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Research Article

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Preparation and Evaluation of Raft Forming Chewable Tablets of Ranitidine Hydrochloride

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ABSTRACT

The present study was aimed to prepare and evaluate raft forming chewable tablets of ranitidine hydrochloride for effective treatment of Gastro Esophageal Reflux Disease.. The tablets were evaluated for various physicochemical parameters and in vitro drug release study. Tablets have shown satisfactory results when evaluated for hardness, friability, weight variation, drug content, raft strength and acid neutralizing capacity. Out of all factorial batches i.e.PB1 to PB10, PB8 has shown promising results of raft strength as it is sufficient for the prevention of the reflux in the esophagus.

Key words: Ranitidine Hydrochloride, Raft forming chewable tablets, Pectin as a raft

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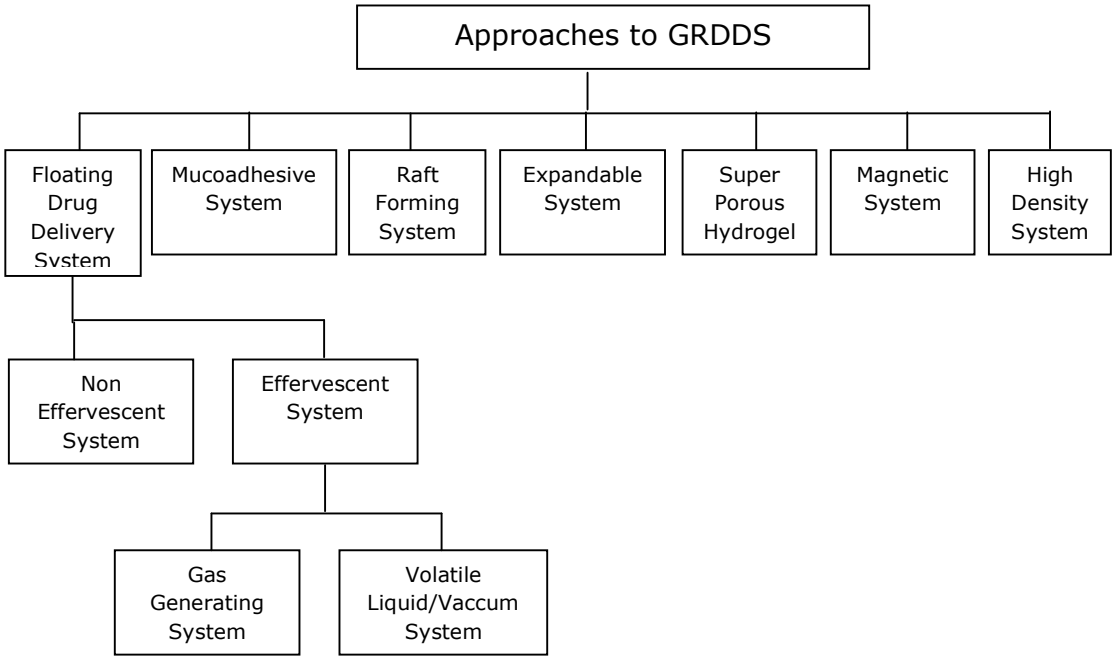
INTRODUCTION

By novel drug delivery system, continuous delivery of the drug at a predictable kinetic over an extended period of time can be achieved. The advantage of this system includes reduction in the drug related side effects which is due to controlled therapeutic blood level instead of oscillating blood level. Another advantage is improved patient compliance because of reduced dosing frequency and reduction of total dose of the drug which is to be administered [1].

Gastro retentive drug delivery system (GRDDS):
Gastro retentive drug delivery system is a site specific delivery system. It delivers the drug either in stomach or in intestine. The drug delivery is obtained by retention of dosage form in stomach and the drug is released in a controlled manner to the specific site either in stomach, duodenum or in intestine [2].

