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# EVALUATION OF STARCH ACETATE: A NEW STARCH BASED POLYMER FOR CONTROLLED RELEASE OF DICLOFENAC SODIUM

**Devi Prasanna.CH[1]*, Venkateswara Rao. S[1], Padmalatha. K[2]**

Department of Pharmaceutics[1], Department of Pharmacology[2],
Vijaya Institute of Pharmaceutical Sciences for Women, Enikepadu, Vijayawada–521108

Corresponding Author E-mail: **venkateshsadhu@gmail.com**

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**ABSTRACT**

The objective of the present investigation is to synthesize starch acetate, a new starch based polymer and to evaluate its application in controlled release (CR) in the design of Diclofenac sodium controlled release tablets. Starch acetate prepared by reacting potato starch with acetic anhydride in the presence of sodium hydroxide at elevated temperatures was insoluble in water and has poor swelling and gelling property when heated in water. In the micromeritic evaluation, the angle of repose and compressibility index values revealed the excellent flow characteristic of starch acetate prepared. All the physical properties studied indicated that starch acetate is a promising pharmaceutical excipient in tablets. Diclofenac Sodium, a widely prescribed anti inflammatory analgesic drug belongs to BCS class II and exhibit variable oral bioavailability due to its poor solubility and dissolution rate. Matrix tablets of Diclofenac Sodium (100 mg) prepared employing starch acetate as matrix former in different proportions gave slow and controlled release more than 12 hr. Diclofenac Sodium release was diffusion controlled and dependent on percentage of starch acetate. As the polymer concentration was increased, release rate was decreased. Good linear relationship was observed between percent polymer and release rate ($K_0$). Thus drug release from the matrix tablets could be controlled by varying the proportion of drug: polymer in the matrix.

## INTRODUCTION

Oral drug administration has been the predominant route for drug delivery. It is known to be the most popular route of drug administration due to the fact the gastrointestinal physiology offers more flexibility in dosage form design than most other routes. A major challenge for the pharmaceutical industry in drug development is to produce safe and efficient drugs, therefore properties of drugs and the way in which they are delivered must be optimised. A controlled release drug delivery system delivers the drug locally or systemically at a predetermined rate for a specified period of time. The goal of such systems is to provide desirable delivery profiles that can achieve therapeutic plasma levels.

Drug release is dependent on polymer properties, thus the application of these properties can produce well characterised and reproducible dosage forms. The primary mechanism of drug release from hydrophilic matrices occurs when the polymer swells on contact with the aqueous medium to form a gel layer on the surface of the system. The drug then releases by dissolution, diffusion and/or erosion[1]. Diclofenac sodium is a non steroidal anti inflammatory (NSAID) drug that reduces pain and inflammation. It has poor aqueous solubility, short biological half life (2 hours) and undergoes excessive first pass metabolism. So it is prescribed 2-3 times / day, which leads to poor patient compliance. Present studies

investigate the possibility for the development of control release tablet of Diclofenac sodium[2]. Starch is a natural, biodegradable polymer and modified starches have been used various pharmaceutical purposes such as fillers, super Disintegrants and matrix formers in capsules and tablet formulations. Among the various approaches, preparation of drug matrix tablet is one of the least complicated approaches for obtaining controlled release. One of the important modification of starch acetate. Starch acetate is reported to have excellent bond forming ability and suitable for coating and controlled release applications. Much of the literature on starch acetate and its industrial applications are patented, the details of which are not known[3]. In the present work, starch acetate was synthesized, characterized and evaluated as rate controlling matrix former for Diclofenac sodium.

## MATERIAL AND METHODS

**Materials**: Diclofenac sodium purchased from Coastal chemicals Pvt. Ltd, Visakhapatnam, Potato starch, potassium dihydrogen phthalate, Hydrochloric acid were obtained from Merck specialties Pvt. Ltd, Mumbai and all other chemicals were used as analytical grade.

