WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 9, Issue 7, 2184-2201. Research Article ISSN 2277– 7105

FORMULATION AND EVALUATION OF RISPERIDONE FLOATING TABLETS USING NATURAL POLYMERS

Panchaxari Dandagi*, Shubham Rangoli, Udaykumar Bolmal, Rajashree Masareddy, Taufik Kazi

KLE Academy of Higher Education and Research, KLE College of Pharmacy, JNMC Campus, Belagavi-590010, Karnataka, India.

Article Received on
19 May 2020
Revised on 09 June 2020
Accepted on 29 June 2020
DOI: 10.20959/wjpr20207-17796

***Corresponding Author**
Panchaxari Dandagi
KLE Academy of Higher Education and Research, KLE College of Pharmacy, JNMC Campus, Belagavi-590010, Karnataka, India.

ABSTRACT

The present study is aimed to develop Risperidone floating tablets using natural polymers. Risperidone is a second generation anti-psychotic drug. This drug plays major role in the treatment of schizophrenia, bipolar and irritability disorders. Risperidone has good lipophilic behavior, so it is rapidly and completely absorbed through oral route of administration and finally metabolized by cytochrome-P450 2D6. This drug has a narrow absorption window at upper G. I. tract leads to variation in bioavailability makes a suitable candidate for floating drug delivery system. The Risperidone floating tablets were formulated by Direct compression method. Hydrocolloid natural polymers like Gaur gum, Xanthan gum were used as a floating polymers and gelling agent in a different concentration. Sodium bi carbonate was used as a gas generating agent to reduce floating lag time. Drug-excipients compatibility was studied by Differential Scanning Colorimeter (DSC) and Fourier Transform Infrared Spectroscopy (FTIR). All the formulations were subjected for Pre-Compression and Post-Compression parameters. The powder showed good flow properties and Compressibility Index. All the formulated tablets were found within the permissible limits for various Post-compression parameters. Optimized formulation F7, which is combination of both polymers were showed 95% of *in vitro* drug release up to 12 hours and followed Korsemeyers Peppas release mechanism of kinetics and was governed by non-Fickian diffusion release. Stability studies were carried out for F7 formulation at room temperature and accelerated temperature, results revealed that formulation was found to be stable for 1 month.

KEYWORDS: Risperidone, floating drug delivery system, Gaur gum and Xanthan gum.

INTRODUCTION

Delivery of drug through oral route is most suitable route because of its easy administration, patient compliance.[1] The main aim of drug delivery is to reach the specific amount of drug to the desired site in the body, which helps to maintain the accurate concentration of drug during treatment.

In market, 50% of drugs are delivered through oral route. However, there is an accepted fact that absorption of medicament throughout GIT is not uniform. By using recent release technology, delivery of medicament for 12 or 24 hours is possible for various drugs that are uniformly absorbed from GI Tract. This release technology is not suitable for drugs with narrow absorption window in the upper portion of GI Tract I.e. stomach & small portion of the GIT.

Many problems are faced while delivering the drug through the oral route. Those problems are variable gastric emptying time, in complete drug release, short residence time of dosage form in stomach. These problems can produce incomplete absorption of drugs, which are having the absorption window in the stomach or upper portion of GIT i.e. duodenum or upper part of jejunum. If once drug passes down from absorption site or window, then that remaining quantity of drug remained as an unabsorbed or waste. One of the major problems is to keep the dosage form in a desired area of GIT.[2] Floating drug delivery systems is the system that keeps the dosage form in the stomach for long period of time and that improves the bioavailibity of the medicament thus extended gastric retention, decreases dug waste and enhances the solubility of drugs that are less soluble in alkaline pH environment.

In floating drug delivery system, sustain or controlled drug release is achieved by use of hydrophilic polymers. Use of natural polymers gained the importance, instead of using the synthetic polymers because of biocompatibility, biodegradability, safe, non toxic, capable of chemical modification, inexpensive and ready availability.[3] As these are hydrophilic polymers these have greater swelling properties, so they are regularly and commonly used in the different gastro retentive dosage form.

Risperidone is considered as a second generation anti-psychotic drug. This drug plays major role in the treatment of schizophrenia, bipolar and irritability disorders.[4] Risperidone has good lipophilic behavior and it has a narrow absorption window at upper G. I. tract leads to variation in bioavailability,[5] hence ‘The present study is aimed to formulate and evaluate

Risperidone floating tablets using natural polymers to achieve maximum bioavailability and patient compliance.

MATERIALS AND METHODS

Materials

Risperidone was obtained as gift sample from Micro Labs limited, Bangalore, Karnataka. Xanthan gum and Gaur gum was obtained from Colorcon Asia pvt. limited. Magnesium Stearate, Di-calcium Phosphate and MCC was obtained from Himedia Pvt Ltd, Mumbai. Sodium bi Carbonate was obtained from Molychem, Mumbai. Pvp K30 and Talc was procured from Ozone International Pvt Ltd.

Methods

Preparation of Floating Tablets of Risperidone Using Direct Compression Method[6]

Floating tablets containing a 3 mg of Risperidone were compressed by direct compression method. Natural polymers like Xanthan gum and gaur gum are used to release the drug in a sustain form. Other excipients are also used, they are Sodium bi carbonate as gas generating agent, Pvp k30 as binding agent, MCC and Di-calcium phosphate as bulking agent, Magnesium stearate as lubricant and Talc as glidant. Formulation of floating tablets is given in table No.1.

Table 1: Formula Table.

