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FORUMATION AND EVALUATION OF ORAL DISINTEGRATING TABLETS OF SELEGILINE

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Abstract:

Difficulty in swallowing is common among all age groups especially elderly and pediatrics. Oral disintegrating tablets may constitute and innovative dosage form that overcome the problem of swallowing and provide a quick onset of action. This study was aimed to formulate and evaluate an orally disintegrate tablet (ODT) containing Selegiline while using Superdisintegrants. Oral disintegrate tablets were prepared by direct compression by using Superdisintegrants Primojel, Ac-di-Sol and Polyplasdone XL10. The prepared tablets were evaluated for hardness, friability, thickness, drug content uniformity. According to the results of optimized batches the concentration of Superdisintegrant were given rapid disintegration in 21 seconds which showed 98.12 % drug release within 45 minutes. Primojel, gives a rapid disintegration and when used in formulation of ODT.

Key Words: *Selegiline, Primojel, Ac-di-Sol, Polyplasdone XL10 and Oral Disintegrating Tablets.*

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INTRODUCTION:

The oral route of administration is considered as the most widely accepted route because of its convenience of self-administration, compactness and easy manufacturing. But the most evident drawback of the commonly used oral dosage forms like tablets and capsules is difficulty in swallowing, leading to patients incompliance particularly in case of pediatric and geriatric patients, but it also applies to people who are ill in bed and to those active working patients who are busy or traveling, especially those who have no access to water [1]. Most of the pharmaceutical dosage forms are formulated for oral administration where, direct ingestion is intended. In such cases like those with conventional dosage forms, chewing imposes issue in pediatric and the geriatric patients form in. Further psychiatric patients, hospitalized or bedridden patients with chronic diseases finds difficult to swallow solid oral dosage. It is expected that Orally disintegrating tablets (ODTs) can address such critical issues. ODTs are solid dosage form that provides the rapid disintegration or dissolution of solid to present as solution or suspension form even when placed in the mouth under limited bio-fluid. These Orally disintegrating tablets have various synonyms such as or dispersible tablets, quick disintegrating tablets, and mouth dissolving tablets, fast disintegrating tablets, fast dissolving tablets, rapid dissolving tablets, porous tablets, and rapimelts. The excipients which are used in ODT technology are usually hydrophilic in nature that could be selected on the basis of drug's physicochemical properties, especially, hydrophillicity or hydrophobicity. If the drug is hydrophobic then dosage form is termed disintegrating tablets whereas, if the drug is hydrophilic then it is called fast dissolving tablets [2-3].

Ideal characteristics of odts:

ODTs should depict some ideal characteristics to distinguish them from traditional conventional dosage forms. Important desirable characteristics of these dosage forms include

1. It should dissolve or disintegrate in the mouth usually within fraction of seconds. There is no requirement of water for swallowing purpose.
2. It should provide pleasant feeling in the mouth.
3. It should be compatible with taste masking agents.
4. It should be portable without fragility concern.
5. ODTs leave negligible or no residue in the mouth after oral administration.
6. ODTs exhibit low sensitivity to altered environmental conditions such as humidity and temperature.
7. ODTs allow high drug loading.
8. Adaptable and amenable to conventional processing and packaging equipment at nominal expense.

ADVANTAGES OF ODTs:

1. ODT can be administer to the patients who cannot swallow tablets/cap., such as the elderly, stroke victims, bedridden patients, patients with esophageal problems & patients who refuse to swallow such as pediatric, geriatric & psychiatric patients and thus improves patient compliance. 2. It contain the certain studies which concluded increased bioavailability and proved rapid absorption of drugs through pregastric
3. Absorption of drugs from mouth, pharynx & esophagus as saliva passes down.
4. ODT is most convenient for disabled, bedridden patients, travelers and busy people, who do not always have access to water.
5. Good mouth feel property of ODT helps to change the perception of medication.
6. As bitter pill particularly in pediatric patients.
7. The risk of chocking or suffocation during oral administration of conventional formulations due to physical obstruction is avoided, thus providing improved safety.
8. ODT opened new business opportunity like product differentiation, product promotion, patent extension and life cycle management.
9. Suitable during traveling where water may not be available.
10. No specific packaging required can be packaged in push through blisters.
11. Allow high drug loading.
12. No chewing needed.
13. Provides rapid drug delivery from dosage forms.

DISADVANTAGES OF ODTs :

1. ODT is hygroscopic in nature so must be keep in dry place.
2. It is also shows the fragile, effervescence granules property.
3. ODT requires special packaging for properly stabilization & safety of stable product
4. The tablets usually have insufficient mechanical strength. Hence, careful handling is required. 5. The tablets may leave unpleasant taste and/or grittiness in mouth if not formulated properly [4,5]

SUITABILITY OF DRUGS FOR ODTs

For developing ODT of a specific drug several factors should be kept forth while selecting drug, excipients and formulation method. These are as follows:

1. Drugs to be used for sustained action are not suitable candidate for ODT.
2. Drugs having very disagreeable taste are not suitable like clopidogrel.

