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Design and Characterization of Melt-In-Mouth Tablets of Montelukast Sodium and Levocetirizine Dihydrochloride

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ORIGINAL ARTICLE

Design and Characterization of Melt-In-Mouth Tablets of Montelukast Sodium and Levocetirizine Dihydrochloride

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ABSTRACT

The main aim of this investigation was to develop mouth dissolving tablets of montelukast sodium and levocetirizine dihydrochloride using different super disintegrants with an intention to achieve better drug bio-availability and patient's compliance. Montelukast sodium is an anti-asthmatic agent and levocetirizine dihydrochloride is an anti-allergic agent. This combination is most commonly used to treat asthmatic conditions and allergic rhinitis. Mouth dissolving tablet of montelukast sodium and levocetirizine dihydrochloride was prepared by using directly compressible diluents and different types of disintegrating agents like croscarmellose sodium, crospovidone, sodium starch glycolate and Kyron T314. The formulations were tested for derived properties of powders, uniformity of weight, thickness, strength, percentage friability, percentage content uniformity, wetting time, water absorption capacity, disintegration time and *in-vitro* dissolution studies. The results of all parameters were within the satisfactory range. From the results it was also found that formulation F_4 with 8% w/w crospovidone was coined as the best formulation, which showed least wetting and disintegration time and high drug release (96.060.80%± of montelukast sodium and 91.691.05%± of levocetirizine dihydrochloride) within 15 minutes.

Keywords: Melt-in-mouth tablet, montelukast, levocetirizine, croscarmellose sodium, crospovidone, sodium starch glycolate, and Kyron T 314.

INTRODUCTION

Melt-in-mouth tablets are one of the new types of tablet formulations which combine the advantage of liquid and solid dosage forms. This type of dosage form is especially suitable for those who are unable to take conventional oral formulations[1].Now-a-days, the concept of melt-in-mouth tablets has been emerged as a good means to improve patient comfort. These tablets are broken down quickly and dissolve the medicaments as they interact with salivary secretions, avoiding the use of water. Because of this advantage, such tablets are suitable for children and elderly patients as they face difficulty in administering conventional tablets. Elderly patients need to administer drugs regularly to lead their healthy life. Children are finding difficulty in swallowing tablets since they have undeveloped muscular and nervous systems. The swallowing problems are also common in cases such as patients with motion sickness, sudden episodes of allergic attack or coughing and due to lack of water. These problems can be avoided by preparing melt-in-mouth tablets[2].

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This type of tablet is also named as mouth dissolving tablets, reprimelts, porous tablets, oro-dispersible, fast dissolving or rapidly disintegrating tablets[3]. Some medicaments enter to the blood stream through the oral cavity, pharynx and esophagus as saliva carried down to the GIT. In such instances, the bio-availability of medicaments is more than that of tablets[4]. The criteria considered for selection of the drug are it should have relatively low dose and bitter less in taste.

For the present investigation, montelukast sodium and levocetirizine dihydrochloride were selected as model drugs, as the properties of these drugs are meeting the criteria for mouth dissolving tablets. Montelukast sodium is a leukotriene receptor antagonist that acts by preventing the effects of cysteinyl leukotrienes. It is used in the prevention and management of asthma. Levocetirizine dihydrochloride is a long acting peripheralH1receptor antagonist. Allergic rhinitis is a disorder of the nose caused by inflammation mediated by immunoglobulin E (IGE) that lines the membranes of the nose after allergen exposure. It will prevent the release of other allergy chemicals and increase blood supply to the areas[5, 6].Combination of montelukast with levocetirizine

provides additional benefits in comparison with each agent and could be considered for patients whose quality of life is impaired by persistent asthma and allergic rhinitis[7].

