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Formulation and characterization of mouth dissolving tablets of Diacerein by Frosta technique using Diacerein: β-Cyclodextrin solid dispersion

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ABSTRACT

Highly plastic granules that can be compressed into tablets at low pressure were developed to make mouth dissolving tablets (MDTs) by compression method. In formulation of MDTs by Frosta technique, perlitol SD 200, maltrin QD M 580 and sucrose solution (30% w/v) were used as plastic material, water penetration enhancer and a wet binder respectively. Maltrin QD M 580 and pearlitol SD 200 were mixed in different proportions (10:90, 20:80, 30:70, 40:60 and 50:50). Mouth dissolving tablets (batches FT1-FT5) were prepared by wet granulation method using optimized Diacerein: β-cyclodextrin solid dispersion (1:2 ratio, Batch DK3). The prepared Diacerein:β-cyclodextrin solid dispersion were characterized by Fourier transform infrared spectroscopy, differential scanning calorimetry, and powder X-ray diffraction and reveals reduction in drug crystallinity which might be responsible for improved dissolution properties. Evaluation of the tablets showed that all the tablets were found to be within official limits and the optimized batch FT3 (Containing 30% maltrin QD M 580 and 70% pearlitol SD 200) exhibited a disintegration time of 14.67 sec, percentage friability of 0.645%, wettability of 12 sec and 98.54 % drug release at the end of 60 minutes. The stability study conducted as per the ICH guidelines for six months and the formulations were found to be stable. The results showed that mouth dissolving tablets of Diacerein was successfully prepared by Frosta technique and improve the bioavailability of drug.

Key words: Diacerein, β-cyclodextrin, Maltrin QD M 580, Mouth dissolving tablet, Frosta Technique

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INTRODUCTION

Diacerein (DIA), 9, 10-dihydro-4, 5-bis (acetyl)-9, 10-dioxo-2-anthracene carboxylic acid, is a new anti-inflammatory anthraquinone derivative used mainly as a slow acting disease modifying drug in osteoarthritis, metabolized to active Rhein [1,2]. Rhein is thought to act via inhibition of interleukin-1band proteolytic enzymes, along with which it stimulates the synthesis of cartilage components and modifies the underlying pathological conditions [3,4]. As it does not inhibit the synthesis of prostaglandins is emerging as better and safe therapeutic agent compared to NSAIDs. Diacerein is sparingly soluble in water (3.197 mg/L) which is the reason for poor dissolution rate, absorption and subsequently low and erratic bioavailability (35–56 %) [3]. Poor aqueous solubility could lead to failure of formulation development in spite of their potential pharmacokinetic activity. Thus, a strategy to improve bioavailability should aim at improving its aqueous solubility and overcoming first pass metabolism.

Innovative drug delivery systems known as melt in mouth or mouth dissolving tablets (MDT) are novel types of tablets that disintegrate/disperse/dissolve in saliva. Their characteristic advantage, such as administration without water anywhere anytime, leads to their suitability for geriatric and pediatric patients. They are also most suitable for drugs that undergo extensive fist pass metabolism. The benefits, in terms of patient compliance, rapid onset of action

as the drug goes directly into systemic circulation and good stability, make these tablets popular as a dosage form of choice on the current market. However, a major challenge is to develop mouth-dissolving tablets of poorly soluble drugs [5].

Techniques that have been used to improve dissolution and bioavailability of poorly water-soluble drugs include micronization, use of surfactants and the formation of solid dispersions [6,7]. Of the various approaches to improve drug solubility, complexation with cyclodextrin is being widely explored. Cyclodextrins are powerful carriers for improving the therapeutic efficacy of drugs with poor aqueous solubility through inclusion complexes.

The Frosta technology is based on the compression of highly plastic granules at low pressures to prepare MDTs [8]. The highly plastic granules are composed of three components: a plastic material, a water penetration enhancer and a wet binder. Each of the three components plays an essential role in obtaining tablets with higher strength and faster disintegration time than the other MDTs. The key benefits of the Frosta technology are: fast disintegration in the mouth: within 5–40 sec depending on the tablet size, low manufacturing cost, simple processing, strong mechanical property: friability <1% and multi-tablet packaging: dozens of tablets in one bottle.

The purpose of this study was to improve the solubility and dissolution rate of Diacerein by forming a binary complex with β-cyclodextrin (β-CD) by kneading method and to formulate its mouth dissolving tablets by Frosta technique.

MATERIALS AND METHODS

The drug Diacerein was procured as gift sample from Zydus Cadila, Ahmedabad (India), β-Cyclodextrin (β-CD), Maltrin QD M 580 and Pearlitol SD 200 was procured from Ranbaxy Lab Ltd. Gurgaon (HR). All other chemicals were procured locally and were of analytical grade.