**Synthesis of starch acetate:** Starch acetylation was conducted by a modification of the procedure of Mark and Mehltretter. Potato starch (20 parts), acetic anhydride (80 parts) and sodium hydroxide 50% solution (4.4 parts) were mixed and refluxed for 5 h at 150ºC. The reaction mixture was added to cold water to precipitate the starch acetate formed. The product was collected by vacuum filtration, washed repeatedly with water and dried at 80ºC for 2h. The excess cold water was added to terminate the reaction and ground the product before testing[4].

**Characterization of starch acetate:** The prepared starch acetate was evaluated for Solubility, Identification, pH, Melting Point, Viscosity, Swelling Index, Test for gelling property, Moisture absorption, Particle size, Density: Bulk density, Angle of repose, Compressibility index and Determination of Degree of Substitution[4].

### Analytical Tests for API

**Solubility Analysis:** Pre-formulation solubility analysis was done, which included the selection of suitable solvent system to dissolve the drug as well as various excipients[4].

**Melting Point Determination:** Melting point determination of the obtained drug sample was done; as it is a first indication of purity of the sample. The presence of relatively small amount of impurity can be detected by lowering as well as widening in the melting point range.

**Identification of Pure Drug:** FTIR spectroscopy was used for identification of pure drug.

**Drug-polymer-excipient compatibility studies:** This was confirmed by infrared light absorption scanning spectroscopy (IR) studies. Infra red spectra of pure drug and mixture of formulations were recorded by dispersion of drug and mixture of formulations in suitable solvent (KBr) using Fourier Transform Infrared Spectrophotometer (FTIR)[4].

**Determination of $\lambda_{max}$:** 20µg/ml solution of Diclofenac sodium was prepared in dilution. The resulting solution was scanned in UV-Vis spectrophotometer from 400- 200nm to determine the $\lambda_{max}$.[4]

**Preparation calibration curve:** 100 mg of Diclofenac sodium pure drug transferred into 100 ml volumetric flask and makeup the final volume with phosphate buffer pH 7.4. 1 ml of this stock solution was taken and make up to 100ml using phosphate buffer pH 7.4 to get a concentration 10 µg/ml. From this stick solution different concentration 2 – 10 µg/ml was made up with phosphate buffer pH 7.4. From each concentration sample was taken & the absorption was measured at 276 nm by using UV spectrophotometer by using phosphate buffer pH 7.4 as a blank. The graph was plotted by taking concentration on X-axis and absorption on Y-axis. The experiment was performed in triplicate and based on average absorbance; the equation for the best line was generated.

## FORMULATION OF MATRIX TABLETS

Matrix tablets of Diclofenac sodium (100 mg) were prepared as per the formulae given in the Table 1. The required quantities of medicament, diluent (lactose) and matrix material (starch acetate) were mixed thoroughly in a mortar by following geometric dilution technique. The granulating fluid (solvent blend of water and alcohol in 1:1 ratio)

was added and mixed thoroughly to form dough mass. The mass was passed through mesh No.12 to obtain wet granules. The wet granules were dried at 60°C for 4 hours. The dried granules were passed through mesh No. 16 to break the aggregates. The lubricant, talc and magnesium stearate were passed through mesh No. 100 on to dry granules and blended in a closed polyethylene bag. The tablet granules were compressed into tablets on a tablet punching machine to a hardness of 8 Kg/sq.cm using 8 mm round and convex punches[5]. **Pre compression parameters**

**Bulk density and Tapped density (g/ml)**: The previously weighed pure drug or granules (W) were placed separately into a graduated measuring cylinder and the initial (bulk) volume ($V_B$) was noted. It was placed in the tapped density tester USP and subjected to constant tapping at a rate of 200drops/min until the difference between the initial and final volumes should be less than 2%. It was recorded as the final (tapped) volume ($V_T$) and various flow properties were calculated with the following formulae[6].

$$\textbf{Bulk Density, } \rho B = W/V_B$$

$$\textbf{Tapped density, } \rho T = W/V_T$$

**Compressibility Index:** It was calculated by using the following formula, The CI value below 15% indicates good flow of the powder and above 30% indicates poor flow property of the powder[6].

