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Original Article

OPTIMIZATION OF STARCH CROTONATE AS A NOVEL SUPERDISINTEGRANT IN THE FORMULATION OF FAST DISSOLVING TABLETS THROUGH 2^3 FACTORIAL DESIGN

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ABSTRACT

Objective: To synthesize, characterize and evaluate starch crotonate as a superdisintegrant in the formulation of Piroxicam fast dissolving tablets by employing 2^3 factorial design.

Methods: Starch crotonate was synthesized and its physical and micromeritic properties were performed to evaluate it. The fast dissolving tablet of Piroxicam were prepared by employing starch crotonate as a superdisintegrant in different proportions in each case by direct compression method using 2^3 factorial design.

Results: The starch chrotonate prepared was found to be fine, free flowing and amorphous. Starch crotonate exhibited good swelling in water with swelling index (50%). The study of starch crotonate was shown by fourier transform infrared spectra (FTIR). The drug content (100±5%), hardness (3.6–4 kg/sq. cm), and friability (<0.15%) have been effective with regard to all the formulated fast dissolving tablets employing starch crotonate. The disintegration time of all the formulated tablets was found to be in the range of 18±03 to 66±03 sec. The optimized formulation F8 had the least disintegration time i.e., 18±03 sec. The wetting time of the tablets was found to be in the range of 49.92±0.11 to 140±0.18s. The *In vitro* wetting time was less (i.e., 74±0.37s) in optimized formulation F8. The water absorption ratio of the formulated tablets was found to be in the range of 27.58±0.01 to 123.07±0.33%. The percent drug dissolved in the optimized formulation F8 was found to be 99.83% in 10 min.

Conclusion: Starch crotonate, when combined with sodium starch glycolate, croscarmellose sodium, with Piroxicam was found to be an effective super disintegrant which improved the dissolution efficiency and could therefore be used in the formulation of quick dissolving tablets to provide immediate release of the contained drug within 10 min.

Keywords: Superdisintegrant, Fast dissolving, Optimization, Starch crotonate

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INTRODUCTION

Drug delivery systems (DDS) have been a strategic tool for expanding markets/indications, extending product life cycles and generating opportunities [1]. Science and technology advances have resulted in the development of a various novel drug delivery systems that were proven to be successful in delivering drugs to the target site. Patient compliance is one of the main issues in pharmacy practise [2]. In this case, solid dosage forms were assumed to provide better drug delivery and less side effects, as well as the ability to self-medicate, which is one of the most significant features of this type of dosage form. Tablets and capsules were the most commonly used solid dosage types, with difficulty in swallowing being one of the main concerns with their usage. This triggered further research into how to change these dosage types, leading to the development of Fast Dissolving Tablets (FDT) [3]. These were tablets that the patient can administer without needing to drink water. According to reports, the acceptance rate of FDTs had risen in recent years.

The most interesting aspect was the rapidity with which numerous FDTs have been formulated in recent years using superdisintegrants [4]. It was true that the majority of prescription dosage forms were taken orally. Oral routes of drug administration have wide acceptance up to 50-60% of total dosage forms, with the downside that certain medications have a bitter taste, which affects patient compliance [5]. As a result, there was an urgent need to mask the taste of these bitter medications, leading pharmaceutical companies to invest time, money, and valuable resources in the creation of palatable and pleasant-tasting products that improved patient compliance. The rapid breakdown or fast disintegrating tablet was intended to disaggregate in the mouth on contact with saliva in less than 60 sec, preferably in less than 40 sec, creating an easy-to-swallow suspension. It's generally referred to as "oral disintegrating tablets" (ODT), melt-in mouth tablets, rapimelts, porous tablets, quick dissolving etc [6].

There were several benefits to FDTs, which have been proven to be more effective in drug delivery than other dosage forms. These dosage forms were better than Effervescent tablets or granules since they used less water. ODT drugs have been developed for a number of indications, like migraines, depression, and schizophrenia [7]. According to one study, elderly people have trouble chewing tablets and feel bitter taste, which had been a major concern in the case of geriatric and paediatric patients for decades. Recently the bitterness of these products had been reportedly decimated using varied flavours, sweeteners and amino acids [8].

Utilisation of recently developed taste masking and product creation techniques such as freeze drying, spray drying, tablet moulding, sublimation, and disintegration had made it possible to produce novel pharmaceutical products with pleasant taste and high patient compliance. Many pharmacists find this to be a big challenge [9]. FDTs can effectively deliver high molecular weight protein and peptides to the targeted site. As a result, FDTs help in eliminating the concern about the supply of water for swallowing a dosage form, making these dosage forms a breakthrough in pharmaceutical research [10].

The advantages of fast dissolving drug delivery system include features like ease of administration to the patient who cannot swallow, such as paediatric, geriatric and psychiatric patients, no need of water to swallow the dosage form, which is highly convenient feature for patients who were traveling and do not have immediate access to water, accurate dose was consumed, masks the bitter taste of the drug so it was convenient for paediatric to swallow the tablet, the drug was dissolved within 15 sec and rapid onset of action and bioavailability of drugs was increased [11].

Even though there were several advantages of fast dissolving tablets there were certain limitations of fast Dissolving Tablets (FDT) like these tablets would leave unpleasant taste if not prepared properly, drugs which constitute large doses were tedious to formulate into

FDT and patients who administered anticholinergic medications would reportedly not to be the best candidates for FDT [12].

Piroxicam; a potent anti-inflammatory drug used in the treatment of osteoarthritis, rheumatoid arthritis, ankylosing spondylitis, and acute gout disease. It had prolonged the half-life of about 45 h [13]. The main objective of this work was to formulate and characterize fast dissolving tablets of Piroxicam fast dissolving tablets employing starch crotonate–a novel superdisintegrant, and also sodium starch glycolate, crospovidone as superdisintegrants by using optimization techniques. A 2 factorial method was used to analyse the primary and interaction effects of the three formulation variables, i.e. starch crotonate (A), starch sodium glycolate (B) and Crospovidone(C), in each case to identify a solution with less disintegration period and more percent released within 10 min and to allow for random collection of tablets with imminent removal within 20 min.

MATERIALS AND METHODS

Materials

Crotonic acid, potato starch, Piroxicam, Crosspovidone, Sodium starch glycolate were obtained from Yarrow chem. Products, Mumbai. Sodium hydroxide, Mannitol were bought from Finar chemicals Ltd, Ahmedabad. Distilled water was prepared in laboratory. Starch Crotonate processed in the laboratory have been used. Microcrystalline cellulose was bought from Qualigens fine chemicals, Mumbai. Stearate of magnesium and talc were purchased from Molychem, Mumbai.

