International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

Applicability of Raw Banana as Super Disintegrant in the Design of Bupropion HCl Orodispersible Tablets

Chandini Vegesna[1], J. Anu Pravallika[2]

[1]Department of Pharmaceutics, Aditya Pharmacy College

[2]Associate Professor, Department of pharmaceutics, Aditya Pharmacy College

Abstract: ***The present study was aimed at developing and evaluating orodispersible tablets of Bupropion HCl using raw banana powder as natural superdisintegrant and sodium starch glycolate as synthetic superdisintegrant. Orodispersible tablets were prepared by sublimation method. Effect of superdisintegrants on wetting, disintegration and dissolution parameters were studied. Orodispersible tablets were characterized by Fourier Transform Infrared (FTIR) spectroscopy. Preformulation studies were found as per literature limits. Drug was compatible with superdisintegrants. The prepared tablets were evaluated for weight variation, thickness, hardness, and friability, in vitro dispersion time, wetting time, in vitro disintegration time, drug content and in vitro drug release. In vitro disintegration time decreases with increase in concentration of all superdisintegrants. Among all the formulations BRB5 from raw banana and BSG6 from sodium starch glycolate showed 100% drug release over period of 1 hour. However, among the two optimized formulations, BRB5 with lower concentration of polymer showed effective drug release when compared BSG6 with higher concentration of polymer.***

Keywords: Orodispersible tablets, Bupropion HCl, sublimation method, superdisintigrants

1. Introduction

Because of high patient compliance, cheap cost, simplicity of administration, correct dose, and the ability to self - medicate, solid dosage forms are the most commonly used dosage forms. The most significant problem of widely used oral dosage forms such as capsules and tablets involves difficulty swallowing, which leads to patient non - compliance, it is most commonly seen in infants and the elderly, although it also applies to individuals in general and also patients who are sick, as well as active working patients who are busy or on the road, especially those without access to water [1].

To fulfil these medical needs a new Oral dosage forms that are new to the market are referred to as OTD's were developed by pharmaceutical technologies which is easily disintegrate in mouth by using saliva without using water within seconds. Comparing to the other conventional dosage forms drug dissolution, absorption and drug bioavailability and clinical effect of onset is more. OTD's release the drug into the mouth, allowing it to be absorbed through local or mucosal tissue and also through pre - gastric, gastric, and post gastric segments of gastrointestinal tract [2].

Advantages of OTD's:

a) Water is not required when the tablet is taken.
b) Low cost and high patient compliance.
c) Drug loading capacity is more and Pleasant taste and smooth mouth feel.
   When a drug's solubility and absorption are high, it achieves a rapid commencement of action.
d) It is simple to administer including both pediatric and geriatric individuals.
e) Reduced first pass metabolism, improved bioavailability and convenience of administration compared to liquid dosage forms [3].

Disadvantages of ODT's:

a) During the production process, more caution is essential.
b) In general, mechanical strength is insufficient.
c) They may leave an unpleasant taste in the tongue if not prepared properly.
d) Larger dosages of ODTs are difficult to formulate [4].

2. Materials and Methods

2.1 Materials

Bupropion HCl was attained as a gift sample from Aspire Life sciences Pvt Ltd, Raw banana powder was purchased from Vital Herbs Delhi, Sodium Starch Glycolate, Micro Crystalline Cellulose, Camphor, and Magnesium sterate, Talc, and Sodium Saccharine were obtained from Suvarna scientific equipment St. fine chemical limited. All ingredients used through the study were of analytical grade and used as received.

2.2 Method

Preparation of tablets:

Required amount of drug and polymer were weighed accurately and mixed geometrically in a motar and pestle for 15 minutes as per the formula. Sodium Starch Glycolate, Micro Crystalline Cellulose, Camphor, and Magnesium sterate, Talc, and Sodium Saccharine was added one by one to the prepared drug polymer mixture and were rigorously mixed. The prepared mixture was passed through mesh #40. Finally, the sieved blended powder is weighed accurately for each tablet and compressed into tablets by direct

compression in a single punch tablet machine. The formulated tablets are then subjected to sublimation method in vaccum oven at 60^0 C for a period of 6 hours.