In the present investigation an attempt was made to develop a simple, precise, accurate and reproducible method for simultaneous estimation of montelukast sodium and levocetirizine dihydrochloride in the formulation which is a basic parameter to quantify the amount of drugs present in a combination. Attempts were also made to design and characterize oro-dispersible tablet of montelukast sodium and levocetirizine dihydrochloride to achieve increased dissolution rate, hence the patient's compliance and also to develop means of administration to patients who are unable to swallow ordinary tablets and in case of motion sickness. The main idea behind the fabrication of such dosage form is the use of different super disintegrants *viz*. croscarmellose sodium, crospovidone, sodium starch glycolate and kyron T314, which burst the tablets immediately after placing over tongue, and release the medicaments in saliva. In the formulation, aspartame and mannitol were also included as sweetener. These systems may provide better qualities with enhanced drug bio-availability.

MATERIALS AND METHOD

Materials

Montelukast sodium and levocetirizine dihydrochloride were obtained from Morpen Lab, Solan (India) and Micro Labs Ltd. (Bangalore). Croscarmellose sodium, crospovidone sodium starch glycolate and kyron T 314 were obtained as gift samples from Wallace Pharma, Goa. Microcrystalline cellulose and mannitol were obtained from S.D Fine Chemical, Mumbai, India. All chemicals and reagents were obtained as AR grade.

Methods

I. Preformulation studies:

Preformulation studies such as melting point, IR spectral analysis, compatibility studies and λ_{max} determination were conducted by appropriate methods to check the identity and purity of the samples.

II. Analytical Method:

The method involves the measurement of absorptivity at its λ_{max}. Two wavelengths selected for the development of simultaneous equation were 245 nm (λ1) and 231nm (λ2). Absorptivity of both the drugs at both the wavelengths were determined and the equations obtained for the estimation of concentration were

$$C_X = \frac{(A1*y2) - (A2*y1)}{x1y2 - x2y1}$$

$$C_Y = \frac{(A2*x1) - (A1*x2)}{x1y2 - x2y1}$$

Where,

A1 and A2 are absorbance of sample solution at 245 and 231 nm respectively.

x_1= Absorptivity of montelukast sodium at 245 nm

x_2 = Absorptivity of montelukast sodium at 231 nm

y_1 = Absorptivity of levocetirizine dihydrochloride at 245 nm

y_2= Absorptivity of levocetirizine dihydrochloride at 231nm

Cx and Cy are concentration of montelukast sodium and levocetirizine dihydrochloride in sample solution[8].

III. Pre-compressional evaluations:

Angle of repose:

The method used was fixed funnel technique. The powdered blend was allowed to pass using a cut funnel till the highest pile height (h) was reached. Radius of base of pile (r) was measured and the angle of repose was calculated using the formula:

$$\theta = \tan^{-1} h/r$$

Where, θ= angle of repose, h =length of pile and r =radius of the base of the pile[9].

Bulk density:

Bulk density apparatus was used to measure bulk density (ρb). The volume (V_b) occupied by a given weight of powder (M) was noted. The bulk density was calculated by using the formula[9]:

$$\rho b = M/V_b$$

Tapped density:

The powder mix was taken in a measuring cylinder and tapped for a specified period of time. The true volume (V_t) and weight (M) of the powder was noted down. The tapped density (ρ_t) was determined by using the formula[9]:

$$\rho_t = M/V_t$$

Carr's consolidation index:

Carr's consolidation index (CI) (%) of the powdered mix was calculated using the formula[9].

Compressibility index (CI)

$$= \frac{\text{Tapped density } (\rho t) - \text{Bulk density } (\rho b)}{\text{Tapped density } (\rho t)} \times 100$$

Hausner's ratio:

Hausner's ratio is a ratio of tapped bulk density to untapped bulk density. It was determined by using the formula[9]:

$$\text{Hausner's ratio} = \varrho_t/\varrho_b$$

Where, ϱ_t is tapped bulk density and ϱ_b is untapped bulk density. The Lower Hausner's ratio (< 1.25) indicates better flow properties than the higher ones (>1.25).

IV. Preparation of mouth dissolving tablets using montelukast sodium and levocetirizine dihydrochloride:

Direct compression technique was used to formulate Melt-in-mouth tablets of montelukast sodium and levocetirizine dihydrochloride. Different super disintegrants of varied concentrations were used for developing mouth dissolving tablets. Quantities of excipients used in different formulations are given in Table No 1. All the adjuvants were weighed and mixed thoroughly in mortar, finally talc and magnesium stearate was added and the blend was compressed into tablets using Proton eight station mini press tablet machine (8 mm flat-faced punches). The total weight of each tablet was 200mg.

