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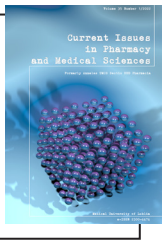

Formulation and evaluation of herbal tablet of jackfruit root for the treatment of antiasthmatic activity

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ABSTRACT

Jackfruit is a highly nutritious plant. The ancient fruit known as jackfruit (*Artocarpus heterophyllus* Lam) is commonly eaten raw. Documenting the therapeutic value of the main jackfruit parts (*Artocarpus heterophyllus* L.) was the primary goal of this study. It contains more protein, calcium, iron, and Thiamine. Jackfruit contains many classes of phytochemicals such as carotenoids, flavonoids, volatile acids sterols, and tannins, with varying concentrations. The excellent medicinal efficacy of Artocarpus has long been recognized. Phenolic compound test. Next, using a direct comparison approach, we developed pills for asthma. After that, check evaluations such as degradability, hardness, friability, homogeneity of content, weight change, solubility, etc. The health benefits of jackfruit are attributed to its many physicochemical applications. Jackfruit is some tropical fruit rich in 4,444 nutrients such as carbohydrates, proteins, vitamins, minerals, and digestive fiber to maintain bronchial pain relief. In the case of asthma, a person suffers from bronchospasm and this herbal tablet acts as a bronchodilator. Therefore, we examined the antiasthamatic characteristics using a herbal mixture prepared from jackfruit root. Jackfruit contains vitamin A, vitamin C, thiamin, riboflavin, calcium, potassium, iron, sodium, zinc, and niacin, among many other nutrients.

INTRODUCTION

Puerto Rico as well as other Pacific Island nations. One alternative to meat is jackfruit. A standard jackfruit product has two grams of protein in it. The jackfruit (*Artocarpus heterophyllus* Lam), which may weigh up to 35 kg, is the biggest known edible fruit and is the most prolific tree species. Jackfruit is useful in a lot of ways. It has anti-inflammatory, hypoglycemia, wound-healing, antibacterial, antibiotic, antifungal, anti-cancer, and a brief decrease in sexual function properties [1].

It is recognized as the world's biggest edible fruit. Nutrient-dense jackfruit is high in proteins, carbs, minerals, vitamins, and phytochemicals. For every kilogram or wet weight of ripe fruit, there are around 2 MJ of energy in fruit. It is well known that jackfruit is high in calcium, thiamin, protein, and carbohydrates. It is now well acknowledged that bioactive chemicals are responsible for some of the beneficial benefits of fruits and vegetables in avoiding certain illnesses. Apart from the distinct taste of the mature fruit, jackfruit seeds are commonly eaten as a dessert or as a component in Asian culinary recipes [2].

Figure 1. The image of Jack fruit Tree & there roots

Jackfruit seed powder can be used to make cakes in pre-made recipes. A considerable quantity of starch may be found in jackfruit seeds. The many parts of the jackfruit

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have been used medicinally, and its wood is an important resource for the timber industry. It requires rather fertile soil that is both moist and well-drained, with a pH range of 4.3 to 8.0. The dark green, broadly elliptic leaves alternate with one another. The eyes of immature shoots are frequently heavily lobed [3].

The ends of males are usually sessile or on short stalked tubules and sometimes appear on terminal filaments, while the female ends are elongated ovoid tubules. Artocarpus is used medicinally and as a food source, having an influence on the agricultural industry. It contains biologically active secondary metabolites of increasing scientific interest. The pulp of the ripe jackfruit is eaten fresh and used in fruit salads. It creates a high nutritional value [4].

Jackfruit root contain chemical such as potassium, caratenoid, vitamin C, it is used for Antiasthamatic activity to treat asthma. From this research we assess Antiasthamatic property by using herbal properties by jackfruit root. Hence, this tablet used as bronchodilators to treat asthma. Given herbal tablet showed significant Antiasthamatic activity [5].

MATERIAL AND METHODS

Collection and authentication of plant

The plant Artocarpus heterophyllous (Jackfruit) was collected from, Tal-kalwan, District: Nashik and authenticated from the Department of Botany and Research Centre PVP College, Loni.

