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Content

Comparative study on effect of natural and synthetic superdisintegrants in the formulation of fast dissolving tablets

Santanu Chakraborty, Madhusmruti Khandai, Satya Prakash Singh, Niranjan Ch. Patra
PG Department of Pharmaceutics, College of Pharmaceutical Sciences, Berhampur - 760 002, Ganjam, Orissa, India

In the present study, the effects of a natural superdisintegrant vis-à-vis isolated mucilage of *Plantago ovata* and synthetic superdisintegrants like sodium starch glycolate (SSG) and croscarmellose sodium (Ac-di-sol) were compared in the formulations of fast dissolving tablets (FDT). FDTs of aceclofenac (model drug) were prepared by direct compression method using microcrystalline cellulose as direct compressible vehicle. Those tablets were evaluated for weight variation, hardness, disintegration time, drug content, friability and dissolution. Swelling index was also investigated with an aim to compare the swelling property of mucilage of *Plantago ovata* with SSG and Ac-di-sol. Among all the super disintegrants, *Plantago ovata* mucilage showed the highest swelling index. Hence, the present study revealed that this natural superdisintegrant (*Plantago ovata* mucilage) showed better disintegrating property than the most widely used synthetic super disintegrants like SSG and Ac-di-sol in the formulations of FDTs.

Key words: Fast dissolving drug delivery, *Plantago ovata* mucilage, swelling index, sodium starch glycolate, croscarmellose sodium

INTRODUCTION

Fast dissolving drug delivery is rapidly gaining acceptance as an important new drug delivery technology (Shangraw, 1980; Sastry, 2000). These dosage forms dissolve or disintegrate in oral cavity within a minute even without the need of water or chewing. Usually, super disintegrants are added to a drug formulation to facilitate the break-up or disintegration of tablet or capsule content into smaller particles that can dissolve more rapidly than in the absence of disintegrants (Alesandro *et al.*, 2001; Weller, 2003). Many substances like microcrystalline cellulose (MCC) (Lerk, 1979), cross povidone (Kornblum, 1973), croscarmellose sodium (Ac-di-sol) (Gissinger, 1980; Shangraw, 1980), sodium starch glycolate (SSG) (Sekulovi, 1986) have been used in the formulations of fast dissolving tablets (FDTs). Similarly, various natural substances vis-à-vis gum karaya, modified starch and agar have been used in the formulations of FDTs. Mucilage of natural origin is preferred over semi-synthetic and synthetic substances because they are comparatively cheaper, abundantly available, non-irritating and non-toxic in nature. Mucilage of *Plantago ovata* has various characteristics like binding, disintegrating and sustaining properties (Baveja, 1968). Hence, in the present study, mucilage of *Plantago ovata* was used to develop FDTs of the selected model drug aceclofenac. The disintegration and swelling properties of FDT were compared with other widely used super disintegrants vis-à-vis SSG and Ac-di-sol. Aceclofenac, a non-steroidal anti-inflammatory drug, was selected as the model drug as it was widely used in the treatment of pain and inflammation.

MATERIALS AND METHODS

Seeds of *Plantago ovata* were purchased from the local market of Berhampur, Orissa, and aceclofenac was obtained as gratis sample from Cadila Pharmaceuticals Ltd., India. Other materials used in the study were of pharmaceutical grade.

Isolation of Mucilage

The seeds of *Plantago ovata* were soaked in distilled water for 48 h and then boiled for few minutes so that mucilage was completely released into water (Washi, 1985). The material collected was squeezed through muslin cloth for filtering and separating out the marc. Then, an equal volume of acetone was added to the filtrate so as to precipitate the mucilage. The separated mucilage was dried (in oven at temperature less than 60°C), powdered, sieved (#80) and stored in a desicator until use.

Preparation of Fast Dissolving Tablets

Fast dissolving tablets of aceclofenac were prepared by direct compression method. The drug and excipients were passed through sieve (#80) to ensure better mixing. MCC was used as a direct compressible vehicle. Super

For correspondence: *Chakraborty Santanu, PG Department of Pharmaceutics, College of Pharmaceutical Sciences, Berhampur - 760 002, Ganjam, Orissa, India. E-mail: santanu_nil@rediffmail.com*
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Table 1: Formulation of batches by direct compression method

Formulation	Aceclofenac (mg)	Mucilage (mg)	Ac-di-sol (mg)	SSG (mg)	MCC (mg)	Talc (mg)	Mg. stearate (mg)	Total wt. (mg)
AM1	50	5	-	-	135	6	4	200
AM2	50	10	-	-	130	6	4	200
AM3	50	15	-	-	125	6	4	200
AM4	50	20	-	-	120	6	4	200
AA1	50	-	5	-	135	6	4	200
AA2	50	-	10	-	130	6	4	200
AA3	50	-	15	-	125	6	4	200
AA4	50	-	20	-	120	6	4	200
AS1	50	-	-	5	135	6	4	200
AS2	50	-	-	10	130	6	4	200
AS3	50	-	-	15	125	6	4	200
AS4	50	-	-	20	120	6	4	200

disintegrants like SSG, Ac-di-sol and mucilage of *Plantago ovata* were used in different proportions (Table 1). The powders were compressed using a single-punch tableting machine (Cadmach Machinery Co. Pvt. Ltd., India) equipped with 6.5 mm round, flat and plain punches.