3. Precompression Parameters

Bulk density determination:
50gm of drug weighed on digital balance is moved into a 100ml measuring cylinder, the volume occupied by the drug is recorded as the bulk volume. It is expressed in gm/cc [5].

Table 1: Formulae for Bupropion HCl Orodispersible tablets by using synthetic polymer

S. NO	Ingredients	BSG1	BSG2	BSG3	BSG4	BSG5	BSG6
1	Bupropion HCL	100	100	100	100	100	100
2	Sodium starch glycolate	1	2	3	4	5	6
3	Micro crystalline cellulose	71	70	69	68	67	66
4	Camphor	20	20	20	20	20	20
5	Magnesium sterate	2	2	2	2	2	2
6	Talc	2	2	2	2	2	2
7	Sodium saccharine	4	4	4	4	4	4
	Total Weight (mg)	200	200	200	200	200	200

Table 2: Formulae for Bupropion HCl Orodispersible tablets by using natural polymer

S. No	Ingredients	BRB1	BRB2	BRB3	BRB4	BRB5
1	Bupropion HCL	100	100	100	100	100
2	Raw banana powder	1	2	3	4	5
3	Micro crystalline cellulose	71	70	69	68	67
4	Camphor	20	20	20	20	20
5	Magnesium sterate	2	2	2	2	2
6	Talc	2	2	2	2	2
7	Sodium saccharine	4	4	4	4	4
	Total Weight (mg)	200	200	200	200	200

Tapped density determination: In a graduated cylinder accurately weighed drug is placed and the volume (V_o) is measured. The graduated cylinder closed with lid, placed in the density determination apparatus is put for 500 taps after that the volume (V_f) should be measured [6].

Angle of repose (ɵ): The material placed in a funnel and the tip is held closed and poured through it to form a cone. Once the heap is formed height of the Pile is to be measured and the circumference of the circle drawn is to be measured [7], [8].

Hausner's ratio: Hausner's ratio determines the flow properties of the powder and it is measured by the ratio of tapped density to bulk density [9].

4. Evaluation Studies

Uniformity of thickness: The thickness of floating tablets is measured with Vernier callipers. From each batch five tablets were picked at random, and the thickness of each tablet was measured and indeed the mean thickness was calculated using the average weight [10].

Hardness test: The amount of force needed to break a tablet in a diametral compression test is known as tablet crushing strength. Monsanto hardness tester is used to measure hardness of the tablets. Six tablets were chosen from each batch measured for hardness [10].

Friability test: Twenty floating tablets were weighed precisely and placed in the Roche friabilator, which was rotated at 25 rpm for four minutes. After revolutions, the tablets should be withdrawn and accurately weighed again. The % friability is measured using the formula [11]

$$\%F = \{1 - (Wt/W) \times 100\}$$

Uniformity of drug content: The amount of drug in a formulation can be determined by uniformity of drug content. From each batch, ten tablets were chosen at random and powdered using mortar and pestle. The powder equivalent to the average weight of the prepared tablet was weighed and dissolved in pH 6.8 phosphate buffer, the solution was filtered and about 1ml of the filtrate was diluted and analysed for Bupropion HCl content spectrophotometrically at 227.2 nm by UV - spectrophotometer [12].

***In vitro* dissolution test:** Invitro drug release test for the tablets is performed by USP dissolution apparatus, type - 2 (paddle type). In the USP dissolution apparatus volume was made up to 900ml using pH 6.8 phosphate buffer. The USP apparatus is maintained at temperature $37^0 \pm 0.5^0$C. The rotation speed is set to 50rpm and 5ml sample was withdrawn at regular time intervals and replaced by fresh medium, during the study with a sampling time interval for 6 hours. Absorbance of the samples is measured at 227.2nm using UV spectrophotometer [13].

Uniformity of weight: Twenty tablets were picked at random from each batch. Average weight and percent standard variation from the average weight of twenty tablets were calculated. If not more than two prepared tablets are beyond the ratio limit, the tablets meet the USP test and no tablet differs by double the percentage limit [14].