$$\textbf{Compressibility Index (CI)} = 1 - \rho B/\rho T \times 100$$

**Hausner's Ratio:** It is calculated by the following formula; The Hausner's ratio below 1.25 indicates good flow property and above 1.25 indicates poor flow property of the powder.

$$\textbf{Hausner's Ratio} = \rho T/\rho B$$

**Angle of Repose (Θ):** It was determined by using a funnel whose tip was fixed at a constant height (H) of 2.5cm from horizontal surface. The granules and the powder were passed separately through the funnel until the tip of the conical pile touches the tip of the funnel. The radius of the base of the conical pile is measured as R (cm). It is determined with the formula

$$\textbf{Angle of repose } (\theta) = \text{Tan-1 (height /radius)}$$

**Post-compression Parameters**

**Hardness:** The hardness of three randomly selected Diclofenac sodium matrix tablets from each batch was measured by placing each tablet diagonally between the two plungers of tablet hardness tester and applying pressure until the tablet broke down into two parts completely and the reading on the scale was noted down in $Kg/cm^2$. The mean and standard deviation values were calculated and reported. (Limits: Tablet hardness should be between 4 – 8 kg)[8].

**Thickness:** Three randomly selected Diclofenac sodium matrix tablets from batch were used for thickness determination. Thickness of each tablet was measured in mm using Vernier Calipers. The mean and standard deviation values were calculated and reported[8].

**Weight variation test:** Twenty tablets were randomly selected from each batch and individually weighed using an electronic balance. The average weight was calculated, individual tablet weight was then compared with the average value to find out the deviation in weight and percent variation of each tablet was calculated[9].

$$\% \text{ Weight variation} = \frac{(\text{Average weight} - \text{Individual Weight})}{\text{Individual Weight}} \times 100$$

**Friability:** Pre weighed 10 tablets ($W_0$) from each batch were taken in Roche friabilator (Lab India, Mumbai) apparatus that revolves at 100 rpm for 4 minutes dropping the tablets through a distance of 6 inches with each revolution. At the end of test, tablets were reweighed (W) and the percentage loss was determined. Permitted friability limit is 1%. The % friability was then calculated by following formula[10]

$$\%F = 100\ (1 - W_0/W)$$

**Drug content estimation:** Ten randomly selected tablets from each formulation (F1 to F6) were finely powdered and powder equivalent to 100 mg of Diclofenac sodium was accurately weighed and transferred to 100 ml volumetric flasks containing 50 ml of phosphate buffer (pH 7.4). The flasks were shaken thoroughly to get uniform solution/suspension. The volume was made up to the mark with the above phosphate buffer and filtered. One ml of the filtrate after suitable dilution was subjected for the estimation Diclofenac sodium content at 276 nm using a double beam UV-visible spectrophotometer. Each reading was carried out in triplicate and

the average Diclofenac sodium content in the matrix tablet was calculated[11].

***In vitro* drug release study:** The *In-vitro* dissolution study was conducted as per the United States Pharmacopoeia (USP) XXIV. The rotating paddle method was used to study the drug release from the tablets. The dissolution medium consisted of 900 ml of phosphate buffer (pH 7.4). The release was performed at $37^0$C ± $0.5^0$C, at a rotational speed of 50 rpm. Five ml samples were withdrawn at predetermined time intervals over the period of 12 hr and the volume was replaced with fresh medium. The samples were filtered through Whatman filter paper and analyzed for Diclofenac sodium after appropriate dilution by UV spectrophotometer at 276 nm. The percent drug release was calculated using the calibration curve of the drug in phosphate buffer pH 7.4[11].