Preparation of starch crotonate (a novel Superdisintegrant)

Initially, dissolve 10 g of crotonic acid in 10 ml of distilled water, then add 10 g of potato starch in 25 ml of distilled water. Both were constantly stirred for 30 min. Using 0.1N NaOH, raise the pH to 3.5 and stir for 16 h at 25 °C. To extract unreacted crotonic acid, it was purified and washed with distilled water after 16 h. Then the product was kept in the oven at 60°c. The products obtained was ground and sieved [14].

Characterization of starch crotonate

The prepared starch crotonate was evaluated for the following

Solubility

Solubility of starch crotonate was tested in water, aqueous pH buffers 1, 2, 3, 4, 5, 6 and 7 and inorganic solvents such as alcohol, dichloromethane, chloroform, acetone and petroleum ether [15].

pH

The pH of 1 % w/v of slurry was visualized [15].

Melting point

The Melting point was measured using the melting point apparatus [15].

Viscosity

Viscosity of 1% dispersion in samples was analysed using the Ostwald Viscometer [15].

Swelling index

Starch crotonate (200 mg) was added to 10 ml of water and light liquid paraffin taken in two different graduated and mixed test tubes. The dispersion in the tubes was permitted to stay for 12 h [15]. The sediment volumes in the tubes have been documented. The swelling index of the material was calculated as follows.

$$S.I\ (\%) = \frac{\text{Volume of sediment in water} - \text{volume of sediment in light liquid paraffin}}{\text{Volume of sediment in light liquid paraffin}} \times 100$$

Test for gelling property

The gelling properties of starch and starch crotonate were prepared and evaluated by heating a 7% w/v dispersion of each in water at 100 °C for 30 min [15].

Particle size

Particle size research was conducted using standard sieves for sifting [15].

Density

Density (g/cc) was determined by the method of liquid displacement using benzene as liquid [15].

Bulk density

Bulk density (g/cc) calculated by three type of tap in a graded cylinder [15].

Angle of repose

The angle of the repose was calculated by a set funnel method [15].

Compressibility index

Compressibility index (CI) was determined by measuring the initial volume (V0) and final volume (V) after hundred tapings of a sample of potato starch in a measuring cylinder [15]. CI had been determined using the equation

$$\text{Compressibility index (CI)} = \frac{Vo - V}{V} \times 100$$

Where V_o= Initial volume, V= Final volume

Fourier transform infrared (FTIR) spectroscopy

FTIR spectra starch Crotonate were reported on samples prepared in potassium bromide (KBr) disks using BRUKER FT–IR (Tokyo, Japan). Samples were prepared in (KBr) disks by hydrostatic press at a pressure of 6-8 tonnes [15].

Ester test

To 1 mg of Starch crotonate, 2 m of ethanol and 1 ml of 0.1 ml of NaOH were added. A phenolphthalein indicator was added to this. The shift of colour had been observed [15].

Drug–excipients compatibility studies

The compatibility of starch crotonate with the selected drug (Piroxicam) was evaluated in FTIR [15].

Infrared spectroscopy

FTIR spectra of piroxicam, and their mixtures (1: 1) with starch Crotonate were recorded on a Perkin Elmer, IR Spectrophotometer model: Spectrum RXI, using KBr disc as reference [15].

Preparation of piroxicam fast dissolving tablets

The tablets have been prepared using a direct compression process. The composition of the different formulations of fast-dissolving piroxicam tablets was shown in table 5.1. To ensure consistency in the particle size, each ingredient was passed through the #100 mesh screen before mixing. Starch Crotonate, Crospovidone, sodium glycolate starch and mannitol and microcrystalline cellulose was carefully weighed and combined with mortar and pestle and then added to piroxicam. In the end, talc and magnesium stearate have been added to the powder. The slurry was finally compressed using eight station rotary press [16] (Shakthi Machineries Pvt. Ltd., Ahmedabad, India).

Evaluation of piroxicam fast dissolving tablets

Hardness

The hardness of the tablet, which seems to be the force needed to divide the tablet with a diametrical compression force. The hardness tester used in the analysis was Monsanto hardness tester, which needs to be applied force to the tablet diametrically with the help of an inbuilt spring and expressed in kg/cm [17].

Uniformity of weight

The Weight variance study was conducted with 20 tablets. It was an actual tablet weight deviation from the average weight of 20 tablets [17].

Average tablet weight	% Deviations
80 mg or below	±10
Over 80 mg or less than 250 mg	±7.5
250 mg or less	±5

Table 1: Formulae of piroxicam fast dissolving tablets employing starch crotonate

Ingredients (mg/tablet)	F1	F2	F3	F4	F5	F6	F7	F8
Piroxicam	20	20	20	20	20	20	20	20
Starch Crotonate	---	10	---	10	---	10	---	10
Croscarmellose sodium	---	---	10	10	---	---	10	10
Crospovidone	---	---	---	---	10	10	10	10
Mannitol	172	162	162	152	162	152	152	142
Microcrystalline cellulose	100	100	100	100	100	100	100	100
Talc	4	4	4	4	4	4	4	4
Magnesium stearate	4	4	4	4	4	4	4	4
Total weight of tablet(mg)	300	300	300	300	300	300	300	300

Friability

The friability of tablets was measured using a roche friabilator. Tablets have been rotated at 25 rpm for 4 min or up to 100 revolutions. After the removal of fines, the tablets were reweighed and the percentage of weight loss was calculated [17].

$$F = \frac{W_{(initial)} - W_{(final)}}{W_{(initial)}} X\ 100$$

Drug content uniformity

For content uniformity test, ten tablets were weighed and powdered a quantity of powder equivalent to 10 mg of Piroxicam was extracted and filtered into a 0.1N HCL buffer The piroxicam content was determined by spectrophotometrically measuring the absorbance at 242 nm after proper dilution with 0.1 N HCL buffer [17].

Wetting time

The tablet wetting time was measured using a very simple process. Five circular tissue papers with a diameter of 10 cm were placed in a petri dish with a diameter of 10 cm. Ten ml of water containing a water soluble dye (Amaranth) was added to the petri dish. The tablet was carefully placed on the surface of the tissue paper. The time taken for the water to hit the upper surface of the tablet was reported as the wetting time [17].