Extraction of herbs

The powder of Root of all the collected herbs was extracted with 95% ethanol by Decoction, Maceration, Microwave Assisted and dried. The dried extract was used for the preparation of the formulation [6-8].

Extraction by decoction method [9,14]

In this research work, 25-30 gm of root powder was collected & fill in the round bottom flask After that the addition of particular solvents 250-300 ml take place like methanol ethanol, chloroform, ethyl acetate, etc. (any one of them). As per the guidelines we provide the heat for the decoction process for 3-4hr. With the help of recrystallization & Chromatographic method, the separation & purification of extract takes place respectively. After heating &extracting well remove that extract & filter it by proper procedure. Then remove the solvent by evaporation at ambient temperature.

Physicochemical Constant Determination Test

The physicochemical Constant like Flavonoids and Phenolic compounds were carried out and reported.

Shinoda Test

After mixing concentrated HCL and fragments of magnesium ribbon with aqueous crude plant extract for a few minutes, the presence of flavonoids was shown by a pink tint. Test for Alkaline Reagents [15,16].

Ferric Chloride Test

Finding out if a substance has a phenol functional group is the aim of the ferric chloride test. The foundation of this test is the observation that phenols combined with a neutral ferric chloride solution yield a colorful complex. Ferric ions from ferric chloride combine with phenols to form a vibrant complex. The solution's hue shifting to red, blue, violet, or green indicates the presence of a phenol group [18,19].

Phthalein Dye Test

The ferric chloride test is used to identify whether a phenol functional group is present in a certain substance. The foundation of this test is the observation that phenols combined with a neutral ferric chloride solution yield a colorful complex. Ferric ions from ferric chloride combine with phenols to form a vibrant complex. The solution's hue shifting to red, blue, violet, or green indicates the presence of a phenol group [20].

Pre-Formulation study

IR Study (Compatibility study)

The graph produced by the FTIR Spectrometer, known as an absorption spectrum, displays the distinct chemical bonding and molecular structure of the sample material. The peaks in this absorption spectrum indicate the components that are present. Functional groups (such as carotenoids, flavonoids, volatile acids, sterols, and tannins) are indicated by these absorbance peaks. Different functional groups and bond types absorb different wavelengths of infrared light [21].

Melting point

A mixture of very small amounts of miscible impurities Lowers the melting point and raises the melting point range. Therefore, melting the point of the compound is the criteria for purity and identification. The melting point of an organic solid can be determined by adding a small amount to a small amount. Capillaries are attached to the stem of the thermometer in the canter of the heat bath to heat the heat bath Slowly observe the temperature at which melting begins and completes. Usually, a pure sample Has a sharp melting point, for our API pre-formulation study we use the Thiele tube method [22,23].

Solubility

Solubility refers to a material's capacity to create a solution with another substance, the solvent, in chemistry. The inability of the solute to produce such a solution is referred to as insolubility. The concentration of a solute in a saturated solution, in which no more solute can be dissolved, is used to determine the extent of a substance's solubility in a certain solvent. The two compounds are said to be at solubility equilibrium at this moment. There may be no such limit for some solutes and solvents, in which case the two compounds are said to be "miscible in any quantities" (or just "miscible") [24,25].

Formulation table for tablet

Table 1. The table contain the different formulation of herbal tablet

Ingredients (mg)	F1	F2	F3	F4	F5	F6
Extract	10	10	10	10	10	10
Chitosan	2.5	3.0	3.5	-	-	-
HPMC	-	-	-	2.5	3.0	3.5
MCC PH 102	122	122	122	122	122	122
Magnesium stearate	14	14	14	14	14	14
Lactose	20	20	20	20	20	20
Talc	08	08	08	08	08	08
Mannitol	Q. S to 200 mg	Q. S to 200 mg	Q. S to 200 mg	Q. S to 200 mg	Q. S to 200 mg	Q. S to 200 mg

Method of preparation of tablet [26,27]

For the creation of herbal tablet formulations, extracts of chosen herbs are used. Isopropyl alcohol was used as a granulating agent together with polyvinyl pyrrolidine (PVP) to create the formulation. The materials were combined thoroughly according to their weights, and the granulating liquid was gently added until the powder took on the consistency of a moist lump. In order to remove the IPA from the granules, the damp mass was passed through sieve number 12 and dried at room temperature. It was then dried in an oven at a temperature of 60°C. To obtain homogenous granules, the dried granules were once more put through sieve number 16. The dry granules were lubricated after that. With an average weight of 200 mg per tablet, it was finally compressed using a Cadmech 6 station rotary compression machine.