Evaluation of Fast Dissolving Tablets

QC tests for FDTs of all formulations were performed, and the average values were calculated. Weight variation was determined by weighing 20 tablets individually; the average weight and percent variation of each tablet was calculated. Hardness was determined by taking six tablets from each formulation, using a digital tablet hardness tester (Electrolab Ltd., India), and the average of applied pressure (kg/cm^2) for crushing the tablet was determined. Friability was determined by first weighing 10 tablets after dusting and placing them in a friability tester (Electrolab Ltd.), which was rotated for 4 min at 25 rpm. After dusting, the total remaining mass of tablets was recorded and the percent friability was calculated. Disintegration test was performed using a disintegration test apparatus (Electrolab Ltd.) using distilled water as medium.

Drug Content

Three tablets were powdered, and 50 mg equivalent weight of aceclofenac in tablet powder was accurately weighed and transferred into a 100 ml volumetric flask. Initially, 10 ml of phosphate buffer (pH 6.8) was added and shaken for 10 min. Then, the volume was made up to 100 ml with phosphate buffer (pH 6.8). Subsequently, the solution in the volumetric flask was filtered, and 1 ml of the filtrate was suitably diluted and analyzed at 273 nm using UV-visible spectrophotometer (Shimadzu UV-2450, Japan). The drug content of the sample was estimated from their standard curve.

Swelling Index

Swelling index (British Pharmacopoeia Vol. II, 1988) is the volume in millilitres that is occupied by 1 gm of drug or any adhering mucilage after it has swollen in an aqueous liquid for 4 h. The methods of studying swelling index for *Plantago ovata*, SSG and Ac-di-sol were carried out as per BP specifications. Swelling index was calculated from mean readings of three determinations (Table 2).

Table 2: Swelling index for different ingredients*

Sl. No.	Name of the ingredient	Swelling index (% v/v)
1	Mucilage (*Plantago ovata*)	98 ± 2.5
2	Ac-di-sol	76 ± 3.46
3	SSG	56 ± 1.75

*Values are expressed as mean ± S.D. n = 3

In vitro Dissolution Study

Dissolution study was carried out by using a digital tablet dissolution test apparatus (Lab India Disso 2000, India) in 900 ml 0.1 N HCl at 50 rpm at 37°C. Five-millilitre aliquots were withdrawn at different time intervals. The aliquots were filtered and analyzed spectrophotometrically at 273 nm. After each sampling, equal volume of fresh medium was added to maintain a constant volume. The data thus obtained are shown in Table 3. The comparison results are shown in Fig. 1.

RESULTS AND DISCUSSION

All the tablets were prepared under similar conditions to avoid processing variables. Weight variation of FDTs was within 1.925%. Hardness of tablets was 4.16 ± 0.39 kg/cm^2. The percentage of friability of all tablets was 0.64 ± 0.11%. The values of tablet hardness and percent friability indicated good handling property of the FDT. The drug content of all formulations was in the range of 98.85 ± 0.59%. All the formulations disintegrated within 12-180 s (Fig. 2, Table 4).

Disintegration time for tablets prepared with mucilage of *Plantago ovata* was nearer to that prepared with SSG and Ac-di-sol, indicating that the mucilage of *Plantago ovata* had

Table 3: Dissolution study of aceclofenac

Time (min)	Percent drug released							
Formulation	**0**	**5**	**10**	**15**	**20**	**30**	**45**	**60**
AM1	0	21.34	32.17	41.19	50.35	67.13	79.17	87.36
AM2	0	23.19	34.25	44.71	52.32	70.43	81.21	89.55
AM3	0	25.71	37.31	47.50	53.72	75.97	86.78	95.91
AM4	0	25.99	40.00	51.14	59.52	81.25	89.36	98.76
AA1	0	16.55	27.12	33.37	42.14	54.74	68.40	73.87
AA2	0	18.34	31.41	39.52	43.90	62.15	72.13	79.78
AA3	0	21.27	33.58	42.57	50.37	67.14	79.00	87.12
AA4	0	23.29	37.18	46.11	54.80	73.10	85.38	94.39
AS1	0	10.47	24.00	36.25	40.29	52.18	67.71	71.31
AS2	0	10.40	25.59	38.17	42.23	57.78	68.23	74.69
AS3	0	11.19	27.92	39.15	47.50	60.98	75.17	81.99
AS4	0	12.71	30.19	42.21	51.68	65.41	81.41	87.52

