Research Article

Formulation and Evaluation of Fast Disintegrating Tablet of Diclofenac Potassium Using *plantago ovata* Seed Mucilage Powder as a Natural Superdisintegrant.

Nilima Narkar[1] , Dr. Prof. Sonia Singh[2], Vibhavari M.Chatur [3],

Pallavi R.Kaple[3], Lipsi Chauhan[3], Akash Lamjane[4].

Corresponding author-Ms.Nilima Narkar Email-nilimanarkar0@gmail.com

[1,4,]Student of M Pharm ,Pharmaceutics Department, Alard College of Pharmacy, SPPU, Pune

[2]Dr. Sonia Singh, Principal & Professor of Pharmaceutics Department, Alard College of Pharmacy, SPPU, Pune

[3]Assistant Professor, Pharmaceutics Department, Alard College of Pharmacy, SPPU, Pune

ABSTRACT:

The purpose of this research was to develop fast disintegrating tablets of Diclofenac Potassium containing natural super disintegrant from *Plantago ovata*(family: *Plantaginaceae*). The mucilage was extracted from seeds of *Plantago ovata*and used to develop the fast disintegrating tablet of Diclofenac Potassium. The disintegration property of mucilage powder in FDTs was compared with widely used superdisintegrants like Sodium Starch Glycolate (SSG), and Ac-Di-Sol.The prepared FDTs were evaluated for uniformity of weight, hardness, thickness, friability,anddisintegration time, *In-vitro* dissolution. From the study, it was concluded that Diclofenac Potassium tablet containing*plantago ovata*seed mucilage powder shows disintegration time 18 sec which was less than SSG and Ac-Di-Sol.

Keywords: Diclofenac Potassium, *Plantago ovata* Seed Mucilage Powder, FDT, Natural Super disintegrant

INTRODUCTION:

Fast disintegrating tablets (FDTs) are oral drug delivery systems resulting in quick disintegration of the administered medicine into solution or suspension when in contact with the saliva. FDTs are commonly known as fast melt, orally disintegrating tablets, fast dissolving tablets, mouth dissolving tablets, quick disintegrating tablet, rapid melt, melt in mouth, quick-dissolving and porous tablet. These formulations have advantages of both solid and liquid dosage systems i.e., they are convenient as solid dosage and easy to swallow as a liquid formulation. The fast-disintegrating drug delivery system provides convenient means of administering tablets especially to paediatrics, geriatrics and patients having difficulty in swallowing conventional dosage form, thus improving compliance to dosage regime. FDTs are also useful when rapid disintegration and absorption of drug is needed thereby producing rapid onset of action. [(1,2)]Fast disintegration is usually achieved using super disintegrants. They have greater disintegrating efficiency than conventional disintegrants and are effective

at low concentrations. Examples of super disintegrant include Ac-Di-Sol, Sodium Starch Glycolate.[2]

The natural super disintegrants involve various natural substances like gums, mucilage, and other substances of natural origin which are more effective at lower concentrations with greater disintegrating efficiency and mechanical strength. Some natural substances like gum karaya, modified starch and agar have been used in the formulation of FDT's. Mucilage of natural origin is preferred over semi- synthetic and synthetic substances because they are comparatively cheaper, abundantly available, non- irritating and nontoxic in nature. Some natural polymer provides the fast disintegration as synthetic super disintegrants. Recently some gums and mucilage have been investigated to improve the disintegration processes. [6]

*Plantago ovata*seed mucilage powder can be used as natural super disintegrant. Ispaghula husk contains the certain amount of dried seeds of the plant which is known as*Plantago ovata*.the plant holds mucilage in the epidermis of the seeds. The mucilage of*Plantago ovata*has different features like binding, disintegrating and sustaining properties.disintegrating activity *Plantago ovata*mucilage provides fast disintegration of tablets. This study aimed to formulate fast disintegrating tablets of Diclofenac Potassium using *Plantago ovata*mucilage powder as a natural super disintegrant .[6,7]

Diclofenac Potassium is a commonly prescribed non-steroidal anti-inflammatory drug (NSAID) that is used as an analgesic, antipyretic and anti-inflammatory drug, and in treating various acute, chronic pain and inflammatory conditions. It is known to dissolve and get absorbed faster than the sodium salt and is thus, recommended in treatment that needs quick onset of action mainly for its analgesic properties. To achieve a fast onset of action, fast disintegrating tablets of Diclofenac can be designed and formulated for quick absorption in the gastrointestinal tract.