Ingredients	F1 (mg)	F2 (mg)	F3 (mg)	F4 (mg)	F5 (mg)	F6 (mg)	F7 (mg)
Risperidone	3	3	3	3	3	3	3
Xanthan gum	_	_	_	12	24	36	36
Gaur gum	12	24	36	_	_	_	36
Sodium bi carbonate	24	24	24	24	24	24	24
Pvp K30	12	12	12	12	12	12	12
Di-calcium phosphate	33	27	21	33	27	21	03
MCC	32	26	20	32	26	20	02
Magnesium stearate	02	02	02	02	02	02	02
Talc	02	02	02	02	02	02	02
Total	120	120	120	120	120	120	120

All above materials were mixed very well in mortar and pestle then passed through sieve no 80. Then obtained powder was taken directly into compression. Floating tablets were compressed in size of 6mm punch in mini press i.e. Remik mini press-I. Total cut weight of each tablet is 120 mg.

Compatibility studies for the drug-excipients[7]

FTIR Spectroscopy of drug and excipients

The obtained FTIR spectrum of drug sample was compared with standard FTIR spectrum Compatibility studies of Risperidone and excipients were studied with help of spectroscopic analysis. FTIR study provides the confirmation of drug identity and also interactions between drugs with excipients.

Method: Ingredients, which are taken under investigations, must be solid and absolutely dry. The sample is taken into mortar and mixed thoroughly with 100 times weight of potassium bromide (IR grade powdered and thoroughly dried) by using pestle. This sample mixture is placed in sample cell and blank disc is prepared by using pure potassium bromide and placed in reference beam path, then spectrum can be scanned. Thus samples were analyzed for compatibility studies by infrared spectroscopic analysis.

Differential Scanning Calorimeter[8]

Method: This is one of the methods which are used for the compatibility studies. Binary mixture of drug and excipients were weighed and transferred into 40 ml aluminum crucibles with a pierced aluminum lid. DSC thermo grams were utilized, with the help of Shimadzu dsc-60 thermo analytical system. To remove the nitrification, nitrogen gas (50 ml/min) was used in the analysis and Pyrolytic effect of heating rate was 100°c/min temperature of 30°c-400°c. The melting point range of active agent and each excipient were known previously and then presently obtained thermo grams were compared with already known one.

Evaluation of Pre-Compressed blends

Bulk Density[9]

Bulk density can be determined by taking already known weight of fully dried granules (2mg) into measuring cylinder, then immediately bulk volume of granules in the cylinder is recorded. The following equation is used to calculate bulk density.

Bulk Density (g/ml) = Mass of the Powder/ Bulk Volume

Tapped density[10]

Tapped density is nothing but ratio of weight of dried granules to the value obtained by the same granules, after providing a standard tapping of measure i.e. called tapped volume. It is expressed in g / ml. The following equation is used to calculate tapped density.

Tapped Density (g/ml) = Mass of the Powder / Tapped Volume

Compressibility Index[11]

Values of bulk density and tapped density are helpful to determine compressibility index. Main aim of compressibility index is to predict compressibility of granules. The powder blend's compressibility index was determined by the compressibility index of Carr. The percentage (%) of compressibility of the mixture was found using the formula given below based on the tapped density and apparent bulk density. The following equation is used to calculate Compressibility Index

%Compressibility = [(Tapped density – Bulk density) / Tapped density] X10

Hausners ratio

It is helps to predict the flow characteristics of dried granules. The following equation is used to calculate Hausners ratio.

Hausners ratio= tapped density/ bulk density

Angle of Repose[12]

It is nothing but possible angle formed between horizontal plane and surface of file of powder. Funnel is used to measure the angle of repose. The already weighed blend was transferred into funnel. The funnel was adjusted in such a way that, tip of funnel should touches the tip of heap of powder. Then mixture from funnel was allowed to flow freely onto the ground then measured diameter and height of Formed and determined the angle of Repose by using following equation.

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

Where, h= height of the pile

r = Radius of the pile.

Physical Evaluation of Tablet[13]

1. Thickness

Thickness of all formulation (F1- F7) was checked out or determined or examined inspected by vernier caliper and was measured in nm.

2. Diameter

Diameter of all formulation (F1- F7) was checked out or determined or examined by vernier caliper and was measured in nm,

3. Hardness

Monsanto hardness tester was used to check out the Hardness of floating tablets. It is measured in kg/cm^2.

4. Friability

Friability is ability of tablets to withstand the abrasion during packing, shipping and handling. It is nothing but Drop test and directly related to hardness of tablet. Friability is checked out by Roche friabilator. Accurately weighed 20 tablets on electronic weighing balance and weighed tablets are transferred into drum of Roche friabilator and friabilator is rotated for 4 minutes i.e. 100 revolutions. Then tablets removed from the drum and dusted. There tablets are reweighed. The variation between initial weight (before friability) and final weight (after friability) gives the friability of tablets. The powder loss should not be more than 1%. The following equation is used to calculate friability.

% Friability = (W initial-W final) / W initial* 100

5. Weight variation as per I.P

After compression of tablets, 20 tablets are taken from each batch, and then individually weighed on electric balance and average weights of these tablets are determined. Later % deviation along with weight variation is calculated.

6. Floating lag time

The total time taken by the tablet to emerge on the surface of the buffer medium is called as the In Vitro Floating Lag time. The tablet was immersed into 100 ml of 0.1 N Hcl and noted, the time taken by the tablet to reach the surface of the medium. The test was carried out in triplicate.