Pre-compression parameter of tablet

Angle of Repose

The ability of the granule to flow from the hopper to the die cavity determines the uniformity of the tablet. If the granule flow characteristic is irregular, we will not obtain tablets with a consistent size. Numerous forces, including surface tension, cohesive/vanderwaals forces, electrostatic force, mechanical force resulting from the interlocking of irregularly shaped particles, and frictional force, affect a material's flow characteristic [28].

$$\text{Tan } \theta = h/r$$

where:
θ-angle of repose,
h-height of pile,
r-radius of pile.

Bulk density

Bulk density, which is defined as the mass, M, of the powder occupying a specified volume, Vo, is a property of a powder as opposed to individual particles. In g/ml, it is expressed. Using the funnel, a precisely weighed amount of granules was placed into a 50 ml measuring cylinder. The measurement was made of the unsettled apparent volume to the closest graded unit that the granules occupied. The formula was used to determine bulk density [29]

$$BD = M/V0$$

where:
BD = Bulk density,
M = Mass of the blend,
Vo = Untapped Volume.

Tapped density

The process of mechanically tapping a measuring cylinder filled with a powder sample yields the desired tapped density. The cylinder is mechanically tapped after the initial volume is noted, and volume readings are taken until there is little further noticeable change in volume 54 Following the determination of the bulk density, a measuring cylinder containing weighted granules was put through 500 taps in an Electro Lab USP II tapped density tester. The following formula was used to determine the tapped density [30].

$$TD = MV$$

where:
T.D = Tapped density,
M = Mass of the granules and V = Final tapped volume.

Compressibility Index

It has a direct bearing on particle size, cohesiveness, and relative flow rate. It's an easy, quick, and widely used way to create powder flow figures. Measurements of bulk density can provide it [31].

$$\% \text{ compressibility index} = \text{Tapped density} - \text{bulk density}/\text{tapped density} \times 100$$

or

$$1 = (1 - V/Vo) \times 100$$

where:
I – % compressibility index,
V – volume occupied by powder/ granules after tapping,
VO – volume of powder/granules before tapping.

Hausner's Ratio

Since it has to do with inter-particulate friction, it may be utilized to forecast the features of powder flow. It shown that powders with low particle friction, such coarse spheres, have a Hausner's ratio of about 1.2, but powders with higher cohesiveness, like flakes, have a Hausner's ratio of more than 1.

$$\text{Hausner's ratio} = \text{Tapped density}/\text{Bulk density}$$

Post compression parameter for tablet

Organoleptic parameters

It may be controlled and characterized in terms of dimensions. A tablet's thickness is only subject to change. The thickness of a tablet can be measured using a micrometer or another tool. Tablet thickness should be kept to no more than 5% of the normal value [32].

Figure 2. The picture of granules & the prepared tablet

Weight Variation Test

Weigh each of the twenty pills individually. Determine the average weight. (Individual weight/Average weight) times 100 equals % weight variation. If no tablet differs by more than twice the percentage restriction and no more than two tablets are outside of the limit, the tablet passes the U.S.P. test [33].

Hardness

Its definition is the amount of power needed to shatter a tablet in a diametric Test of Compression Hardness is an informal measurement. The Monsanto tester is used to measure hardness [34].

Friability Test

A tablet's friability can be tested in a scientific setting using the Roche friabilator. This comprises of a plastic chamber that fills the tablets into a friabilator that spins for 100 revolutions per minute while rotating at a speed of 25 revolutions per minute. Once more, the pills are weighed. Weight loss of between 0.5 and 1.0% is considered suitable with tablet compresses [35,36].