Water absorption ratio

A piece of tissue paper folded twice was placed in a small petri dish with 6 ml of water. The tablet was put on the tissue paper and permitted to be fully wet. The wet tablet was then weighed [17]. Water absorption ratio, R was calculated by using the following equation

$$R = \frac{100(W_a - W_b)}{W_a}$$

Where, W_a = Weight of tablet after water absorption, W_b = Weight of tablet before water absorption.

***In vitro* disintegration time**

Disintegration time for FDTs was determined using a USP disintegration device with a 0.1 N HCL buffer. The medium volume was 900 ml and the temperature was 37±0.2 0C. The time taken for complete disintegration of the tablet without any palatable mass remaining in the apparatus was measured in sec [17].

***In vitro* dissolution rate studies**

In vitro Dissolution Rate Study of Piroxicam Fast Dissolving Tablets must have been performed using an 8-station dissolution test device (ElectrolabTDT-08L) fitted with paddles (50 rpm) at 37±0.50 C, using a 0.1 N HCL buffer (900 ml) as dissolution media. At fixed time intervals, 5 ml samples were collected, purified via a 0.45 µ membrane filter, diluted and measured at 242 nm using a UV/Visible Double Beam Spectrophotometer (Analytical Technology T360). Cumulative percentage of drug release was calculated using the standard calibration curve absorbance. All dissolution experiments have been conducted in triplicate (n=3) [17].

Optimization technique

The optimization technique provides both a scope of knowledge and an ability to analyse and define sets of formulation and processing variables for a reasonable approach to choosing a variety of testing and manufacturing measures for a specific substance for quantitative evaluation. At this stage optimization will become a valuable method for quantifying a qualitatively defined formulation. The present investigation wants to focus on an attempt to follow a systematic formulation approach to the optimisation of fast-dissolving piroxicam tablets using starch crotonate, starch sodium glycolate and Crospovidone as superdisintegrants.

RESULTS AND DISCUSSION

The starch crotonate prepared was found to be a fine, free-flowing amorphous powder. The physical and micromeritic properties of starch crotonate were summarized in table 2. Insoluble in aqueous solvents and insoluble in organic solvents measured (methanol, petroleum ether, dichloromethane and chloroform) the pH of 0.1% of the aqueous dispersion was 3.84.

Starch crotonate had a strong swelling in the bath. The swelling index was 50%of all the micrometric properties suggested strong flow and compressibility required for the solid dose of the manufacturing cycle. The starch crotonate density was found to be 0.66 g/cc. The FTIR of starch and crotonate starch was shown in fig. 1, 2.

The presence of peak absorption at the characteristic ester peak was therefore concluded from FTIR studies that starch crotonate (ester) was formed when starch was allowed to react with formic acid. X-ray diffraction pattern.

As starch crotonate was amorphous and had all the characteristics of superdisintegrant, it was hypothesized that starch crotonate may be used as a novel superdisintegrant in the formulation of fast-dissolving tablets.

Drug–excipients compatibility studies

Compatibility of starch Crotonate with the selected drug (Piroxicam) was evaluated in the FTIR studies. and Piroxicam–starch Crotonate was shown in fig. 3 and 4. The test of FTIR therefore showed that there was no association between the chosen medication and the new superdisintegrant starch crotonate. As a result, starch crotonate may be used as a superdisintegrant in the formulation of fast-dissolving tablets of the selected medication.

Evaluation of tablets

Hardness

The hardness of the tablets varied from 3.6 to 4 kg/cm^2. It implies high resilience and the potential to withstand both physical and pre-functional stress while handling. The hardness of the tablets was more when compared to the tablets i. e 3.5 kg/cm^2 prepared according to S. Jaya, *et al.* [18].

Friability

By performing friability test to all the optimized formulations the weight loss was found to be less than 0.15% indicating good mechanical resistance of tablets. Thus, it was proved that tablets could withstand the pressure, mechanical shocks during handling, transportation, storage and manufacturing processes. The friability results were better when compared with the tablets i. e less than 1% prepared according to Raha Khalid Dhahir, *et al.* [19].

Drug content

All of the fast-dissolving tablets prepared included Piroxicam with 100±5% of the branded argument which was higher in comparison to the tablets with drug content 99.01%, prepared according to Prashant Bhide, *et al.* [20].

Table 2: Physical and micromeritic properties of the starch crotonate prepared

Parameters	Observation
Solubility	Insoluble in all aqueous and organic solvents tested
pH(1% w/v aqueous dispersion)	3.84±0.01
Melting Point	Charred at145 °C±0.01 °C
Viscosity(1% w/v aqueous dispersion)	1.35±0.01cps
Swelling index	50%±0.02%
Gelling property	No gelling and the swollen particles of starch crotonate separated from water. Where as in the case of starch, it was gelatinized and formed gel.
Particle Size	149 µm±1.654(80/120mesh)
Density	0.66±0.0006 g/cc
Bulk Density	0.57±0.04 g/cc
Angle of Repose	29.59 °±0.01
Compressibility Index	13.63±0.02 %