Drug - polymer interaction studies:
FT - IR Spectroscopy: Drug and excipient compatibility was performed by Fourier transform infrared (FT - IR) spectroscopy. The samples containing pure drug and final

formulation (1: 1) is mixed thoroughly with KBr, an infrared transparent matrix (sample: KBr - 1: 5) respectively. The KBr discs are prepared in a hydraulic press for 5 minutes at a pressure of 5 tons. The compatibility studies give the structure for drugs combination with excipients in the preparation of dosage form. The goal of this study is to prove that the therapeutically active drug has not altered after subjected to various steps during formulation [11].

5. Results and Discussion

Orodispersible tablets were formulated using different drug to polymer ratios for both natural and synthetic polymers. The blended powder for compression was evaluated for all pre compression parameters after compression tablets were evaluated for post compression parameters, *in vitro* dissolution studies and drug polymer interaction studies.

Pre - compression parameters of tablet blend: Precompression studies were performed for the selected drug and all excipients and the results tabulated in table 3 and 4 confirmed that obtained values were found to be within limits as per Indian pharmacopoeia.

Post compression parameters: All the prepared formulations were confirmed to uniformity of weight and identified to be in the range of 198±0.09 - 201±0.18 % and uniformity of thickness were observed to be in the range of 3.10 ± 0.10 - 3.18 ± 0.12 mm respectively. The drug content was within the specified range of 99.20 ± 0.51 - 99.88 ± 0.59%. Hardness of the prepared tablets was within the range of 3.21±0.35 - 3.30 ± 0.36 Kg/cm^2 and friability values are observed to be in the range of 0.46 ±0.17 - 0.65±0.15% respectively. The wetting time were observed to be in range from30.2 seconds – 41.6 seconds and results were tabulated in table 5 and 6 from the results, it was observed that all the prepared tablets were acceptable and were well within the limits as per IP.

Table 3: Pre - compression parameters of Bupropion HCl - Sodium Starch Glycolate formulation

Formulation	Bulk density (g/ml) Mean ±S. D (n=3)	Tapped density Mean±S. D (n=3)	Compressibility index (%) Mean±S. D (n=3)	Hausner ratio Mean±S. D (n=3)	Angle of repose (ɵ) Mean±S. D (n=3)
BSG1	0.52±0.15	0.65±0.12	0.65±0.12	1.17±0.05	23.5±0.27
BSG2	0.54±0.19	0.58±0.17	0.58±0.17	1.13±0.04	24.7±0.17
BSG3	0.62±0.21	0.63±0.21	0.63±0.21	1.10±0.08	25.9±0.21
BSG4	0.58±0.26	0.67±0.24	0.67±0.24	1.12±0.06	24.6±0.14
BSG5	0.49±0.23	0.59±0.22	0.59±0.22	1.20±0.04	23.5±0.19
BSG6	0.67±0.22	0.66±0.13	0.66±0.13	1.15±0.05	26.3±0.28

Table 4: Pre compression parameters of Bupropion HCl - Raw banana powder formulations

Formulation	Bulk density (g/ml) Mean ±S. D (n=3)	Tapped density Mean±S. D (n=3)	Compressibility index (%) Mean±S. D (n=3)	Hausner ratio Mean±S. D (n=3)	Angle of repose (ɵ) Mean±S. D (n=3)
BRB1	0.55±0.14	0.70±0.19	0.70±0.19	1.16±0.07	24.2±0.22
BRB2	0.63±0.17	0.69±0.17	0.69±0.17	1.18±0.09	25.4±0.16
BRB3	0.56±0.12	0.63±0.14	0.63±0.14	1.10±0.05	26.2±0.23
BRB4	0.47±0.20	0.57±0.15	0.57±0.15	1.17±0.03	25.3±0.18
BRB5	0.54±0.18	0.65±0.20	0.65±0.20	1.09±0.02	24.5±0.25

Table 5: Post compression parameters Bupropion HCl - Sodium Starch Glycolate of formulations