MATERIALS: Diclofenac Potassium (Research lab fine chem ,Mumbai), Dipac (Analab fine chemicals ,Mumbai), Mannitol (Analab fine chemicals ,Mumbai), Ac-di-sol (Hilab chemicals) ,SSG(research lab fine chem ,Mumbai), Aerosil 200 (Analab fine chemicals, Mumbai) Magnesium Stearate(AG traders, Pune), MCC (Analab fine chemicals, Mumbai), *Plantago ovata* seed was purchased at a local market in pune and processed into powder in the laboratory.

METHODS: Preparation of *Plantago ovata* Mucilage Powder

Seeds of *Plantago ovata* were used for isolation of mucilage .they were soaked in distilled water for 24 h and then boiled for 30 min for complete release of mucilage into water. the material was filtered by squeezing in a muslin cloth to remove marc, then equal volume of acetone was added to filtrate to precipitate the mucilage. The mucilage was separated and dried in oven at a temperature less than 60℃, powdered (60 mesh) and stored in desiccator.[2

Evaluation of Diclofenac Potassium [3,4,5)

Determination of ⅄max for Diclofenac Potassium:

Diclofenac Potassium Pure drug 100 mg was transferred into 100 ml of Phosphate buffer pH 6.8 in a volumetric flask to prepare Standard stock solution. From this Std stock solution 10ml was diluted to 100 ml with Phosphate buffer 6.8 solution and scanned for Diclofenac Potassium drug over range of 200-400 wavelength. The ⅄max 276 nm was determined from this scan.

Standard calibration curve of Diclofenac Potassium in buffer pH 6.8

Accurately weighed 100 mg of Diclofenac Potassium was added to 100 ml volumetric flask, volume made up to 100 ml with Phosphate buffer pH 6.8 as stock solution. From this Std stock solution working solutions of 5,10,15,20,25,30 ppm were prepared separately. Absorbance was measured for each solution at ⅄max 276 nm using UV spectrophotometer. Calibration curve was plotted for absorbance vs. Concentration to confirm linearity.

Formulation of Fast Disintegrating Tablet: Direct Compression method- FDT of Diclofenac Potassium were formulated by using direct compression method. The composition of tablet are given in table 1 below. All the ingredient except Magnesium Stearate as shown in table were pass through mesh 60 and mixed thoroughly. The above blend was lubricated with Magnesium Stearate and the powder blend was compressed into tablets on a 12 station rotary tablet punching machine using 8 mm flat round bevelled edged punch.[8, 9]

Table 1 : Formulation of Fast disintegrating tablet of Diclofenac Potassium.

Sr. no.	Ingredient mg/tablet	F1	F2	F3	F4	F5	F6	F7	F8	F9
1	Diclofenac Potassium	25	25	25	25	25	25	25	25	25
2	Di-Pac	170	165	164	159	-	-	-	-	-
3	MCC	-	-	-	-	159	159	169	164	159
4	Mannitol	50	50	50	50	50	50	50	50	50
5	Ac-Di-Sol	2.5	7.5	7.5	12.5	12.5	-	-	-	-
7	SSG	-	-	-	-	-	12.5	-	-	-
8	*plantago ovata* seed mucilage powder	-	-	-	-	-	-	2.5	7.5	12.5
9	Aerosil	-	-	1	1	1	1	1	1	1
10	Magnesuim Stearate	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
11	Total weight	250	250	250	250	250	250	250	250	250

Pre-Compression Evaluation Parameter Prior to compression, the powder blends should be evaluated for their Bulk and Tapped density and Compressibility Index and Hausner's Ratio calculated.[10,11] The Angle of Repose was also determined.

