RESEARCH ARTICLE

Design and *in-vitro* evaluation of mouth dissolving tablets of olanzapine

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The aim of the present investigation was to formulate mouth dissolving tablets of olanzapine, an anti-psychotic drug. Mouth dissolving tablets (MDT) of Olanzapine were prepared with the addition of different superdisintegrants, namely, crospovidone, croscarmellose sodium, and sodium starch glycolate. Each of these superdisintegrants was used in concentrations of 2% w/w, 4% w/w, 6% w/w, and 8% w/w. Formulation with 4% w/w crospovidone showed minimum disintegration time (<30 seconds). Furthermore, increasing the concentration of the superdisintegrants did not decrease the disintegration time (DT) significantly, so the same formulation was selected to incorporate the effervescent agent to reduce the disintegration time further. The formulation was optimized successfully with sodium bicarbonate and citric acid (monohydrate) as the effervescent agent, with 4% of crospovidone, thereby reducing the disintegration time to 10 seconds. The prepared batches were evaluated for organoleptic properties, hardness, friability, weight variation, *in-vitro* disintegration time, *in-vitro* dispersion time, wetting time, *in-vitro* drug release studies, and stability studies. The drug-excipient interaction was studied by Fourier transform infrared spectroscopy (FTIR) studies. The optimized formulation showed minimum disintegration time (10 seconds) and an almost complete release of the drug within five minutes. Finally it was concluded that the MDT of Olanzapine could be successfully formulated by adding superdisintegrants and an effervescent agent, with improved patient compliance.

Key words: *Croscarmellose sodium, crospovidone, mouth dissolving tablets, olanzapine, superdisintegrants*

INTRODUCTION

Mouth dissolving tablets (MDT) are also called orally disintegrating tablets, orodisperble tablets, fast dissolving tablets, rapidly dissolving tablets, porous tablets, and rapimelts. However, of all these terms, the United State Pharmacopoeia (USP) approved this dosage forms as Orally Disintegrating Tablets (ODT). The Center for Drug Evaluation and Research defines an ODT to be: "A solid dosage form containing medicinal substances, which disintegrates rapidly, usually within a matter of seconds, when placed upon the tongue." Of late, the European Pharmacopoeia has used the term 'Orodispersible tablet', which disintegrates and disperses readily in the oral cavity within a period of three minutes, before swallowing.[1]

Olanzapine is an atypical antipsychotic drug that belongs to the thienobenzodiazepine class, approved by the Food and Drug Administration (FDA), for the treatment of schizophrenia, depressive episodes associated with bipolar disorder, acute manic episodes, and maintenance treatment in bipolar disorder. Furthermore, on account of the low aqueous solubility it is well-absorbed after oral administration. The absolute bioavailability is only approximately 31.5% due to extensive hepatic metabolism.[2-4]

Various techniques can be used to formulate orally disintegrating tablets or fast dissolving tablets. Direct compression is one of the techniques, which requires the incorporation of superdisintegrants into the formulation or the use of highly water-soluble excipients, to achieve fast disintegration of tablet. Direct compression does not require the use of water or heat during the formulation procedure and is the ideal method for moisture and heat-labile medicaments.[5-7]

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MATERIALS AND METHODS

Materials

Olanzapine was procured as a gift sample from the Ipca Laboratories Ltd., Mumbai, as also Mannitol, Microcrystaline cellulose, Crospovidone,[8] Croscarmellose Sodium,[9] Sodium Starch Glycolate,[10] Citric acid, Sodium Bicarbonate, Aspartame, Peppermint Flavor, Colloidal Silicone Dioxide, Magnesium Stearate. All the chemicals and solvents used were of analytical grade and used as supplied by the manufacturer.

Methods

Formulation of mouth dissolving tablets of Olanzapine

Formulation of Olanzapine mouth dissolving tablets by direct compression involve the use of mannitol (Pearlitol SD 200), and microcrystalline cellulose (Avicel-PH 112) as diluents, aspartame as the sweetener, peppermint flavor as flavoring agent, colloidal silicone dioxide (Aerosil 200) as the glidant, and magnesium stearate as the lubricant. Crospovidone (Polyplasdone XL10), Croscarmellose sodium (AC-Di-Sol), and Sodium starch glycolate (Primojel) were used as superdisintegrants. To select the best superdisintegrant for this formulation and to detect its effective concentration, various batches were taken in different concentration ranges, from 2 to 8% w/w, for each superdisintegrant.[11]

Manufacturing procedure

All ingredients except the lubricant were sifted through a # 40 sieve. The sifted material was mixed thoroughly in an octagonal blender for 15 minutes. Magnesium stearate was sifted through a # 60 sieve and mixed with the blend for two minutes. The blend was compressed with 5 mm S/C punch. The different formulations of olanzapine mouth dissolving tablets are given in Table 1.