Disintegration Test

The glass tubes used in the U.S.P. disintegration test equipment are three inches long, with ten mesh screens at the bottom and an open top. To measure the disintegration time, one tablet is inserted in each tube, and the basket rack is set up in a one-liter beaker of water, simulated gastric fluid, or simulated intestinal fluid at 37 2°C. At a pace of 28-32 cycles per minute, raise and lower the tablet-containing basket across a distance of 5-6 centimeters [37,38].

In Vitro study

Dissolution is the process by which a solid solute gets into a solution. In the pharmaceutical industry, it is defined as the amount of a medicine ingredient that dissolves in a certain amount of time at a given temperature, solvent composition, and liquid/solid interface. Dissolution is one of the most important quality control tests done on pharmaceutical dosage forms. It is now developing into a method for predicting bioavailability and, in certain cases, replacing clinical testing to determine bioequivalence. Drugs' pharmacological action is significantly influenced by how they dissolve. In fact, it has been shown that the bioavailability of several medications and them in vitro dissolution rate are directly related [39,40,41].

RESULTS AND DISCUSSION

Physicochemical Constant Determination Test

The physicochemical Constant like Flavonoids and Phenolic compounds were carried out and reported.

Table 2. The table content of the Observations records different Physicochemical Constant Determination Tests

Extract	Identification Test			Conclusion
	Shinoda Test	Ferric Chloride Test	Phthalein Dye Test	
Extraction in Methanol	Show black colour	Show faint green colour	Show red colour fluorescent	Not pass all test
Extraction in Ethanol	Show pink colour	Show red colour	Show pink colour fluorescent	Pass all Test
Extraction in Acetone	Show faint pink colour	Show red colour	Show pink colour fluorescent	Not pass all test
Extraction with Chloroform	Show pink colour	Show yellow colour	Show faint pink colour fluorescent	Not pass all test

As per protocol, the physicochemical constant determination tests have been performed. As per the tests of determination of phytoconstituents, the ethanoic extract passes all the tests hence we select that extract for farther processing

Pre formulation study

Drug Excipient compatibility study

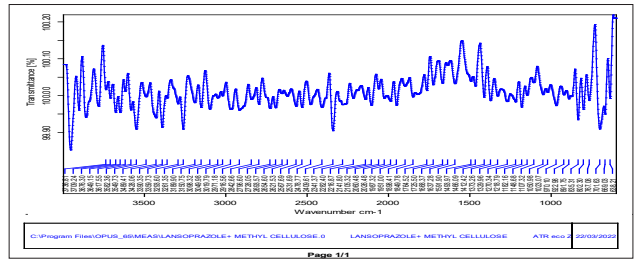

Figure 3. IR graph of Jack fruit root extract

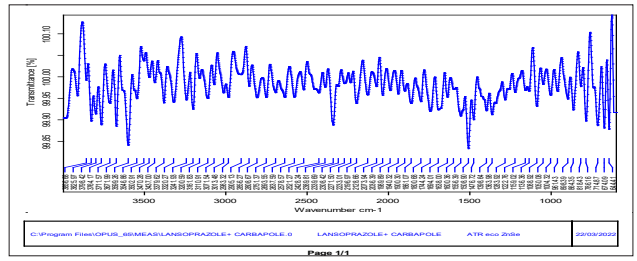

Figure 4. IR graph of Jack fruit root extract + Tablet Base

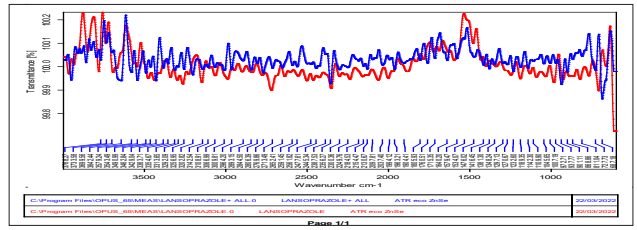

Figure 5. IR Over lapping graph of graph of Jack fruit root extract + Tablet Base

According to observation and interpretation, all extract and excipient graphs were in agreement with the table and graph shown at the 2350 cm^{-1} pick of the CH functional group. The total excipient choices for the C=C functional

group exhibit 1570 and 1580 cm^{-1}, respectively, as we have observed. Consequently, we draw the conclusion that the medication is compatible with all mentioned, formulation excipients.