V. Post compression parameters:

Weight variation test:

Twenty tablets were selected randomly, weight of individual tablet and collective weight of all tablets were noted down. The average weight of one tablet was calculated from collective weight and the percentage weight deviation was calculated.

Hardness test:

The hardness of the tablet was checked using Monsanto and Pfizer hardness testers[9].

Thickness:

The thicknesses of the selected tablets were determined using screw gauge and Vernier calipers. Four tablets were taken and their thickness was recorded. It is expressed in mm[9].

Friability test:

Roche friabilator (Servewell Equipment Pvt. Ltd. Mumbai, India) was used to determine the percentage friability. Required number of tablets were selected randomly and the collective weight of all tablets was noted down. These tablets were charged into friabilator. The equipment was allowed to rotate for four min at 25 revolutions per minute or to complete100 revolutions. The tablets were collected, dedusted and noted down the weight of all tablets. The difference in weight before and after testing was calculated and percentage friability was determined using the following formula[9]:

$$\text{Friability (\%)} = \frac{\text{Loss in weight}}{\text{Initial weight}} \times 100$$

Water absorption ratio:

One tablet was placed in a petri plate (internal diameter 5.5cm) that contains 6ml purified water on which a piece of tissue paper with two folds was kept. The wetted tablet was taken and weight was noted down. Water absorption ratio, R was calculated by using the formula[10].

$$R = \frac{(Wa - Wb)}{Wb} \times 100$$

Where, W_a= weight of tablet before test and W_b= weight of tablet after water absorption.

Wetting time:

One tablet was placed in a petri plate (internal diameter 5.5cm) that contained 6ml purified water on which a piece of tissue paper with two folds was kept. The time required to wet the tablet completely was noted[10].

Drug content uniformity test:

This test was performed by selecting five tablets randomly. Accurately weighed tablet was crushed and dissolved in 100 ml of buffer (pH 6.8) solution in volumetric flask. The resulting solution was clarified, required dilution was made and the content was determined using UV -spectrophotometer at 245nm and 231nm[11].

Disintegration test:

This test was conducted using disintegration test apparatus (Servewell Equipment Pvt. Ltd. Mumbai, India). One tablet was placed in each of six tubes of the basket. The basket assembly was placed in water bath maintained at 37 ± 2^0C. The time in seconds required for the breaking down of tablet and the state of no trace of mass should remain in the tubes of the basket was measured. The standard limit for disintegration of melt-in-mouth tablet is less than three minutes[12,13].

In-vitro dissolution test:

The *in-vitro* dissolution study of mouth dissolving tablets made of montelukast sodium and levocetirizine dihydrochloride was conducted using USP type – II dissolution apparatus (Electrolab – TDT – 08L) conditions used for the test is as follows:

Phosphate buffer solution (900 ml; pH 6.8) was used as dissolution medium, temperature was maintained at 37±0.5°C and rotation was fixed at 50 rpm. Every interval of time, 5 ml of aliquot was withdrawn and the same quantity of fresh solution was replaced. The samples were filtered and suitably diluted with pH6.8 buffer solution. The absorbance of the solution was measured for both 245 nm and 231nm using UV-visible spectrophotometer (Shimadzu UV -1800)[14].

VI. Stability Studies:

Best formulation was chosen for stability studies as per ICH guidelines for three months. At an interval of 30 days, samples were taken and tested for physical appearance, drug content, wetting studies, and disintegration test and dissolution studies[15].