Formulation with effervescent disintegrants

Formulation F2 containing 4% crospovidone shows the minimum disintegration time among all formulations. Further improvement in the concentration of crospovidone does not show significant improvement in DT, so formulation F2 has been selected for the incorporation of effervescent disintegrants to reduce the DT further.

Evaluation of mouth dissolving tablets of olanzapine

Loss on drying (LOD)

The moisture content of the lubricated granules was analyzed by using the Halogen Moisture Analyzer. Approximately one gram of the blend was heated at 105°C until the change in the weight was no more observed by the instrument. The % loss in weight was recorded.[12]

% LOD = 100 (Initial Weight - Final Weight) / Initial Weight

Hardness and thickness

Six tablets of each batch were selected and measured for thickness and diameter using the digital vernier calipers. The extent to which the thickness of each tablet deviated from ±5% of the standard value was determined.

The hardness of the tablet was determined by the monsanto hardness tester. The tester consisted of a barrel containing a compressible spring held between two plungers. The lower plunger was placed in contact with the tablet, and zero reading was taken. The upper plunger was then forced against a spring by turning a threaded bolt until the tablet fractures. As the spring was compressed, a pointer was raised along a gauge in the barrel to indicate the force. The force of fracture was recorded, and the zero force reading was deducted from it. Six tablets from each batch were selected and evaluated, and the average value with standard deviation were recorded.[12]

Friability test

It is the phenomenon, whereby, the tablet surfaces are damaged and / or show evidence of the lamination or breakage when subjected to mechanical shock or attrition. The friability of the tablets was determined by using the Roche Friabilator. It is expressed in percentage (%). Ten tablets were initially weighed ($W_{initial}$) and transferred into the friabilator. The friabilator was operated at 25 rpm for four minutes. The tablets were weighed again (W_{final}). The percentage friability was then calculated using the equation $F = (W_{initial} - W_{final} \times 100) / W_{initial}$% Friability of tablets less than 1% was considered acceptable.The friability was expressed as the loss of mass and was calculated as a percentage of the initial mass.[13]

Table 1: Formulation of tablets with different superdisintegrants, namely, Crospovidone, Ac-Di-Sol, and Primojel

Ingredients (mg)	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Olanzapine	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Pearlitol SD 200	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Avicel pH 112	21.5	20.5	19.5	18.5	21.5	20.5	19.5	18.5	21.5	20.5	19.5	18.5
Crospovidone	1.0	2.0	3.0	4.0	–	–	–	–	–	–	–	–
Ac-Di-Sol	–	–	–	–	1.0	2.0	3.0	4.0	–	–	–	–
Primojel	–	–	–	–	–	–	–	–	1.0	2.0	3.0	4.0
Aspartame	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Peppermint flavor	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Aerosil 200	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Magnesium stearate	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Weight variation test

Twenty tablets selected at random were weighed and the average weight was calculated. Not more than two of the individual weights deviated from the average weight by more than the percentage shown in Table 2.[14]

Estimation of drug content

Five uncoated tablets were selected randomly and the average weight was calculated. The tablets were crushed in a mortar and an accurately weighed amount of an average tablet was taken from the crushed blend. Then, the samples were transferred to three 100 ml volumetric flasks and diluted up to the mark using 0.1N HCl solution. The content was shaken periodically and kept for 24 hours for dissolution of the drug completely. The mixtures were filtered and appropriate dilutions were made. The drug content in each tablet was estimated at λ_{max} 260.0 nm against a blank reference, and reported.[14]

Wetting time and water absorption ratio

Wetting time of the dosage form is related to the contact angle. The wetting time of the mouth dissolving tablets is another important parameter, which needs to be assessed, to give an insight into the disintegration properties of the tablets; a lower wetting time implies quicker disintegration of the tablet. The wetting time of the tablet can be measured using a simple procedure.

