IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

FABRICATION AND EVALUATION OF SPIRULINA ORO-DISPERSIBLE FILM FOR PERIODONTITIS MANAGEMENT

Bhavya G[1]*, Jhnanitha[2], Dr. Ravikumar[3] .

[1]Assistant Professor, Department of Pharmaceutics, [2]UG Research Scholar, [3]Professor & Head, Department of Pharmaceutics, Karavali College of Pharmacy, Mangalore, Karnataka-575028

ABSTRACT

The present study was undertaken with an intention to develop fast disintegrating films of Spirulina especially designed for paediatric and geriatric use that provides fast onset of action. Gingival and periodontal illnesses are becoming more common, impacting people of all ages. chemical plaque control strategies have been used, including the use of various mouthwashes and anti-plaque chemicals. There are various mouthwashes on the market that contain triclosan, metronidazole, chlorhexidine, and many more ingredients. These substances have certain undesirable side effects, such as altered taste perception and tooth discoloration, Therefore, using plants and plant-based products can be a substitute for this. Fast disintegrating drug delivery system offers a solution for those patients having difficulty in swallowing tablet/capsules. The film placed on the top or the floor of the tongue instantly gets wet by saliva rapidly hydrates, adhere to tongue and rapidly disintegrates. The solvent casting method was used to prepare the films. Films were formulated using the polymers like HPMC E15, PVA, Crospovidone as fast disintegrating agent, Glycerine as a plasticizer, Citric acid as saliva stimulating agent, Raspberry syrup as a flavouring agent and Sucrose as a sweetening agent. The prepared formulations of films were evaluated for film thickness measurement, weight variation, folding endurance, percentage drug content, *in-vitro* disintegration time, *in-vitro* dissolution study. All the formulated films were found to disintegrate within 72 sec. All formulations showed good physico-mechanical properties. Among six formulations F4 with thickness 0.07±17.320 mm, disintegration time 52 sec. folding endurance 350, % drug content 93.75% and %CDR 94.73% at the end of 15min and selected as optimum formulation.

Keywords: Fast disintegrating films; Spirulina; Crospovidone.

INTRODUCTION

Among the different routes, the most acceptable route for the patients is oral route. Especially solid dosage form (tablet/capsules) is most preferred dosage form due to ease of manufacturing, transportation, administration, low cost and dose accuracy.[1]

Besides many advantages there are also some drawbacks such as slow onset of action, difficulty in swallowing in case of paediatrics, geriatrics, and nauseous patients. These can be overcome by fast disintegrating systems which were developed within the late seventies as an alternative to tablets, capsules and syrup.

The major benefit of fast disintegrating systems such as fast disintegrating tablets, fast disintegrating films over conventional oral dosage forms is, the drug gets rapidly disintegrates in saliva without the use of water and chewing, and shows relatively rapid onset of action, making them particularly suitable for paediatrics and geriatric patients.[2]

But many fast-disintegrating tablets prepared by using the expensive lyophilisation process and sometimes they are difficulty to carry, store and handling. To eliminate the drawbacks of fast disintegrating tablets, fast disintegrating film can be placed.[3]

Fast disintegrating films (FDF) a novel drug delivery system; it's an ultra-thin film of the size of a postage stamp, prepared using hydrophilic polymers that rapidly disintegrates on the top or floor of the tongue or buccal cavity. Fast disintegrating film was developed based on the technology of transdermal patches.[1]

METHODS OF PREPARATION OF FDF [4]

There are different methods

1. Casting and drying
    a) Solvent casting
    b) Semi-solid casting
2. Extrusion
    a) Hot melt extrusion
    b) Solid dispersion extrusion
    c) Rolling method

Advantages of fast disintegrating films[5,6]

-Fast disintegration due to larger surface area.

-Rapid onset of action compared to conventional oral dosage forms.

-No need of water for administration.

-No need of chewing.

-Low drug dose, which enhance the efficacy.

-Easy to administer.

-No risk of chocking.

-Accuracy in dose as compared to liquid dosage form.

-Stable for longer duration.

-Easy to handle and transport.

Disadvantages of fast disintegrating films

- High dose cannot be incorporated
- Drugs which irritate the oral mucosa cannot be administered
- Require special packaging
- Expensive packaging
- Drugs unstable at buccal pH cannot be administered.

Ideal drug candidates for fast disintergrating films

- The drug should have pleasant taste.
- The drug to be incorporated should have low dose (up to 40mg).
- The drug should remain partial unionized in oral pH.
- The drug should be non-irritant to oral mucosa.
- The drug should have good stability and solubility in water as well as saliva.
- The drug should have smaller and moderate molecular weight.

Spirulina is a type of blue-green algae or cyanobacterium that has a number of nutritive and physiological advantages. According to research, S. Aureus, E. Coli, P. Aeruginosa, Klebsiella sp, Proteus sp, and Embedobacter sp are all susceptible to Spirulina's antibacterial properties [7].

Gingivitis is an inflammatory condition brought on by bacterial biofilms that build up in the gingival border. Pathogenic bacteria in this condition cause a sequence of inflammatory reactions that, if left untreated, lead to periodontal collapse.

7,8

MATERIALS AND METHODS

Materials

Spirulina, HPMC E15, Crospovidone Sodium obtained from Yarrow Chem products, Mumbai; PVA cold, Sucrose from Hi Media, Bengaluru; Citric acid from Medilise, Kerala; Raspberry from Viveka essence mart, Bengaluru, Glycerine from Central drug house(Pt) Ltd.

A) PRE-FORMULATION STUDIES: [9,10]

Pre-formulation testing is the initial step in rational development of dosage forms of a drug substance. It is an investigation of physical and chemical properties of drug substance alone and when combined with excipients. It gives basic knowledge necessary information of drug substance to develop suitable formulation. Pre-formulation investigations are designed to yield all required data especially physiochemical, physico-mechanical and biopharmaceutical properties of drug substances, excipients and packaging materials.

1. Organoleptic properties:

The colour, odour and taste of Spirulina was recorded using descriptive terminologies.

2. Determination of solubility:

Spirulina was dissolved in solvents namely distilled water, methanol and phosphate buffer pH 6.8 respectively until few crystals remain undissolved at the bottom and absorbance was measured after suitable dilution at λmax using Double beam UV-VIS Spectrophotometer (SYSTRONICS).

3. Preparation of phosphate buffer pH 6.8: [11]

28.80gm of disodium hydrogen phosphate and 11.45gm of potassium dihydrogen phosphate was dissolved in sufficient water and volume was made upto1000ml.

4. Scanning for λmax of Spirulina in phosphate buffer pH 6.8:[12]

The Spirulina (100mg) was accurately weighed and transferred to 100 ml of volumetric flask, dissolved in phosphate buffer pH 6.8 and volume was made up to 100 ml to get a stock solution of 1000 µg/ml. From stock solution subsequent dilutions made to obtain 50 µg/ml and which was scanned between 200 to 400 nm to obtain λmax.