RESULTS

In the present study melt-in-mouth tablets comprising montelukast sodium and levocetirizine dihydrochloride were prepared by direct compression technique using crospovidone, croscarmellose sodium, sodium starch glycolate and kyron T314 as super disintegrants. Altogether eight formulations were prepared as per the Table No. 1. A suitable analytical method was used for simultaneous estimation of montelukast sodium and levocetirizinedihydrochloride[7]. The results of pre-compression parameters such as flow of powder, measurement of density, Hausner's ratio and percentage consolidation index are tabulated in Table No.2.The results of post-compression parameters such as weight uniformity, hardness, thickness, percentage friability, drug content uniformity, wetting time, water absorption ratio and disintegration time are given in Table No.3. *In vitro* dissolution study was conducted for all the formulations and the results are shown in Figure No 1-4. Based on the results of all the formulations, F4 formulation was chosen as a better formulation and used for stability studies, the result is depicted in Table No.4.

Table 1: Formulation of montelukast sodium and levocetirizine dihydrochloride mouth dissolving tablets.

Ingredients	**F_1**	**F_2**	**F_3**	**F_4**	**F_5**	**F_6**	**F_7**	**F_8**
Montelukast Sodium	10	10	10	10	10	10	10	10
Levocetirizine dihydrochloride	5	5	5	5	5	5	5	5
Croscarmellose Sodium	**3**	**4**	-	-	-	-	-	-
Crospovidone	-	-	**6**	**8**	-	-	-	-
Sodium starch glycolate	-	-	-	-	**6**	**8**	-	-
Kyron T-314	-	-	-	-	-	-	**3**	**4**
MCC	50	50	50	50	50	50	50	50
Mannitol	122	121	119	117	119	117	122	121
Aspartame	4	4	4	4	4	4	4	4
Mg stearate	3	3	3	3	3	3	3	3
Talc	3	3	3	3	3	3	3	3
Total-Wt(Mg)	200	200	200	200	200	200	200	200
*** Quantity in mg for one tablet**								

Table 2: Pre-compression parameters for all the formulations

Formulation code	**Parameters**				
	Angle of repose (θ)	**Bulk density (gm/cm³)**	**Tapped density (gm/cm³)**	**Hausner's ratio**	**Compressibility index (%)**
F_1	25.45**±0.773**	0.390**±0.007**	0.448**±0.010**	1.14**±0.005**	13.08**±0.441**
F_2	25.18**±0.725**	0.358**±0.010**	0.402**±0.007**	1.12**±0.018**	11.41**±0.924**
F_3	24.97**±8047**	0.395**±0.001**	0.456**±0.024**	1.15**±0.002**	13.32**±0.005**
F_4	25.21**±1.785**	0.373**±0.013**	0.427**±0.017**	1.14**±0.006**	12.66**±0.409**
F_5	25.20**±0.732**	0.394**±0.007**	0.451**±0.010**	1.14**±0.024**	12.80**±1.322**
F_6	24.23**±0.372**	0.385**±0.014**	0.450**±0.025**	1.13**±0.011**	13.78**±1.636**
F_7	24.27**±0.814**	0.390**±0.019**	0.443**±0.018**	1.13**±0.018**	11.98**±1.660**
F_8	24.79**±1.141**	0.402**±0.008**	0.465**±0.010**	1.15**±0.000**	13.55**±0.226**

Note: The values presented are ± SD's of three determination

Table 3: Post-compression parameters for all formulations.

Formulation Code	Parameters								
	Weight variation (mg)	Thickness (mm)	Hardness (kg/cm²)	Friability (%)	Drug content uniformity (%)		Wetting time (Sec)	Water absorption ratio (%)	*In vitro* disintegration test (Sec)
					Montelukast Sodium	Levocetirizine dihydrochloride			
F_1	197±0.19	3.15±0.01	3.26±0.19	0.20	96.28±0.37	96.96±0.60	43.10±0.33	62.45±0.19	49.66±2.14
F_2	196±0.50	3.04±0.01	3.33±0.19	0.20	96.28±0.37	90.97±1.37	39.33±0.19	66.81±0.10	40.33±0.50
F_3	199±0.66	3.30±0.03	3.26±0.19	0.30	96.28±0.37	95.14±0.40	34.00±0.33	60.26±0.28	28.33±0.50
F_4	196±0.50	3.38±0.05	3.46±0.38	0.40	96.28±0.37	96.96±0.60	29.33±0.38	64.16±0.05	19.33±0.69
F_5	198±0.33	3.21±0.08	2.90±0.33	0.29	95.18±0.24	95.14±0.40	36.00±0.33	62.70±0.23	50.00±0.88
F_6	199±0.19	3.40±0.03	3.03±0.19	0.30	96.28±0.37	95.14±0.40	33.00±0.33	68.17±0.09	42.33±0.83
F_7	199±0.19	3.43±0.05	3.26±0.19	0.40	95.18±0.24	95.14±0.40	41.33±0.76	60.57±0.32	42.66±1.71
F_8	199±0.19	3.19±0.01	3.03±0.19	0.20	96.28±0.37	96.96±1.37	37.00±0.66	64.24±0.39	38.00±1.20