Method

Five circular tissue papers, of 10 cm diameters, were placed in a petri dish with a 10 cm diameter. Ten milliliters of water containing Eosin, a water-soluble dye was added to the petri dish. A tablet was carefully placed on the surface of the tissue paper. The time required for water to reach the upper surface of the table crospovidone was noted as the wetting time.[15,16]

Water absorption ratio (R) was calculated using the formula $R = 100 \times [W_a - W_b] / W_b$, where, W_a = weight of tablet after absorption, W_b = weight of tablet before absorption

In-vitro disintegration time

The disintegration time for all formulations was carried out using a tablet disintegration test apparatus. Six tablets were placed individually in each tube of the disintegration test apparatus and the disks were placed. The water was maintained at a temperature of 37±2°C and the time taken for the entire tablet to disintegrate completely was noted.[17]

In-vitro dispersion time

In-vitro dispersion time was measured by dropping a tablet in a measuring cylinder containing 6 ml of simulated saliva fluid (pH 6.8). Three tablets from each formulation were randomly selected and *in-vitro* dispersion time was expressed in seconds.[18]

Table 2: IP Standards for percentage weight variation

Average weight of tablet	Percentage deviation
130 mg or less	10
More than 130 mg, but less than 324 mg	7.5
324 or more	5

In-vitro drug release studies

In-vitro drug release studies were carried out using the USP XXIII Dissolution Apparatus II (Paddle Type) at 50 rpm. The drug release profile was studied in 900 ml of 0.1N HCl solution maintained at 37±0.5°C. Aliquots of 5 ml of dissolution medium were withdrawn at specific time intervals (5, 10, 15, 20, 25, and 30 minutes), filtered, and the amount of drug released was determined by the UV-Visible spectrophotometer (Shimadzu UV 1601PC).[18]

Multimedia dissolution study

A multimedia dissolution study was performed for the optimized batch (F2) in 0.1 N HCl solution, acetate buffer solution (pH 4.5), and phosphate buffer solution (pH 6.8), and a comparison of the drug release was done with the marketed product in the same three media.[19]

Stability studies

Formulations F2, F2a, and F2b as well as the marketed products were kept for stability studies as follows.[20,21]
Accelerated testing: 40 ± 2°C / 75 ± 5%RH (1 Month)
Accelerated testing: 30 ± 2°C / 65 ± 5%RH (1 Month)
Ambient temperature: 25 ± 2°C / 60 ± 5%RH (1 Month)

RESULTS AND DISCUSSION

Formulations with Ac-di-sol (F5 to F8) and sodium starch glycolate (F9 to F12) showed the disintegration time to be more than 30 seconds. Therefore, formulations F5 to F12 were rejected. Formulations with crospovidone showed a disintegration time of less than 30 seconds. Increasing the concentration of crospovidone from 4 to 6% did not lead to any significant improvement in *in-vitro* disintegration time, thus, the formulation F2 with 4% crospovidone was selected for incorporation of the effervescent agent, to decrease the DT further.

Loss on drying

Loss on Drying (LOD) of all formulations was found to be less than 2%, which was suitable to avoid the sticking and picking problem during direct compression. The result obtained is reported in the Table 3.

Thickness

The thickness of the six tablets selected randomly from each formulation was measured using the digital vernier calipers, and is reported in Table 3.

Hardness test

The hardness of all the formulations was checked using the Tablet Hardness Tester, by the method described in

the methodology section. The results obtained are given in Table 3. The average hardness of all the batches was in the range of 24±0.26 N to 31±0.58 N. The lower standard deviation values indicated that the hardness of all the formulations was almost uniform in a specific method and possessed good mechanical strength, with sufficient hardness.

Friability

The percentage friability for all the formulations lay in the range of 0.22 to 0.29%, which was found to be within the limit (i.e., <1%). When all the formulations were compared with each other, the friability of the optimized formula, F2 (0.294%), was found to be the highest, but it was within the limit (i.e., <1%). The result obtained is reported in Table 3.

Weight variation

All the formulations passed the weight variation test as the % weight variation was within the pharmacopoeial limits of ±7.5%. It was found to be from 47.26±1.55% to 52.75±0.60%. None of the formulations were exceeding the limit of±7.5% specified by the IP. The result obtained is shown in Table 3.

Drug content

The % drug content of all the formulations is as mentioned in Table 4. The drug content values for all the formulations were in the range of 98.98 to 103.08%.

Wetting time and water absorption ratio

The wetting time in different formulations depended on the ability of the superdisintegrant to swell and its capacity to absorb water. It was in the range of 28.12 to 47.51 seconds.