7. Total floating time

The total time taken by the tablet remains buoyant in the buffer medium is called as Total Time of Floating. The tablet was immersed in 0.1 N Hcl and the time interval from the formulation remains buoyant was noted. The test was carried out in triplicate.

8. Swelling Index

The extent of swelling was measured in terms of % weight gain by the tablet on immersing it in aqueous medium. One tablet from each formulation was kept in a beaker containing 0.1 N Hcl. At 0.5 hrs, the tablet was withdrawn, soaked with tissue paper and weighed and the

process was continued till the end of 3 hrs % weight gain by the tablet was calculated by formula;

S.I = [(Mt-Mo) / Mo] × 100

Where, S.I = swelling index,

Mt = weight of tablet at time t

Mo = weight of tablet at time t = 0.

9. Drug content[14]

5 tablets were chosen randomly. These tablets were powdered by crushing. 3 mg of Risperidone was taken in volumetric flask containing 100 ml of 0.1N Hcl, this solution has concentration of 30ug/ml, then this solution taken for checking absorbance at 238 nm against blank with help of U. V. Spectrophotometer.

10. *In-vitro* Dissolution study[15]

In-vitro dissolution study is carried to all 7 formulation in 900 ml of 1.2pH (0.1N Hcl) dissolution media for 12 hours. Paddles revolve at 50 RPM and Temperature set was 37°c+0.50°c. At particular time of interval 5 ml of sample was withdrawn and replaced it with fresh 5 ml 0.1N Hcl buffer. Sample was pipette at an interval of 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 hours. Sample withdrawn is filtered through whatmann filter paper and finally absorbance taken at 238 nm by using U. V. Spectrophotometer.

11. Drug Release Kinetics[16]

Release rate kinetics mechanism of dosage form is analyzed, by fitting the obtained data into several models like zero order, first order, higuchi matrix and Pappas. From this, we obtain the "r" values. By comparing "r" values can select the best fit model.

12. Short Term Stability Studies[17]

Ability of drug or particular formulation present in specific container should hold it's all the established specifications of quality, identity and purity within a specific period of time. Stability of study is nothing but, determining how the best formulation undergo changes with time depending on its various environmental conditions like humidity, temperature and light. Short term stability studies for formulation F7 has conducted at both room temperature and accelerated temperature. The tablets stored in a amber colored bottles. With help of cotton, bottles can be plugged and capped. Tablets are stored tightly in room temperature storage

condition at 25±2°c and 65% RH. In case of accelerated stability studies, bottles containing tablets were stored in a humid chamber at temperature 40±2°c at 75%RH. Later these tablets are evaluated for hardness, friability, drug content, in-vitro drug release at regular time interval of 30 days.

RESULTS AND DISCUSSION

A successful endeavor was performed to formulate Risperidone floating tablets. Floating tablets were formulated using direct compression method with help of natural polymers and excipients. Totally prepared and evaluated the seven formulations. One of the formulations was selected as optimized formulation (F7).

FT- IR Spectroscopy

The pure drug (Risperidone) FT-IR spectra and the drug combination spectrum with the excipients were performed. From the pure drug FT-IR spectrum and the drug spectrum combination of excipients, Characteristic peaks of Risperidone were spotted in combination spectrum, indicating the drug's compatibility with its used additives. It shows that the drug's integrity has not changed significantly. Compatibility studies of polymer and drug combination with pure drug were depicted in Table No 02. Fig 1 and 2 showed the FT-IR spectrum of Risperidone and Physical combination of Risperidone + Xanthan gum + Gaur gum.

Table 2: Compatibility study of Risperidone and polymers.

Functional Group	Frequencies cm-1		
	Standard frequencies (cm^{-1})	Pure Drug (Risperidone)	Risperidone+ Polymers
C-F	1000-1400	1130.29	1132.21
-CH3	2960-2850	2943.37	2954.65
C-N	1200-1350	1224	1228.66
C=O	1785-1815	1799	1732.08
C=N	1020-1250	1192.01	1192.01
C-O	1210-1320	1269.16	1271.09

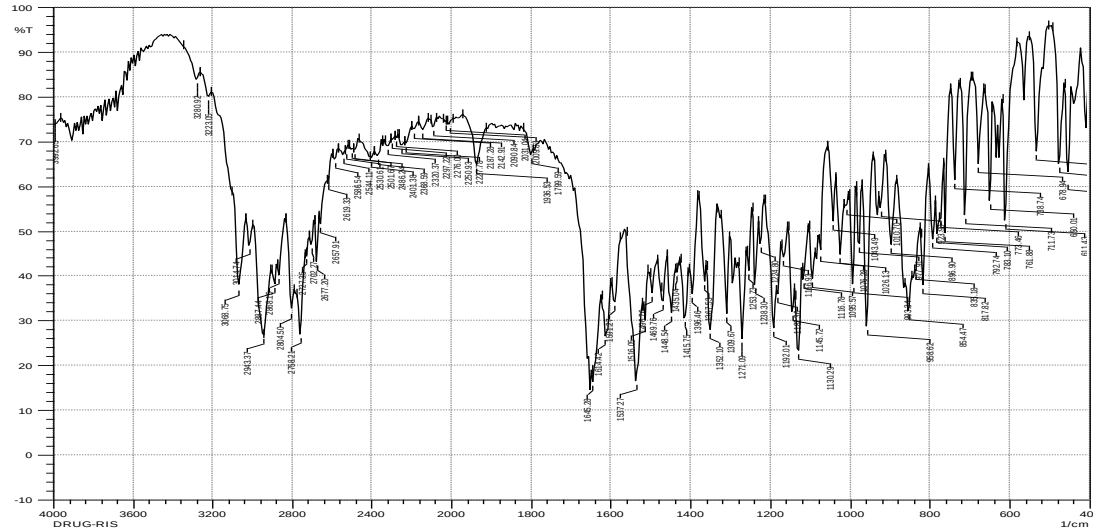

Fig. 1: FT-IR Spectrum of Risperidone.