Table 3. The interpretation records of extract samples & the Excipients

Samples	Stretching (cm^{-1})		
	=CH	C=C	-OH
Extract	2350	1570	3125
Extract + Tablet Base	2355	1580	3155

Melting Point

Table 4. The table contains the observation of the melting point

Sample	Reference MP °C	Observed MP °C	Final MP °C
Extract	180	179	180
		180	
		180	

Solubility

Table 5. The solubility of extract in different solvent

Solvent	Absorbance
Ethyl acetate	0.0021
Chloroform	0.0147
Methyl Chloride	0.0156
Ethanol	0.0217
Water	0.0005

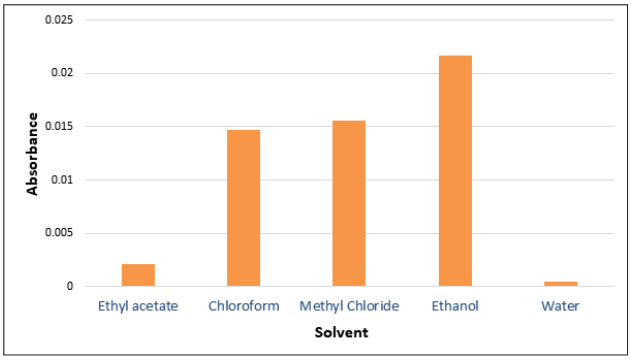

Figure 6. The graph of solubility of extract in different solvent

The extract was tested using UV spectroscopy, and the results show that it is sufficiently soluble in water and highly soluble in ethanol.

Pre-compression parameter of tablet

Table 6. The all pre compression parameter study in the table

Formulation No.	Angle of repose Degree (°)	Bulk Density (mg/ml)	Tap Density (mg/ml)	Hausner's Ratio
F1	19.74	0.311	0.425	1.250
F2	17.75	0.4861	0.5664	0.9045
F3	37.83	0.4973	0.5983	0.7944
F4	43.66	0.3902	0.4435	0.9019
F5	21.21	0.5814	0.3994	0.6883
F6	42.82	0.2579	0.2909	0.9327

The conclusion of the pre-compression parameter observation study is that all formulations have passed all compression tests. The entire formulation has excellent flow, filling, and packing capacities.

Post compression parameter for tablet

Organoleptic parameters

Table 7. The Observation of Organoleptic parameters of different formulation

Formulations	F1	F2	F3	F4	F5	F6
Colour	Faint Brown	Brown	Faint Brown	Faint Brown	Dark Brown	Dark Brown
Test	Bitter	Bitter	Bitter	Bitter	Bitter	Bitter
Shape	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical
Size	4 mm	4 mm	4 mm	4 mm	4 mm	4 mm
thickness	3 mm	3 mm	3 mm	3 mm	3 mm	3 mm

Weight Variation Test

Table 8. The Observation of Weight Variation of different formulation

Sr. No	Tablet	Weight of Tablet (mg)					
		F1	F2	F3	F4	F5	F6
1	T1	200	199	199	199	200	200
2	T2	201	198	200	198	200	200
3	T3	200	199	200	199	200	200
4	T4	199	198	200	199	199	200
5	T5	198	202	200	198	198	199
6	T6	199	200	200	200	199	200
7	T7	200	200	201	200	199	200
8	T8	200	200	198	200	201	200
9	T9	200	200	199	200	200	199
10	T10	199	199	200	200	200	198
11	T11	198	197	200	200	200	199
12	T12	201	199	200	200	201	201
13	T13	200	201	200	202	198	201
14	T14	200	201	201	199	201	200
15	T15	200	200	200	197	200	200
16	T16	200	201	200	200	200	200
17	T17	200	200	200	199	200	201
18	T18	200	200	200	198	200	198
19	T19	201	200	200	199	199	201
20	T20	200	200	200	200	198	198
Total weight		3996	3994	3998	3987	3993	3995
Averages weight		199.8	199.7	199.9	199.35	199.65	199.75
Upper limit		201	202	201	202	201	201
Lower Limit		198	197	198	197	198	198
% Variation		1.49	2.47	1.44	2.33	2.23	1.66

The weight variation of all batches has been determined by determining average weight, total weight, upper and lower limits of the tablet, and it has been determined that, as per specification, a weight variation of 5% is acceptable. According to that perspective, all formulations passed the test, although formulation number F3 had a very low

variation (1.44%), and formulation number F2 had a high variation (2.47%).