Table 3: Evaluation parameters for all the prepared formulations

Formulations	% LOD	Thickness (mm)** AM±SD	Hardness** (N) AM±SD	% Friability	Weight variation (mg)*** AM±SD	% Drug content* AM±SD
F1	1.32	2.24±0.06	28±0.26	0.284	52.75±0.60	100.04±1.79
F2	1.78	2.25±0.07	25±0.24	0.290	50.61±0.52	101.05±1.09
F3	1.10	2.21±0.02	26±0.49	0.287	51.96±0.86	99.98±1.44
F4	1.50	2.22±0.06	27±0.48	0.285	47.26±1.55	100.01±1.21
F5	1.58	2.23±0.02	27±0.54	0.275	52.64±1.23	103.08±1.79
F6	1.40	2.20±0.05	29±0.26	0.267	50.27±0.97	99.97±1.35
F7	1.67	2.22±0.04	30±0.75	0.261	51.46±0.65	101.12±1.78
F8	1.89	2.21±0.01	32±0.37	0.259	49.07±0.88	101.08±1.03
F9	1.64	2.23±0.02	32±0.36	0.254	50.62±0.57	98.98±1.68
F10	1.42	2.20±0.04	35±0.40	0.249	51.45±0.83	101.21±1.78
F11	1.36	2.24±0.09	38±0.56	0.234	50.55±0.48	100.16±1.78
F12	1.55	2.22±0.05	40±0.58	0.223	48.83±0.69	102.12±3.51
F2	1.30	2.24±0.06	25±0.24	0.294	50.75±1.51	101.07±1.66
F2a	1.32	2.25±0.05	25±0.48	0.293	50.55±1.25	100.04±1.58
F2b	1.34	2.24±0.07	25±0.57	0.291	51.15±0.25	101.08±1.48

*5tablets, **6 tablets, ***20 tablets

Table 4: Evaluation parameters for all the prepared formulations

Formulation	Wetting time (seconds)** AM±SD	Water absorption ratio** (%) AM±SD	*In-vitro* disintegration time (seconds)*** AM±SD	*In-vitro* dispersion time (seconds)* AM±SD
F1	32.12±1.02	64.70±1.45	28.00±2.00	30.00±1.23
F2	29.23±2.08	66.44±1.45	25.12±2.08	27.33±1.35
F3	28.52±1.15	68.70±0.70	24.48±1.15	26.52±1.15
F4	28.12±1.00	70.87±0.71	24.32±1.00	26.10±1.18
F5	39.51±0.58	66.00±1.46	35.38±0.58	37.50±0.38
F6	35.21±1.00	68.50±1.08	30.12±1.00	33.13±0.57
F7	38.48±2.52	70.90±0.60	33.41±2.52	35.67±1.38
F8	40.53±1.53	73.13±0.53	34.10±1.53	35.33±1.49
F9	39.55±2.65	70.37±1.52	34.36±2.65	36.52±2.05
F10	41.57±1.73	74.49±1.41	36.10±1.73	38.11±1.07
F11	42.25±3.06	79.55±1.33	38.36±3.06	40.52±2.03
F12	47.51±2.01	84.69±1.27	42.21±2.89	45.46±1.29
F2			10.37±1.45	12.32±1.25
F2a	Not applicable		10.25±1.29	12.44±1.32
F2b			10.28±1.35	12.50±1.15

*3 tablets, **5 tablets, ***6 tablets

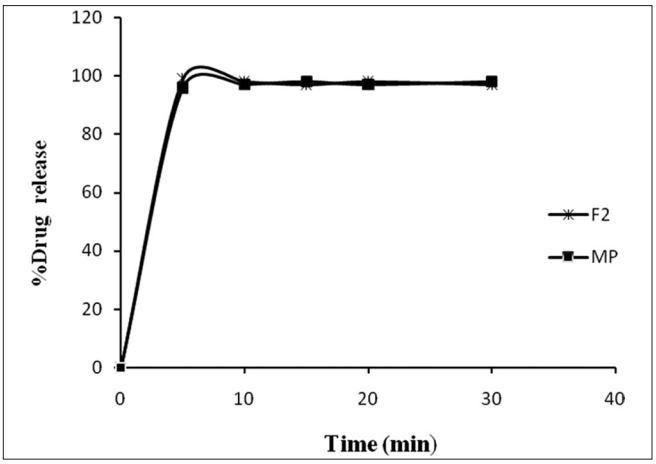

Figure 1: Comparison of *in-vitro* drug release of formulation F2 in 0.1 N HCl solution with MP (Marketed product)