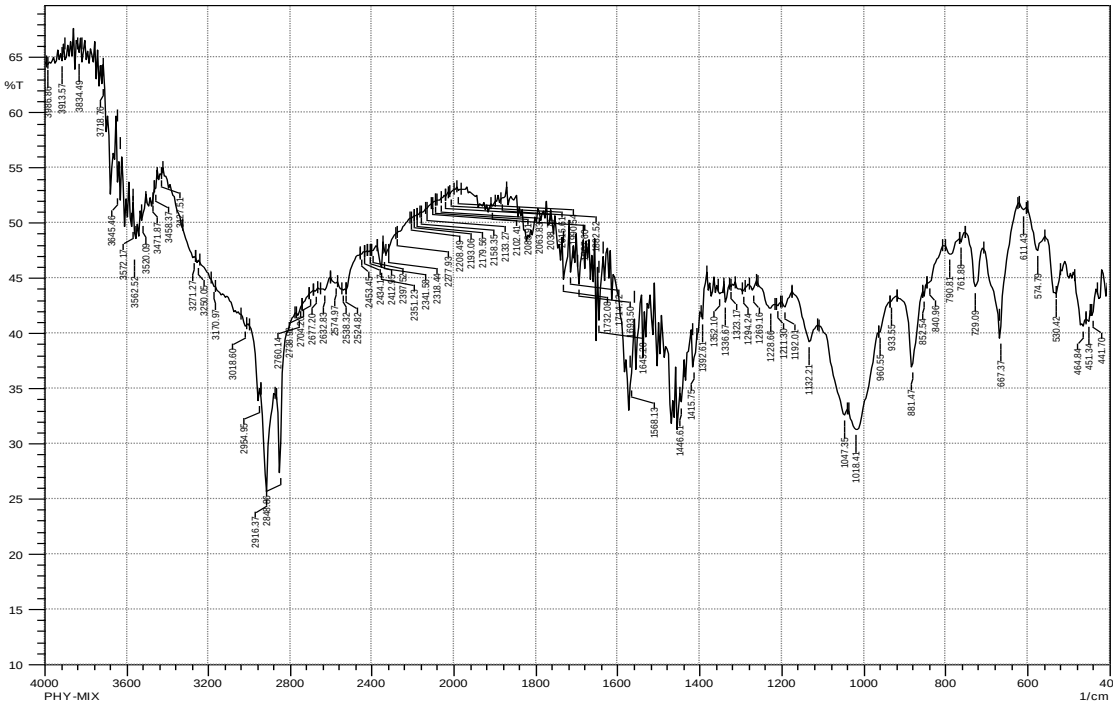

Fig. 2: FT-IR Spectrum of Risperidone + Gaur gum + Xanthan gum.

Differential Scanning Colorimetry (DSC) Analysis

Compatibility studies of Risperidone alone and along with all excipients were carried out and DSC curves (thermographs) were analyzed. The DSC thermographs of sample drug (Risperidone) and physical mixture of Risperidone with excipients were compared with standard which was lies within standard range of monographs (170-174). DSC thermographs of Risperidone were found to be 173.36°C and DSC thermographs of physical mixture of Risperidone with excipients were found to be 171.28°C. Both the results are lies within the

standard range i.e. 170-174°C. The DSC thermographs of sample drug (Risperidone) and physical mixture of Risperidone with excipients were shown in fig 3 and 4 respectively.