5. Preparation of Standard graph of Spirulina in phosphate buffer pH 6.8:[12,13]

Stock solution A (1000 µg/ml): 100 mg of drug was dissolved in 100 ml phosphate buffer pH 6.8 to get 1000 µg/ml.

Stock solution B (100 µg/ml):10 ml of stock A was diluted to 100 ml phosphate buffer pH 6.8 to get 100 µg/ml.

Dilutions:1, 2, 3, 4, 5 and 10 ml of stock B diluted to10ml to get 10, 20, 30, 40 and 50 µg/ml respectively.

The absorbance of these solutions was measured at λmax using Double beam UV-VIS spectrophotometer (SYSTRONICS) against corresponding blank.

B) DRUG COMPATIBILITY STUDIES:

Fourier Transforms Infrared (FTIR) Spectroscopy studies:

The pure drug, physical mixture of Spirulina with PVA and Crospovidone and physical mixture of Spirulina with HPMC E15 and Crospovidone were scanned from 4000-400cm^{-1} in FTIR spectrophotometer.

C) FORMULATION OF FAST DISINTEGRATING FILMS

Formulation development[14,15]

Table 5: Criteria for selection of Oral Films.

Sl.no.	Category	Conc. (%)
1	Drug	01-25
2	Polymer	40-50
3	Plasticizer	25-35
4	Sweetener	02-10
5	Saliva stimulating agent	03-06
6	Flavour	02-05

Dose calculation for Chlorpheniramine maleate:

The dose of Spirulina is 4mg. Therefore, amount of Spirulina required for 2×2 cm^2 film is 4mg.

Length of glass mould (L) =14cm

Breadth of glass mould (B) = 2 cm

Area of glass mould (A) = L ×B

=14 × 2

= 28 cm^2

Number of patches = Area of glass mould /size of the square film

=28 / 4

=7

Total amount of the drug = Number of patches x Dose

=7×4

=28 mg

Therefore 28 cm^2 of glass mould should contain 28 mg of drug. It is fixed for all formulation.

Preparation of solution of Spirulina in distilled water:

350 mg of Spirulina was dissolved in sufficient distilled water in 25ml volumetric flask and the volume made up to 25ml with distilled water.

i.e., 25ml solution contains 350mg of Spirulina.

Therefore, 2ml solution contains 28mg of Spirulina.

Solvent casting method[14]:

- The fast-disintegrating films were prepared using polymers like HPMC E15, PVA.
- The formulation F1, F2 and F3 were prepared using polymer PVA with 700mg, 800mg and 900mg respectively.
- Whereas F4, F5 and F6 were prepared using polymer HPMC E15 with 800mg, 900mg, 1000mg respectively.
- Then the respective quantity of polymer was dispersed in 7ml of solvent (Hot water) and stirred for 1 hour using magnetic stirrer until the homogenous solution was formed.
- Then 2ml water containing 28mg of Spirulina was added to the polymeric solution and stirred for 1/2 hour.
- Later the Glycerine(plasticizer), Crospovidone (fast disintegrating agent), sucrose(sweetener) and Raspberry syrup were added to drug mixed polymeric solution and continued stirring for 1/2 hour.
- Then the solution was kept in bath sonicator for degassing. The bubble free solution was casted on to glass mould of size 2cm breadth and 14cm length and kept in hot air oven at 60ºC for 4 hours.
- The dried film was cut into desired shape i.e., 2×2 cm^2; then, packed in butter paper and stored in stability chamber.

Table 6: Formulation chart

Formulation	Drug (mg)	PVA (mg/7 film)	HPMC (mg/7 film)	Crospovidone (%w/w of polymer)	Glycerol (%w/w of Polymer)	Sucrose (%w/w of polymer)	Citric Acid (%w/w of Polymer)	Flavour (%w/w of polymer)	Water (ml)
F1	28	700	--	10	20	4.0	4.0	8.0	up to 9ml
F2	28	800	--	10	20	4.0	4.0	8.0	
F3	28	900	--	10	20	4.0	4.0	8.0	
F4	28	--	800	10	20	4.0	4.0	8.0	
F5	28	--	900	10	20	4.0	4.0	8.0	
F6	28	--	1000	10	20	4.0	4.0	8.0	

4mg of Spirulina was required for 1film of size 2×2 cm^2. Therefore, to prepare 7 films 4×7= 28mg of Spirulina was required.

D) IN-VITRO CHARACTERIZATION OF FAST DISINTEGRATING FILMS.[17]

1.% Drug Content: A film of size 2×2 cm^2 was dissolved in 100ml phosphate buffer pH 6.8 and stirred using magnetic stirrer for 1 hour. Then it was filtered and absorbance of the solution was measured after suitable dilutions and percentage drug content was calculated.

$$\%\text{Drug content} = \frac{\text{Actual drug content}}{\text{Theoretical drug content}} \times 100$$

2. Thickness: The thickness of film is directly concern with polymer quantity. It was measured using screw gauge at three different spots of the films and average was taken.

3. Folding Endurance: Folding endurance was found by repeated folding of the film at the same place till the film breaks. This indicates brittleness of the film. The number of times the film was folded without breaking was computed as the folding endurance value.

4.Weight variation: Three films of each formulation were weighed using weighing balance; mean weight and standard deviation was calculated.

5. *In-vitro* drug release studies:

a) *In-vitro* disintegration Study by petri-dish method:[18]

The film of size 2×2 cm^2 was placed in a Petri-dish containing 10ml of distilled water. Time required for the film to disintegrate was noted.

b) *In-vitro* Dissolution Test:[19]

The dissolution study was carried out, using the USP apparatus (Electrolab dissolution tester TDT-08L, Mumbai, Maharashtra). The film sized 2×2 cm^2 was placed in the basket, lowered into dissolution flask holding the medium 900ml phosphate buffer pH 6.8 maintained at temperature 37±0.5°C and rotation speed

of 50rpm. 10mL aliquots were withdrawn at 5, 10, 15, 20, 25, 30, 45, 60 min. and replaced with fresh phosphate buffer pH 6.8 of same volume. Absorbance of withdrawn aliquots were determined after suitable dilution using UV Visible spectrophotometer at λmax.

E) STABILITY STUDIES AS PER ICH GUIDELINES[14]: According to the ICH guideline the stability of the films was studied at controlled conditions of 25±2 ºC with 60±5 % RH as well as at 40±2°C with 75±5 %RH. Initially drug content and *in-vitro* dissolution study of FDFs were carried out. Then the films were packed in butter paper and stored in stability chamber. The drug content and *in-vitro* dissolution study were carried out for 0, 30, 90 and 180 days.