Note: The values presented are ± SD's of three determination.

Table 4: Stability parameters of best formulation containing crospovidone as super disintegrants (F_4)

Parameters	After one month		After two month		After three month	
Formulation (F_8)	Montelukast sodium	Levocetirizine Dihydrochloride	Montelukast sodium	Levocetirizine Dihydrochloride	Montelukast sodium	Levocetirizine dihydrochloride
Physical appearance	No change		No change		No change	
Drug content (%)	96.11	96.32	95.77	95.82	95.09	95.11
Wetting time (Sec)	29.33		30.12		29.88	
In-vitro Disintegration time(Sec)	19.33		18.03		20.67	
% CDR at 15 Min.	95.76	91.07	95.12	90.69	94.89	90.12

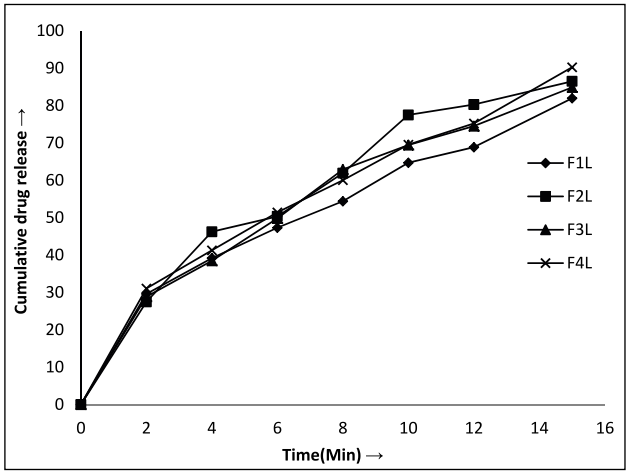

Figure 1: Comparative *in vitro* release profile of levocetirizine dihydrochloride (formulation F_1–F_4) in phosphate buffer (pH 6.8)

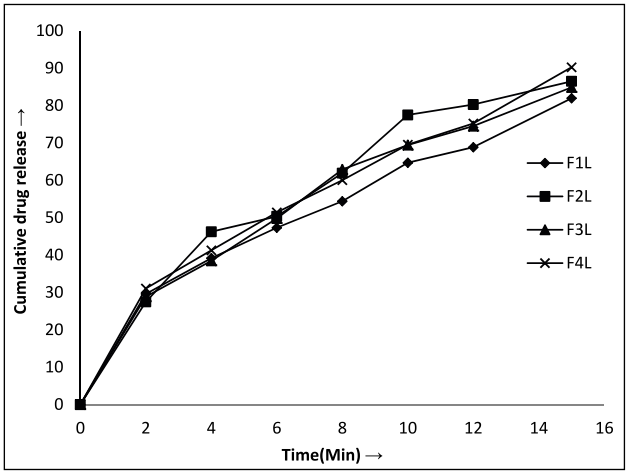

Figure 2: Comparative *in vitro* release profile of levocetirizine dihydrochloride (formulation F_5–F_8) in phosphate buffer (pH 6.8)