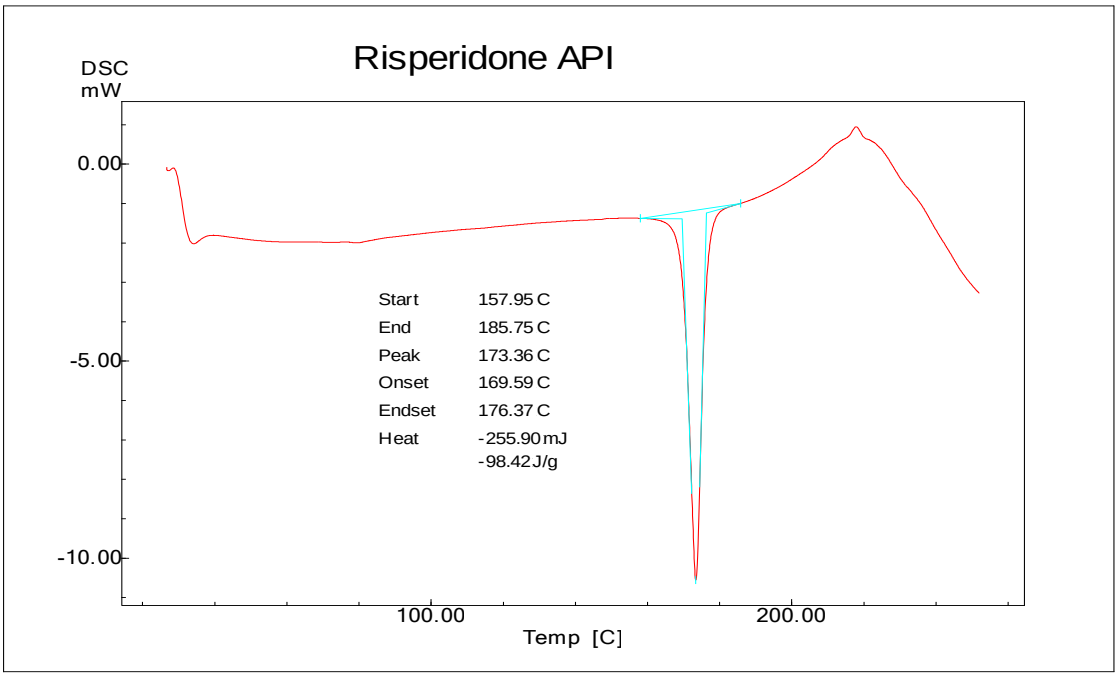

Fig. 3: DSC curve of Risperidone.

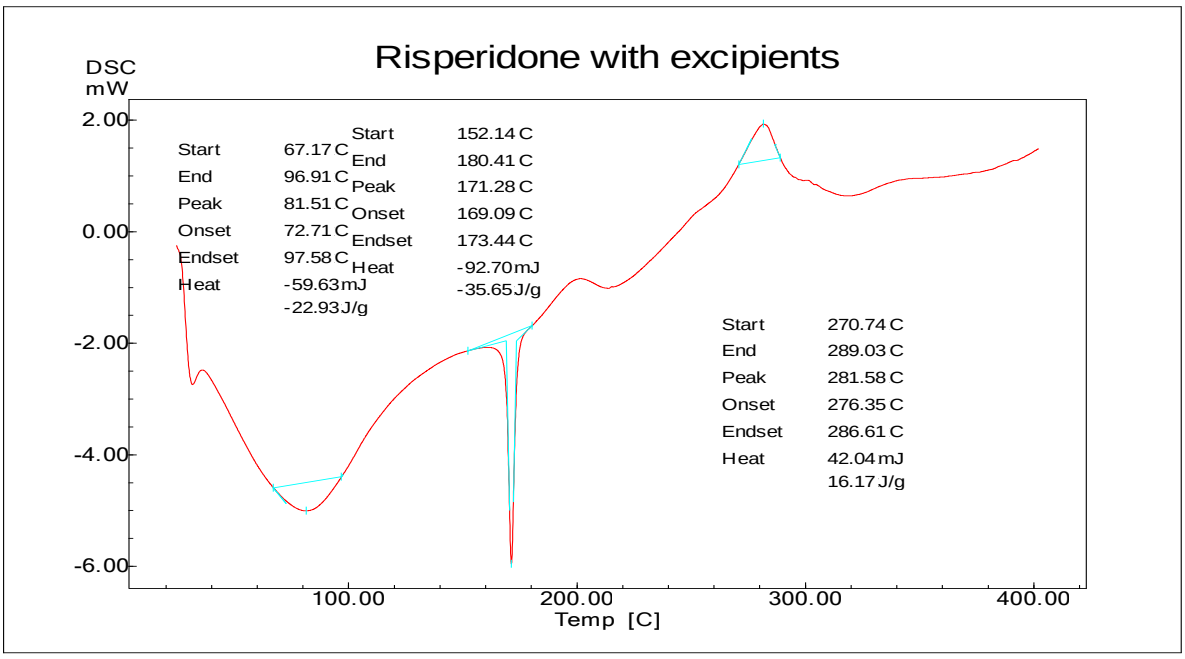

Fig. 4: DSC curve of Risperidone + Gaur gum + Xanthan gum.

Evaluation of the Prormulations

A) Evaluation Of The Pre-Compressed Blend

Powders precompression parameters like tapped density, angle of repose, bulk density; Hausners ratio and Carr's index for all the formulations were evaluated. This shows the following results.

1. Bulk density

Bulk density of Pre-compressed blend was determined by using measuring cylinder. All the obtained values were in the acceptable range and showed in the table 3.

2. Tapped density

Tapped density of Pre-compressed blend was determined by using measuring cylinder. All the obtained values were in the acceptable range and showed in the table 3.

3. Compressibility Index

Compressibility Index of Pre-compressed blend was determined. All the obtained values were in the acceptable range and showed in the table 3.

4. Angle of Repose

Angle of Repose of Pre-compressed blend was determined by using Funnel method. All the obtained values were in the acceptable range and showed in the table 3.

5. Hausners ratio

Hausners ratio of Pre-compressed blend was determined. All the obtained values were in the acceptable range and showed in the table 3.

Table 3: Pre-compression parameters of formulations (F1-F7).

Formulation Batch code	Bulk Density (gm/ml)	Tapped density (g/ml)	Carr's Index (%)	Hausners Ratio	Angle of Repose (θ)
F1	0.51±0.04	0.626 ±0.01	17.2 ± 0.01	1.22 ± 0.02	28.50 ± 0.7
F2	0.52±0.01	0.58 ± 0.01	10.7 ± 0.48	1.02 ± 0.13	26.91 ± 0.5
F3	0.52±0.03	0.58 ± 0.03	7.86 ± 0.55	1.08 ± 0.01	25.52 ± 0.5
F4	0.49±0.06	0.59 ± 0.02	17.12 ± 0.91	1.2 ± 0.04	28.48 ± 0.1
F5	0.53±0.02	0.60±0.03	12.61±0.64	1.14±0.01	26.63±0.65
F6	0.55±0.02	0.65±0.04	14.81±0.49	1.29±0.57	24.52±0.59
F7	0.53±0.06	0.56±0.025	5.69±0.76	1.05±0.03	24.57±0.71

B) Evaluation of Post-Compression Parameters of Tablets

1. Hardness test

Hardness for floating tablets was examined individually by using Monsanto hardness tester. The obtained results of tablet average hardness (n=3) were uniform. The mean values of hardness of tablets are represented in Table 4.