*SD Standard Deviation from mean, n=3, mean±SD

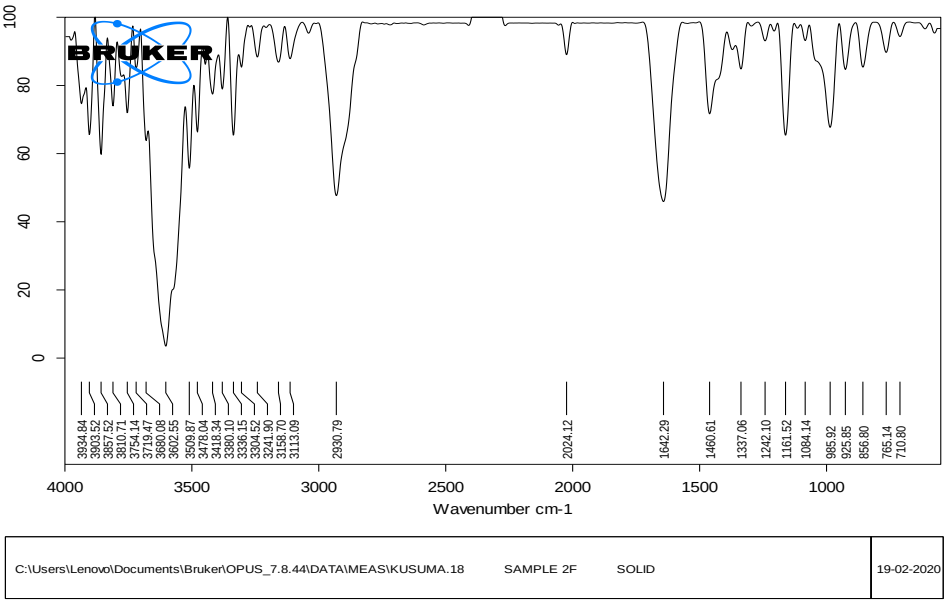


Fig. 1: FTIR spectra of potato starch

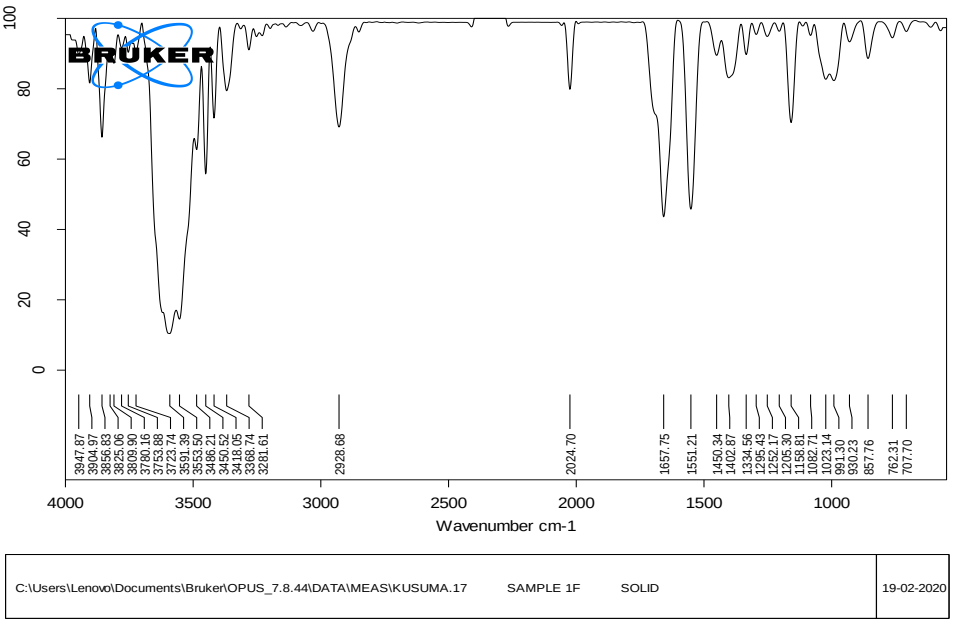


Fig. 2: FTIR spectra of starch crotonate

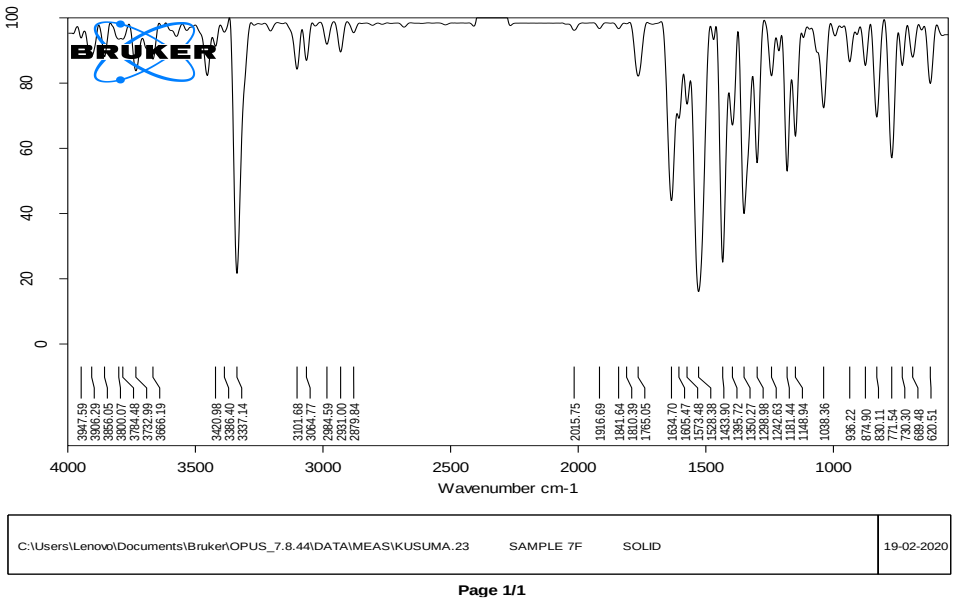


Fig. 3: FTIR spectra of piroxicam pure drug

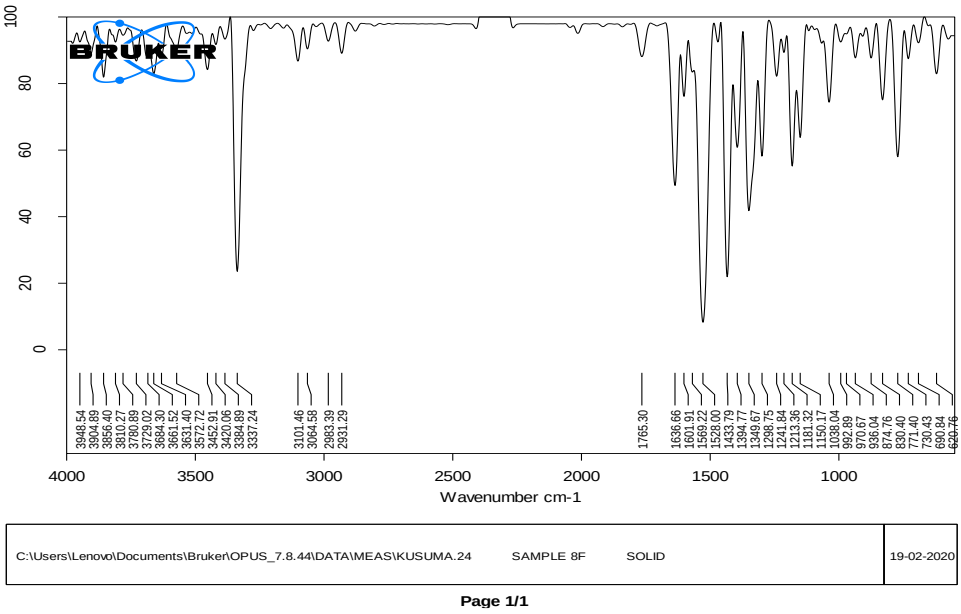


Fig. 4: FTIR Spectra of piroxicam with starch crotonate

In vitro wetting period and water absorption ratio

Have been found to be below the defined limitations and the requirements for fast-dissolving tablets must be followed (fig. 3). *In vitro* wetting time in F8 was smaller i. e 74±0.37 sec, consisting of a mixture of 10% starch crotonate, 5% sodium starch glycolate and 5% cross-crospovidone. This was shown in fig. 5. The wetting time was less in comparison to the tablets having wetting time of 76.4 sec which were prepared according to A. S. Panwar, *et al.* [21].