Hardness

Table 9. The table contains the formulations hardness

Formulation number	Testing (kg/cm²)	Mean (kg/cm²)
F1	3.55	3.55
	3.56	
	3.56	
F2	2.15	2.22
	2.36	
	2.15	
F3	2.36	2.82
	2.59	
	3.52	
F4	5.66	4.6
	2.33	
	5.88	
F5	5.66	4.5
	2.33	
	5.55	
F6	2.55	3.1
	3.66	
	3.2	

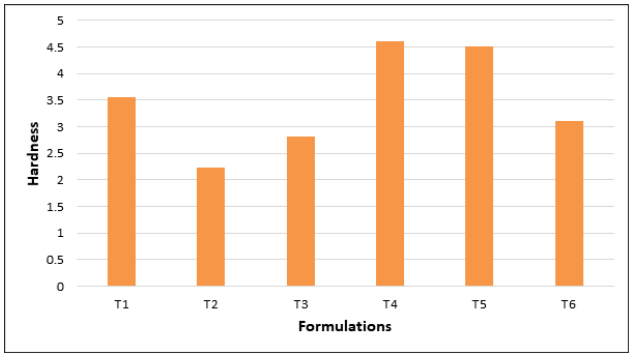

Figure 7. The graph contains the formulations hardness

For the tablet to meet USP requirements, its friability must be less than 1%. There are two formulations available: F3, which has the least amount of hardness, and F6, which has the most amount of hardness.

Friability Test

Table 10. The table contains the Friability of different formulation

Formulation Number	Initial weight (gm)	Final Weight (gm)	% Friability
F1	20	19.81	0.95
F2	20	19.92	0.40
F3	20	19.95	0.25
F4	20	18.58	7.1
F5	20	19.82	0.9
F6	20	18.85	5.75

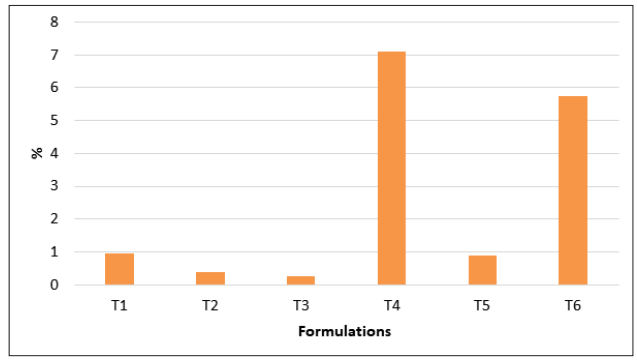

Figure 8. The graph contains the Friability of different formulation

The tablet's friability should be less than 1% in compliance with USP specifications. The formulations with the lowest hardness, F3, and the maximum hardness, F6, are identified.

Disintegration Test

Table 11. The table contains the Disintegration time of different formulation

Formulation Number	Time of Disintegration of Tablet (min)			
	C1	C2	C3	Mean
F1	110.45	8.25	9.38	9.693
F2	7.10	7.58	8.01	7.563
F3	11.15	15.59	6.10	10.95
F4	6	6.10	7.25	13.16
F5	14.16	13.23	6.0	11.03
F6	18.58	6.80	11.12	18.27

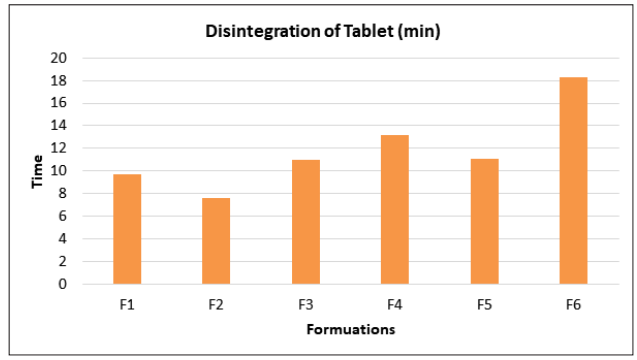

Figure 9. The Graph of disintegration of different formulations

With the help of a disintegration apparatus & various USP guidelines test has been performed, Observations show that formulation number F2 has the lowest DT possible whereas formulation number F6 has the highest possible DT.