2. Thickness uniformity

Thicknesses of floating tablets were examined individually by using Calibrated Dial caliper or screw gauze. Obtained results of tablet mean thickness were constant for individual formulation. The mean values of thickness of tablets are given in Table4.

3. Diameter test

Diameter of floating tablets was examined individually by using Screw gauze. Obtained results of tablet mean diameter were constant for individual formulation. The mean values of diameter of tablets are given in Table4.

4. Friability test

Friability test of floating tablets were calculated individually in Roche friabilator. The result of tablet average (n=3) of each formations were consistent. The mean values of friability of tablets are represented in Table 4.

5. Uniformity of Weight

As per IP standards for weight variation test, the highest value expected for 120 mg tablet is ±7.5%. It was stated that mean percentage deviation for the evaluated formulations were in the standard range. Weight uniformity test of each formulation was satisfied with official specifications. The mean values of weight uniformity of tablets are given in table 4.

Table 4: Post-compression parameters of formulations.

Formulation batch code	Diameter (mm)	Thickness (mm)	Hardness (Kg/cm2)	Friability (%)	Weight Variation(mg)
F1	6.01± 0.01	2.76± 0.02	4.32± 0.57	0.86± 0.01	118± 0.20
F2	6.00± 0.04	2.86± 0.05	4.33± 0.51	0.94± 0.01	121± 0.11
F3	6.01± 0.05	2.80± 0.01	5.00± 0.59	0.39± 0.01	120± 0.52
F4	6.03± 0.03	2.76± 0.01	5.66± 0.41	0.33± 0.01	121± 0.69
F5	6.01± 0.01	2.8± 0.05	4.30± 0.49	0.25± 0.01	117± 0.35
F6	6.01± 0.01	2.9± 0.06	5.59± 0.55	0.49± 0.01	118± 0.15
F7	6.02± 0.02	2.86± 0.02	6.00± 0.15	0.35± 0.01	121± 0.26

6. Floating lag time

Floating lag time of all the formulations was determined. The results shown in Table 5

7. Total floating time

Floating lag time of all the formulations was determined. The results shown in Table 5

8. Drug content

The drug content of Risperidone floating tablets of F1-F7 in pH 1.2, 0.1N Hcl was determined.

These results indicate that the drug is dispersed uniformly. Each test recorded Three times. The standard deviation and mean of all formulations were calculated. The mean values of Content Uniformity of tablets are given in Table 5.

9. Swelling index

The swelling index of floating tablets was conducted in 0.1N HCl at room temperature. The weight of swollen floating tablets was examined at predetermined time intervals of 12 hours. The mean values of swelling index of floating tablets are given in Table 5.

Table 5: Floating behavior, Drug content and Swelling Index of tablets.

Formulation Code	Floating lag Time (min)	Total floating time (hr)	Drug Content (%)	Swelling Index In 12 hr (%)
F1	02	09	97.10 ±0.60	86
F2	05	10	102 ± 0.87	106
F3	07	>12	100.03 ± 0.48	154
F4	04	09	103.01± 0.97	111
F5	07	12	99.05± 0.97	115
F6	10	>12	98.02± 0.97	161
F7	08	>12	98.02± 0.94	171

10. *In vitro* drug release study

In vitro drug release study was carried out for all the Formulations (F1 to F7).

Formulation F1, F2 and F3 containing gaur gum showed the drug release of 96.34± 0.21%, 94.28± 0.24% and 90.94± 0.94% up to 8, 10 and 12hours respectively and formulations containing Xanthan gum showed the drug release of 95.94± 0.96, 80.08± 0.36 and 90.42± 0.92 respectively.

Formulations F1 to F6 containing different polymers i.e. formulations F1, F2, F3 containing only gaur gum of 10%, 20%, 30% of the total formulation respectively and formulations F4, F5, F6 containing only Xanthan gum of 10%, 20%, 30% of the total formulation respectively. By performing the in-vitro drug release results were found to be the formulation F3 containing 30% gaur gum showed drug release of 90.42% up to 12 hours & F6 contains 30% Xanthan gum showed drug release of 90.90% up to 12 hours. After considering the drugs release of F3 & F6 the F7 formulation was formulated by combining 15% of gaur gum and 15% of Xanthan gum of total formulation and showed the drug release of 95.39% up to 12 hours. F7 formulation was showed the maximum drug release as synergetic effect of both the polymers.[17] The mean data of drug release of floating tablets are given in Table 6 and

Figure 5.

Table 6: *In-Vitro* Dissolution Profile of Floating Tablet Formulations F1-F7.