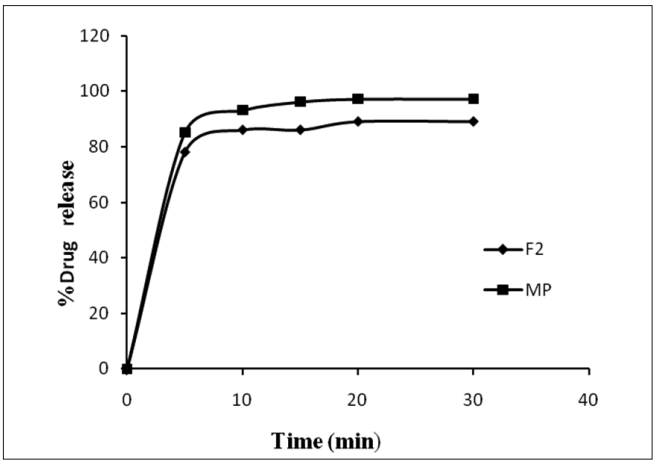

Figure 2: Comparison of *in-vitro* release of formulation F2 in acetate buffer solution (pH 4.5) with MP (Marketed product)

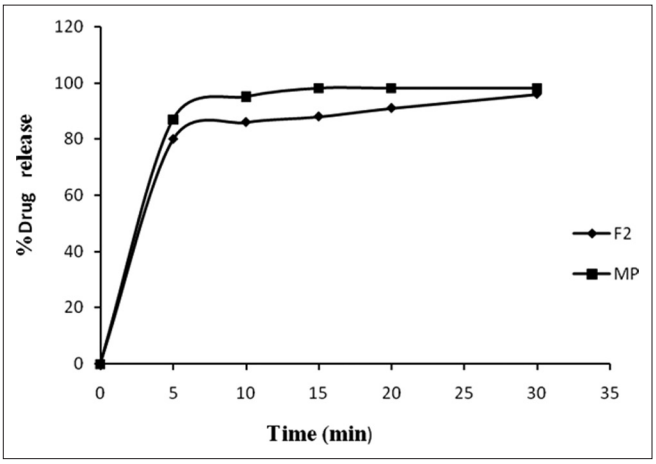

Figure 3: Comparison of *in-vitro* release of formulation F2 in phosphate buffer solution (pH 6.8) with MP (Marketed product)

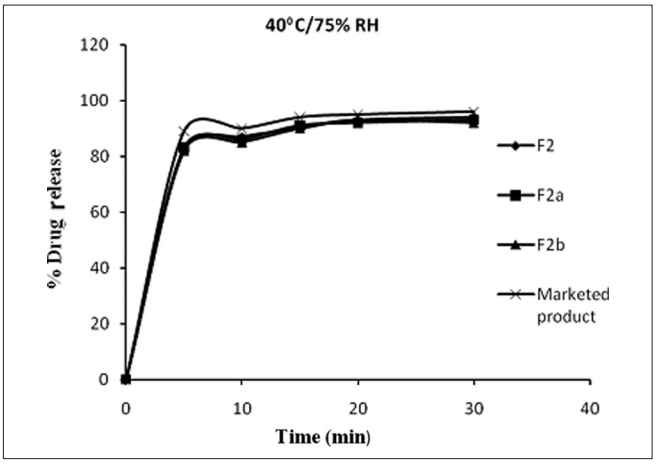

Figure 4: *In-vitro* drug release profile of F2, reproducible batches (F2a and F2b), and marketed product after the stability studies

Table 5: Dissolution profile of formulations F1 to F12

Time (minutes)	Mean% dissolution in 0.1N HCl solution											
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
0	0	0	0	0	0	0	0	0	0	0	0	0
5	90	94	92	91	74	82	79	76	69	65	62	55
10	92	95	93	92	85	89	88	87	74	70	66	61
15	95	96	94	94	92	97	95	96	82	77	72	66
20	96	97	97	95	96	97	95	96	86	81	76	71
30	97	98	98	97	96	97	96	97	92	93	92	90

The water absorption ratio, which was an important criterium for understanding the capacity of disintegrants to swell in the presence of a little amount of water, was calculated. It was in the range of 64.70% to 84.69%. The results obtained are shown in Table 4.