Different approaches of GRDDS:



Raft forming system [2],[3],[4],[5]:

This system focus more for delivery of antacid and delivery of drugs used to treat gastrointestinal infection and disorders. The basic mechanism involves formation of viscous cohesive gel when the system comes in contact with gastric fluid. In this each portion of liquid swells and forms a continuous layer of gel known as raft. The raft floats because of buoyancy created by formation of CO_2. This raft acts as a physical barrier to prevent the reflex of gastric content into the esophagus. This raft forming system contains a gel forming agent and alkaline bicarbonates or carbonates which is responsible for making the system less dense than the gastric fluid and to float on the gastric fluid.

Effect of sodium bicarbonate on the drug release from raft forming system:

Sodium bicarbonate is used as a gas generating agent. Gas generating agent sodium bicarbonate interacts with the gastric acid and generates carbon dioxide which gets entrapped within the swellable matrix. Carbonate or bicarbonate may be present in the amount ranges from 5% to 50% and preferably from about 10% to 30% by weight of composition. Increasing the concentration of bicarbonate decreases the floating lag time because of faster and higher carbon dioxide generation. At higher concentration of effervescent agent, coating of the tablet become less stable. This is because of increase in the internal pressure and there by rupturing the polymer coating which ultimately results in sudden increase in drug release.

Advantages of raft forming system:

- It is used for the treatment of heartburn and oesophagitis. It is also useful to treat laryngopharyngeal reflux (LPR) and gastro esophageal reflux disease.
- It does not interfere with activity of anti secretory agent e.g. cimetidine.
- Rapid and long duration of action can be achieved. It shows its action within seconds.
- It may not interfere with the function of pyloric sphincter.
- Improved patient compliance.

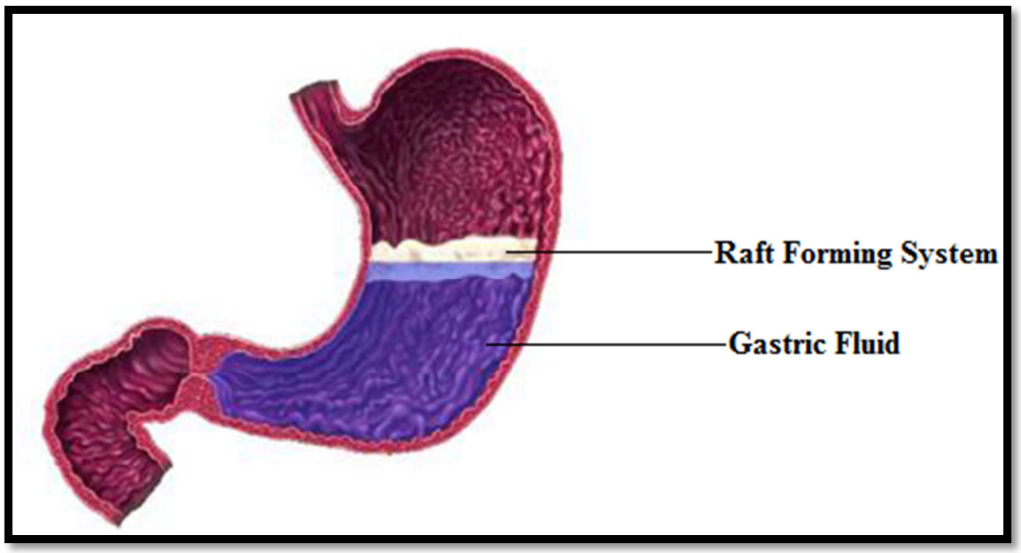


Figure 1: Raft forming system

MATERIALS AND METHODS

Materials:
Ranitidine Hydrochloride, Pectin, Sodium Bicarbonate, Calcium Carbonate, Mannitol, PVP K30, Isopropyl Alcohol, Aspartame, Magnesium Stearate, Talc.

Method:
Drug, polymer and other ingredients were weighed accurately. All ingredients except the binder and lubricant were mixed thoroughly. PVP K30 was dissolved in sufficient quantity of isopropyl alcohol and added to a powder mixture to prepare dough wet mass. The prepared wet mass was passed through a 22# sieve. The granules were allowed to dry in a hot air oven and then resifted through a 40# sieve. The granules were collected and lubricated. Tablets were compressed by a 12.7 mm diameter flat punch with the help of a rotary tablet compression machine.