In vitro disintegration time

As mentioned in the table no. 3, the disintegration time of all formulated tablets was laid between 18.0±03 to 66±03 sec with optimised formulation F8 having 18±03 sec which was relatively less when compared to the tablets with disintegration time of 47.44±2.49 sec, prepared according to Nani Parfati, *et al.* [22].

In–vitro dissolution studies

From *in vitro* dissolution studies of fast dissolving tablets containing Piroxicam employing starch crotonate, their profile was shown in fig. 6 and 7. The dissolution data and parameters of all the formulations i.e., F-1 to F-8 were given in table no. 4 and 5. K1 had also improved in all formulations Similar to the model for F1. The number of folds decreased by 10% and the number of folds decreased by 10%. The number of folds decreased by k1(min-1) was shown in table 5. It has been concluded from the Results that Crotonate starch (new superdisintegrant) should be used as a superdisintegrant in the formulation of fast-dissolving Piroxicam tablets. The amount of drug release in optimised formulation F8 was wound to be 99.83% in 10 min which is comparatively more in comparison to the tablets having 92.46% release in 1 hr, which were prepared according to G. B Preeti, *et al.* [23].

Table 3: Physical properties: hardness, friability, drug content, disintegration time, wetting time, water absorption ratio of piroxicam fast dissolving tablets

Formulation	Hardness (Kg/Cm²)±SD	Friability (%)±SD	Drug Content (mg/tab)±SD	Disintegration time (s)±SD	Wetting time(sec)±SD	Water absorption ratio (%)±SD
F1	3.7±0.02	0.12±0.015	19.11±0.33	66±03	140±0.18	27.58±0.01
F2	4.0±0.01	0.13±0.012	27.39±0.47	32±02	174±0.65	86.20±0.01
F3	3.9±0.05	0.14±0.015	48.85±0.18	19±05	49.92±0.11	96.66±0.04
F4	3.6±0.02	0.11±0.014	97.72±0.56	24±04	65±0.88	93.10±0.06
F5	3.6±0.01	0.12±0.011	28.52±0.44	20±02	55.46±0.42	57.69±0.31
F6	3.7±0.04	0.14±0.012	88.66±0.63	19±05	57.14±0.19	123.07±0.33
F7	4.0±0.02	0.15±0.013	37.70±0.45	22±01	51.84±0.21	100±0.52
F8	3.9±0.01	0.12±0.012	99.33±0.71	18±03	74±0.37	113.7±0.21