In-vitro disintegration time

The average *in-vitro* disintegration time for all the formulations lay within the range of 10.25 to 42.21 seconds, fulfilling the official requirements (<3 minutes) of orally disintegrating

Table 6: Dissolution profile of formulations F2, F2a, and F2b

Time (minutes)	Mean% dissolution in 0.1N HCl solution		
	F2	F2a	F2b
0	0	0	0
5	99	99	99
10	99	98	98
15	97	99	99
20	98	98	97
30	97	97	98

Table 7: Multimedia dissolution of formulations F2 and marketed product (Zyprexa Zydis)

Time (minutes)	Percent drug release					
	F2 Formulation			Marketed product		
	O.1 N HCl solution	Acetate buffer solution (pH 4.5)	Phosphate buffer solution (pH 6.8)	O.1 N HCl solution	Acetate buffer solution (pH 4.5)	Phosphate buffer solution (pH 6.8)
0	0	0	0	0	0	0
5	99	78	80	96	85	87
10	98	86	86	97	93	95
15	97	86	88	98	96	98
20	98	89	91	97	97	98
30	97	89	96	98	97	98

tablets. Formulations containing crospovidone showed minimum disintegration time. Formulations with the effervescent agent (F2) showed a further decrease in disintegration time. The results obtained are given in Table 4.

In-vitro dispersion time

The average *in-vitro* dispersion time for all the formulations lay within the range of 12.32 to 45.46 seconds, fulfilling the official requirements (<3 minutes) of orally disintegrating tablets. The results obtained are given in Table 4.

In-vitro drug release studies

All formulations were subjected to dissolution studies. The samples were withdrawn at specified time intervals and analyzed with the help of a UV-Visible Spectrophotometer. The present drug release was calculated on the basis of the mean amount of Olanzapine present in the respective formulation. The percentages of drug release of MDT formulations of Olanzapine were plotted against time to obtain the drug release profiles. Results obtained are given in Table 5. Drug release studies were also carried out for optimized (F2) and reproducible batches of olanzapine tablets. Results are depicted in Table 6. Comparison of *in-vitro* drug release of formulation F2 in multimedia dissolution solution with MP (Marketed product). Results are depicted in Table 7 and Figure 1 to 3.

Stability studies

Stability studies were conducted on the tablets of optimized (F2) and reproducible (F2a and F2b) batches as per ICH guidelines. After stability studies, formulations were subjected to evaluation and the results obtained are depicted in Tables 8 to 10 and as shown in Figure 4.

CONCLUSION

Mouth dissolving tablets of olanzapine were developed successfully by the addition of three types of superdisintegrants namely crospovidone, croscarmellose sodium, and sodium starch glycolate. Among the superdisintegrants tested, crosspovidone 4% w/w had proved to be more effective in promoting the disintegration of MDT. Incorporation of an effervescent agent further improved the efficacy of the

Table 8: Evaluation of hardness and drug content after stability studies

Conditions	Formulation	Hardness* (N) AM±SD	% Drug Content* AM±SD
25°C/60%RH	F2	25±0.27	101.03±2.04
	F2a	24±0.21	100.02±1.03
	F2b	26±0.26	100.03±1.05
30°C/65%RH	F2	23±0.26	99.99±2.09
	F2a	27±0.23	100.01±2.06
	F2b	25±0.29	99.98±1.07
40°C/75%RH	F2	30±0.32	97.99±1.09
	F2a	31±0.29	97.89±1.05
	F2b	30±0.24	97.68±2.03

*3 tablets

Table 9: Evaluation of *in-vitro* disintegration time and *in-vitro* dispersion time after stability studies

Conditions	Formulation	*In-vitro* Disintegration Time* (seconds AM±SD	*In-vitro* Dispersion Time* (seconds) AM±SD
25°C/60%RH	F2	12.33±1.39	15.34±1.31
	F2a	12.29±1.32	15.36±1.29
	F2b	12.27±1.37	15.38±1.32
30°C/65%RH	F2	13.18±1.31	16.47±1.25
	F2a	13.17±1.33	16.39±1.24
	F2b	13.15±1.36	16.42±1.27
	Market product	3 Sec	ND
40°C/75%RH	F2	26.53±2.39	32.53±1.30
	F2a	29.37±1.42	31.37±1.41
	F2b	27.48±1.49	33.28±1.35