Bulk density and Tapped density : An accurately weighed amount of powder should be introduced in 100 ml measuring cylinder. Note the initial volume as Bulk Volume, then the cylinder should be tapped 100 times on a plane hard surface and tapped volume of material should be recorded. Bulk density (BD) and Tapped Density (TD) should be calculated using following formula:

BD = Mass/Bulk Volume ……(1)

TD = Mass/Tapped Volume. …….(2)

Hausner Ratio: Hausner's ratio is an index of ease of powder flow. It is calculated by the ratio of Tapped density andBulk density as given in formula :

HI = Tapped Density / Bulk density ……(3)

Angle of repose : It is determined by the funnel method. The blend was poured through a funnel, that can be raised vertically to a maximum cone height (h). The radius of the heap (r) was measured. The Angle of Repose is calculated by following formula:

TanØ= h / r ……. (4)

Carr's index (Compressibility) : The difference between tapped and bulk density divided by the tapped density was calculated and ratio expressed as a percentage. The equation is as given below:

CI = (TD- BD)/ TD ……..(5)

Post- Compression Evaluation Parameters :

General Appearance and Organoleptic Properties: It involes measurement of tablet size,shape,colour,surface texture.volunteers opinion for bitterness were recorded.[13,14]

Weight variation test : Individually weigh 20 tablets, which are selected at random and calculate the average weight. Then calculate differnce of individual weigh from average weight.

Tablet hardness: Monsanto hardness tester can be used to determine the force required to break the tablet.

Tablet Friability : Weigh twenty tablets and subject them to abrasion by employing a Roche friability Apparatus at 25 rpm for 4 min. Weigh the tablets and compare with their initial weights to obtain percentage friability.

Thickness: The thickness in millimeters (mm) should be measured individually by vernier caliper.

Disintegration time : For this test, six tablets are used in water at 37^0 C using a tablet disintegration tester. The time required for disintegrating all tablets and passing completely through the sieve is recorded.

***In vitro* dissolution study :**The release rate of drug from FDTs is determined using USP dissolution testing apparatus 2 (paddle method). The dissolution test is performed using 900 ml of Phosphate buffer 6.8 at 37±0.5 ^{0} C at 100 rpm.upto30 min by withdrawing 5ml sample every 5 min intervals and replacing with Phosphate buffer.

Drug Content : Accurately weighed 10 tablets are powdered and quantity equivalent to 25 mg of Diclofenac Potassium weighed and transferred into 100 ml volumetric flask. Initially 5 ml Ethanol was added and shaken for 10 min, then volume made up with Phosphate buffer pH 6.8. This solution filtered.diluted suitably and evaluated spectro-photometrically at 276 nm.

Drug excipient compatibility study by FTIR : Compatibilty of drug with excipient was confirmed by carrying out IR studies,using FTIR spectrophotometer. The pure drug along with excipient were subjected to IR studies.IR of pure drug and IR of FDT were carried out by Potassium Bromide pellet was employed.

RESULT AND DISCUSSION :

Determination of ⅄max for Diclofenac Potassium :

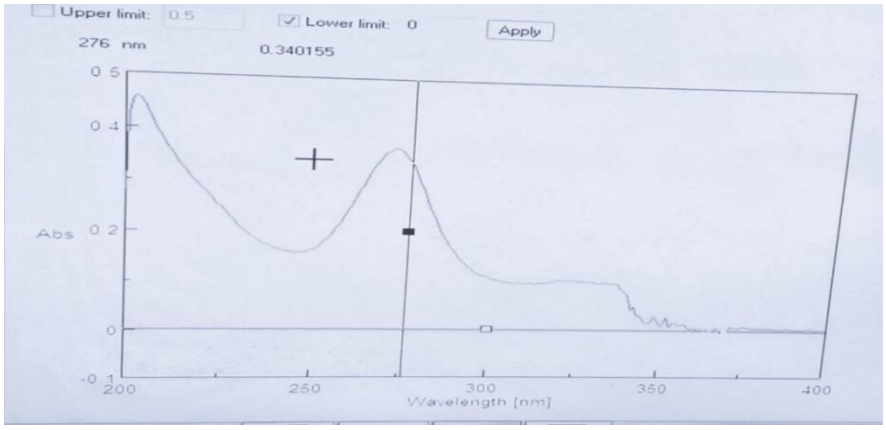


Fig. 1: **Determination of ⅄max of Diclofenac Potassium** at 276nm

Calibration Curve of Diclofenac Potassium :