Preparation of solid dispersion by kneading method (DK1-DK4)

Inclusion complex of Diacerein with β-cyclodextrin (β-CD) in different molar ratios (1:1, 1:1.5, 1:2 and 1:2.5) was prepared by kneading method. An accurately weighed amount of β-cyclodextrin was taken in glass mortar and kneaded with small amount of water to make slurry. Diacerein was added slowly into the slurry with continuous kneading. Once all the drug was incorporated into the slurry, the thick slurry was then kneaded for 45 min. The slurry was taken into the petri dish and dried at 50 ^{0}C. The dry powder was pulverized and passed through sieve # 100 and stored in dessicator. Different batches of Diacerein: β-CD solid dispersion is shown in table 1.

Table 1: Abbreviations used to designate different solid dispersion batches

S. No	Batches	Diacerein: β-cyclodextrin ratio
1	DK1	1:1
2	DK2	1:1.5
3	DK3	1:2
4	DK4	1:2.5

Characterization of solid dispersions

I. Estimation of drug content [9]

Solid dispersions of Diacerein were tested for drug content uniformity. Solid dispersion equivalent to 50 mg of drug was weighed and transferred to 50 ml volumetric flask and volume was made up to mark with phosphate buffer pH 6.8. The solution was shaken thoroughly and filtered using Whatman filter paper no. 41. The filtrate was suitably diluted with phosphate buffer pH 6.8 and analysed against blank solution by spectrophotometrically at 258 nm. This was done in triplicates and the average drug contents were estimated.

II. In vitro drug release profile

In vitro dissolution test for Diacerein solid dispersions (DKI-DK4) was performed in triplicate using USP dissolution apparatus type II (paddle method). The medium was 900 ml of phosphate pH 6.8 buffers, maintained at 37° C ± 0.5° C. The paddles were rotated at 75 rpm. The solid dispersions equivalent to 50 mg of Diacerein were taken in muslin cloth and tied to the paddle. Sample (5 ml) was withdrawn at different time intervals (5, 10, 15, 30, 45 and 60 minutes) and replaced with the same amount of pH 6.8 buffer to maintain the perfect sink condition.

Sample (5 ml) was made up to 10 ml with pH 6.8 buffer (for pure drug: no dilution), filtered and the drug absorbance was measured at wavelength of 258 nm using a double beam spectrophotometer.

III. Fourier Transform Infrared Spectroscopy (FTIR)

Infrared spectroscopy is one of the most powerful analytical technique which offers the possibility of chemical identification. FTIR spectra of Diacerein, β-cyclodextrin (β-CD) and solid dispersions of Diacerein with β-CD (optimized batch DK3) were recorded using ATR spectrophotometer (Bruker- Alpha E). Samples were scanned from 4000 to 600 cm^{-1}.

IV. Differential Scanning Calorimetry (DSC)

Differential Scanning Calorimetry (DSC) analysis of the samples (Diacerein, β-cyclodextrin, and solid dispersions of Diacerein with β-CD (optimized batch DK3) was carried out on a DSC-60 (Shimadzu Corporation, Japan). Samples were heated under nitrogen atmosphere on an aluminum pan at a heating rate of 10^0C per min over the temperature range of 50 - 300^0C.

V. Powder X-ray diffraction studies (PXRD)

This technique is extremely reliable to evaluate the changes in the crystalline phase and amorphization of solid drug as a result of excipient or carrier interactions. Crystallinity is indicated by the presence of sharp peaks that are absence in case of amorphous drugs [10,11].

The powder X-ray diffraction (XRD) of Diacerein, β-cyclodextrin and solid dispersions of Diacerein with β-CD (optimized batch DK3) was recorded using an X-ray diffractometer (Goniometer PW3050). The scanning rate was 10^0/min and diffraction angle (2θ) was 5-50^0.

Amongst, all the solid dispersion batches (DK1-DK4), the solid dispersion batch DK3 prepared by kneading method at molar ratio of 1:2 (Diacerein: β-CD) showed best in-vitro dissolution results was selected as optimized batch and used for formulating into mouth dissolving tablets.

Preparation of mouth dissolving tablets of Diacerein by Frosta technique

In formulation of MDTs by frosta technique, perlitol SD 200, maltrin QD M 580 and sucrose solution (30% w/v) were used as plastic material, water penetration enhancer and a wet binder respectively. Maltrin QD M 580 and pearlitol SD 200 were mixed in different proportions (10:90, 20:80, 30:70, 40:60 and 50:50) as listed in table 2. Wet binder (sucrose solution, 30% w/v) was used because it preserved the porous structure of maltrin QD M 580 and give better mechanical strength.