* 3 tablets

Table 10: Evaluation for *in-vitro* drug release profile after stability studies

Condition	Formulation	% of drug release				
		5 mins	10 mins	15 mins	20 mins	30 mins
40°C/75%RH	F2	82	87	90	93	94
	F2a	83	86	91	92	93
	F2b	82	85	90	93	92

From the above results and following the Figure 4 it was concluded that, formulations F2, F2a, and F2b were stable and retained their original properties

superdisintegrants. The tablets prepared, using a combination of the techniques of the superdisintegrant addition method and effervescence method, were equivalent to the marketed product. A result of the accelerated stability study indicated that Olanzapine mouth dissolving tablets were stable. The prepared formulations of olanzapine MDTs were not only economical, but equally effective.

REFERENCES

1. Fu Y, Yang S, Jeong SH, Kimura S, Park K. Orally fast disintegrating tablet: Developments, technologies, taste-masking and clinical studies. Crir Rev Ther Drug Carrier Syst 2004;21:433-76.
2. Available from: http://www.rxlist.com[Last accessed on 2011 Mar 8].
3. Available from: http://www.drugbank.com [Last accessed on 2011 Mar 8].
4. Available from: http://www.druglib.com [Last accessed on 2011 Mar 8].
5. Sharma S, Gupta GD, Bharadwaj S, Hans V. New generation of tablet: Fast dissolving tablet. http://www.pharmainfo.net [last accessed on 2011 Mar 8]
6. Shukla D, Chakraborty S, Shingh S, Mishra B. Mouth dissolving tablets I: An overview of formulation technology. Sci Pharm 2009;77:309-26.
7. Arora V, Gupta VB, Singhal R. Advances in direct compression technology. Pharma Times 2007;39:26-7.
8. Zade PS, Kawtikwar PS, Skarkar DM. Formulation, evaluation and optimization of fast dissolving tablet containing tizanidine hydrochloride. Int J Pharm Tech Res 2009;1:34-42.
9. Gohel MC, Parikh RK, Brahmbhatt BK, Shah AR. Improving the tablet characteristics and dissolution profile of ibuprofen by using a novel coprocessedsuperdisintegrants: A technical note. AAPS PharmSciTech 2007;8:13.
10. Jagadale S, Gattani M, Bhavsar D, Kuchekar B, Chabukswar A. Formulation and evaluation of chewable tablet of levamisole. J Res Pharm Sci 2010;1:282-9.
11. Sarasija S, Pandit V, Joshi HP. Preparation and evaluation of mouth dissolving tablets of salbutamol sulphate. Indian J Pharm Sci 2007;69:467-9.
12. The Indian Pharmacopoeia 2007. Vol. 1. Published by Ministry of Health and Family Welfare. India: Govt. Of India; 2007. p. 134.
13. Lachman L, Libermann HA, Kanig JL. The theory and practice of industrial pharmacy. 3rd ed. London: Varghese Publishing House; 1991.
14. Gosai AR, Patil SB, Sawant KK. Formulation and evaluation of orodispersible tablets of ondansetron hydrochloride by direct compression using superdisintegrants. Int J Pharma Sci Nanotechnol 2008;1:106-11.
15. Dina NM, Madhu B, Shailendra KS, Sengodan GV. Spray dried excipient: A novel technique for the formulation of orally disintegrating tablets. Chem Pharm Bull 2006;54:99-102.
16. Aly AM, Semreen M, Qato MK. Superdisintegrants for solid dispersion to produce rapidly disintegrating tenoxicam tablets via camphor sublimation. Pharmaceutical Technology 2005;68-73.
17. Mohsin AA, Nimbalakar NE, Sanaullah S, Aejaz A. Formulation and evaluation of mouth dissolving tablets of amitriptyline hydrochloride by direct compression technique. Int j Pharm Pharma Sci 2010; 2:204-10.
18. Chopra VS, Singhai SK. Formulation and characterization of fast-dissolving tablet of nimesulide. Int J Pharma Clin Res 2009;1:82-4.
19. Shukla D, Chakraborty S, Singh S, Mishra B. Mouth dissolving tablets II: An overview of evaluation techniques. Sci Pharm 2009;77:327-41.
20. ICH stability guidelines, available from: http://www.ich.org/cache/compo/276-254-1.html. [Last accessed on 2011 Mar 08].
21. Mazzo DJ, Crowley PJ. International stability testing. Buffalo Grove: Interpharm Press Inc. 1999.

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