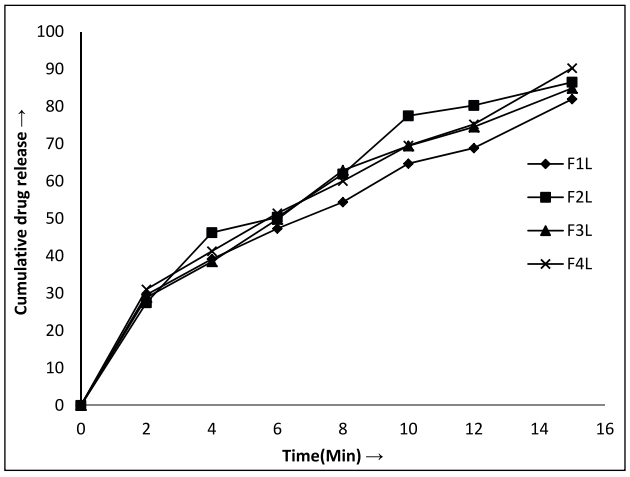

Figure 3: Comparative *in vitro* release profile of montelukast sodium (formulation $F_1 – F_{4)}$ in phosphate buffer (pH 6.8)

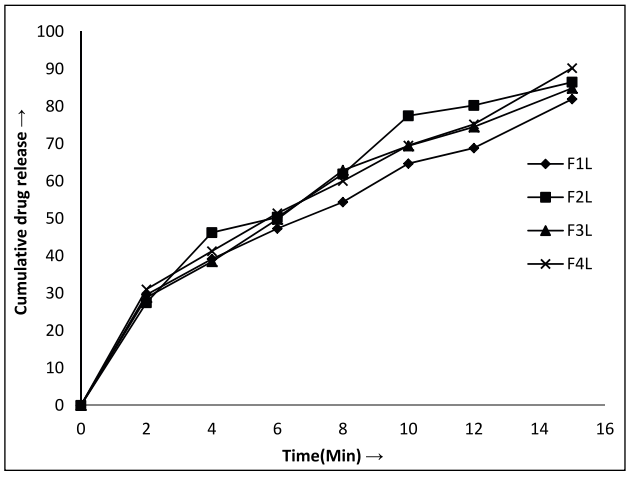

Figure 4: Comparative *in vitro* release profile of montelukast sodium (formulation $F_5 – F_8$) in phosphate buffer (pH 6.8)

DISCUSSION

Based on the results of IR and melting point studies (results not shown), it was confirmed that the obtained drug samples meet the requirements for purity. The compatibility study results confirm that there was no interaction between drugs and excipients (results not shown). From the results of pre-formulation parameters, it was observed that all the formulations were within the standard limits and indicated that the powder mix of all the formulations showed free flowing property (Table No 2).

The hardness of all the formulations was within the appropriate ranges indicating that the tablets have sufficient strength with an ability to withstand various types of shocks. This was supported by low percentage friability values of the formulations (< 1%). The result of weight variation test indicates that the weight of all the batches of tablets was found to be uniform with least percentage weight variation and within the standard range. The percentage drug content values of all the batches were found to be uniform and also observed within the standard range. The result of these two parameters explains the uniform mixing of drugs and non-drug components. The wetting time and water absorption ratio data have shown that the tablets were wetted at faster rate which helps in faster disintegration of tablets. The time required to disintegrate such type of tablets was found to be within the limits and meets the requirements for melt-in-mouth tablets. It was also observed that the tablets prepared using crospovidone as a super-disintegrating agent bursts rapidly due to high swelling capacity when compared to formulations containing other super-disintegrating agents. Among all the formulation, F_4 containing crospovidone(8%) was found to be better formulation, since these tablets have shown better mechanical strength, least percentage friability and less wetting time (29.33**±0.38** sec.) and disintegration time(19.33**±0.69**sec.), which is an ideal requirement for melt-in-mouth tablets. The result of dissolution study indicated that percentage CDR from F_4 formulation was found to be 96.06±%**0.80** and 91.69±%**1.05** for montelukast sodium and levocetirizine dihydrochloride(Figure No 1-4)respectively at the end of 15 min; whereas the drug release from other formulations was found to be less. The good drug release from F_4 tablet may be due to sudden dissolution fluid uptake into the tablet that leads to swelling of tablets which results in bursting of tablets. These disaggregated particles dissolve quickly in the dissolution medium thereby increase the dissolution rate of the drugs. The results of stability study (data not presented) showed that there was no much variation in the physical appearance, drug content, wetting time and *in- vitro* drug release studies.