Mouth dissolving tablets were prepared by wet granulation method using optimized diacerein solid dispersion (Batch DK3), maltrin QD M580, pearlitol SD 200, talc and magnesium stearate. The composition of tablets is shown in the table 2. All the ingredients (except talc and magnesium stearate) were passed through #60 separately, weighed, mixed in geometrical order in a poly bag for 10 minutes and then the blend was transferred into mortar. Sucrose solution (30% w/v) was gradually added to the mixture and the wet mass was prepared with hand. The wet mass was passed through a # 14 screen and was spread on a tray to dry at 50°C for one hour. The dry granules was forcedly passed through a # 18 screen and mixed with lubricant and glidant (# 60) for further 5 minutes in a poly bag. Then, finally the granules were compressed using 8 mm flat round punches on a 10-station rotary tablet machine (Ratnakar, Ahmedabad, India). A batch of 50 tablets was prepared for all the designed formulations.

Table 2: Composition of mouth dissolving tablets of Diacerein solid dispersion prepared by Frosta technique

S. No	Ingredients (mg/tab.)	FT1	FT2	FT3	FT4	FT5
1	Dia: β-CD Solid dispersion*	151.88				
2	Maltrin QD M580	12.21	24.42	36.63	48.84	61.06
3	Pearlitol SD 200	109.91	97.70	85.49	73.28	61.06
4	Sucrose solution (30% w/v)	20	20	20	20	20
5	Magnesium Stearate	3	3	3	3	3
6	Talc	3	3	3	3	3
	Total	**300**	**300**	**300**	**300**	**300**

** Diacerein: β-CD (1:2, batch DK3) solid dispersion equivalent to 50 mg of Diacerein*

Evaluation of mouth dissolving tablets

Weight variation test was carried out as per IP 2010. The hardness of the tablets was measured using a Monsanto hardness tester and friability was measured using a Roche Friabilator [12]. Wetting time and water absorption ratio of mouth dissolving tablets was carried out by using the method given by Bi et al. (1996) [13]. In this method a piece of tissue paper folded twice placed in a petri dish containing 6 ml of water. A tablet is placed on the paper, and the time for complete wetting was measured. The wetted tablet was then weighed and the water absorption ratio was calculated using the equation ($R = 100 (W_b - W_a) / W_a$), Where W_a and W_b are the weights of tablets before and after water absorption respectively. Disintegration test was carried by using the method given by Madgulkar AR et al. (2009) [14]. Drug content was determined by the method given by khemchand et al. (2013) [9].

In vitro drug release studies

In vitro dissolution test for mouth dissolving tablets was performed in triplicate using USP dissolution apparatus type II (paddle method). The medium was 900 ml of phosphate pH 6.8 buffers, maintained at 37° C ± 0.5° C. The paddles were rotated at 75 rpm. Sample (5 ml) was withdrawn at different time intervals (5, 10, 15, 30, 45 and 60 minutes) and replaced with the same amount of pH 6.8 buffer to maintain the perfect sink conditions. Sample (5 ml) was made up to 10 ml with pH 6.8 buffer, filtered and the absorbance was measured at wavelength of 258 nm against blank using a double beam spectrophotometer.

Accelerated stability studies

The stability studies were performed on the most promising mouth dissolving tablet formulation FT3 according to ICH (International Conference on Harmonization) guidelines for six months [15]. The study was performed by keeping the prepared tablets in air tight high density polyethylene bottles and placed in a desiccator containing saturated solution of sodium chloride, which gave a relative humidity of 75±5%. The desiccator was placed in a hot air oven maintained at 40±2^{o}C and samples were withdrawn at 30, 90 and 180 days. All the parameters (friability, disintegration time, wetting time, water absorption ratio, drug content and in-vitro drug release) of formulation were measured at predetermined time interval.

RESULTS AND DISCUSSION

Characterization of solid dispersions

I. Estimation of drug content

The results of estimation of drug content (%) from sold dispersions of Diacerein with β-CD are shown in table 3. The drug content was found to be in the range of 96.37 to 98.76% (DKI- DK4), indicating the acceptability of kneading method for preparation of solid dispersions. Low values of standard deviation in drug content of solid dispersion indicated uniform drug distribution in all the prepared batches.

Table 3: Drug content (%) from solid dispersion batches DK1 to DK4

	DK1	DK2	DK3	DK4
Drug content (%)*	96.37±1.08	97.84±0.92	98.76±0.68	96.88±1.24

**(Mean± S.D.): n=3*

II. In vitro drug release profile

Dissolution studies of pure Diacerein and all prepared solid dispersions were carried out in phosphate buffer pH 6.8. From these data, it is evident that the onset of dissolution of pure Diacerein was very low. The drug released from pure Diacerein (PD) was only 56.11% in 60 minutes during the in vitro dissolution study, suggesting a strong need to enhance the dissolution of Diacerein.