Table 1: Formulations of preliminary batches (PB1 to PB10)

Ingredients	PB1 (mg)	PB2 (mg)	PB3 (mg)	PB4 (mg)	PB5 (mg)	PB6 (mg)	PB7 (mg)	PB8 (mg)	PB9 (mg)	PB10 (mg)
Ranitidine Hydrochloride	168	168	168	168	168	168	168	168	168	168
Pectin	300	300	350	350	400	400	450	450	450	450
Sodium Bicarbonate	25	25	25	25	25	25	25	50	25	57
Calcium Carbonate	150	232	180	232	180	232	182	232	232	200
D-Mannitol	282	200	202	150	152	100	100	25	50	50
Pvp K30	30	30	30	30	30	30	30	30	30	30
Aspartame	25	25	25	25	25	25	25	25	25	25
Magnesium Stearate	10	10	10	10	10	10	10	10	10	10
Talc	10	10	10	10	10	10	10	10	10	10
Total (mg)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

EVALUTION PARAMETERS:
Pre- compression evaluation parameters:
Angle of repose, bulk density, tapped density,carr's index and hausner's ratio were evaluated to determine the flow property of the prepared granule's mixture.

Post- compression evaluation parameters:

Weight Variation Test [6]:
Twenty tablets were randomly selected, weighed individually and the average weight was calculated. Not more than two of the individual weights deviate from the average weight by 5% as per IP 2010.

Table 2: IP standards for weight variation test

Average weight of tablets	% deviation
80 mg or less	10
More than 80 mg but less than 250 mg	7.5
250 mg or more	5

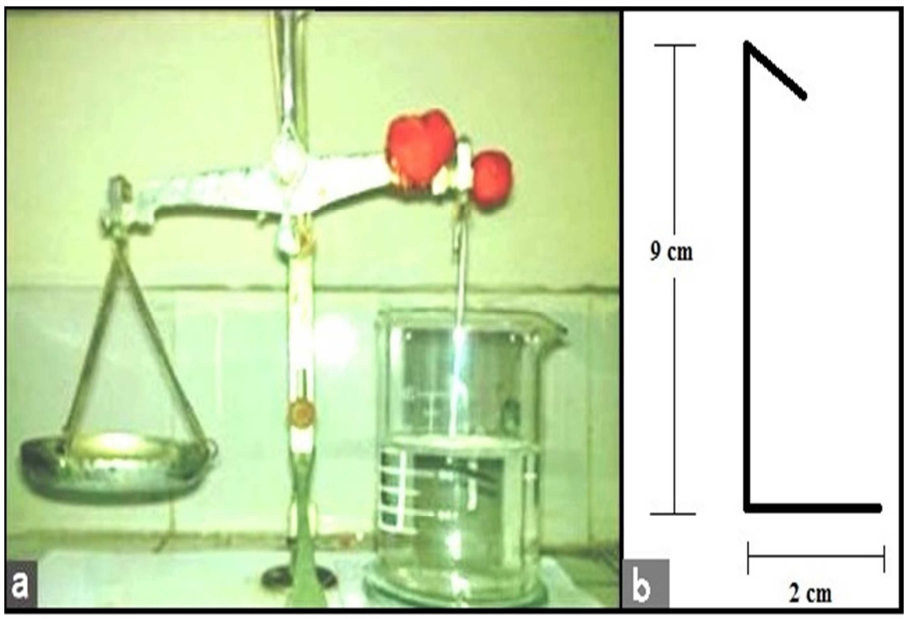
Friability [6]:
Friability was determined by using roche friabilator. Six tablets were weighed and placed in the friabilator. This friabilator was then operated at 25 rpm for four minutes. The tablets were then de-dusted and weighed. It should not be more than 1%. %Friability was calculated as per the following equation:

%Friability = (Initial weight – Final weight)/Initial weight * 100

Hardness [6]:
The Monsanto hardness tester was used to determine the tablet hardness. Scale was adjusted to zero and load was gradually increased until the tablet fractured. The value of the load at that point gave the measure of the hardness of tablet. Hardness was expressed in kg/cm^2.