RESULTS AND DISCUSSION

PRE-FORMULATION STUDY OF SPIRULINA

Organoleptic properties of Spirulina were evaluated manually by visual inspection and characterized by white in color, crystalline powder and odorless.

Table 7: Organoleptic properties of Spirulina

Properties	Reported	Result
Description	Green, odourless, crystalline powder	Green, odourless, crystalline powder
solubility	Freely soluble in water, soluble in methanol	Freely soluble in water, soluble in methanol
Odour	odourless	odourless

Solubility study of Spirulina:

Table 8: Solubility study chart of Spirulina

Solvent	Conc.(µg/ml)
Water	78.33
Methanol	76.66
Phosphate buffer pH 6.8	67.5

The solubility of Spirulina was determined in water, methanol and phosphate buffer pH 6.8 and concentration was found to be 78.33, 76.66 and 67.5 µg/ml respectively. The drug was freely soluble in water and soluble in methanol.

λ_{max} Spirulina in phosphate buffer pH **6.8**

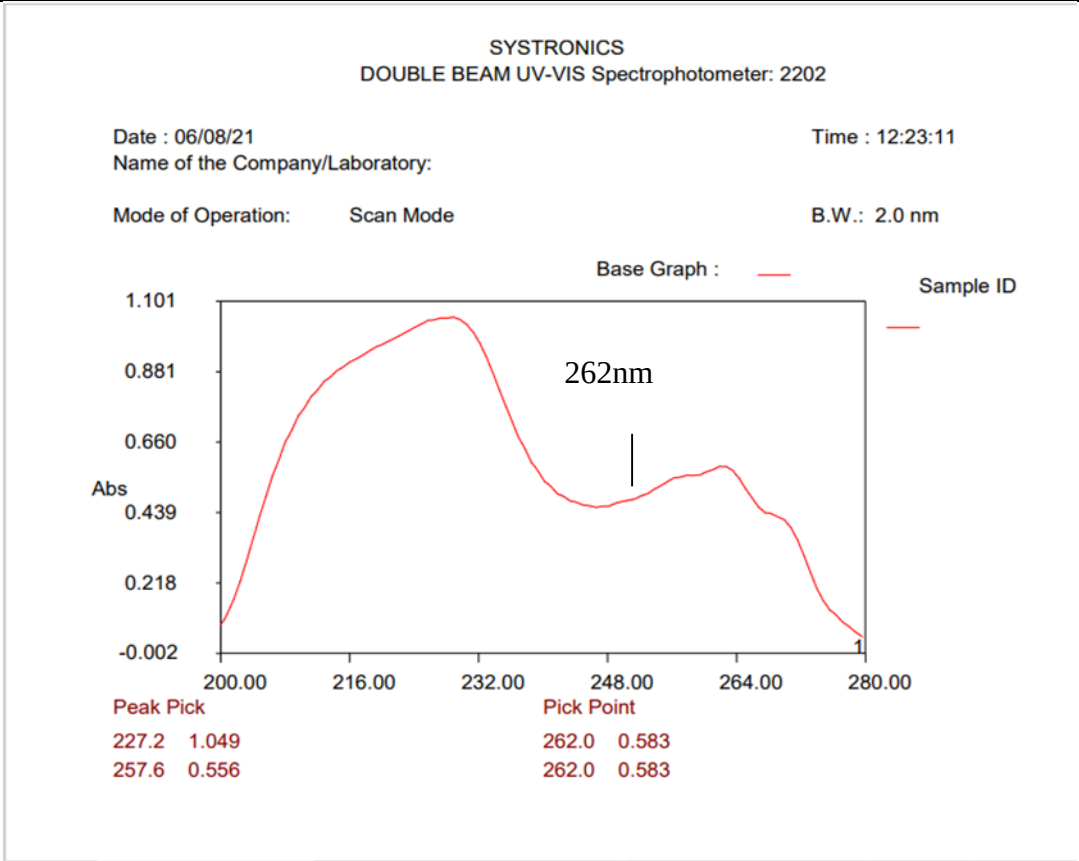

Figure 4: UV spectrum of Spirulina in phosphate buffer pH 6.8

The λ max was obtained at 262 nm as shown in the figure.4. 262 nm is consequently the wavelength of choice for this method.

Standard graph of Spirulina.

The values of the absorbance at different concentration (µg/ml) in phosphate buffer pH 6.8 are given in the table no.9 and the standard plot is shown in the figure.5.

Table 9: Concentration and Absorbance of Spirulina in Phosphate buffer pH 6.8.

Sl.no.	Concentration(µg/ml)	Absorbance
1	10	0.142
2	20	0.255
3	30	0.388
4	40	0.500
5	50	0.599

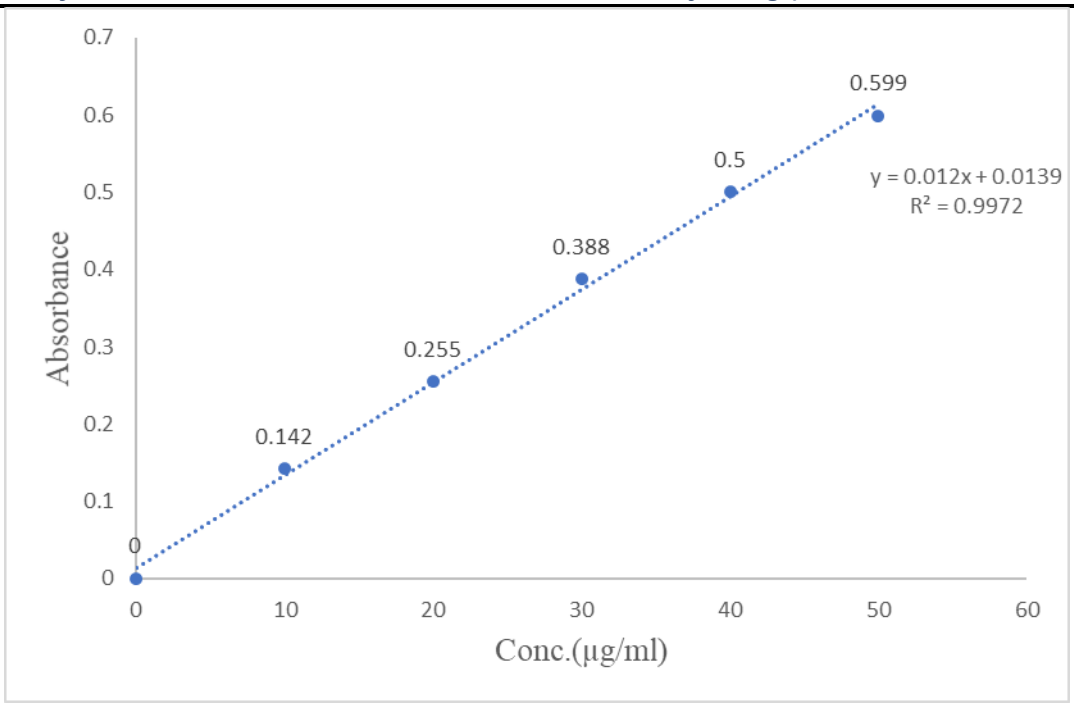

Figure 5: Standard graph of Spirulina in phosphate buffer pH 6.8 (λ max 262 nm)

The absorbance value retained linear and obeyed Beer's Lamberts law in the range of 0-50 µg/ml with the R^2(regression coefficient) value of 0.9972.