The in vitro dissolution profiles of the pure Diacerein and solid dispersions containing various ratios of Diacerein to β-CD (DK1-DK4) are shown in figure 1. The solid dispersions prepared by kneading method in the ratios of 1:1, 1:1.5, 1:2 and 1:2.5 (Diacerein: β-CD) were showed 76.34 %, 93.08%, 99.26 % and 91.25 % drug release respectively at the end of 60 minutes. However, the inclusion complex at a molar ratio of 1: 2 (DK3) achieved maximum dissolution rate of the drug. The enhancement of dissolution of Diacerein from the Diacerein:β-CD solid dispersions may be due to several factors such as lack of crystallinity, increased wettability and dispersibility of the drug from dispersion. On further increasing the amount of β-cyclodextrin in solid dispersion i.e. formulations at 1:2.5 ratio (DK4) showed slightly decrease in dissolution rate, this might be due to the higher amount of carrier itself takes time to dissolution.

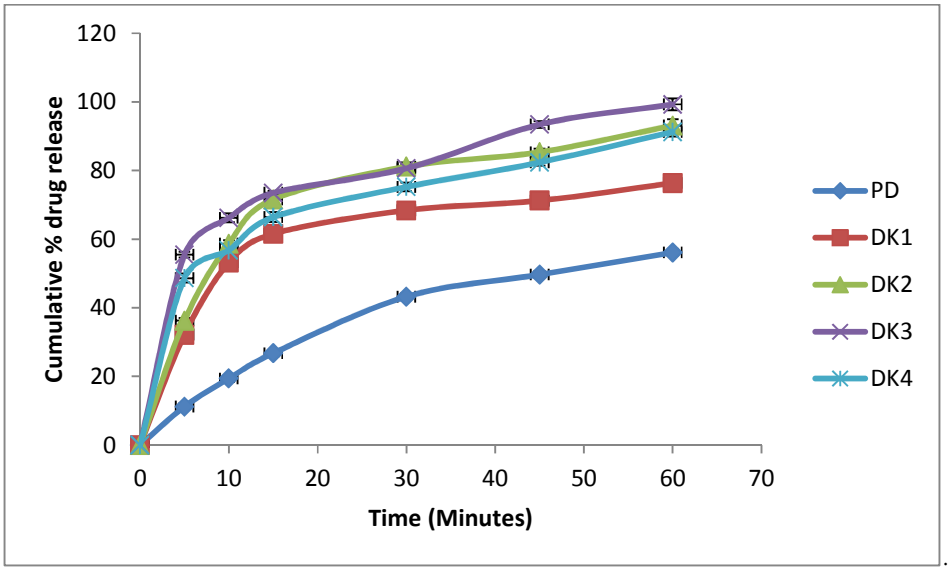
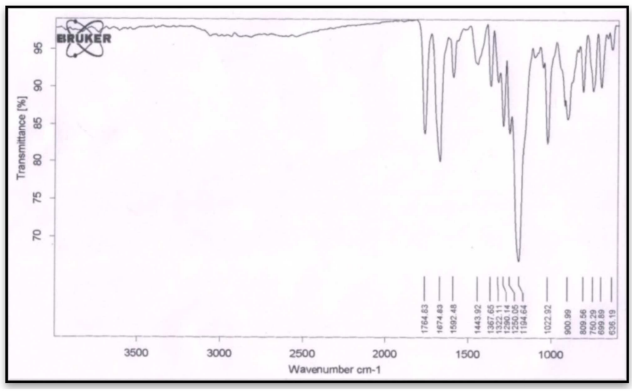
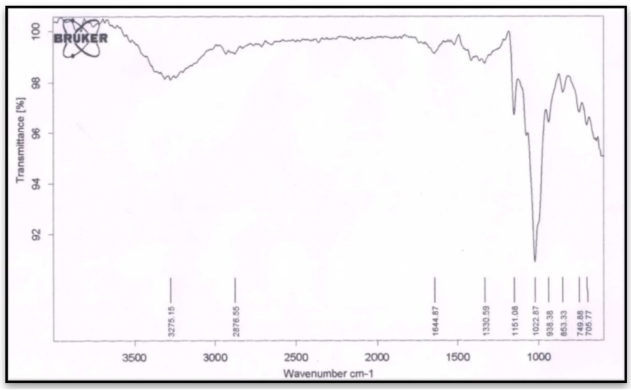


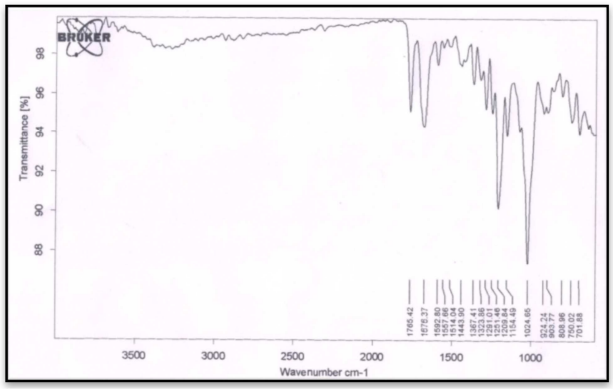
Figure 1: In vitro drug release from Diacerein: β-CD solid dispersion in pH 6.8 Phosphate buffer