Drug Content [6]:
Twenty tablets were weighted and powdered in a mortar. Accurately weighted quantity of the powder equivalent to about 168 mg of Ranitidine Hydrochloride was diluted to 100 ml with 0.1 N HCl in 100 ml volumetric flask. It was stirred for 15 minutes and filtered. 1 ml of the filtrate was diluted with 0.1 N HCl to produce 100mcg / ml solution. The absorbance of the resulting solution was measured at λmax 312.5 nm and the content of Ranitidine Hydrochloride was calculated from the absorbance obtained.

Raft Strength Measurement [7]:
- A tablet powder equivalent to unit dose was transferred to 150 ml of 0.1 N HCl and maintained at 37°C in a 250 ml glass beaker. Each raft was allowed to form around an L-shaped wire probe (diameter: 1.2 mm) held upright in the beaker throughout the whole period (30 min) of raft development.
- Raft strength was estimated using the modified balance method. Water was added drop wise to the pan and the weight of water required to break the raft was recorded.
- Note: A double-pan dispensing balance was modified for raft strength measurement. One pan of the dispensing balance was replaced with an L-shaped wire probe as shown in Figure.



(a) Modified balance method (b) Wire probe for raft strength measurement

Figure 2: Modified dispensing balance for raft strength measurement

Acid Neutralizing Capacity [8]:
A tablet powder equivalent to unit dose was taken in a 250-ml beaker. Water was added to make a total volume of about 70 ml, heated to 37°C and stirred continuously by maintaining the temperature at 37°C. 30 ml of 1M hydrochloric acid (previously heated to 37°C) was added and mixture was maintained at 37°C for 15 minutes with continuous stirring. The excess acid was titrated with 1M sodium hydroxide to a pH of 3.5. The number of mEq of acid consumed by the tablet tested was calculated by the following formula:

Total mEq = (30 × M_{HCl}) – (V_{NaOH} × M_{NaOH})

Where,
M_{HCl} = molarity of hydrochloric acid
M_{NaOH}= molarity of sodium hydroxide
V_{NaOH}= volume of sodium hydroxide

In Vitro Drug Release Study [7]:
In vitro drug release study of Ranitidine Hydrochloride chewable tablets (n = 3) was performed using USP apparatus II fitted with a paddle (50 r.p.m.) at 37 ± 0.5°C using a simulated gastric fluid (pH 1.2; 900 ml) as a dissolution medium. Unit dose was powdered and then added to the dissolution medium. At pre-determined time intervals, 10-ml samples were withdrawn, filtered through a 0.45-µm membrane filter and analyzed at 312.5 nm using a UV spectrophotometer. Cumulative percentage drug release was calculated using an equation obtained from a calibration curve.

RESULTS AND DISCUSSION

Table 3: Pre - compression data of Preliminary batches

Batch no.	Angle of repose (θ)	Bulk density (gm/ml)	Tapped density (gm/ml)	Carr's index (%)	Hausner's ratio
PB1	34.97	0.34	0.40	12.5	1.14
PB2	33.83	0.35	0.39	12.8	1.14
PB3	33.8	0.39	0.46	15.2	1.17
PB4	32.26	0.375	0.46	18.4	1.22
PB5	32.69	0.33	0.392	15.8	1.19
PB6	33.16	0.35	0.43	18.6	1.23
PB7	32.93	0.33	0.39	15.3	1.18
PB8	35.94	0.36	0.45	20	1.25
PB9	34.92	0.378	0.46	17.82	1.22
PB10	33.41	0.342	0.417	17.8	1.21

The prepared granules for raft forming chewable tablets were characterized for angle of repose, bulk density, tapped density, carr's index and hausner's ratio which are shown in table. Angle of repose of all batches was within 31° – 35°, carr's index of all batches was within 11 – 20 and hausner's ratio of all batches was found within 1.12 – 1.25 which indicate good flow property of granules.