DRUG-EXCIPIENT COMPATIBILITY STUDY

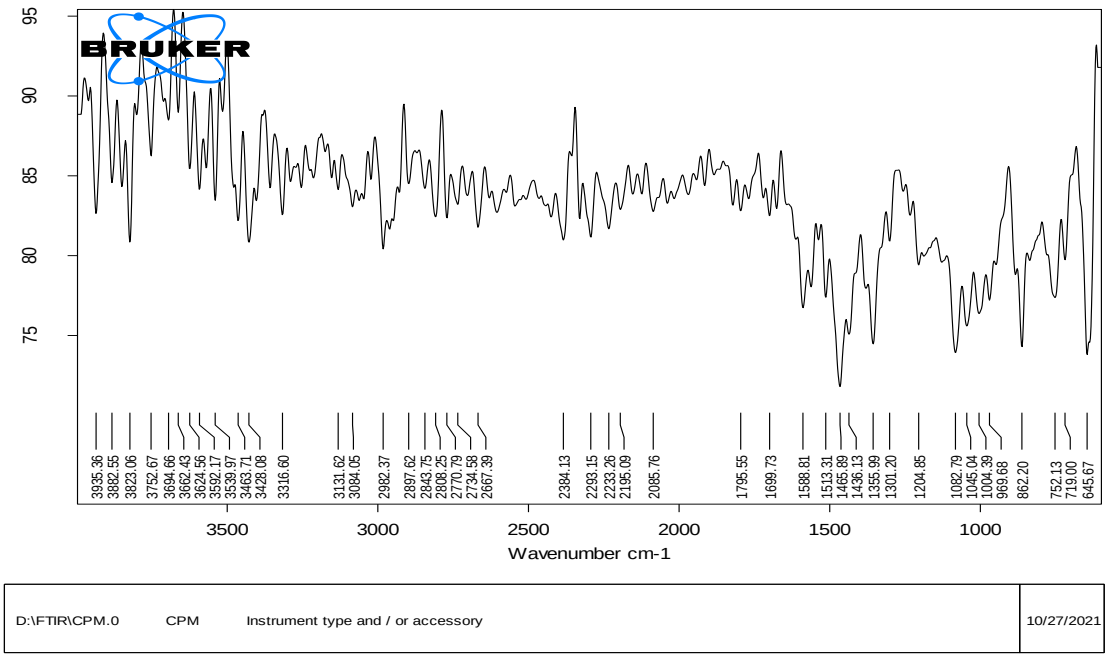

Figure 6: FTIR Spectrum of Spirulina

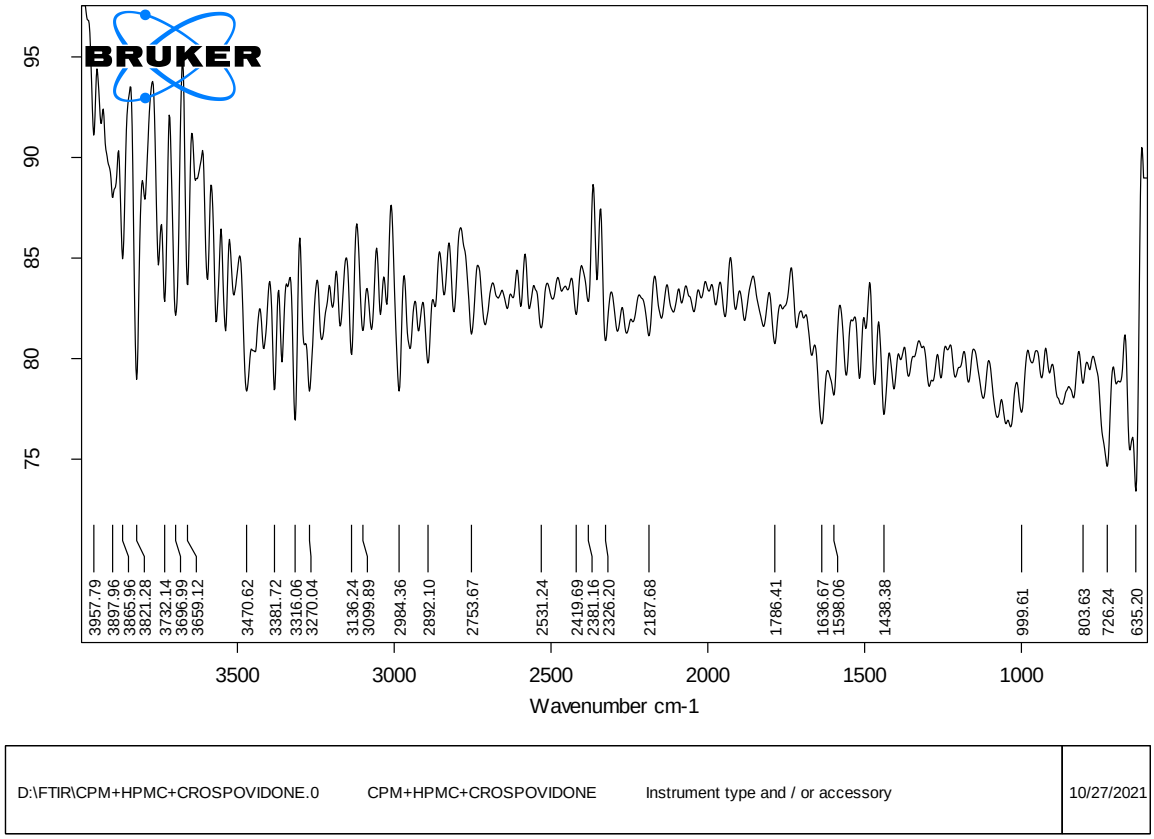

Figure 7: FTIR Spectrum of Spirulina with HPMC E15 and Crospovidone

Table 10: FTIR Spectra data of Spirulina and polymers

Bond	**Functional group**	**Standard frequency in cm^{-1}**	**Frequency of Spirulina in cm^{-1}**	**Frequency of Spirulina, PVA and Crospovidone in cm^{-1}**	**Frequency of Spirulina, HPMC E15 and Crospovidone in cm^{-1}**
C-H stretch	Alkanes	3300-3500	3325	3432	3224
N-H stretch	1^0 amines	3200-3400	3212	3200	3330
=C-H stretch	Alkenes	3010-3100	3010	3010	3100
-C=C- stretch	Alkynes	2100-2660	2445	2200	2445