A. Diacerein



B. β-cyclodextrin



C. Solid dispersion of Diacerein with β-CD (optimized batch DK3)

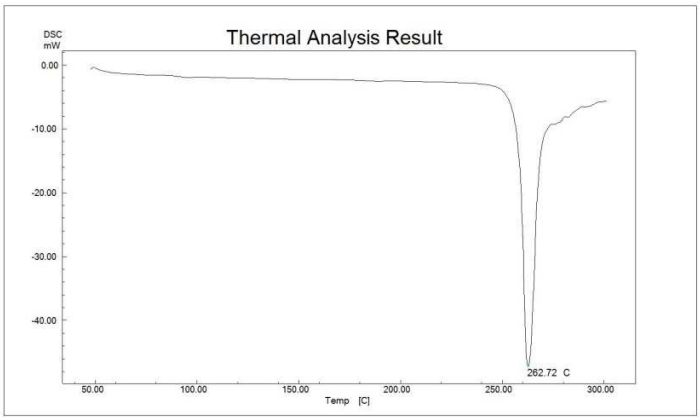
Figure 2: FTIR spectra of Diacerein (A), β-cyclodextrin (B) and solid dispersion of Diacerein with β-CD (C)

III. Fourier Transform Infrared Spectroscopy (FTIR)

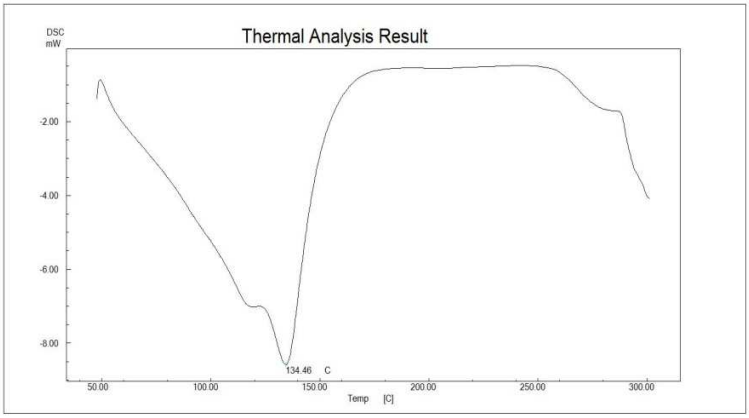
The FTIR spectra of Diacerein, β-cyclodextrin and solid dispersions of Diacerein with β-CD (Optimized batch DK3) are shown in figure 2 A, B and C respectively. The principal absorption peaks of Diacerein at 1764.83, 1674.83 and 1194.49 cm^{-1} shifted to a slightly higher frequency at 1765.42, 1676.37 and 1209.84 cm^{-1} respectively and broadening of these peaks were also observed. The observed shifts and broadening of the peaks clearly indicated the presence of host–guest interactions and formation of monomeric drug dispersion as a consequence of the interaction with β-CD, which could result in inclusion of the Diacerein in the hydrophobic cavity of the β-CD. The binary system of Diacerein-β-CD did not show any new peaks, indicating the absence of chemical bond formation in binary system.

IV. Differential Scanning Calorimetry (DSC)

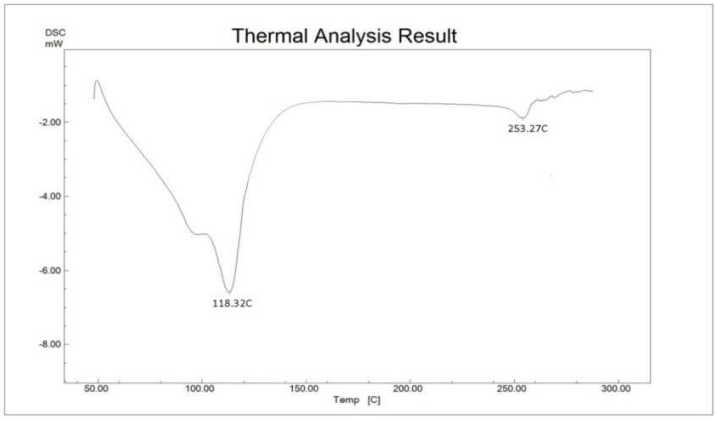
The thermogram of Diacerein, β-CD and complex with β-CD (Optimized batch DK3) are shown in the figure 3 A, B & C respectively. Diacerein showed an endothermic peak at 262.72 ºC corresponding to its melting point. Diacerein in its complex with β-CD showed very small peak at 253.27 ºC while another peak at 118.32 ºC was due to loss of water from β-CD molecule. The peak in complex was shifted considerably in comparison of Diacerein which might be due to entrapment of Diacerein in the cavity of β-CD and dispersed in the free state between inclusion complexes.