Time (hr)	Percentage of cumulative drug release						
	F1	F2	F3	F4	F5	F6	F7
0	0	0	0	0	0	0	0
1	19.10	11.05	8.430	23.00	15.05	10.98	12.22
2	24.68	15.05	16.40	34.75	19.69	25.17	19.17
3	37.50	19.69	25.41	62.65	31.86	30.12	28.42
4	51.20	31.86	36.71	75.61	38.07	41.92	34.71
5	68.92	38.07	45.83	84.14	46.58	50.82	41.02
6	75.64	46.58	57.22	92.48	53.62	59.64	48.88
7	83.20	53.62	64.23	95.94	60.68	65.47	56.02
8	96.34	60.68	72.77	_	71.45	73.76	63.97
9	_	71.45	82.01	_	80.08	79.65	71.18
10	_	80.08	86.33	_	_	83.38	79.41
11	_	94.28	90.14	_	_	88.38	85.74
12	_	_	90.94	_	_	90.42	95.39

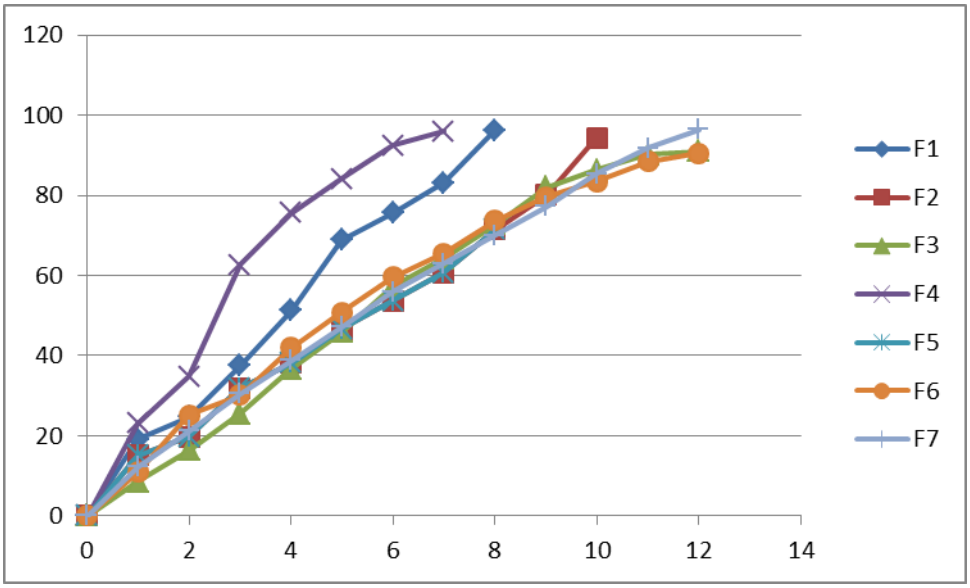

Fig. 5: *In Vitro* Dissolution profile of Formulation F1 to F7.

Release kinetics

Various equations were used to determine the release kinetics of drug for all prepared formulations and results were obtained. The value states that kinetics release of formulations containing Gaur gum i.e. F1, F2 and F3 followed zero order, zero order and Korsemeyers-Peppas release mechanism respectively and also formulations containing Xanthan gum i.e. F4, F5 and F6 followed zero order, first order and Korsemeyers- Peppas release mechanism respectively.

The Optimized formulations F7 containing combination of Gaur gum and Xanthan gum followed Korsemeyers- Peppas release mechanism. Then regression value ("r^2") and "n" value were found to be 0.9965 and 0.841 respectively. The obtained "n" value is between "0.45 to 0.85". This indicates that drug release depends on swelling, diffusion and erosion and also this formulation showed the non-fickian / anomalous type of diffusion.

Study of Stability

Optimized formulation F7 at room temperature (25±2^{0}C and 65 ±5 % RH) and at accelerated condition (40 ±2^{0}C and 75 ±5% RH) for a 30 days. Tablets evaluated for Drug content Hardness and % Drug Release at the end of 15 days and 30 days. Formulations had slight variations for hardness, drug content & % drug release for accelerated condition (40 ±2^{0}C and 75 ±5% RH). As number of days increase tablet hardness decreases may be due to cohesion forces between particles are reduced. Loss of moisture from the tablet may also be added as a reason to cause the tablets to lose its hardness.

Therefore, there was no variation in Drug content & hardness of tablets on 15th day at 25^{0}C ± 2^{0}C / RH 60 ± 5%. The hardness of the tablets was 6 (kg/cm^2) and drug content of tablets was 98.02%.

There was a slight variation in tablets hardness on the 30th day at 25^{0}C ± 2^{0}C / RH 60 ± 5%. The hardness of tablets was 5.5 (kg/cm^2) and drug content of tablets was 94 %. The % drug release at 25^{0}C ± 2^{0}C / RH 60 ± 5% on 15th day was 95.16 % and on 30th day the % drug release at 25^{0}C ± 2^{0}C / RH 60 ± 5% is94.43%. The obtained results of stability studies are shown in table 7.

Table 7: Stability Profile of F7 Formulation.

Parameters	F7 FORMULATION				
	Initial	Room Temperature 25^{0}C ± 20C / RH 60 ±5%		Accelerated Temperature 40^{0}C ± 2^{0}C / RH 75 ± 5%	
		15 Days	30 Days	15 Days	30 Days
Hardness (kg/cm2)	6	6	5.5	5.2	4.7
% Drug Content	98.02	98	94	92.86	90.65
% DR at 12Hours	95.39	95.16	94.43	93.89	91.76

CONCLUSION

There is good satisfactory endeavor in this work to formulate Risperidone floating tablets using natural polymers, having dose of 3 mg using direct compression method. This study

can be concluded from the experimental reports. The IR spectra & DSC thermo grams provided clear idea that there is no any interaction between mixture of drug and polymer, therefore compatible.