The calibration curve of Diclofenac Potassium in Phosphate buffer pH 6.8 , its dilutions used for absorbance are given in table 2.

Table 2: Calibration curve of Diclofenac Potassium

Sr. no	Concentration in ppm	Absorbance at 276nm
1	5	0.125
2	10	0.251
3	15	0.379
4	20	0.551
5	25	0.625
6	30	0.781

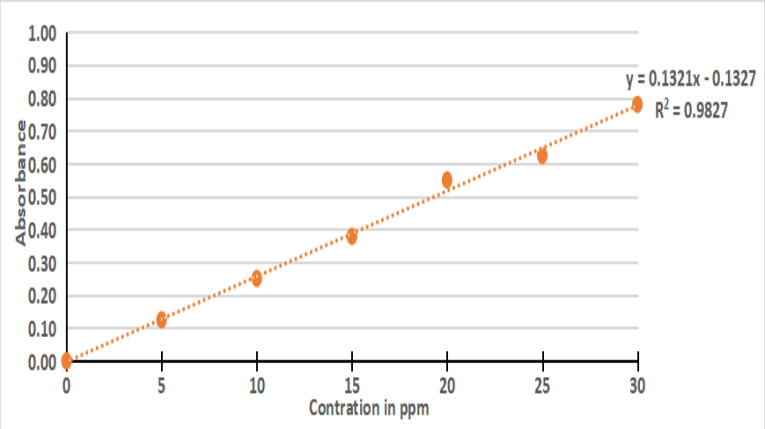


Fig. 2 Calibration curve: Diclofenac Potassium in PBS 6.8

Pre- Compression Parameters : The values of all precompression parameters are given in Table 3.

Table 3 : Pre Compression Parameter

Formulation	Bulk Density (g/ml)	Tapped Density (g/ ml)	Angle of repose (°)	Hausners ratio	Carr's Index %
F1	0.45 ±0.05	0.58 ±0.04	26.10 ±0.02	1.28 ±0.02	22 ±0.02
F 2	0.44 ±0.03	0.60 ±0.03	24.22 ±0.03	1.33 ±0.01	25 ±0.02
F 3	0.50 ±0.04	0.57 ±0.04	29.12 ±0.03	1.25 ±0.01	31 ±0.03
F 4	0.43 ±0.05	0.56 ±0.05	31.05 ±0.02	1.29 ±0.02	35 ±0.01
F 5	0.37 ±0.05	0.62 ±0.04	26.10 ±0.03	1.23 ±0.02	24 ±0.02
F6	0.43 ±0.05	0.56±0.04	35.10 ±0.02	1.34 ±0.02	24 ±0.02
F 7	0.46 ±0.03	0.58 ±0.03	32.34 ±0.03	1.39 ±0.01	28 ±0.02
F 8	0.49 ±0.04	0.60 ±0.04	28.12 ±0.03	1.28 ±0.01	31 ±0.03
F 9	0.44 ±0.05	0.59 ±0.05	27.05 ±0.02	1.23 ±0.02	30 ±0.01

Post Compression Parameters : The values of compression parameters are shown in table 4 below.