**Drug Release Rate:** The release rate of Diclofenac sodium from matrix tablets was determined by using zero order equation[12].

$$Qt - Qo = Ko\ t$$

Where, Qo = Initial amount of drug**,** Qt = Amount of drug at time t, Ko = Zero order rate constant, Ko = Zero order rate constant

**Stability study:** The purpose of stability study is to provide evidence on the quality of a drug substance or drug product, which varies with time under the influence of a variety of environmental factors such as temperature, humidity and light. Formulation F6 was selected for stability on the basis of the In vitro drug release profile. The formulations were subjected to accelerated stability studies as per ICH (The International Conference of Harmonization) guidelines i.e. and $40^0$ C/75% RH in air tight high density ethylene bottles for 3 months in thermo stated ovens. The samples were taken out at 0, 30, 60 and 90 days. Tablets were evaluated for the different physicochemical parameters i.e. weight variation, content uniformity and percentage of drug release[12].

## RESULT AND DISCUSSION

**Synthesis of starch acetate:** Acetylation of potato starch to high degree of substitution (DS) was studied by reacting starch with acetic anhydride using 50% aqueous NaoH as the catalyst. During acetylation, three free hydroxyl groups on C2, C3, and C6 of the starch molecule can be substituted with acetyl groups.

**Characterization of Starch Acetate:** The starch acetate prepared was characterized by determining various physicochemical properties. Starch acetate prepared was found to be white, crystalline, non hygroscopic powder and can easily be ground to different sizes. This powder has an average particle size of 5.58 μm. The starch acetate prepared was insoluble in water, aqueous buffers of pH 1.2 and 7.4, methanol, petroleum ether, dichloromethane, cyclohexane and chloroform. When tested for melting point, it was charred at 260 $^0$C. In water it exhibited good swelling index (3.5%). No gelling/pasting was observed with starch acetate when its aqueous dispersion was heated at $100^0$C for 30 min, where as potato starch formed a paste/gel during the above heat treatment. In the micromeritic evaluation, the angle of repose and compressibility index values revealed the excellent flow characteristic of starch acetate prepared. The percent acetylation was 30.1 % and the degree of substitution was found to be 1.606. All the physical properties studied indicated that starch citrate is a promising pharmaceutical excipient in tablets.

**Analytical Tests for API**

**Solubility Studies*:*** Solubility of Diclofenac sodium was determined in different media including distilled water, 0.1 N HCL and Phosphate buffer pH 7.4. Excess amount of Diclofenac sodium was added into three different conical flask containing 100 ml of distilled water, 0 .1 N HCL and phosphate buffer pH 7.4. These solutions were shaken for 48 h at room temp on a magnetic stirrer. After equilibrium, the suspensions were filtered through 0.45 μm Millipore membrane filters. The filtrate was appropriately diluted and the concentration of the Diclofenac sodium in the filtrate was determined by UV spectrophotometer at 276 nm. Solubility of Diclofenac sodium in water, 0.1 N HCL and Phosphate buffer pH 7.4 were found to be 88.6, 33.6 and 1058.9 μg/ml.

**Melting Point Determination:** After performing capillary method melting point of Diclofenac sodium found in range of 283-285$^o$C.

**Identification of Pure Drug:** FT-IR spectroscopy was used to determine the functional group present in the pure drug sample. The spectrum of Diclofenac sodium are shown characteristic peak at 3221 cm-1 due to N-H stretching frequency of secondary amine. The absorption bands at 1306 and 1386 cm-1 resulted from C-N stretching and the peaks at 1552 and 1572 cm-1 due to C=C stretching and C=O stretching of carboxyl ate group, respectively. The C-Cl stretching characteristic peak was observed at 745 cm-1.

**Drug Excipients Compatibility Studies:** The IR spectral analysis of Diclofenac sodium and the physical mixture of Diclofenac sodium and starch acetate are presented in figure 2 respectively. Pure Diclofenac sodium spectra showed principal peaks at different wave numbers corresponding to its functional groups, confirming the purity of the drug as per established standards. All the above characteristic peaks appear in the spectra of physical mixture of Diclofenac sodium and starch acetate, indicating no possibility of chemical interaction between the drug and starch acetate.

**Determination of λmax:** The Diclofenac sodium solution was scanned in UV-Vis spectrophotometer from 400- 200nm to determine the λmax. The λmax was found to be at 276 nm, so the calibration curve of Diclofenac sodium was developed at this wavelength.