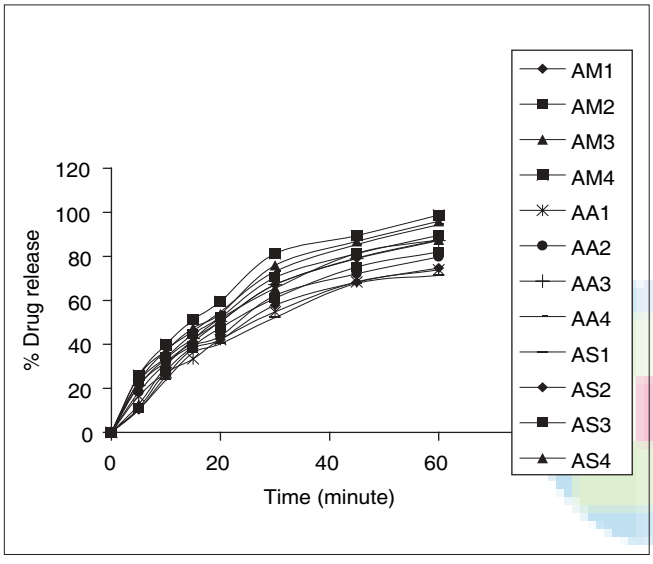

Figure 1: Comparison of dissolution profile of different formulations

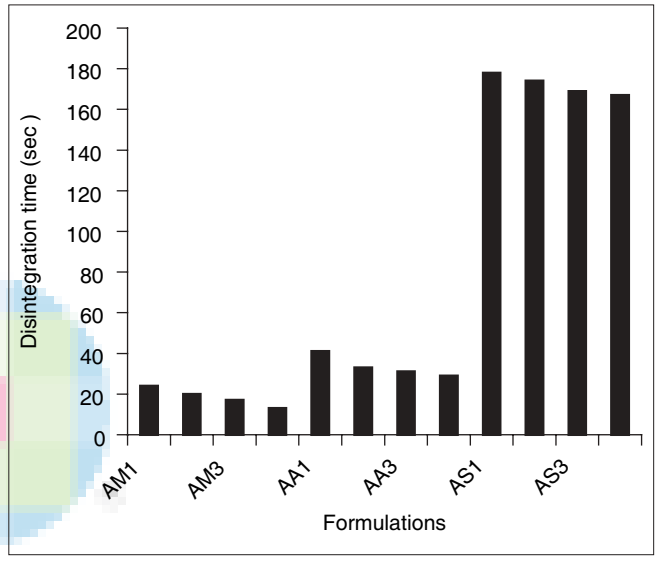

Figure 2: Comparison of disintegration time of various formulations

Table 4: Physical characteristics of dispersible tablet formulations*

Formulation	Hardness	Friability	Wt. variation (%)	Disintegration time (s)	% drug content
AM1	4.7 ± 0.01	0.7 ± 0.01	1.4	24 ± 2	99.2 ± 0.7
AM2	4.2 ± 0.24	0.6 ± 0.01	1.9	20 ± 2	99.0 ± 0.8
AM3	4.5 ± 0.31	0.2 ± 0.09	1.6	17 ± 3	97.9 ± 1.3
AM4	4.0 ± 0.32	1.1 ± 0.02	1.6	13 ± 1	99.3 ± 0.4
AA1	4.1 ± 0.08	0.4 ± 0.01	2.7	41 ± 4	98.2 ± 1.1
AA2	3.6 ± 0.67	0.3 ± 0.07	3.9	33 ± 2	98.7 ± 0.9
AA3	3.9 ± 0.31	0.3 ± 0.09	2.6	31 ± 1	99.4 ± 0.1
AA4	4.4 ± 0.85	0.1 ± 0.09	1.2	29 ± 1	98.1 ± 0.2
AS1	4.4 ± 0.60	0.7 ± 0.12	1.9	178 ± 2	99.5 ± 0.1
AS2	4.2 ± 0.64	0.9 ± 0.30	1.2	174 ± 3	99.4 ± 0.3
AS3	4.1 ± 0.19	1.0 ± 0.09	1.4	169 ± 2	98.6 ± 0.6
AS4	3.9 ± 0.57	1.4 ± 0.46	1.7	167 ± 2	98.9 ± 0.6

*Values are expressed as mean ± SD. $n = 3$

good disintegrating property (Table 2, Fig. 1). The mucilage of Plantago ovata showed very high percentage of swelling index as compared to the other superdisintegrating agents (Table 4). This rapid disintegration of the FDTs was due to the penetration of saliva into the pores of the tablet, which lead to the swelling of super disintegrants to create enough hydrodynamic pressure for quick and complete disintegration of the tablet. Mucilage of *Plantago ovata* was effective at a very low concentration, i.e. 7.5%, as compared to others. *In vitro* dissolution study on an optimized formulation (AM3) revealed that more than 90% drug was released within 60 min.

CONCLUSION

From the present study, it can be concluded that natural super disintegrants like *Plantago ovata* mucilage showed better disintegrating property than the most widely used synthetic super disintegrants like SSG and Ac-di-sol in the formulations of FDTs.

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