Formulation	Uniformity of weight variation Mean ± S. D (n=3)	Uniformity of Thickness (kg /cm^2) Mean ± S. D (n=3)	Hardness (kg / cm^2) Mean ± S. D (n=3)	Friability (%) Mean ± S. D (n=3)	Wetting time Mean ± S. D (n=3)	Drug content Mean ± S. D (n=3)
BSG1	199 ± 0.12	3.10 ± 0.14	3.23 ± 0.27	0.46 ± 0.17	38.0 ± 31.2	99.57 ± 0.67
BSG2	200 ± 0.16	3.16 ± 0.09	3.20 ± 0.34	0.54 ± 0.10	37.0 ± 1.6	99.38 ± 0.56
BSG3	198 ± 0.16	3.18 ± 0.12	3.24 ± 0.38	0.57 ± 0.11	41.6 ± 1.5	99.61 ± 0.69
BSG4	198 ± 0.09	3.14 ± 0.13	3.27 ± 0.29	0.63 ± 0.14	41.3 ± 1.3	99.28 ± 0.57
BSG5	200 ± 0.13	3.10 ± 0.10	3.30 ± 0.36	0.56 ± 0.16	39.2 ± 1.6	99.36 ± 0.64
BSG6	201 ± 0.18	3.15 ± 0.13	3.22 ± 0.32	0.64 ± 0.09	41.1 ± 1.3	99.54 ± 0.56

Table 6: Post compression parameters Bupropion HCl - Raw banana powder of formulations

Formulation	Uniformity of Weight variation Mean ± S. D (n=3)	Uniformity of Thickness (kg / cm^2) Mean ± S. D (n=3)	Hardness (kg / cm^2) Mean ± S. D (n=3)	Friability (%) Mean ± S. D (n=3)	Wetting time Mean ± S. D (n=3)	Drug content Mean ± S. D (n=3)
BRB1	199 ± 0.09	3.14 ± 0.16	3.26 ± 0.28	0.49 ± 0.17	34.6 ± 1.8	99.73 ± 0.62
BRB2	199 ± 1.15	3.12 ± 0.14	3.28 ± 0.33	0.52 ± 0.12	33.3 ±1.7	99.88 ± 0.59
BRB3	198 ± 1.17	3.13 ± 0.15	3.24 ± 0.31	0.65 ± 0.15	30.2 ± 1.2	99.46 ± 0.62
BRB4	201 ±0.13	3.15 ± 0.09	3.21 ± 0.35	0.59 ± 0.13	31.4 ± 1.4	99.20 ± 0.51
BRB5	199 ± 1.19	3.17 ± 0.13	3.25 ± 0.30	0.55 ± 0.16	30.5 ± 1.7	99.53 ± 0.65

***In vitro* dissolution time:** The drug release was mostly impacted by the superdisintegrants employed in the formulations, according to the dissolving experiments of the prepared tablets. The tablets used in this study were designed to deliver the medication over a period of 1 hour. Among the formulations prepared with natural super disintegrant (RB), BRB5 showed 100 % release of a medication over a period of 1 hour. Preparation of the

remaining formulas with natural super disintegrant shown 74% - 90% of drug release during 1 hour as the concentration of the superdisintigrant is low. Among the formulations prepared with synthetic superdisintegrants, BSG 6 showed 99.8% release of a medication over a period of 1 hour and the other formulations prepared with synthetic superdisintegrant showed 72% - 89% of drug release due to lower concentration of superdisintegrant used. The rate of drug release was found to increase as the concentration of superdisintegrant was increased, as per the study.

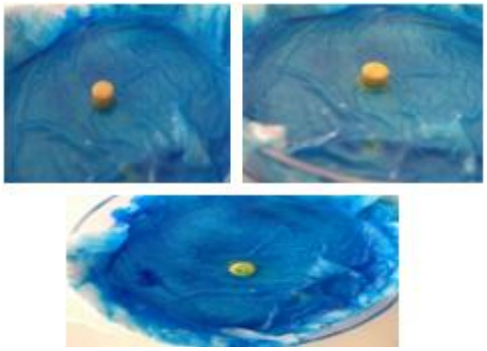

Figure 1: Wetting time of natural superdisintegrant (RB) at 2 sec, 5 sec, 10 sec, and 15 sec.