Drug Content

Table 12. The Drug content in the formulation in percentage

Formulations	Drug Content (%)
F1	94.83
F2	95.84
F3	98.45
F4	90.56
F5	91.63
F6	91.88

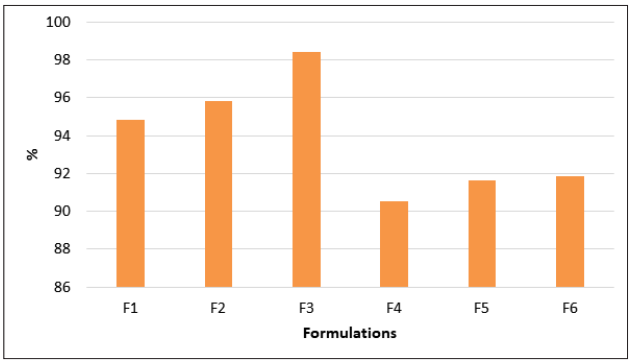

Figure 10. The Graph of Drug Content of different formulations

In vitro study

Table 13. Contain Percentage drug release's time at various time intervals

Time (Min)	Percentage Drug Release					
	F1	F2	F3	F4	F5	F6
0	0.00	0.00	0.00	0.00	0.00	0.00
30	10.07129	9.47523	15.24554	10.65149	8.6436	12.8812
60	15.27723	17.06929	25.71683	29.52871	18.099	26.56436
90	27.6495	25.901	35.18812	40.40594	28.9762	33.42574
120	35.14059	30.0653	45.4851	48.10891	39.8772	43.91089
150	45.67327	40.4138	55.901	60.2594	45.0277	53.54455
180	52.26535	48.0356	68.9287	67.099	58.8673	66.33267
210	61.11287	54.1921	70.1584	70.9624	68.6653	73.1307
240	68.598	65.1426	74.804	75.9129	72.5228	79.9881
270	72.1644	74.8851	78.5683	80.3485	84.4634	81.9287
300	78.4218	80.697	82.1822	82.8238	86.4396	86.905
330	84.2139	85.3703	87.4218	86.299	90.8554	90.3208
360	90.2636	96.452	99.4254	93.584	95.954	92.2267

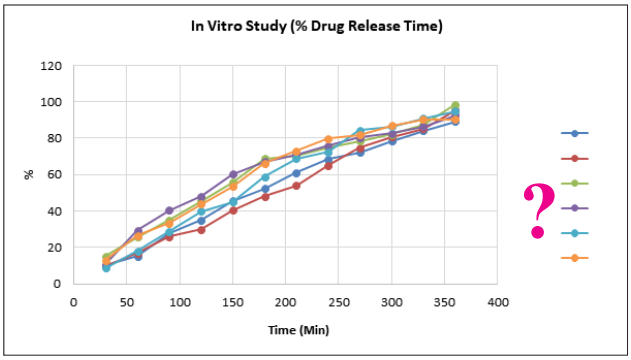

Figure 11. The Graph of *in vitro* study of different formulations

This study, which is an in-vitro investigation of drug release and dissolution, was conducted for six hours using USP II apparatus, or a paddle-type device, at room temperature. The study's conclusion showed that Formulation Number F3 had the greatest and continuously increasing drug release capacity (99.452%), while Formulation Number F1 had the lowest and most lost drug release capacity (90.2636%).

CONCLUSION

Herbal tablets have been formulated with the help of a variety of ingredients and polymers, including the natural polymer chitosan and the synthetic polymer methylcellulose. Through research and development, formulation F3 was found to be different due to different evaluation parameters such as weight variation, friability, hardness, drug content, disintegration time, and drug release rate & *In vitro* studies of tablets representing optimized formulations compared to other formulations show more ideal results than other formulations.

CONFLICTS OF INTEREST

There are no conflicts of interest and disclosures regarding the manuscript.

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