A. Diacerein



B. β-cyclodextrin



C. Solid dispersion of Diacerein with β-CD (optimized batch DK3)

Figure 3: DSC spectra of Diacerein (A), β-cyclodextrin (B) and Solid dispersion of Diacerein with β-CD (C)

V. Powder X-ray diffraction studies (PXRD)

The XRD patterns of Diacerein, β-CD and Diacerein: β-CD inclusion complexes are shown in figure 4 A, B & C respectively. The powder X-ray diffraction pattern of pure Diacerein exhibited a series of intense peaks at 2θ value of 10.4°, 17.4°, 15.045°, 25.375°, 27.9°, 32.27°, 37.09° and 41.45° which were indicative of their crystallinity. However, the patterns of β-CD are crystalline in nature with major peaks at 2θ values of 4.75°, 12.7°, 19.7°, 21.1°, 22.8°, 24.3° and 35.9°. The inclusion complexes of Diacerein: β-CD in the ratio of 1:2 prepared by kneaded method have completely diffused diffraction patterns and some peaks were also absent in the complex. These results suggested the amorphization of the drug and formation of amorphous inclusion complexes. These results of PXRD were strongly supported by the above DSC observations.

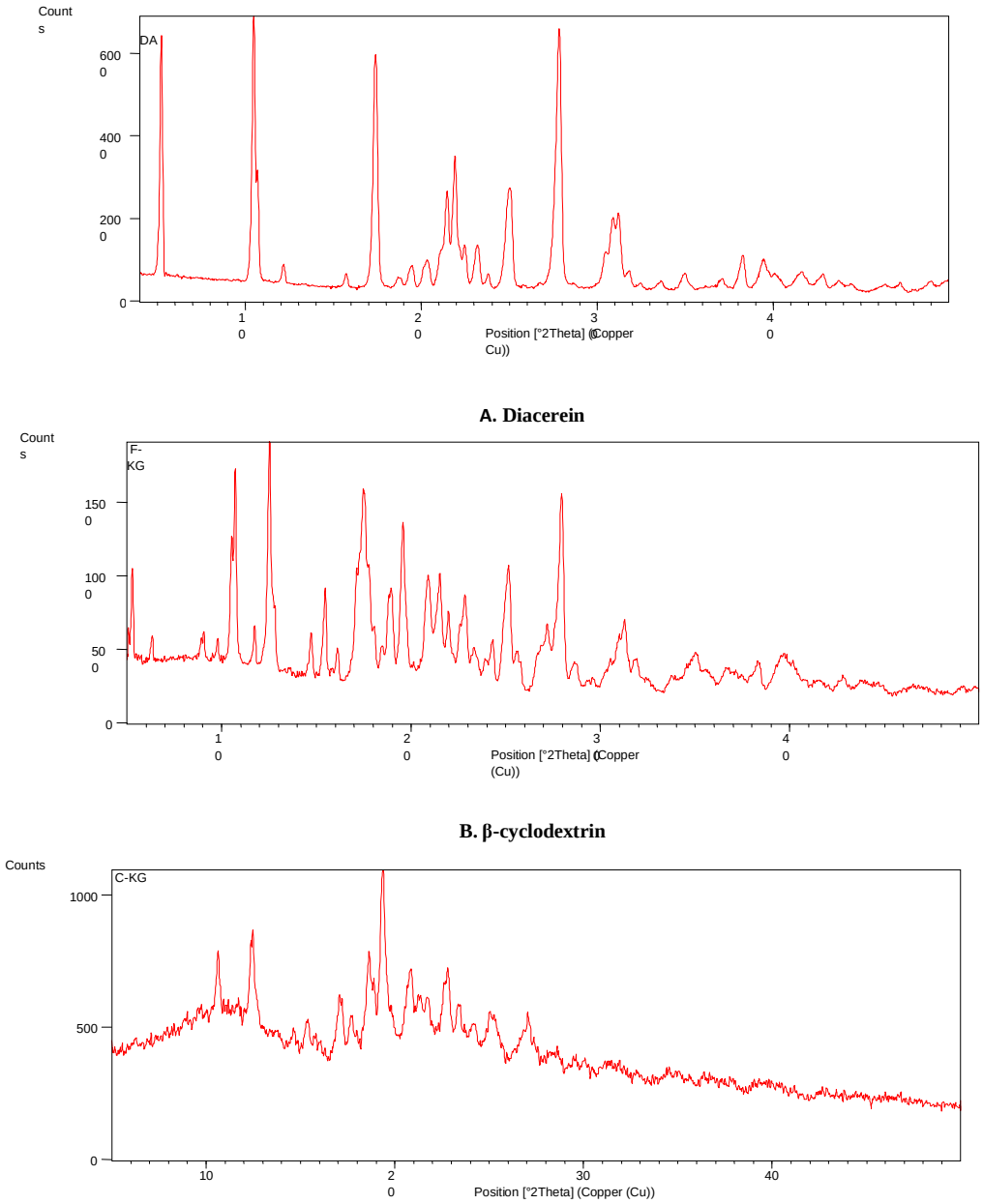


Figure 4: X-ray diffraction patterns of Diacerein (A), β-cyclodextrin (B) and solid dispersion of Diacerein with β-CD (C)

