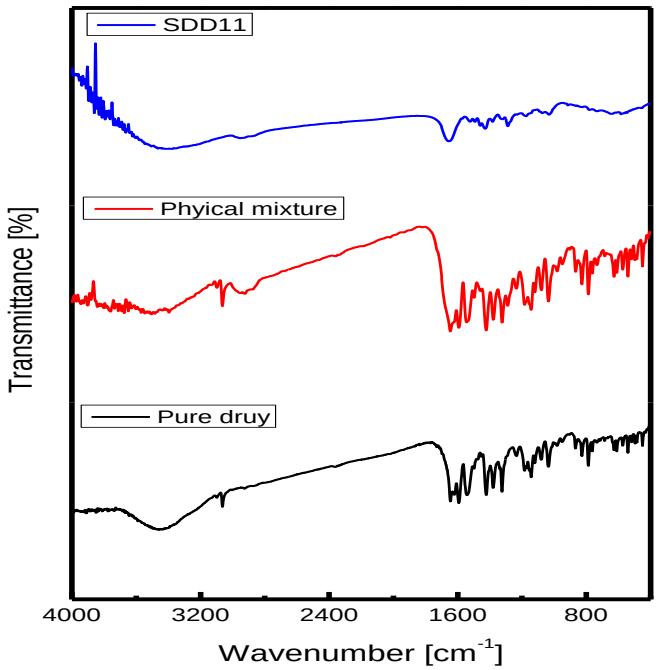

Figure 6. Fourier transform infrared (FTIR)spectrum of Lornoxicam, the FTIR spectra of the final formula SSD11 also indicated that there was no interaction between the bands.

Conclusion

The surface solid dispersion method significantly improves the dissolution rate of lornoxicam. The type and amount of carrier play a crucial role in enhancing this rate. Among the super disintegrants tested, Crospovidone showed a significant increase in the dissolution rate when used in a 1:5 ratio with lornoxicam. In all cases, the dissolution rate increased proportionally with increased the concentration of carriers in the surface solid dispersion.

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Conflicts of Interest

No conflicts of interest.

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Ethics Statements

In vitro study, no ethical statements are required.

Author Contribution

The following areas of the authors' confirmation of their involvement with the article are experimental work, data collecting, analysis and interpretation of findings, and creation of the draft manuscript: Riyam Sadiq Jafer. After reviewing the findings, Hanan J. Kassab gave his approval to the manuscript's final version.

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زيادة كمية وسرعة الاذابة اللورنوكسيكام باستخدام تشتت السطح الصلب

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الخلاصة

اللورنوكسيكام عقار مضادا للالتهاب غير الستيرويدية مسحوق بلوري يتراوح لونه بين البرتقالي والأصفر. الهدف من هذه الدراسة هو استخدام تشتت السطح الصلب لزيادة ذوبانية ومعدل الذوبان لـ. كمحامل مائية غير قابلة للذوبان، تم استخدام ايروسيل وكروس كارميلوس صوديوم ومسحوق النشأ كروسبوفدون وافيسيل ١٠١ لتحديد تفاعل المحمل مع الدواء، تم تحضير تركيبات تشتت السطح الصلب مع اللورنوكسيكام باستخدام طريقة العجن في نسب وزنية مختلفة للدواء: المحمل. ثم تم تقييمها لمحتواها المئوي، ومحتوى الدواء، وذوبان الماء، والإفراج في محلول فوسفات الصوديوم٧،٤والتفاعل الاشعة السينية للمسحوق، والتحليل الطيفي للأشعة تحت الحمراء بالتحويل الفوري أظهرت معظم التركيبات المنتجة زيادة في ذوبان الدواء. كان للكروسبوفيدون أفضل النتائج، نسبة عائد مرتفعة (٩٨٪)، ومحتوى دواء عالي ٩٥،٢٪وزيادة بنسبة١٤٧،٦ مرة في الذوبانية مقارنة بذوبانية الدواء النقي مع زيادة في معدل الذوبان. دون أي تفاعل كيميائي مع المحمل، تم تحويل الدواء إلى شكل غير بلوري. لذا، يمكن القول أن تقنية تشتت السطح الصلب، التي تم تطويرها عن طريق العجن للمواد مع محامل مائية غير قابلة للذوبان، زادت من ذوبانية اللورنوكسيكام

الكلمات المفتاحية:حاملات غير القابلة للذوبان في الماء ،معدل الذوبان ،طريقة العجن ،اللورنوكسيكام ،التشتت السطح الصلب.