Table 11: Formulation chart of Spirulina fast disintegrating films:

Formulations	Drug (mg)	PVA (mg)	HPMC (mg)	Crospovidone (mg)	Glycerine (mg)	Sucrose (mg)	Citric acid (mg)	Flavour (mg)	Water (ml)
F1	28	700	-	70	140	28	28	56	Upto 9ml
F2	28	800	-	80	160	32	32	64	
F3	28	900	-	90	180	36	36	72	
F4	28	-	800	80	160	32	32	64	
F5	28	-	900	90	180	36	36	72	
F6	28	-	1000	100	200	40	40	80	

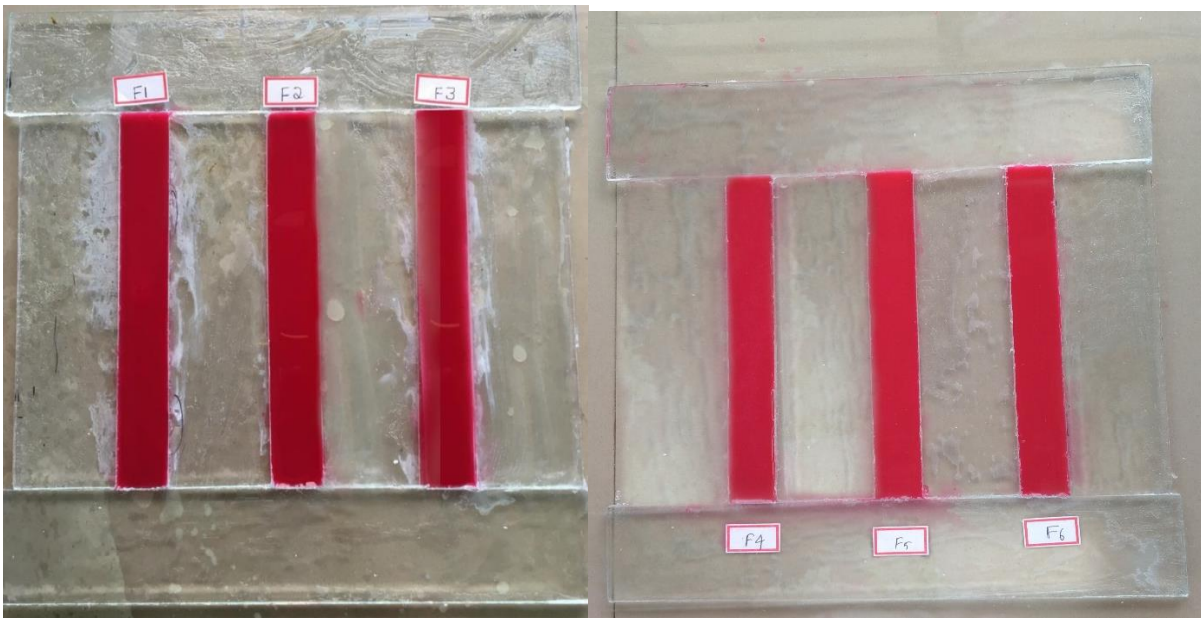

Figure 8: Pictures showing formulations F1-F6.

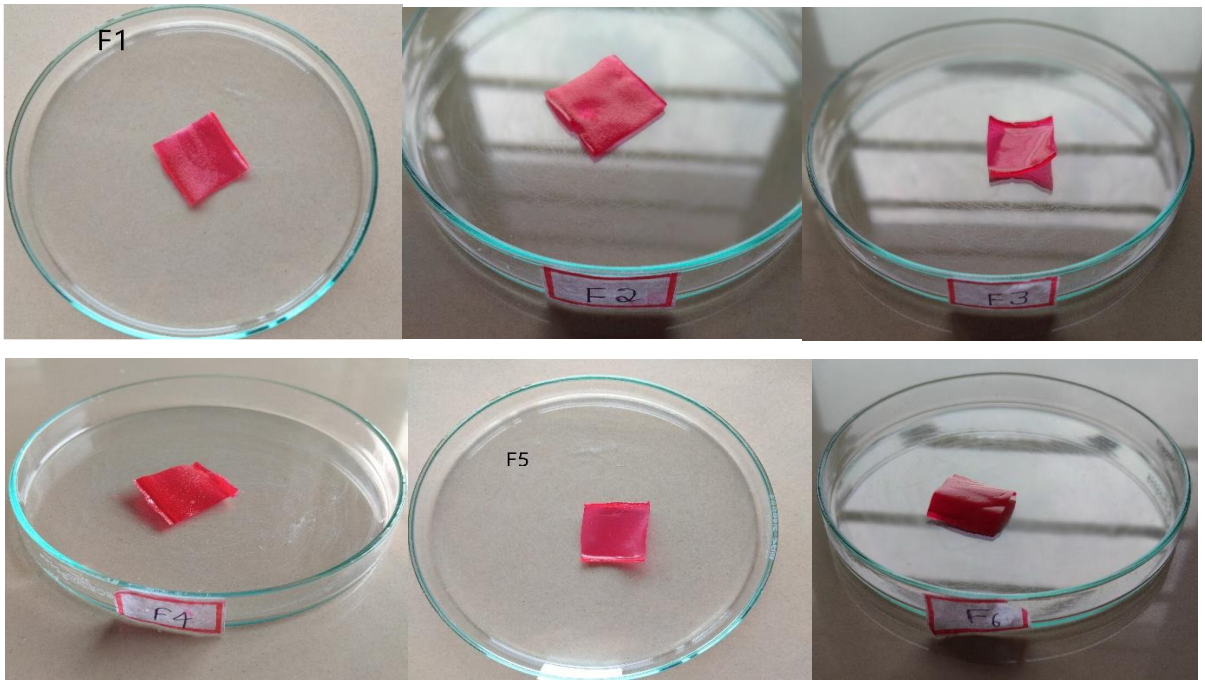

Figure 9: Pictures showing the formulations F1-F6 of size 2×2 cm^2.

Six formulations were prepared. Among six formulations, three formulations (F1, F2, F3) prepared by using PVA (700mg,800mg,900mg respectively) and other three formulations (F4, F5, F6) using HPMC E15 (800mg,900mg,1000mg).

EVALUATION OF PREPARED FAST DISINTEGRATING FILMS:

Thickness of fast disintegrating films:

The thickness of all formulations F1-F6 was found by using screw gauge and the results are shown in table.12.

Table 12: Thickness of FDFs (F1-F6).