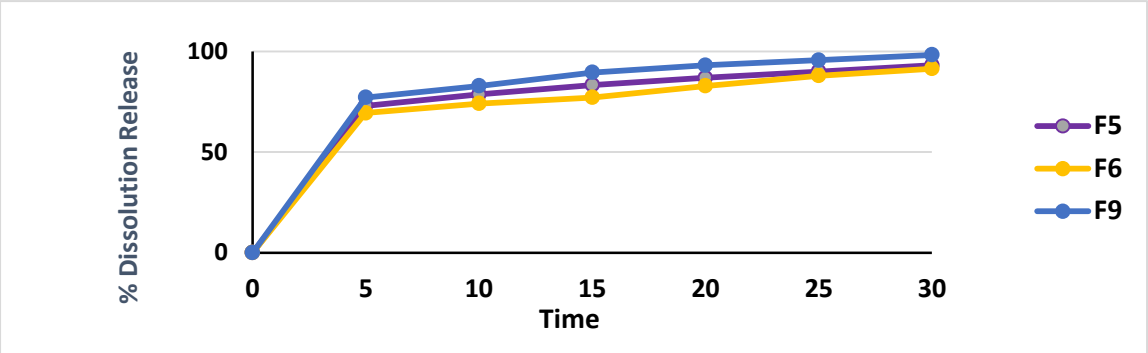
Table 4: Compression parameters of trial batches.

Trial no .	Wt mg	Hardness kg	Thickness mm	Friabilty (%)	D.T	Drug Content	Remarks
F 1	255	3.38±0.1	4.09± 0.15	0.37	4min 15	-	High D.T observed
F 2	248	3.4 ±0.2	3.89± 0.01	0.32	1min 30	-	Capping&Sticking observed i n tablet
F 3	250	3.5 ±0.1	3.70 ± 0.1	0.63	1min 18	-	Capping & sticking observed
F 4	251	3.5 ±0.3	3.40± 0.05	0.37	1min 7	-	Spotting observec
F 5	250	3.3 ±0.2	4.53± 0.01	0.49	39 s	96.30	Accepted trail with Ac-di-Sol
F 6	249	3.3±0.2	3.85± 0.15	0.37%	49se	95.28	Batch with SSG to compare D.T.
F 7	249. 4	3.4 ±0.2	3.89± 0.01	0.32%	1min 38 sec	-	Plantago ovataseedmucilage powder used as natural superdisintegrant 2.5 mg
F 8	250	3.5 ±0.1	4.21± 0.15	0.63 %	43 sec	92.08	Plantago ovata seed mucilage powder used 7.5 mg
F 9	250	3.5 ±0.3	4.27± 0.05	0.37%	18 sec	97.76	Plantago ovata seed mucilage powder used 12.5 mg.

Comparative study of all batches i.e F1 to F9 shown in below pie chart with respect to disintegration time. From pie chart, it can be seen that batch F9 shows minimum disintegration time i.e .18 sec compare to others (with *plantago ovata* seed mucilage powder natural superdisintegrant)

Dissolution Study:

The % dissolution release data shows that F5 contain(12.5mg Ac-Di-Sol) 91.44%DR,F6 contain(12.5mg SSG)93.06%DR,F9 contain (12.5 mg P*lantago ovata* seed mucilage powder) 98.22%DR,To compare %DR graph plotted as time/%DR for batches F5,F6,and F9.



Comparative %DR of F5(Ac-Di-Sol),F6(SSG),F9(*plantago ovata* seed mucilage powder)

Disintegration time of batch F5 (contain Ac-Di-Sol)-39 sec,F6 (contain SSG)-49 sec,F9 (P*lantago ovata* seed mucilage powder)-18 sec.batch F9 shows lowest D.T compared to F5 and F6.

Drug content (%) of batch F5,F6,F8,F9 were determined.which is obtained as (F5-97.60),(F6-95.28),(F8-92.08),(F9-97.76).compared to others batch F5,F6,F8 batch F9 shows maximum % drug content.% Dissolution release of batch F5-93.06%,F6-91.44%, and F9-98.22 %,here F9 shows maximum % drug release compared to F5 and F6.All pre-compression and post compression parameters of F9 was also in limits.Batch F9 with (*Plantago ovata* seed mucilage powder) as a natural superdisintegrant shows optimum result compared to F5 and F6 with (Ac-Di-Sol) and (SSG).