*SD Standard Deviation from mean, n=3, mean±SD

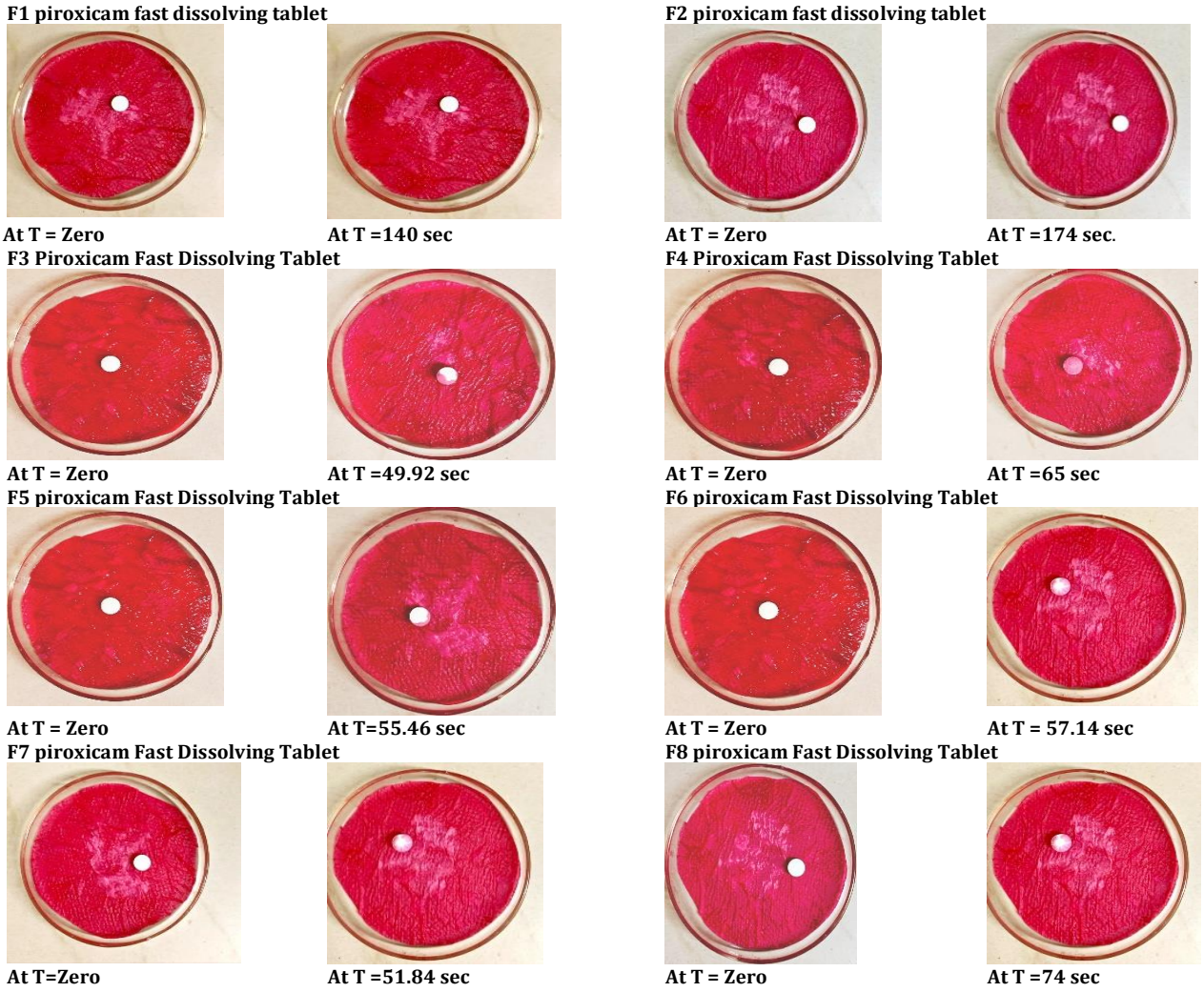


Fig. 5: Wetting times of piroxicam fast dissolving tablets formulated by direct compression employing starch crotonate (A novel superdisintegrant) and other known superdisintegrants

Table 4: Dissolution data of piroxicam fast dissolving tablets employing starch crotonate and other known superdisintegrants

	Cumulative percent piroxicam released							
Time (min)	F1	F2	F3	F4	F5	F6	F7	F8
5	11.18±0.22	74.59±0.87	95.83±0.44	96.81±0.13	96.32±0.41	96.81±0.14	98.27±0.19	99.99±10
10	22.86±0.53	90.72±0.17	99.24±0.61	99.75±0.37	99.27±0.43	99.72±0.58	99.24±0.30	----
15	24.32±0.67	99.91±0.27	----	----	----	----	----	----
30	33.56±0.32	----	----	----	----	----	----	----
45	37.81±0.11	----	----	----	----	----	----	----

*SD Standard Deviation from mean, n=3, mean±SD

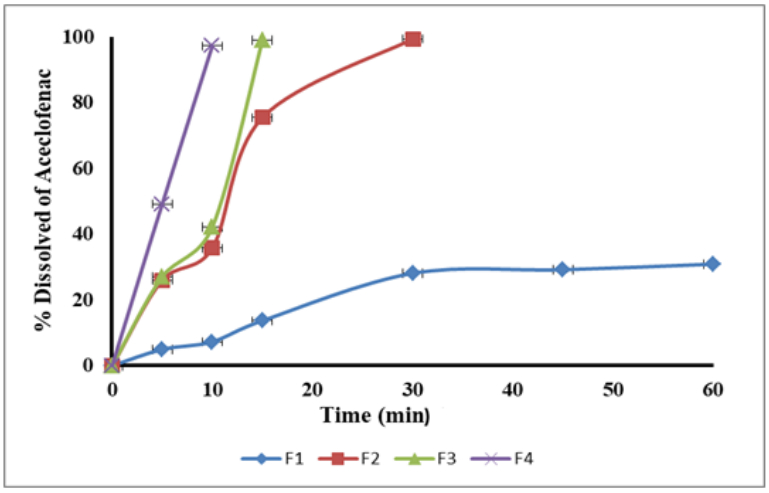


Fig. 6: Dissolution profiles of piroxicam fast dissolving tablets employing starch crotonate and other known superdisintegrants (F1-F4); n=3, mean±SD

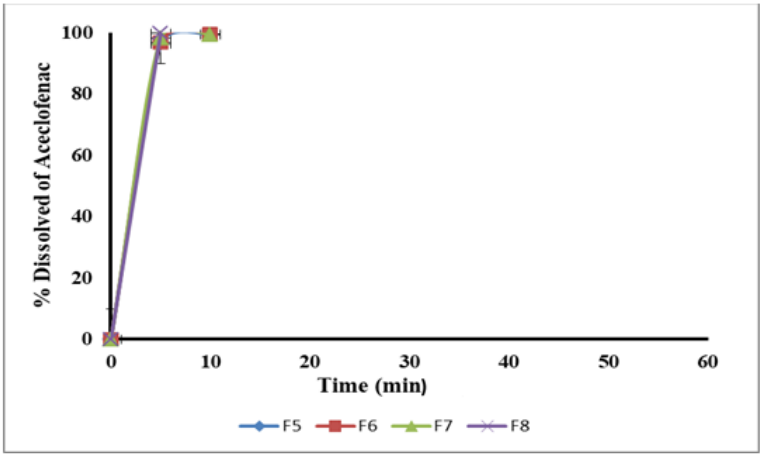


Fig. 7: Dissolution profiles of piroxicam fast dissolving tablets employing starch crotonate and other known superdisintegrants (F5-F8). n=3, mean±SD

Table 5: Dissolution parameters of piroxicam fast dissolving tablets formulated employing starch crotonate and other superdisintegrants

Parameters	F1	F2	F3	F4	F5	F6	F7	F8
PD_{10}	22.86	90.72	99.24	99.75	99.27	99.72	99.24	99.83
T_{50}(min)	68.35	4.91	3.48	3.44	3.46	3.44	3.40	3.4
DE_{10}(%)	21	97.7	93	92.8	93	93.3	93.7	49.9
Increase in DE_{10}(%)No of folds.	---	0.21	1.05	1.00	0.99	0.99	0.99	1.87
K_1 (min^{-1})	0.0027	0.0084	0.0047	0.016	0.0059	0.036	0.052	0.133
Increase in k_1(min^{-1}) No of folds	---	0.32	1.78	0.29	2.71	0.16	6.92	0.39

*SD Standard Deviation from mean, n=3, mean±SD, PD_{10}-Percent dissolved in 10 min, $DE_{10\%}$-Dissolution efficiency in 10 min

The disintegration time and percentage released in 10 min indicates that the dependent variables were strongly dependent on independent variables. The equipped equations linking the disintegration period percent release at the end of 10 min to the transform factors were shown in equations.