CONCLUSION

Melt-in-mouth tablets prepared of montelukast sodium in combination with levocetirizine dihydrochloride were successfully prepared by direct compression technique using different super-disintegrants. The ability of super-disintegrants to disintegrate tablets is in the following order: crospovidone>croscarmellose sodium > sodium starch glycolate> Kyron T314.From the study it was observed that crospovidone at a concentration of 8% w/w **(**F_4) showed maximum *in-vitro* drug release, and hence this formulation emerged as the best formulation

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REFERENCES

1. Dali S, Subhashis C, Sanjay S, Brahmeshwar M. Mouth dissolving tablet II; an overview of evalution techniques. *Scientia Pharmaceutica* 2009; 77: 327-341.
2. Shukla D, Chakraborty S, Singh S, Mishra B. Mouth dissolving tablets: an overview of formulation technology. *The Austrian Journal of Pharmaceutical Science*2009; 76:309–326.
3. Dureja K, Saini H. Mouth dissolving Tablets: A Review. *Indian Drugs* 2004; 41(4):187-193.
4. Jaysukh JH, Dhaval AR, Kantilal RV. Orally disintegrating tablet: a review. *Tropical Journal of Pharmaceutical Research*2009; 8(2):161-172.
5. Richard AH, Pamela CC, Respiratory system. In: Wolters Kluwer (eds) *Lippincott's illustrated reviews: pharmacology: 4thed.* New Delhi; 2009.p: 319.
6. Kanakadurga Devi N, Prameela Rani A, SaiMradula B, Formulation and evaluation of oral disintegrant tablet of montelukast sodium: effect of super-disintegrants. *Journal of Pharma Researc*h 2013;3(4):802-808.
7. Gupta MM, Niraj Gupta, Bhupendra SC, Shweta Pandey, Fast disintegrating combination tablet of taste masked levocetirizine dihydrochloride and montelukast sodium: Formulation design, development and characterization: *Journal of Pharmaceutics*2014, article ID568320:15 pages
8. NageshC, Mahendrakumar D, Karigar Asif, Chandrashekhara S, Attimarad Sunil, Naduvinamani Suma, Development and validation of simultaneous equation method for estimation of montelukast sodium and levocetirizine dihydrochloride by U.V spectrophotometric method. *Unique Journal of Pharma and Biological Sciences* 2013; 01(2); 33-36.
9. Rockville MD. United States of Pharmacopeia-National Formulary. USP 30 – NF 25. The United States Pharmacopoeial Convention, 2007; 1: 634-645.
10. Bandari S, Mittapalli RK, Gannu R, Rao YM. Orodispersible tablets: An overview, *Asian Journal of Pharmaceutics*2008; 1:2-11.
11. Visth S, Ali S, Agrawal S, Bhola A. Preparation and evaluation of fast dissolving drug delivery system containing levocitrizine HCl. *International Journal of Pharmacy and Pharmaceutical Sciences* 2010; 2(3):109-111.
12. Patel B, Patel D, Patel C, Serasiya T, Sanja SD. Development and evaluation of fast dissolving tablets of glipizide. *International Journal of Pharmacy and Pharmaceutical Sciences*2009; 1(1):145-150.
13. Ravikumar, Patil SR, Patil MB, Paschapur MS, Mahalaxmi R. Design and characterization of aceclofenac mouth dissolving tablets by effervescent formulation approach. *Scholars Research Library*2010; 2(1):220-236.
14. Kakade SM, Mannur VS, Ramani KB, Bhagvat A. Formulation and evaluation of mouth dissolving tablets of losartan potassium by direct compression techniques. *International Journal of Research in Pharmaceutical Sciences*2010; 1(3):290-295.
15. Ahad HA, Anuradha CM, Kumar CS, Reddy KK, Jagadeesh KD. Novel approach in formulation and evaluation of mouth dissolving tablets of ondansetron hydrochloride. *International Journal of Applied Biology and Pharmaceutical Technology* 2010; 1(2):582-588.