Table 4: Post - compression data of Preliminary batches

Batch no.	Tablet weight (mg)*	Diameter (mm)**	Thickness (mm)**	Friability (%) **	Hardness (kg / cm^2) **
PB1	998.5 ± 3.7	11.96 ± 0.05	4.92 ± 0.04	0.6 ± 0.01	4.4 ± 0.55
PB2	998.5 ± 4.8	11.94 ± 0.05	4.96 ± 0.05	0.58 ± 0.01	4.8 ± 0.45
PB3	998.0 ± 4.1	11.98 ± 0.04	4.98 ± 0.04	0.6 ± 0.01	5.4 ± 0.54
PB4	998.5 ± 4.8	11.94 ± 0.05	4.92 ± 0.04	0.6 ± 0.01	5.0 ± 0.71
PB5	998.5 ± 3.7	11.94 ± 0.05	4.94 ± 0.05	0.65 ±0.01	4.6 ± 0.54
PB6	997.0 ± 6.6	11.96 ± 0.05	4.96 ± 0.05	0.75 ± 0.02	4.2 ± 0.44
PB7	996.0 ± 7.5	11.94 ± 0.08	4.94 ± 0.05	0.59 ± 0.01	4.4 ± 0.45
PB8	997.0 ± 6.5	11.96 ± 0.1	4.92 ±0.1	0.79 ± 0.02	4.4 ± 0.55
PB9	997.0 ± 5.5	11.98 ± 0.04	4.99 ± 0.07	0.65 ±0.01	5.6 ± 0.55
PB10	998.5 ± 3.7	11.96 ± 0.05	4.98 ± 0.04	0.68 ± 0.02	5.0 ± 0.71

**Mean ±SD (n=20) ** (n=6)*

- All prepared batches were subjected for weight variation study and results are given in table 5.5. The deviation from the average weight was found to be within the prescribed official limits and pass the test. Hardness of tablets was found to be in the range of 4 – 5 kg / cm^2 which is sufficient for chewable tablet.
- The friability of all tablets was found to be in range of 0.58% – 0.79% which is less than 1% that showed good mechanical strength.

Table 5: Data for raft strength and Acid Neutralizing Capacity of preliminary batches

Batch no.	Raft strength (gm)*	Acid Neutralizing Capacity (mEq)*
PB1	0.96 ± 0.01	6.2 ± 0.1
PB2	1.13 ± 0.01	6.2 ± 0.1
PB3	2.12 ± 0.02	6.4 ± 0.2
PB4	2.3 ± 0.02	6.5 ± 0.1
PB5	2.65 ± 0.01	6.5 ± 0.1
PB6	2.8 ± 0.1	6.8 ± 0.1
PB 7	3.02 ± 0.1	6.5 ± 0.2
PB8	3.2 ± 0.05	6.9 ± 0.2
PB9	3.5 ± 0.1	7.0 ± 0.1
PB10	3.52 ± 0.05	7.2 ± 0.3

**mean ±SD (n=3)*

• All batches had good raft strength which was within the range of 0.96-3.52 g and all batches had Acid Neutralizing Capacity within the range of 6.2 – 7.2 mEq. Raft strength was found to be sufficient for prevention of reflux of gastric content into the esophagus.

Table 6: Dissolution profile of preliminary batches (PB1 – PB 10)