Final equation for coded factors

Disintegration time =+27.50+4.25A-6.75B-7.75C+4.50AB+3.00AC+7.00BC-5.25ABC. (R^2 = 1.000)

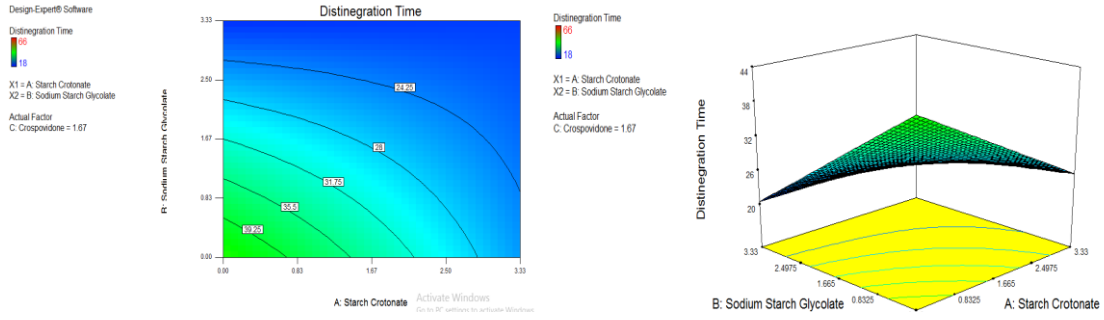
Percent release in 10 min =+80.08+8.62A+14.32B+14.22C-8.37AB-8.37AC-13.17BC+8.17ABC. (R^2 = 1.000)

The meaning of the R^2 shows the right suit. Polynomial calculations can be used to draw an inference by evaluating the size of the variable and the statistical meaning it bears (positive or negative).

One can easily deduce from polynomial equations that factor A, B, C had a negative effect on the disintegration time of Piroxicam fast-dissolving tablets. The relations between AB, BC and AC have a favourable impact on the rate of disintegration.

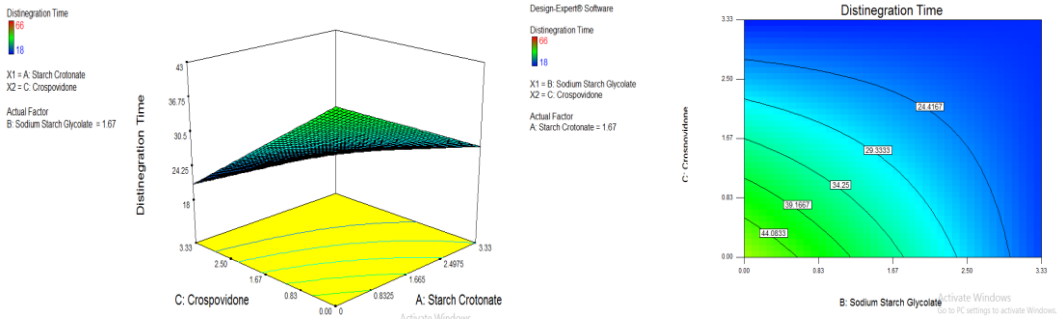
From the polynomial equations one can easily deduce that the factor A, B, C had negative effect on the disintegration time of Piroxicam fast dissolving tablets. The interactions of AB, BC and AC have positive effect on the disintegration time. The relationship of ABC had a negative disintegration time. Except for the interaction of AB and AC, all other main interactions have a positive effect on the percentage produced in 10 min.

Once the polynomial equation, which compares the rates of each component and their subsequent correlations with the time of disintegration and the percentage of release in 10 min, the surface response curves and contour plots were developed using software.



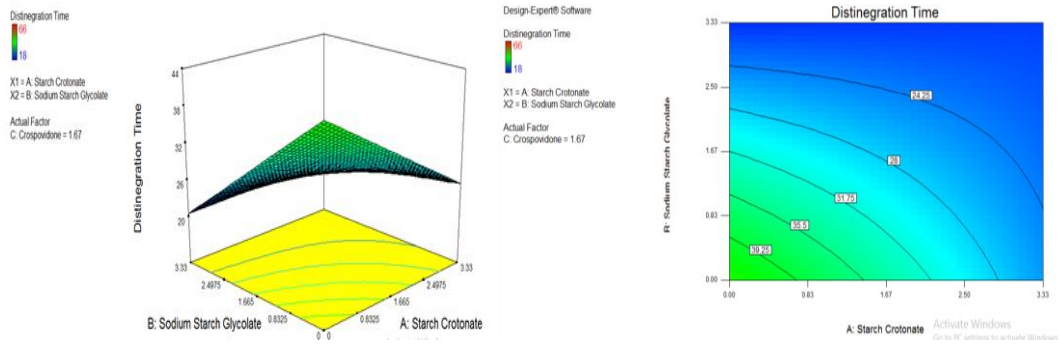
(B) Counter plot **(A) Response plot**

Fig. 8: (A) Response plot, (B) Contour plot of piroxicam fast dissolving tablets (effect of starch Crotonate and Sodium starch Glycolate on disintegration time)



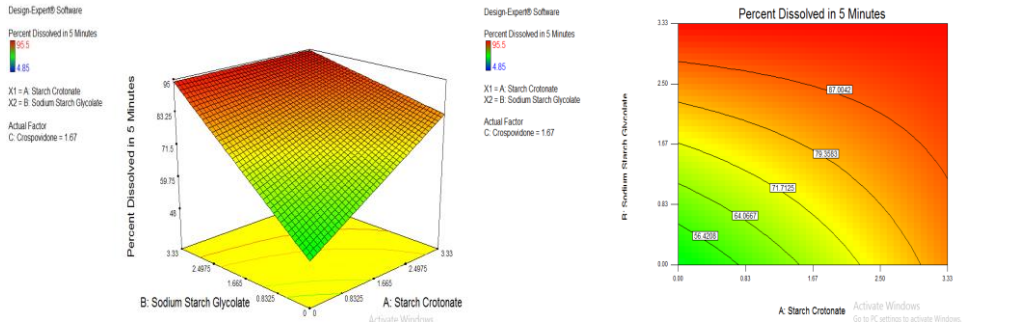
(A)Response plot **(B) Counter plot**

Fig. 9: (A) Response plot, (B) Contour plot of piroxicam fast dissolving tablets (effect of sodium starch glycolate and crospovidone on disintegration time)