**Calibration of Standard Curve:** The standard curve of Diclofenac sodium was done by using pH 7.4 PBS as the medium and making the concentrations of 2 µg/ml, 4 µg/ml, 6 µg/ml, 8 µg/ml and 10 µg/ml solutions. The absorbance of solutions was examined under UV-spectrophotometer at an absorption maximum of 276 nm. The standard graph was constructed by taking the absorbance on Y-axis and concentrations on X-axis. The standard calibration curve of Diclofenac sodium in pH 7.4 PBS was shown in Fig4. Drug concentration and absorbance followed linear relationship the curve obeyed Beer-Lambert's law and the correlation coefficient value ($R^2$) is 0.999.

**FORMULATION OF MATRIX TABLETS**

Matrix tablets of Diclofenac sodium could be prepared by employing different proportions of starch acetate by conventional wet granulation method. Starch acetate was added at 2, 4, 6, 8, 12 and 16 % in tablet weight and assess it influence on drug release characteristics. A total of six (F1 – F6) formulations were prepared using Diclofenac sodium as potent drug and starch acetate as release retardant polymer. The diluent lactose was also incorporated in the tablets. Magnesium stearate and talc were added in a final step and mixed, The Blend was compressed on 8 mm biconcave multiple punch tablet compression machine. Each tablet weighing 300 mg corresponding to 100 mg of Diclofenac sodium were obtained.

**Precompression Parameters:** The powdered blends of all the formulations were evaluated for bulk density and tapped density by using bulk density apparatus. The bulk density was found in the range of 0.73±0.29-0.84±0.14gm/$cm^3$. The tapped density ranged between 0.76±0.32 - 0.87±0.26gm/$cm^3$. The Compressibility index of all the formulations exists in the range between 3.46±0.55 - 8.43±0.65. The result of the Hausner's ratio of all the formulations was between 1.02±0.13–1.09±0.02. These values indicate that the prepared powder blend had exhibited good flow properties. The prepared powder blend of all the formulations was evaluated for the flow properties. The angle of repose of all the formulations was within the range of 17.74 - 25.17. These values indicate that the powder blend had exhibited good flow properties.

**Post compression Parameters:** All the formulations were prepared under similar conditions and the tablets exhibited white color, convex in shape with smooth surface. The hardness for the tablets of all formulations was adjusted to 6.8–8.0 Kg/$cm^2$ so that indicating good mechanical strength with an ability to withstand physical and mechanical stress conditions while handling. The thickness was measured for the tablets of all formulations and was found to be within the acceptable range. The weight of the tablet varied between 297 ± 0.28 to 303 ± 0.58 mg for all the formulations. All the tablets passed weight variation test as the ±5% weight variation was within the pharmacopoeial limits. In all the formulations, the friability value is less than 1% and meets the IP (Indian Pharmacopoeia)

limits; indicate good mechanical resistance of the tablet. The drug content varied between 99.54%±0.5 to 101.31%±0.2 for all the formulations. The content of all the tablets was found to be uniform with low standard deviation values indicating efficient mixing of drug, polymer and excipients.

***In Vitro* Release Studies:** The *in vitro* drug release studies were performed to evaluate the release of Diclofenac sodium from matrix tablets. The drug release of six formulations was compared with each other and the results are represented diagrammatically in Fig-5. The percentage drug release from F1, F2 and F3 formulations was found to be 100% after 8, 10 and 12 hours time intervals. The percentage drug release from F4, F5 and F6 formulations was found to be 93.71, 82.74 and 68.38 after 12 hours time intervals. From all the formulations F6 formulation shows slow drug release when compared to other five formulations. The result indicates that the percentage of starch acetate increase the drug release was decrease and the formulation F6 contains highest concentration of 16% starch acetate.