Formulation	Thickness (mm)			Mean Thickness(mm)± S.D*
	Trial 1	Trial 2	Trail 3	
F1	0.05	0.08	0.06	0.063±0.0152
F2	0.10	0.10	0.07	0.090±0.0173
F3	0.08	0.11	0.12	0.103±0.0268
F4	0.06	0.07	0.08	0.070±0.0100
F5	0.14	0.15	0.11	0.133±0.0208
F6	0.17	0.22	0.21	0.200±0.0264

***n=3**

- Thickness of fast disintegrating film depends on the quantity of polymer used.
- The thickness of FDFs F1-F6 varies from 0.0630±0.0152mm to 0.200±0.0264mm as shown in table 11.
- Formulation F1, F2 and F3 were prepared using polymer PVA with 700, 800 and 900 mg showed thickness 0.0630±0.0152, 0.090±0.0173 and 0.103±0.0268mm respectively; where F1 showed least thickness and F3 showed highest thickness.
- Formulation F4, F5 and F6 were prepared using HPMC E15 with 800, 900 and 1000mg showed thickness 0.070±0.01, 0.133±0.0264 and 0.200±0.0264mm respectively; where F4 showed least thickness and F6 showed highest thickness.
- Hence result of thickness measurement showed that as the concentration of polymer increases, thickness of FDF increases.

Folding endurance of fast disintegrating films:

Folding endurance was determined by repeatedly folding a small strip of film at the same place till it broke. The folding endurance value of formulations F1-F6 are shown in table.13

Table 13: Folding endurance value of formulations F1-F6

Formulation	Folding endurance
F1	390
F2	410
F3	660
F4	350
F5	415
F6	460

- The folding endurance value determines film flexibility. Examining the no. of folds gives an indication of FDF brittleness and is important for their storage and administration without being ruptured.
- Folding endurance of the formulations F1- F6 ranges from 350 -660.
- Formulation F1, F2 and F3 were prepared using polymer PVA with 700, 800 and 900 mg showed folding endurance value 390, 410, 660 respectively where F1 had lower folding endurance of 390 and F3 had higher folding endurance of 660.
- Whereas formulation F4, F5 and F6 were prepared using HPMC E15 with 800, 900 and 1000mg showed folding endurance value 350, 415 and 460 respectively; where F4 had lower folding endurance and F6 had higher folding endurance.
- These results of folding endurance of FDFs showed that folding endurance of FDFs increases with increase in quantity of polymer used.
- Also, FDFs prepared using polymer PVA i.e., F1-F3 showed comparatively higher folding endurance than FDFs prepared using polymer HPMC E15.

Weight variation of fast disintegrating films:

Three films of each formulation were individually weighed and weight variation was calculated and the results are shown in table.14.

Table 14: Weight variation chart of FDF formulations(F1-F6)

Formulations	Weight of the film (2x2 cm^2) in mg			Mean weight (mg) ±S. D*
	Trial 1	Trial 2	Trial 3	
F1	140	110	110	120.00±17.32
F2	150	120	130	133.33±16.32
F3	120	170	180	156.60±32.14
F4	60	90	60	070.00±17.32
F5	150	150	120	140.00±17.32
F6	140	170	160	156.60±15.27

***n=3**

- The weight of prepared films was determined using digital balance and average weight was calculated.
- Weight variation varies from70±17.320 - 156.6±32.14mm.
- Formulation F1, F2 and F3 were prepared using polymer PVA with 700, 800 and 900 mg showed weight 120.00±17.320, 133.33±16.32 and156.60±32.14mg respectively i.e. The weight of the FDF increased with increase in the quantity of PVA used.
- Formulation F4, F5 and F6 were prepared using HPMC E15 with 800, 900 and 1000mg showed weight 70.00±17.320, 140.00±17.320 and156.60±15.275mg respectively i.e. The weight of the FDF increased with increase in the quantity of HPMC E15 used.

Percentage drug content of fast disintegrating films:

Percentage of drug content for different formulations was calculated and the results are shown in table.15.

Table 15: Percentage drug content of Spirulina Fast disintegrating films(F1-F6).

Formulations	%Drug content
F1	93.375
F2	77.125
F3	72.000
F4	93.750
F5	73.750
F6	107.50

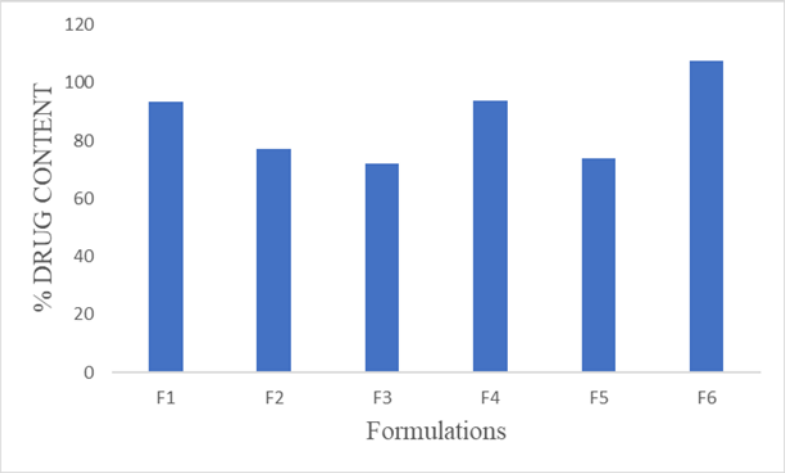

Figure 10: % Drug content of formulations F1-F6.

- % Drug content of formulations varies from 72.00 – 107.50%.
- The formulation F3 showed least %drug content of 72.00%and formulation F6 showed highest % drug content of 107.50%.

Disintegration time of fast disintegrating films:

The disintegration is the time when a film starts to disintegrate. The *in-vitro* disintegration time of FDFs was determined visually and the results are shown in table.16.

Table 16: Disintegration time of formulations F1-F6.