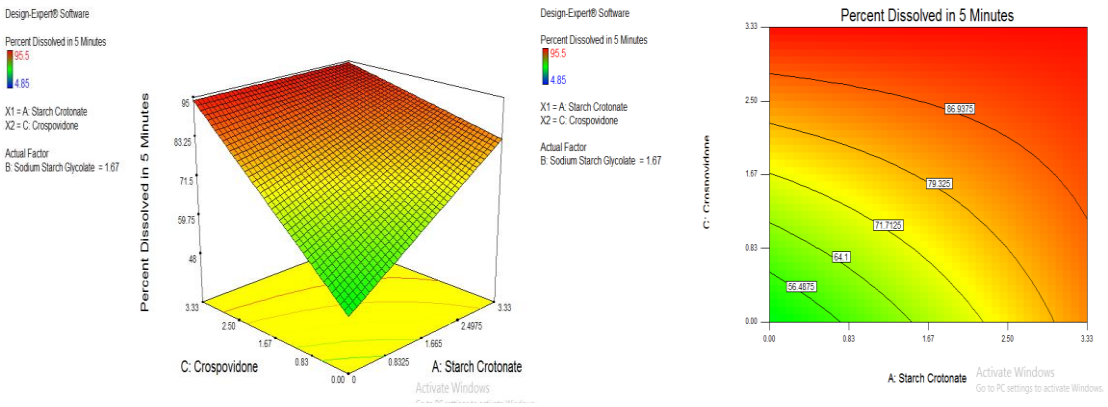
(A) Response plot **(B) Counter plot**

Fig. 10: (A) Response plot, (B) Contour plot of piroxicam fast dissolving tablets (effect of starch crotonate and sodium starch glycolate on disintegration time)



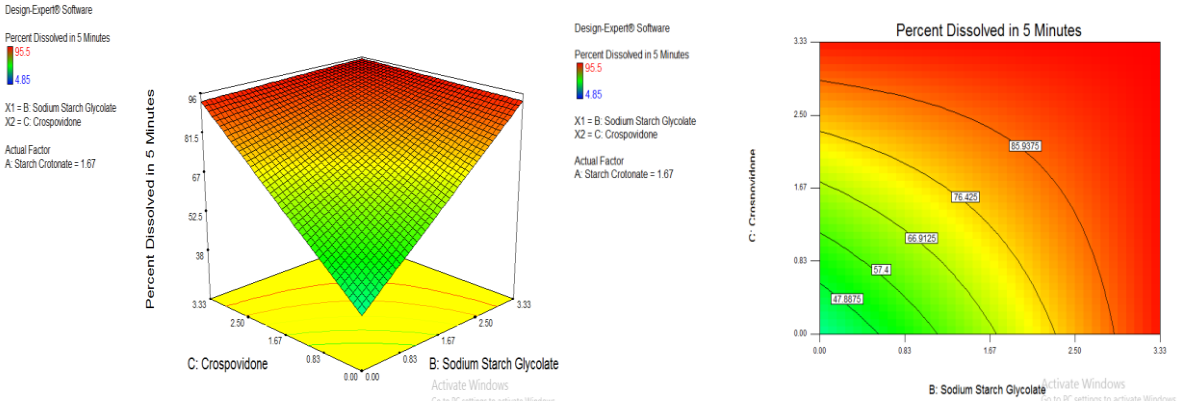
(A) Response plot **(B) Counter plot**

Fig. 11: (A) Response plot, (B) Contour plot of piroxicam fast dissolving tablets (effect of starch crotonate and sodium starch glycolate on percent dissolved in 5 min)



(A) Response plot **(B) Counter plot**

Fig. 12: (A) Response plot, (B) Contour plot of piroxicam fast dissolving tablets (effect of starch crotonate and crospovidone on percent dissolved in 5 min)



(A) Response plot **(B) Counter plot**

Fig. 13: (A) Response, (B) Contour plot of Piroxicam Fast dissolving tablets (effect of Sodium starch Glycolate and Crospovidone on percent dissolved in 5 min)

Response surface plots and contour plots show that as the concentration of starch crotonate (A), Crosscarmellose sodium (B), Crospovidone (C) increases, the time to disintegrate decreases. The effects of A and B on the time of disintegration were shown in fig. 5.6.

Contour plots have been found to be linear up to a certain degree, and there have been non-linear plots thereafter. It was determined from the contour plot (fig. 5.6) that less disintegration time can be achieved with a level range between 9 and 10 percent and a level of B between 4 and 5 percent. The influence of B and C was shown in fig. 5.7. The contour plots were found to be a liner that indicates a linear relationship between B and C.

It was determined from the contour plot (fig. 5.7) that less disintegration time can be achieved with the B level between 3 to 4 % and the C level between 3 and 4 %. The effects of A and C were shown in fig. 5.8. Contour plots were almost found to be linear, indicating a linear relationship between A and C.

It was calculated from the contour plot that less disintegration time can be accomplished with A at between 9 and 10% and C at between 3 and 4%. As a result, we can conclude that less disintegration time can be obtained when factor (A) was used in a concentration range of 9 to 10%. B and C in the range from 3 to 4 percent of the overall tablet weight.

The surface response plot and contour plots indicate that as the accumulation of A, B, C increases, the release rate decreases in 10 min. The impact of A and B on the percent release in 10 min was shown in fig 5.9. Contour plots have been found to be linear to a certain extent.

It was calculated from contour plot fig. 5.9 that more percent release can be done in 10 min with A range between 9 and 10 %and B level between 4 and 5 %. The results of both B and C were shown in fig. 5.10. Contour plots have been found to be linear, indicating the linear relationship between B and C.

It was calculated from the contour plot fig. 5.10 that more percent release in 10 min can be accomplished with a B level range of between 4 and 5 % and a B level range of between 4 and 5 %. The results of A and C were seen in fig. 5.11. Contour plots have been found to be linear, indicating the linear relationship between A and C.

CONCLUSION

The prepared starch crotonate was found to be fine, free flowing and amorphous powder. Also, its physical and micromeritic properties were analysed, which indicated good flow and compressibility properties that were required for a solid dosage form to be manufactured there by fulfilling all the aspects of superdisintegrant characteristics. Hence starch crotonate; a novel superdisintegrant can be used as a superdisintegrant in the formulation of fast dissolving tablets.

From the above data, the superdisintegrants that to be used in fast dissolving tablets with less disintegration time and more dissolution efficiency in 10 min were; factor-A i.e., Starch crotonate 10%, factor-B i.e., Sodium starch glycolate 5% and factor-C i.e., Crospovidone. These were found to be the ideal concentrations to formulate into fast dissolving tablets.

ABBREVIATION

M–Molar, NaOH–Sodium Hydroxide, °C-Degree Centigrade, #-Number, pH-Potential of hydrogen, ml-millilitre, g–grams, S. I-Swelling Index, W/V–Weight/Volume, FTIR-Fourier Transform Infrared Spectra

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Nil

AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

CONFLICT OF INTERESTS

Declared none

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