**Release rate of Matrix tablets:** The release rate of Diclofenac sodium from matrix tablets was determined by using zero order equation. The graph was plotted between percentage polymer verses release rate and it given steep down curve. As the polymer concentration was increased, release rate was decreased. Good linear relationship was observed between percent polymer and release rate ($K_0$). Thus drug release from the matrix tablets could be controlled by varying the proportion of drug: polymer in the matrix.

**Stability Studies:** The stability studies were conducted on the selected formulation F6 as per the ICH guidelines. The stability studies were done at the intervals of 0, 30, 60 and 90 days. The parameters studied were weight variation, percentage drug content and percentage of drug release. The results are shown in Table-6. From the results it was concluded that there were no significant changes in any values. Hence this formulation was considered to be highly stable.

**Table-1: Formulation of Diclofenac Sodium Matrix Tablets**

| Ingredients | Formulation code | | | | | |
|---|---|---|---|---|---|---|
| | F1 | F2 | F3 | F4 | F5 | F6 |
| Diclofenac sodium | 100 | 100 | 100 | 100 | 100 | 100 |
| Lactose | 168 | 162 | 156 | 150 | 138 | 126 |
| Starch Acetate | 5 | 10 | 15 | 20 | 30 | 40 |
| Mg. Stearate | 2.2 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Talc | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Total | 300 | 300 | 300 | 300 | 300 | 300 |