Evaluation of mouth dissolving tablets

The data obtained for post-compression parameters such as weight variation test, hardness, friability, disintegration time, wetting time, water absorption ratio and drug content of batches FT1- FT5 are shown in the table 4.

Tablets obtained were of uniform weight with acceptable weight variation limits as per IP specification i.e., below 5%. Hardness of tablets was found to be 3.84 to 6.50 kg/cm^2. Friability below 1% was an indication of good mechanical resistance of the tablets. Disintegration time was found to be in the range of 14.67 to 26.33 seconds. As the proportion of pearlitol SD 200 decreased, the tablet hardness as well as the tablet disintegration time decreased. The low hardness of tablets made of 50:50 (Maltrin QD M 580 and pearlitol SD 200, batch FT5) granules may be due to the loss of the granule plasticity resulting from dissolution of a large portion of Maltrin QD 580 during

granulation. Water absorption ratio and wetting time was found to be in the range of 33.12 to 51.10 % and 12 to 21 seconds respectively. Drug content was found to be in the range of 98.87 to 100.25 %, which was within acceptable limits.

Table 4: Evaluation parameters of MDTs of Diacerein solid dispersion prepared by Frosta technique (FT1-FT5)

Batches	WVT (mg)***	H (kg/cm^2)**	F (%)	DT (sec) *	WT (sec)*	WAR (%)*	DC (%)*
FT1	301±1.48	6.50±1.04	0.562	26.33±2.51	21.0±1.0	33.12±1.14	100.25±0.85
FT2	300±2.17	5.17±0.75	0.588	19.0±1.0	15.33±0.57	36.57±0.98	99.56±1.10
FT3	300±1.95	4.33±0.51	0.645	14.67±1.52	12.0±1.73	43.36±0.70	99.12±0.97
FT4	299±1.36	4.0±0.63	0.721	18.0±1.73	15.67±1.52	46.06±1.04	98.87±1.28
FT5	301±2.10	3.84±0.54	0.724	20.0±1.73	16.33±1.52	51.10±1.24	99.64±0.56

*(Mean ±S.D), ***n=20, **n=6, *n=3, WVT= Weight variation test, H= Hardness, F= Friability DT= Disintegration time, WT= Wetting time, WAR= Water absorption ratio, DC= Drug content*

In vitro drug release studies

In-vitro dissolution test for mouth dissolving tablets was performed in triplicate using USP dissolution apparatus type II (paddle method). The medium was 900 ml of phosphate pH 6.8 buffers, maintained at 37° C ± 0.5° C. The paddles were rotated at 75 rpm. Sample (5 ml) was withdrawn at different time intervals (5, 10, 15, 30, 45 and 60 minutes) and replaced with the same amount of pH 6.8 buffer to maintain the perfect sink conditions. Sample (5 ml) was made up to 10 ml with pH 6.8 buffer, filtered and the absorbance was measured at wavelength of 258 nm against blank using a double beam spectrophotometer. Dissolution profile of mouth dissolving tablets for the batches FT1- FT5 are shown in table 5 and figure 5.

Table 5: In-vitro drug release (%) from Diacerein: β-CD mouth dissolving tablets prepared by Frosta technique (FT1-FT5)

Time (Minutes)	Cumulative % drug release (Mean ± S.D; n = 3)				
	FT1	FT2	FT3	FT4	FT5
5	38.48±1.12	47.78±1.30	53.40±0.94	64.14±1.96	67.26±2.16
10	54.11±0.97	57.14±1.76	62.23±1.35	76.38±1.60	79.65±1.86
15	63.60±1.48	66.23±1.55	71.66±1.48	81.20±1.38	87.46±1.40
30	71.52±1.40	74.17±1.24	80.83±1.69	86.47±1.53	93.50±1.55
45	76.32±1.63	80.73±1.08	84.77±1.37	91.53±1.26	100.12±1.20
60	80.74±1.78	84.40±1.61	98.54±1.25	97.83±1.44	100.38±0.95