Time (min)	Cumulative percentage drug release									
	PB1	**PB2**	**PB3**	**PB4**	**PB5**	**PB6**	**PB7**	**PB8**	**PB9**	**PB10**
0	0	0	0	0	0	0	0	0	0	0
10	60.2 ± 0.5	59.85 ± 0.2	62.82 ±1.05	61.5 ± 0.4	63.89 ± 0.5	62.66 ± 0.2	64.25 ±0.12	71.57 ± 0.1	68.25 ± 0.6	69.25 ± 0.3
20	70.26 ± 0.2	70.85 ± 0.5	72.53 ± 0.1	71.96 ± 0.1	73.41 ± 0.7	63.25 ± 0.5	74.56 ± 0.5	77.83 ± 0.2	76.52 ± 0.2	75.25 ± 1.1
30	85.62 ±1.02	84.52 ± 1.1	86.52 ± 0.4	87.42 ± 0.1	85.25 ± 0.4	90.17 ± 0.6	86.25 ± 0.4	97.28 ± 0.5	87.54 ± 1.2	90.25 ± 0.5
40	90.52 ± 0.8	89.89 ± 0.9	91.25 ± 0.7	93.12 ± 0.2	91.52 ± 0.2	90.34 ± 1.2	94.23 ± 1.1	98.4 ± 0.9	95.26 ±1.05	96.20 ± 0.2
50	94.35 ± 0.6	96.81 ± 0.4	95.72 ± 0.2	96.24 ± 0.5	97.87 ± 0.5	99.08 ± 1.02	96.52 ±1.01	99.51 ± 1.04	97.48 ± 0.8	98.62 ± 0.5
60	96.2 ±1.01	97.3 ± 0.6	97.84 ± 0.2	98.2 ± 0.2	99.52 ± 0.9	100.05 ± 1.00	98.23 ± 0.9	100.12 ± 0.5	98.5 ± 0.8	99.98 ± 0.6

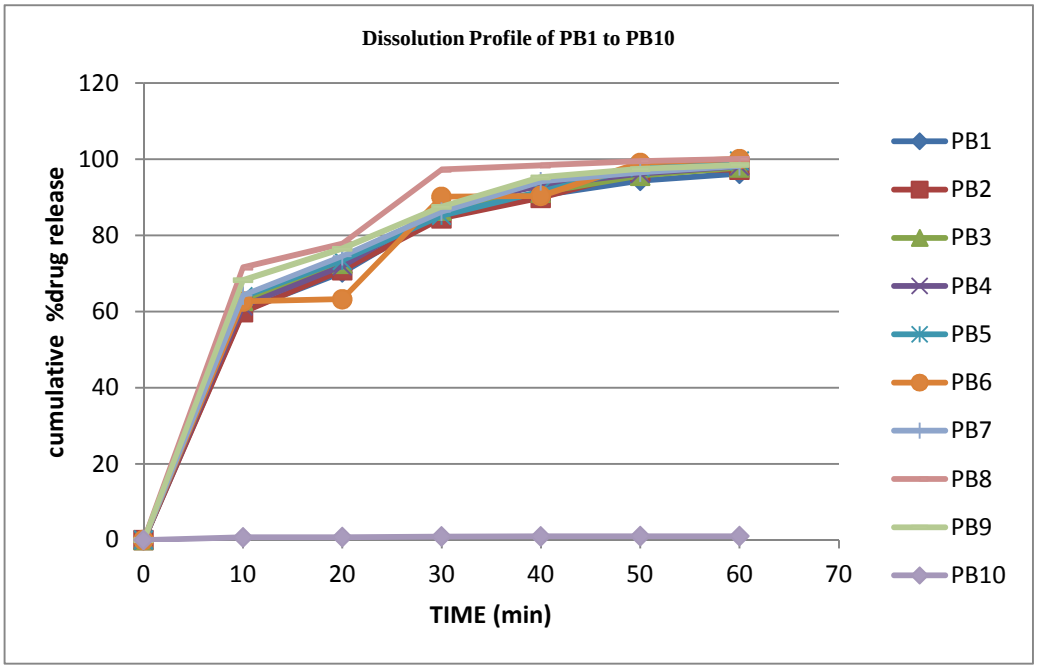


Figure 3: Dissolution profile of preliminary batches

• From the data, it was concluded that, formulation with maximum amount of pectin and calcium carbonate showed higher release of drug amongst all the batches.

CONCLUSION

Many of the patients are suffering from the gestro esophageal reflux disease (GERD) and this can be overcome by using raft forming chewable tablets of ranitidine hydrochloride. It was concluded that prepared raft forming chewable tablets containing pectin, sodium bicarbonate and calcium carbonate form raft on 0.1N HCl which form sufficient raft strength to prevent reflux of the gastric content.

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