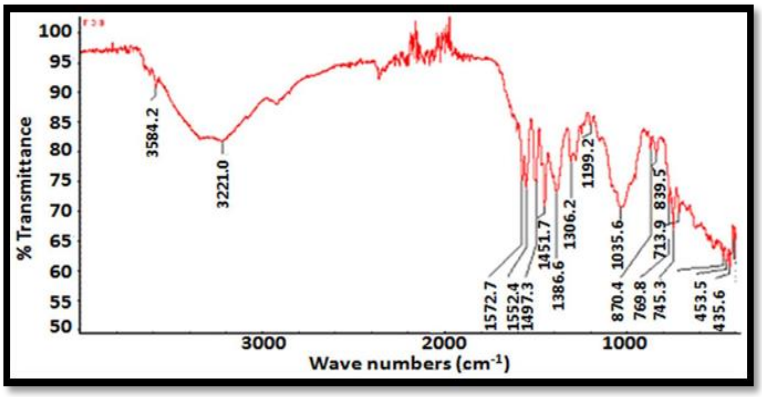


**Fig-1: IR Spectra of Diclofenac sodium**

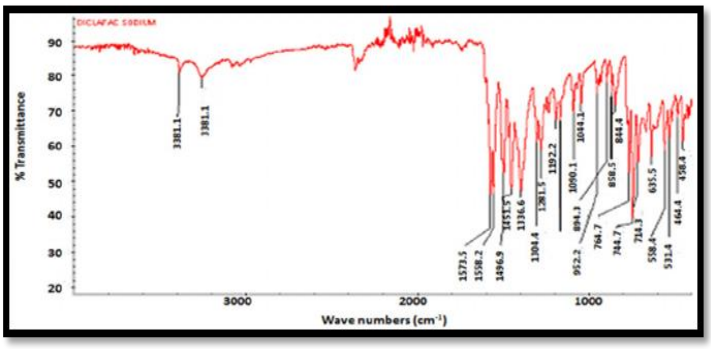


**Fig-2: IR Spectra of Diclofenac sodium and Starch acetate**

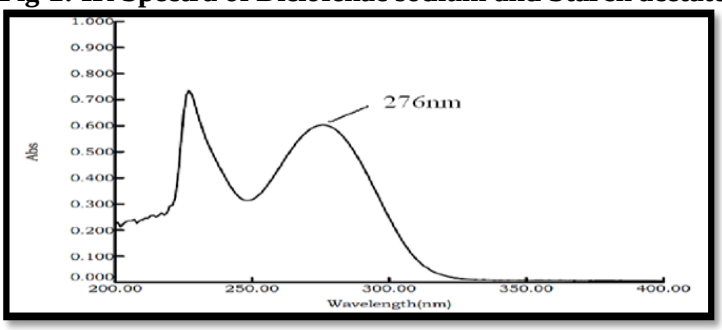


**Fig-3: UV Spectra of Diclofenac sodium**

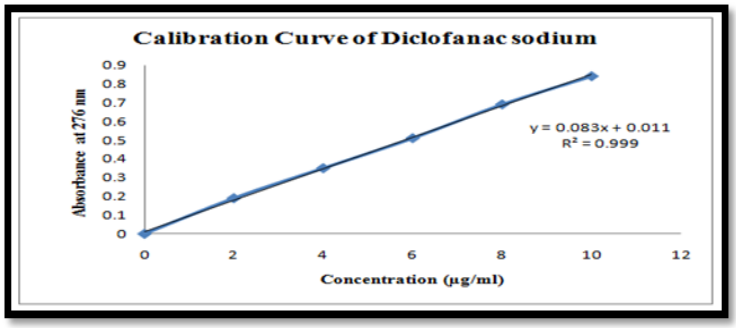


**Fig-4: Standard Calibration Curve of Diclofenac sodium in pH 7.4 PBS**

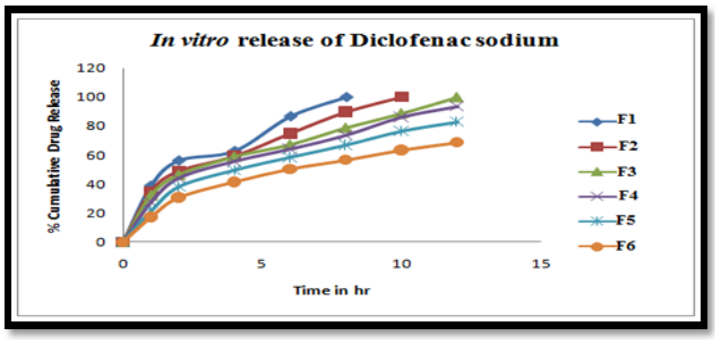


**Fig-5: Cumulative % drug release from Diclofenac sodium matrix tablets**

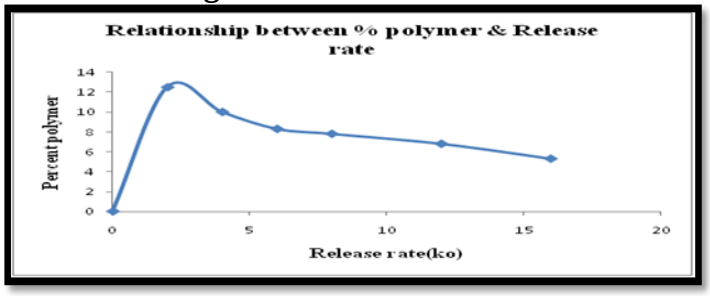


**Fig -6: Relationship between percent polymer and release rate ($K_0$)**

**Table-2: Standard Calibration Curve of Diclofenac sodium**

| S.NO | Concentration(µg/ml) | Absorbance in pH 7.4 PBS (nm) |
|---|---|---|
| 1. | 0 | 0.0 |
| 2. | 2 | 0.19 |
| 3. | 4 | 0.35 |
| 4. | 6 | 0.51 |
| 5. | 8 | 0.69 |
| 6. | 10 | 0.84 |

**Table-3: Precompression Parameters of all the formulations F1 – F6**

| S. No | Formula Code | Bulk Density ($gm/cm^{3)}$ | Tapped Density ($gm/cm^{3)}$ | Carr's Index | Hausner's Ratio | Angle of Repose |
|---|---|---|---|---|---|---|
| 1. | F1 | 0.76±0.27 | 0.83±0.31 | 8.43±0.65 | 1.09±0.02 | 17.74±0.14 |
| 2. | F2 | 0.73±0.29 | 0.77±0.25 | 5.19±0.65 | 1.05±0.03 | 24.22±0.26 |
| 3. | F3 | 0.84±0.14 | 0.87±0.26 | 5.44±0.66 | 1.03±0.24 | 25.17±0.23 |
| 4. | F4 | 0.83±0.17 | 0.86±0.18 | 3.48±0.58 | 1.03±0.26 | 25.56±0.25 |
| 5. | F5 | 0.76±0.14 | 0.78±0.28 | 3.46±0.55 | 1.02±0.13 | 24.70.±0.42 |
| 6. | F6 | 0.74±0.36 | 0.76±0.32 | 3.63±0.27 | 1.02±0.16 | 24.22±0.18 |