Formulation	Disintegration time(sec.)
F1	40
F2	72
F3	59
F4	52
F5	66
F6	51

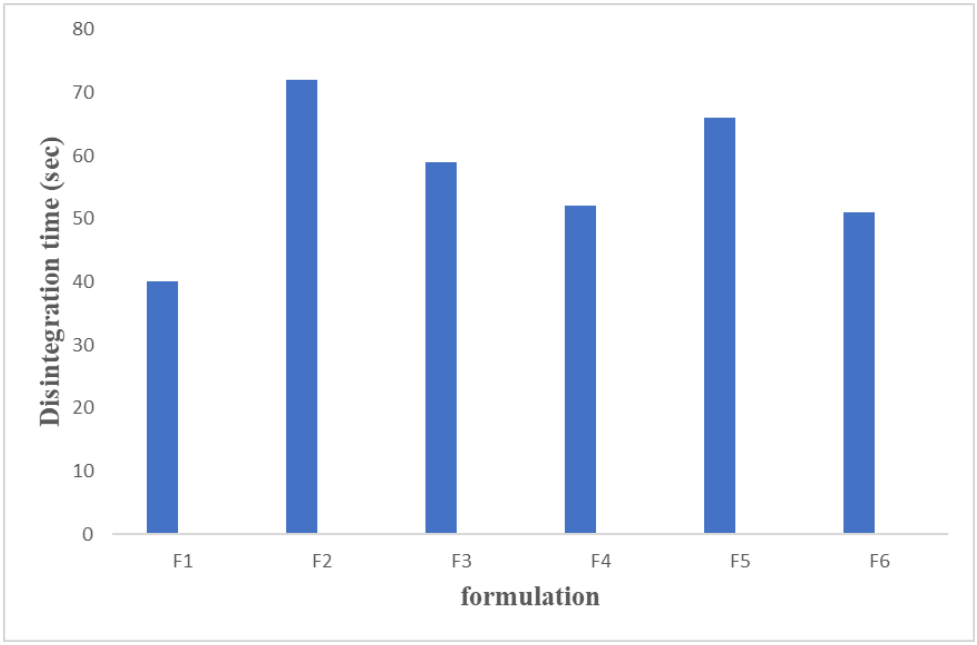

Figure 11: Disintegration time of Spirulina fast disintegrating films (F1-F6).

All films disintegrated rapidly. The disintegration time of F1-F6 was found to be in the range of 40-72 sec. Amongst the 6 formulations F1 took less time to disintegrate i.e.in 40sec. whereas F2 took more time to disintegrate compared to F1, F3, F4, F5 and F6.

***In-vitro* dissolution study of fast disintegrating films:**

In-vitro dissolution profile of all formulations were performed using Electrolab dissolution tester (USP) TDT-08L. *In-vitro* release profile of all formulations F1-F6 are given in table.no.17.

Table 17: *In-vitro* dissolution profile of Formulations F1-F6.

Time	Cumulative percentage drug release					
	F1	**F2**	**F3**	**F4**	**F5**	**F6**
0	0.000	0.000	0.000	0.000	0.000	0.000
5	37.385	17.691	15.115	36.126	17.061	20.267
10	60.744	41.851	42.481	76.374	60.172	29.771
15	74.126	60.821	54.635	94.735	94.141	42.503
20	79.933	66.728	76.452	96.558	95.391	74.154
25	85.174	72.528	91.994	98.955	97.157	88.549
30	91.566	83.085	96.104	99.465	97.197	93.800

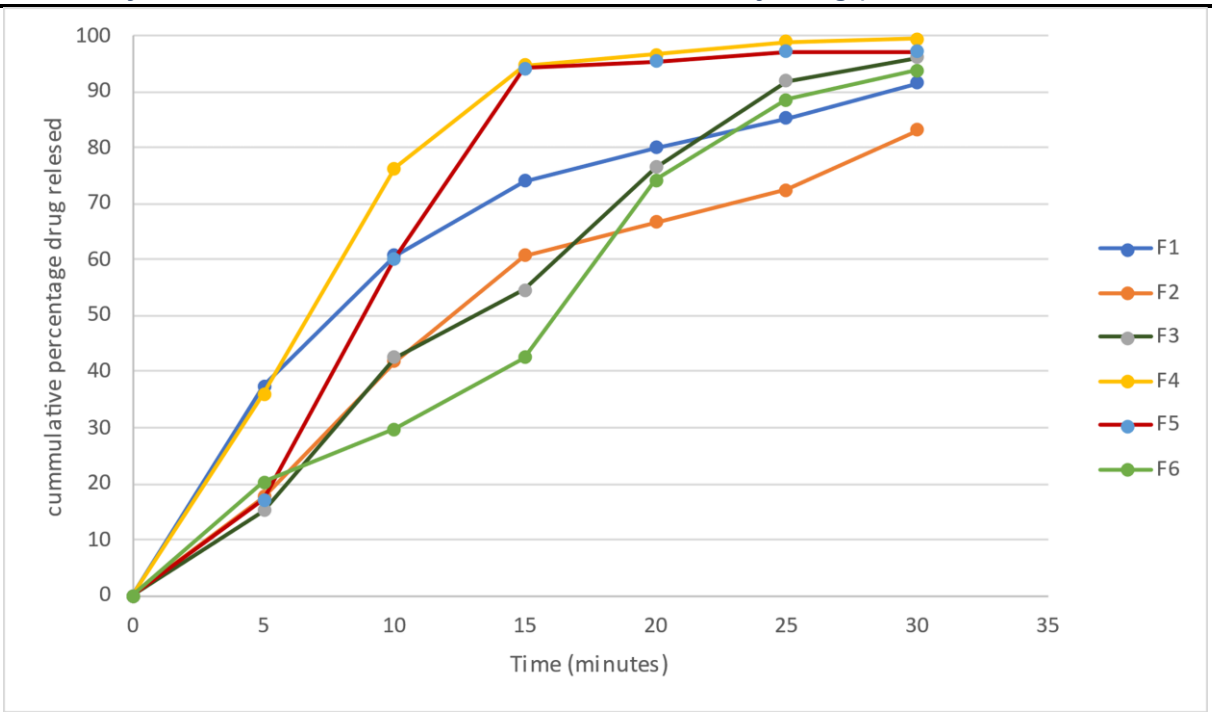

Figure 12: *In-vitro* Dissolution study of Spirulina fast disintegrating films(F1-F6).

- The *in-vitro* dissolution studies were carried in phosphate buffer pH 6.8. All formulations except F2 showed more than 90 % of drug release from the film in 30min.
- Formulation F1, F2 and F3, were prepared using polymer PVA with 700, 800 and 900 mg respectively, F3 showed better drug release i.e., 91.99% drug release at the end of 25 minutes.
- Formulation F4, F5 and F6, were prepared using polymer HPMC E15 with 800, 900. 1000 mg respectively, F4 showed better drug release i.e., 94.735% drug release at the end of 15 minutes.
- Between formulations prepared using PVA (especially F3) and HPMC E15(especially F4), formulation prepared using HPMC E15 showed comparatively better drug release.