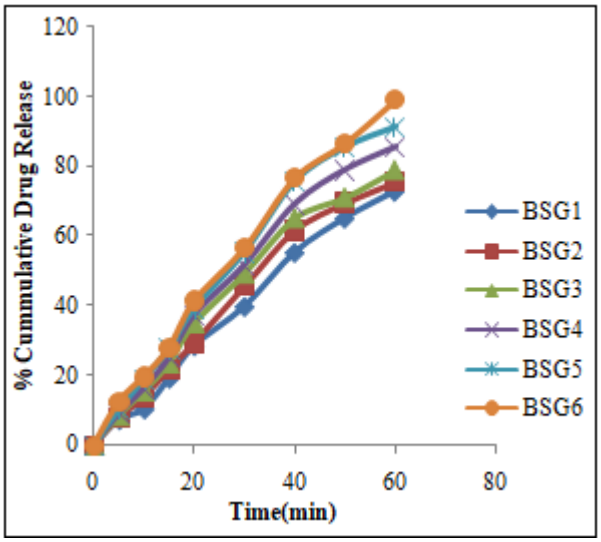

Figure 2: *in - vitro* drug release profiles of BSG1 - BSG6

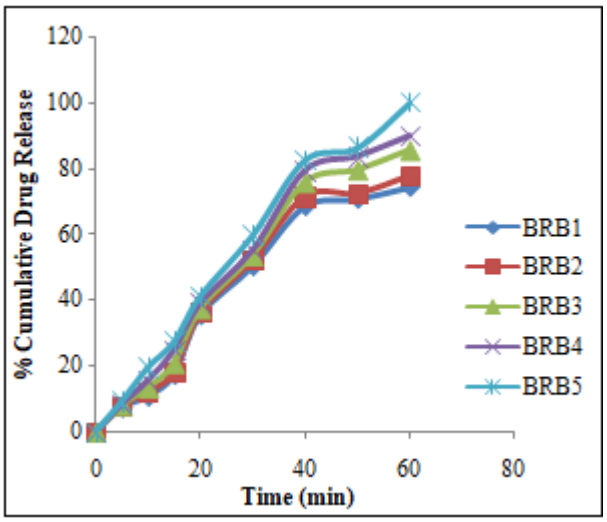

Figure 3: *in - vitro* drug release profiles of BRB1 – BRB5

Release kinetics: The data was fitted into popular exponential equations such as Zero order, First order, Higuchi, Hixson - Crowell, and Peppas to determine the order and mechanism of drug release. The drug release kinetics from the raw banana basic formulations mostly followed zero order kinetics, other than BRB1 and BRB2, which followed first order kinetics. Except for formulation BSG1, which has first order kinetics, the drug release kinetics from sodium starch glycolate - based formulations follows zero order.

Table 7: Release kinetics of Bupropion HCL Orodispersible tablets

S. NO	Formulation	Zero order	First order	Higuchi	Hixson - Crowell	Korsmeyar Peppas	Zero order	First order	Higuchi
		K_0	r	K_1	r	r	K_0	r	K_1
1	BSG1	9.583	**0.989**	0.021	**0.990**	0.961	0.896	0.995	0.992
2	BSG2	10.08	0.992	0.028	0.989	0.966	0.904	0.959	0.997
3	BSG3	10.65	0.994	0.031	0.991	0.967	0.915	0.933	0.995
4	BSG4	11.96	0.977	0.038	0.995	0.970	0.911	0.942	0.996
5	BSG5	12.19	0.992	0.049	0.991	0.971	0.913	0.919	0.994
6	BSG6	12.70	0.993	0.081	0.911	0.972	0.912	0.993	0.997
7	BRB1	10.59	**0.971**	0.029	**0.979**	**0.893**	**0.951**	0.994	0.997
8	BRB2	10.93	**0.971**	0.032	**0.982**	0.995	0.895	0.956	0.996
9	BRB3	11.88	0.985	0.040	0.983	0.985	0.896	0.970	0.958
10	BRB4	12.47	0.988	0.047	0.986	0.962	0.901	0.984	0.992
11	BRB5	13.40	0.998	0.101	0.876	0.996	0.892	0.989	0.998

FTIR spectroscopy: The FTIR bands of Bupropion and optimized formulations BRB5, BSG6 are shown in fig 5.5 and 5.6. The FTIR spectrum of Bupropion HCl showed ketone group (C=O stretch) at 1689 cm^{-1}, Di alkyl amine (R_2NH) at 905 cm^{-1}, Alkyl halides (C - Cl) at 1232 cm^{-1}, Aromatic (C - C stretch) at 1459 cm^{-1}. Both the optimized

formulations showed all the characteristic peeks of the drug in their respective formulations. The optimized formulations also showed the parent peeks of the polymers in their respective optimized formulation. This indicates there are no physical or chemical interactions in the drug and excipients used.