**Mean ± S.D. of three determinations**

**Table No -4: Postcompression Parameters of all the formulations F1 – F6**

| Formula Code | Hardness ($Kg/cm^2$) | Friability (%) | Weight Variation (mg) | Thickness (mm) | Drug Content (%) |
|---|---|---|---|---|---|
| F1 | 6.9±0.22 | 0.29±0.12 | 299±0.65 | 4.92±0.55 | 99.61±0.45 |
| F2 | 6.8±0.55 | 0.42±0.25 | 300±0.55 | 4.73±0.24 | 101.31±0.25 |
| F3 | 7.4±0.51 | 0.51±0.58 | 301±0.58 | 4.83±0.32 | 99.54±0.55 |
| F4 | 7.8± 0.25 | 0.58±0.36 | 297±0.69 | 4.9±0.33 | 99.79±0.58 |
| F5 | 8.1±0.69 | 0.52±0.64 | 300±0.45 | 4.96±0.85 | 99.82±0.54 |
| F6 | 6.8± 0.25 | 0.53±0.58 | 303±0.28 | 4.83±0.55 | 99.69±0.58 |

**Mean ± S.D. of three determinations**

**Table -5: Cumulative % drug release from Diclofenac sodium matrix tablets**

| Time(hr) | F1 | F2 | F3 | F4 | F5 | F-6 |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 38.91 | 34.92 | 32.24 | 27.65 | 21.36 | 17.25 |
| 2 | 56.24 | 48.92 | 46.42 | 44.21 | 38.12 | 30.56 |
| 4 | 62.84 | 59.21 | 58.91 | 55.83 | 49.53 | 41.32 |
| 6 | 86.78 | 74.93 | 67.24 | 64.26 | 58.44 | 50.21 |
| 8 | 100 | 89.72 | 78.84 | 73.87 | 66.83 | 56.29 |
| 10 | --- | 100 | 88.78 | 86.38 | 76.47 | 63.21 |
| 12 | --- | --- | 100 | 93.71 | 82.74 | 68.38 |

**Table-6: Stability Studies of Formulation F6**

| Parameter | Time (days) | | | |
|---|---|---|---|---|
| | 0 | 30 | 60 | 90 |
| | 40 ± 2 °C 75±5% RH | 40 ± 2 °C 75±5% RH | 40 ± 2 °C, 75±5% RH, 40 ± 2° C, 75 ± 5% RH | 40 ± 2 °C 75±5% RH |
| Weight Variation | 303±0.28 | 303±0.17 | 304±0.35 | 304±0.42 |
| Drug Content (%) | 99.69±0.58 | 98.69±0.58 | 96.69±0.58 | 96.69±0.58 |
| % Drug release | 68.38 % | 67.38 % | 63.38 % | 65.38 % |

## CONCLUSION

Starch acetate prepared by reacting potato starch with acetic anhydride at elevated temperatures was insoluble in water and has no pasting or gelling property when heated in water. In the micromeritic evaluation, the angle of repose and compressibility index values revealed the excellent flow characteristic of starch acetate prepared. All the physical properties studied indicated that starch citrate is a promising pharmaceutical excipient in tablets. Diclofenac sodium release from the tablets formulated employing starch acetate was slow and controlled more than 12 hr and depended on percentage of polymer in the tablet. Diclofenac sodium release from F6 formulation employed 16 % starch acetate was showed better controlled release than other formulations. Hence the starch acetate polymer is suitable for the design of oral controlled release of Diclofenac sodium.

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