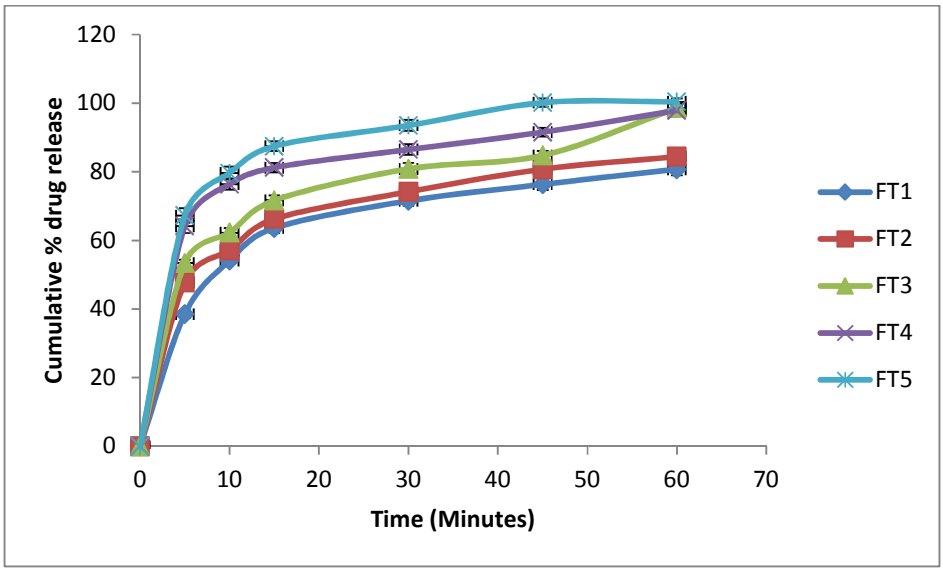


Figure 5: In-vitro drug release (%) from Diacerein: β-CD MDTs prepared by Frosta technique (FT1-FT5)

Figure 5 showed the dissolution profiles of Diacerein from mouth dissolving tablets batches FT1-FT5 (prepared from Diacerein: β-CD solid dispersion, batch DK3). The cumulative percentage drug release of formulation batch

FT1-FT5 was found to be in the range of 80.74 to 100.38 % at the end of 60 minutes. The lowest release (batch FT1-80.74%) was seen with tablets containing 10% maltrin QD M 80 and 90% pearlitol SD 200 while tablets containing 50% maltrin QD M 80 and 50% pearlitol SD 200 showed highest drug release (batch FT5-100.38%) at the end of 60 minutes but the batches FT4 and FT5 comparatively showed higher disintegration time as compared to other batches. The formulation FT3 containing 30% maltrin QD M 580 and 70% pearlitol SD 200 showed good hardness, low wetting and disintegration time and showed 98.54% drug release at the end of 60 minutes was selected as optimized batch and used for accelerated stability studies.

Accelerated stability studies

No significant variation (1 to 3%) in drug release and other evaluation parameters were observed at accelerated conditions of 45 ± 2º C with 75 ± 5% RH. Therefore, it was concluded that the batch FT3 was stable over the chosen temperature and humidity for 6 months. The results are shown in table 6

Table 6: Accelerated stability studies of the optimized formulation MT3 at 40 ± 2 °C/ 75 ± 5 % RH for six months

Parameters	Days			
	0	30	90	180
Friability (%)	0.645	0.652	0.655	0.671
Disintegration time (sec)*	14.67±1.52	15.0±1.0	15.67±1.15	16.33±1.52
Wetting time *	12.0±1.73	12.33±2.08	13.0±2.0	13.67±1.15
Water absorption ratio*	43.36±0.70	44.21±1.13	44.89±1.33	45.35±1.47
Drug content (%)*	99.12±0.97	99.06±1.08	98.23±0.85	98.10±1.15
In vitro drug release in 60 Minutes*	98.54±1.25	98.17±1.46	97.30±1.14	96.88±1.55

**(Mean± S.D.): n=3*

CONCLUSION

The present study concluded that β-cyclodextrin is a suitable carrier for the preparation of Diacerein solid dispersions. FTIR and DSC study demonstrated absence of any notable interaction between Diacerein and β-CD. PXRD data showed conversion of Diacerein from crystalline to an amorphous form which is responsible for the enhanced solubility. The optimal batch (FT3) exhibited a disintegration time of 14.67 sec, percentage friability of 0.645%, wettability of 12 sec and 98.54 % drug release in 60 minutes. The key properties of the Frosta tablet are its highly porous structure offering fast disintegration in the mouth and yet enough mechanical strength due to the highly plastic granules. The Frosta tablets are expected to improve patient compliance, provide a rapid onset time of action and increase bioavailability.

Acknowledgments

The authors are thankful to Zydus Cadila, Ahmedabad (India) for providing the gift samples of Diacerein and Ranbaxy Lab Ltd. Gurgaon (HR) for β-Cyclodextrin (β-CD), Maltrin QD M 580 and Pearlitol SD 200.

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