Functional group	Pure Drug Values (cm^{-1})	Obtained values of Pure Drug (cm^{-1})	Drug+SSG (cm^{-1})	Drug+BRB (cm^{-1})
ketone group (C=O stretch)	1687	1689	1685	1691
Di alkyl amine (R_2NH)	902	905	898	901
Alkyl halides (C - Cl)	1234	1232	1230	1236
Aromatic (C - C stretch)	1457	1459	1454	1461

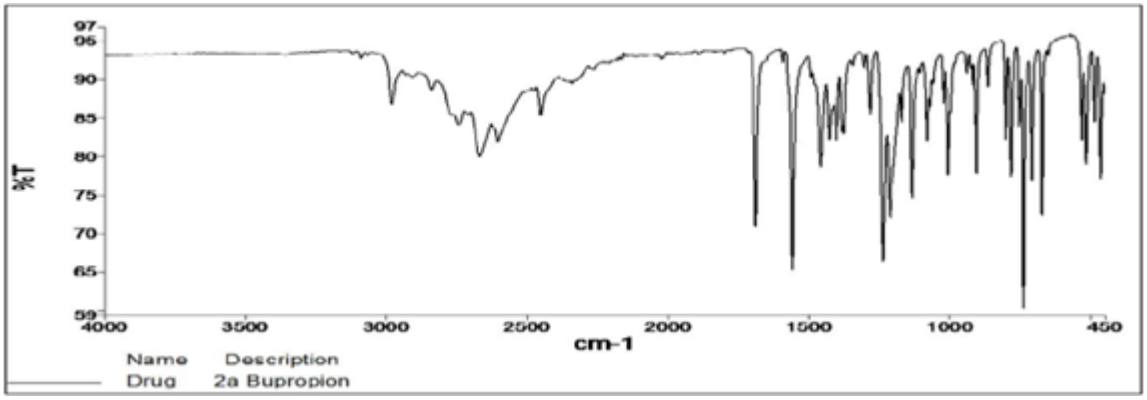

Figure 4: FTIR spectrum of Bupropion HCL

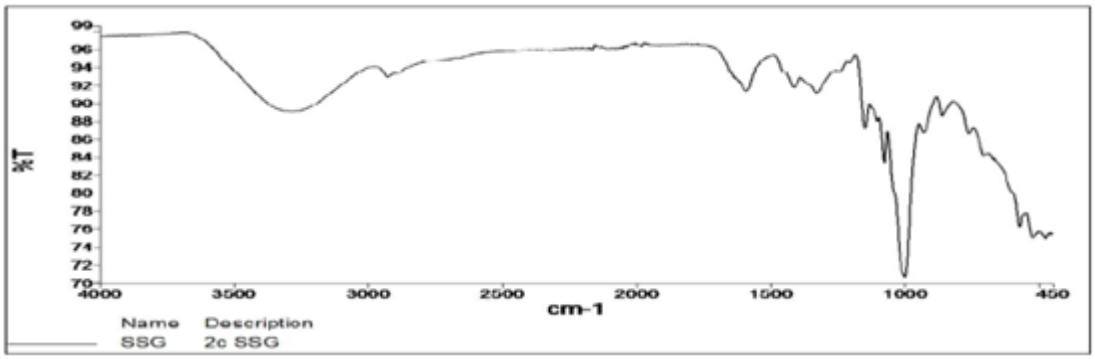

Figure 5: FTIR spectrum of Drug with SSG

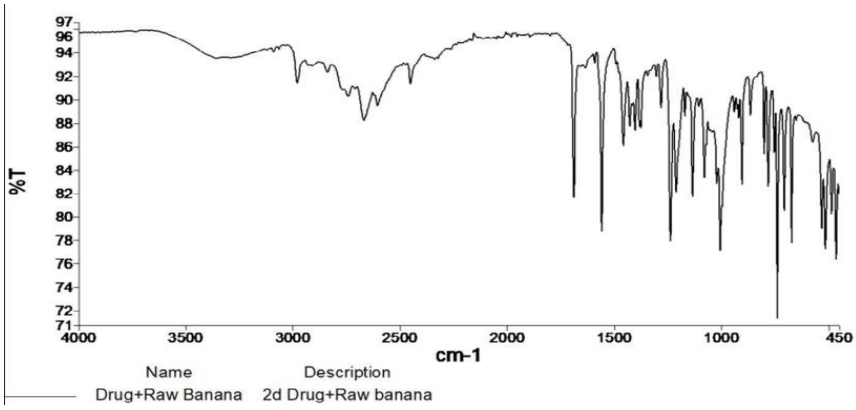

Figure 6: FTIR spectrum of Drug with raw banana powder

6. Conclusion

The prepared orodispersible tablets could able to extend the drug release over a period of 1 hour and exhibited good physico - chemical properties. The prepared tablets were evaluated for all the tests and the results indicated the acceptable limits. Among all the formulations prepared with 2 different polymers BRB5 showed an effective drug release when compared with already established synthetic polymer. Hence the applicability of raw banana as superdisintegrant was successfully tested in the design of Bupropion HCl orodispersible tablets.

References

[1] Sastry SV, Nyshadham JR, Fix JA. Recent technological advances in oral drug delivery–a review.

Pharmaceutical science & technology today.2000 Apr 1; 3 (4): 138 - 45.
[2] Seager H. Drug - delivery products and the Zydis fast - dissolving dosage form. Journal of pharmacy and pharmacology.1998 Apr; 50 (4): 375 - 82.
[3] Tejvir K, Bhavandeep G, Sandeep K, Gupta GD. Mouth dissolving tablets: a novel app to drug delivery. Int. J. Curr. Pharm. Res.2011; 3: 1 - 7.
[4] KolheSR, Chaudhari PD, More DM. Development and evaluation of melt - in - mouth tablets by sublimation technique. International Journal of Pharmaceutical Sciences and Research.2011 Apr 1; 2 (4): 839.