Direct Compression method is used to formulate Risperidone floating tablets. Based upon the experimental results it can be concluded that the pre-compression parameters (% compressibility, angle of repose & Hausners ratio) were conducted on mixture of powder blend before compression. The results of pre-formulation study revealed that powder mixtures are free flowing and are acceptable for compression. The post-compression parameters of prepared tablets were evaluated for friability, hardness, uniformity of weight, thickness, diameter, floating lag time, total floating time, swelling index & drug content. An obtained result indicates that all the parameters comply with the limits of Indian Pharmacopoeia. The percentage cumulative drug releases of all the formulations were found to 80% -95%. Formulation F7 was found to be optimized as it was formulated by combining 15% of gaur gum and 15% of Xanthan gum of total formulation and showed the drug release of 95.39% up to 12 hours. The formulations F1, F2 and F4 followed zero order and R values obtained were linear. The formulation F5 followed linear R value and mechanism of First order release obtained. The formulations F3, F6 and F7 followed Korsmeyer Peppas release mechanism and R values obtained were linear. Studies of stability were conducted for 30 days as per guidelines of ICH in normal conditions and accelerated conditions. Risperidone floating tablets were found to be stable at the end of 30days. Hence, formulated Risperidone floating tablets were seem to be promising formulation for the safe and effective delivery through oral route in treatment of schizophrenia.

ACKNOWLEDGEMENT

The authors would sincerely like to thank Micro Labs Limited, Bangalore for providing gift sample of Risperidone. The authors are also thankful to the principal KLE College of Pharmacy, Belagavi and Dr. Prabhakar Kore Basic Science Research Centre, Belagavi for providing laboratory facilities.

Conflict of interest

There are no conflicts of interest.

REFERENCES

1. Iannucelli V, Coppi G, Bernabei MT, Camerorni R. Air compartment multiple-unit system for prolonged gastric residence: Part-I formulation study. Int. J. Pharm, 1998; 17(4): 47-54.
2. Praveen N, Sheefali M, Deepika S. Floating systems: A novel approach towards gastroretentive drug delivery systems. Int. J. Pharm. Sci., 2010; 2(3): 2-7.
3. Zubedi SZ, Mohammed S. Floating tablets and its polymers. J. Drug. Deliv. Ther, 2018; 8(5): 16-24.
4. Kishore A, Ramana MV. Development and in vivo evaluation of gastroretentive floating tablets of antipsychotic drug Risperidone. Int. J. pharm. Pharm. Sci., 2016; 8(11): 0975-1491.
5. Ammar HO, Ghorab MM, Mahmoud AA, Noshi SH. Formulation of Risperidone in floating microparticles to alleviate its extrapyramidal side effects. Future. J. Pharm. Sci., 2016; 2: 43-59.
6. Jishnu V, Gilhotra RM, Prabhakaran R. Formulation and evaluation of Cephalexin extended release matrix tablets using 32 Factorial Design. J. Young. Pharm, 2011; 3(4): 259-66.
7. Kasturi M, Patil SK. Elementary organic chemistry and pharmaceutical analysis. Acta. Pol. Pharm, 2005; 1(2): 217-20.
8. Sharma B K. "Instrumental Method of Chemical Analysis". 26th ed. Goel Publication House: Krishna prakashana publishers Ltd, 2007; 318-327.
9. Rajyalakshmi Ks, Reddy Kn, Kumar Kr, Babuc Ks. Formulation and evaluation of sustained release tablets of Ibuprofen. Int. J. Pharm. Sci., 2016; 2(3): 1-7.
10. Sahu S, Dangi R, Patidar R, Rathi J, Asati V. Formulation and evaluation of sustain released matrix tablet of Atenolol. J. Drug. Deliv. Ther, 2019; 9(1): 183-9.
11. Nagaich U, Bharti C, Pal AK, Gulati N. Diclofenac sodium loaded sustained release matrix tablet possessing natural and synthetic polymers: Formulation and invitro characterization. Indian. J. Pharm. Educ, 2014; 48(2): 49-55.
12. Kondapuram P, Mounika DB, MuthadiRadhika R, Chindam S, Aneesha T. Formulation and evaluation of sustained release matrix tablet of Domperidone. Eur. J. Pharm. Biopharm, 2017; 4(8): 509-524.
13. Kaleemullah M, Jiyauddin K, Thiban E, Rasha S, Al-Dhalli S, Budiasih S, Gamal OE, Fadli A, Eddy Y. Development and evaluation of Ketoprofen sustained release matrix tablet using Hibiscus rosa-sinensis leaves mucilage. Saudi. Pharm. J., 2017; 25(5): 770-9.

14. Kambham V, Bonnoth CK. Development of Stavudine sustained release tablets: In-vitro studies. Future. J.Pharm. Sci., 2016; 2(2): 37-42.
15. Sun L, Zhang W, Liu X, Sun J. Preparation and evaluation of sustained-release Azithromycin tablets in vitro and in vivo. Asian. J.Pharm. Sci., 2014; 9(3): 155-61.
16. Shah KU, Khan GM. Regulating drug release behavior and kinetics from matrix tablets based on fine particle-sized ethyl cellulose ether derivatives: An in vitro and in vivo evaluation. Sci. World J., 2012; 57(6): 89-99.
17. Emara LH, El-Ashmawy AA, Taha NF. Stability and bioavailability of Diltiazem matrix tablets. Pharm. Dev. Techol, 2018; 23(10): 1057-66.
18. Rehmankhan AU, Muhammad N, Ali A, Rehman NU, Nawaz Z, Muhammad R et al. Assessment of Gaur and Xanthan gum based floating drug delivery system containing Mefenamic acid. Acta. Pol. Pharm, 2016; 73(5): 1287-97.