STABILITY STUDIES OF OPTIMIZED FORMULATION

Table 18: Stability study of all formulations(F1-F6)

Evaluation study	Formulations	0^{TH} Day	After 1 Month		After 3 Months	
			25 ± 2^0C and 60±5% RH	40 ± 2^0C and 75±5% RH	25 ± 2^0C and 60±5% RH	40 ± 2^0C and 75±5% RH
% Drug content	F1	93.375	93.210	93.054	93.010	92.106
	F2	77.125	77.001	76.756	76.725	76.665
	F3	72.000	71.943	71.827	71.810	71.768
	F4	93.750	93.073	92.970	92.957	92.811
	F5	73.750	73.146	72.911	72.900	72.876
	F6	107.50	106.984	106.879	106.855	106.678
%CDR	F1	91.566	91.233	90.982	90.877	90.786
	F2	83.085	82.816	82.767	82.766	82.663

	F3	96.104	96.012	95.922	95.870	95.700
	F4	99.465	98.867	98.612	98.564	98.453
	F5	97.197	96.978	96.867	96.773	96.675
	F6	93.800	93.592	93.227	93.207	93.106

The stability of FDFs were studied at 25±2ºC with 60±5% RH and 40±2ºC with 75±5% RH according to WHO and ICH guidelines. There was no significant change in the %drug content and %CDR after three months of storage from 0^{th} day.

CONCLUSION:

The present study was undertaken with an intention to develop Fast Disintegrating films of Spirulina as an antigingival drug and to provide a convenient means of administration to those patients suffering from difficulties in swallowing such as pediatric and geriatric patients. Solvent casting method was employed for the preparation of film. FDF (Fast disintegrating Film) were prepared with polymers like PVA (F1-F3), HPMC E15 (F4-F6). Six films were evaluated for weight variation, thickness, folding endurance, *in-vitro* dissolution study, disintegration test and showed satisfactory results.

All the formulated films were found to disintegrate within 72 seconds. F1, F2, F4, F6 shows comparatively good thickness, weight and F3, F5, F6 shows better folding endurance than the other formulations.

Among six formulations F4 can be selected as optimum formulation in comparison of other formulations (i.e., F1, F2, F3, F5, F6), which showed better Thickness (0.07mm±0.01), folding endurance (350), weight (70mg±17.320), disintegration time (52sec), % drug content (92.75%) and drug release rate (95%) at the end of 15 minutes. The polymer and super disintegrating agent ratio were found to influence the release of drug from formulations. As the amount of polymer increases weight, folding endurance and thickness of fast disintegrating films increases.

From the present investigation it can be concluded that fast disintegrating film formulation can be a potential novel drug dosage form for pediatric, geriatric, bedridden and non- cooperative patients.

CREDENTIALS:

We would like to take this opportunity to express our heartfelt thanks to everyone who stood by us, directly and indirectly, helped throughout the project work.

We would like to express our deep regard and gratitude to our guide, Mrs. Bhavya Assistant Professor, Department of Pharmaceutics, Karavali College of Pharmacy, Mangalore for her constant encouragement, useful suggestions, continuous support and timely advice during completion of the project. We are very much thankful for his tremendous support and help.

We take immense pleasure and express our deep sense of gratitude towards our respected Principal Dr. Ravikumar, , Principal and HOD of Pharmaceutics, Karavali College of pharmacy, Mangalore, for his constant encouragement, continuous support and valuable suggestions.

We take this opportunity to express our sincere gratitude towards Vision Group on Science and Technology, Department of Information Technology, Biotechnology and Science,Karnataka.

BIBLIOGRAPHY

1. Naga SJ. Fast Dissolving Oral Films. IJAPBC. 2013; 2(1): 108-112.
2. Shruti CP, Sarvesh DP, Amitha S, Samuel SM, Mohd A, Shabaraya AR. Review on Fast Dissolving Sublingual Films for Systemic Drug Delivery. Int J of pharm and chem sci. 2014; 3(2): 501-511.
3. Parul S, Anoop K, Pankaj S, Sharad V. Fast Disintegrating Oral Films: A Recent Trend of Drug Delivering. J. Drug Dev. & Res. 2012; 4(4): 80-94.
4. Mishra R, Amin A. Manufacturing techniques of orally dissolving films. Pharm. Technol. 2011; 35(1): 70-73.
5. Julie MJ, Hari R, Fithal KJ, Saritha AS. Fast Dissolving Oral Thin Films: An Effective Dosage Form for Quick Releases. Int. J. Pharm. Sci. Rev. Res.2016;38(1): 282-289.
6. Nehal MDS, Garima G, Pramod KS. A Short Review on "A Novel Approach in Oral Fast Dissolving Drug Delivery System and Their Patents". Advan. Biol. Res. 2011; 5(6): 291-303.
7. Teja D, Jasvanth E, Mounika B, Buchi N. Formulation and Evaluation of Chlorpheniramine Maleate Mouth Dissolving Films. Journal of Drug Delivery & Therapeutics. 2019; 9(1): 244-251.
8. Sura ZM, Hiba SS, Nora Z, Zeina DS. optimization and evaluation of chlorpheniramine maleate oral strip for Paediatric use. Asian J Pharm Clin Res. 2018; 11(12): 548-54.
9. Martin A, James S. Physical Pharmacy, 3rd edition, 272-273; Publisher: Henry Kimpton, London.
10. Manvalan R, Ramaswamy C, Physical Pharmaceutics, 2nd edition, 315-338; Publisher: Vignesh Publisher, Chennai.
11. Lalit J, Tapar KK, Game MD, Tushar B, Gokul G. Development and Validation of Spectrophotometric Method for Mesalamine in Pure and In Tablets. Research J.Pharm. and Tech,2011; 4(4): 589-591.
12. Kirtimaya M, Kiran KB, Muthu KM, Subrahmanyam BSS. New analytical method development and validation of chlorpheniramine maleate by using UV-Visible spectrophotometry. IAJPS, 2016; 3(7): 767-772.
13. Poornima S, Navneet V, Vijay S. Formulation and evaluation of mouth dissolving film of Chloam phenicol maleate. Ejbps. 2020; 7(10): 428-433.
14. Prudvi NK, Prasad G, Vijay BK. Oral Dissolving Films of Chlorpheniramine maleate. IJPSR. 2014; 5(5): 1859-73.
15. Usha TKR, Sunil KKR, Manogna K, Thyagaraju K. A detailed review on fast dissolving oral films. Indo American Journal of Pharm Res. 2018; 8(6): 1315-26.
16. Zainab EJ, Mais FM, Zainab AS. Formulation and evaluation of fast dissolving film of Lornoxicam. Asian J Pharm Clin Res. 2018; 11(9): 217-223.
17. Deepu S, Kuriachan MA, Sreekavya B. Formulation and Evaluation of Antihistaminic Activity of Proniosome Based Transdermal Patches. Int J of Res & Review. 2018; 5(10): 177-88.
18. Ayorinde JO, Effiong DE, and Odeniyi MA. Design and Evaluation of Oral Dissolving Films of Chlorpheniramine from Native and Modified Enterolobium cyclocarpum Gum. Afr. J. Biomed. Res. 2018; 21(2): 175-82.
19. Pamula RB, Mohan VM, Sudheer B, Basava RD, Ramu M, Vijaya RJ. Formulation development and characterization of chlorpheniramine maleate mouth dissolving films. Der Pharmacia Sinica, 2013; 4(5): 1-9.