[5] Kiran Kumar GB, Annangi VK, Ahamed DM, Kumar GP. Preparation and evaluation of kollidon SR matrix tablets of tinidazole for colon specific drug delivery. IJSIT.2013; 2 (1): 97 - 106.
[6] Abhilash G, Baby B, Rao BP, Rajan SR, Ramesh K, Kumar GR. Comparative study on the efficiency of various binder combinations for metformin tablets. Journal of Pharmacy and Pharmaceutical Science Research and Review.2013; 2: 20 - 4.
[7] Damodar R, Movva B, Vinay CV. Role of Novel Hole Technology in Fast Dissolving Tablets. J mol pharm org process Res.2014; 2 (1): 1 - 5.
[8] Vargas M, Bustamante C, Villarraga EA. Fed and fasting bioequivalence study for two formulations of bosentan 125 mg tablets in healthy Colombian people. Journal of Bioequivalence & Bioavailability.2015 Jul 1; 7 (5): 210.
[9] Muñoz E, Ocampo D, Yepes N. Bioequivalence study of two formulations of escitalopram oxalate 20 mg tablets in healthy volunteers. Journal of Bioequivalence & Bioavailability.2015 Jul 1; 7 (5): 205.
[10] United State Pharmacopoeia 30 - NF 25.31: 1462, 909, 618
[11] Arora P, Sethi VA. Orodispersible tablets: A comprehensive review. International Journal of Research and Development in Pharmacy & Life Sciences.2013 Mar 15; 2 (2): 270 - 84.
[12] National Center for Biotechnology Information (2021). PubChem Compound Summary for CID 656582, Saccharinsodium. RetrievedSeptember17, 2021from https: //pubchem. ncbi. nlm. nih. gov/compound/Saccharin - sodium
[13] Upare SW, Chandewar AV, Kshirsagar MD, Koli US, Pokale HK. A formulation and development of Orodispersible Tablet of Lornoxicam. The Pharma Innovation.2012 Aug 1; 1 (6).
[14] United State Pharmacopoeia 30 - NF 25.31: 1462, 909, 618