CONCLUSION : In the Present work FDT of Diclofenac Potassium by using *Plantago ovata* seed mucilage powder were prepared by direct compression method.use of other superdisintegrant like SSG,Ac-Di-Sol to compare with natural superdisintegrant.F5contain (Ac-Di-Sol),F6 contain(SSG),and F9 contain (*plantago ovata* seed mucilage powder as a natural superdisintegrant) compared D.T obtained F5-39 sec,F6-49sec,F9-18sec.Batch F9 found to be more optimum compared with F5 and F6,comparative %DR vs time graph also indicates F9 shows 98.22% drug release.hence we can say natural superdisintegrant shows more efficiency than commercial disintegrants.i.e (Ac-Di-Sol),(SSG).The FTIR spectra study shows that no interaction between drug and excepient,drug is compatible with all excepient used in optimized formulation.Hence it is concluded that the Diclofenac Potassium FDT using *plantago ovata* seed mucilage powder as a natural superdisintegrant can be successfully prepared by direct compression method.

REFERENCES :

1. Femi Joseph,K. Premaletha, Natural Superdisintegrants for the Formulation of Orally Disintegrating Tablets,International Journal of Research and Review,vol-8,2021,Pg,No.126.

2. Ogochukwu Augustina Meko,Formulation & Evaluation of Fast disintegrating tablet of Diclofenac Potassium using Pleurotus tuber-regium powder,International Journal of Pharmacy & Pharmaceutical Research,vol-1 2020,Pg.No.218,231.

3. The united states pharmacopeia,the national formulary,by authority of the united states pharmacopial convention prepared by the council of experts and its expert committees,vol-2,2014,pg no-2592-2593.

4. Indian pharmacopia,goverment of india ministry of health and family welfare,published by the indian pharmacopia commission ghaziabad,vol-1,2014,pg no-757.

5. British Pharmacopoeia, the department of health,social services and public safety,published by medicines and healthcare product regulatory agency,vol-1,2013,pg no-701.

6. S.M.Shahidulla,Mohib Khan.Formulation & Evaluation of Fast disintegrating tablet of Domperidone by using *plantago ovata* mucilage, Dr.Samuel George Institue of Pharmaceutical sciences,2012,Pg.No.1527.

7. Tadious Chimombe,Subhankar Mukhopadhyay,Orally Disintegrating Tablets: Formulation, Preparation, Evaluation And Recent Advances: A Review,Dr.Samuel George Institue Of Pharmaceutical Sciences,2012,Pg.No.1527.

8. Bhise Sucheta D, Jarande Kiran,Isolation and Evaluation of Natural Superdisintegrant from *plantago ovata* in MDTs of Telmisartan,IJPI's Journal of Pharmaceutics and Cosmetology,2012,Pg.No.11,15.

9. Tansel Comoglu,Aysegul Dogan,Formulation & Evaluation of Fast disintegrating tablet of Diclofenac Potassium and their clinical application in migraine patients,Drug Development and Industrial Pharmacy,2011,Pg.No.261,262.

10. Eraga SO,Akpan FE.Evaluation of fast disintegrating tablet of paracetamol prepared from cross carmellose and pleurotus tuber regium powder. Pakistan journal of pharmaceutical science.2018,2503-2508.

11. Hartsell T, Long D and Kirsh JR. The efficacy of postoperative ondansetron (Zofran) orally disintegrating tablets for preventing nausea and vomiting after acoustic neuroma surgery. Anaesthesia and Analgesia. 2005;105(5): 1492-1496.

12. Iwuagwu MA and Onkeyweli AO. Preliminary investigation into the use of pleurotus tubberregium. Mushworld publication 2004; 1: 29-37.

13. Markl D and Zeitler JA. A review of disintegration mechanism and measurements techniques. Pharmaceutical research. 2017; 34(5): 890-917.

14. Reddy LH, Ghosh B and Rajneesh. Fast dissolving drug delivery system: A review of literature. Indian Journal of pharmaceutical Sciences. 2002; 64(4): 331-336.