3. Patients suffering from Sjogren's syndrome and those with less saliva secretion and not suitable for FDT dosage form.
4. Drugs of very short half life and requiring frequent dosing are not appropriate candidate. Patients on anticholinergic therapy are not suitable for ODT.
5. Drugs showing altered pharmacokinetic behavior if formulated in such dosage form with respect to their conventional dosage form are not suitable, like selegiline, swallowing bulky conventional dosage forms.[6]

Requirements of fast dissolving tablets
Patient factors [7]

- ✓ Fast dissolving dosage forms are suitable for those patients are not able to swallow tablets and capsules like pediatric and geriatric patients.
- ✓ Patients who have difficulty in swallowing or chewing solid dosage forms.
- ✓ Patients in compliance due to fear of choking.
- ✓ Very old patients of depression who may not be able to swallow the solid dosage forms.
- ✓ An eight-year-old patient with allergies desires a more convenient dosage form than antihistamine syrup.
- ✓ A middle-aged patient undergoing radiation therapy for breast cancer may be too nauseous to swallow her H2-blocker.
- ✓ A schizophrenic patient who may try to hide a conventional tablet under his or her tongue to avoid their daily dose of an atypical antipsychotic.
- ✓ A patient with persistent nausea, who may be a journey, or has little or no access to water.

Effectiveness factor [8]:
Increased bioavailability and faster onset of action are a major claim of these formulations. Dispersion in saliva in oral cavity causes pregastric absorption from some formulate ions in those cases where drug dissolves quickly. Buccal, pharyngeal and gastric regions are all areas of absorption for many drugs. Any pre-gastric absorption avoids first-pass metabolism and can be a big advantage in drugs that undergo hepatic metabolism. Furthermore, safety profiles may be improved for drugs that produce significant amounts of toxic metabolites mediated by first-pass liver metabolism and gastric metabolism, and for drugs that have a substantial faction of absorption in the oral cavity and pre-gastric segments of GIT.

Excipients used for the preparation of FDT
FDT contain one superdisintegrant, a diluent, a lubricant. Contain optionally a swelling agent, a permeabilizing agent, sweeteners and flavouring agents.

Super disintegrants [9-11]:
As day's passes, demand for the faster disintegrating formulation is increased. For, that pharmacist needs to formulate disintegrants i.e. Super disintegrants which are effective at less concentration and have greater disintegrating efficiency. The superdisintegrant must quickly wick saliva into that tablet to generate the hydrostatic pressure and volume expansion necessary to provide rapid disintegration in the mouth.

Examples:
• Croscarmellose Sodium
• Crospovidone
• Cross-linked alginic acid
• Gellan gum
• Sodium starch glycolate
• Soy polysaccharide meant for diabetics.
• Xanthan gum

Bulking materials [12,13]:
Bulking materials are very important in the development of fast dissolving tablets. They contribute the functions of a diluent, filler and cost reducer. Bulking agents improve the texture of the tablets that consequently enhances the disintegration in the mouth, besides adding volume and reducing the concentration of the active in the formulation. The bulking agents for this formulation should be sugar-based such as mannitol, polydextrose, lactose derivatives such as directly compressible lactose (DCL) and starch hydrolysate for higher aqueous solubility and good sensory perception. Mannitol especially has high aqueous solubility and good sensory perception, as it provides a cooling effect due to its negative heat of solution. Bulking agents are added in the range of 10% to about 90% by weight of the final composition. Sugar based excipients are two types they classify on the basis of moulding and dissolution rate:
Type 1 saccharides: (lactose and mannitol) which exhibit low moldability but high dissolution rate.
Type 2 saccharides: (maltose and maltitol) which exhibit high moldability but low dissolution rate.

Emulsifying agents [13]:
Emulsifying agents are more significant for formulation of fast dissolving tablets they help in quick disintegration and drug release without the need for chewing, swallowing or drinking water. Also, emulsifying agents stabilize the immiscible blends and increase bioavailability. A variety of emulsifying agents for fast dissolving tablet

formulations include alkyl sulfates, propylene glycol esters, lecithin, sucrose esters and others. These can be added in the range of 0.05% to about 15% by weight of the final formulation.

Lubricants [8]:
Though not essential excipients, these can aid in making the tablets more palatable after they disintegrate in the mouth. Lubricants reduce grittiness and help in the drug transit process from the oral to the stomach.

Flavours (taste masking agents) and sweeteners [13]:
Flavours and taste masking agents are useful for the formulation they make the products more palatable and pleasing for patients. The incorporation of these ingredients assists in overcoming bitterness and undesirable tastes of some actives. Natural as well as synthetic flavours can be used to enhance the organoleptic characteristic of fast dissolving tablets. A wide range of sweeteners including sugar, dextrose and fructose, as well as non-nutritive sweeteners such as aspartame, sodium saccharin, sugar alcohols and sucralose are available. The addition of sweeteners imparts a pleasant taste as well as bulk to the formulation.

MATERIALS:

Selegiline Procured From Rakshit Drugs PVT LTD., India. Provided by SURA LABS, Dilsukhnagar, Hyderabad. Primojel S.D. Fine chemicals, Mumbai, India ,Ac-di-Sol S.D. Fine chemicals, Mumbai, India, Polyplasdone XL10 Rubicon Research Pvt. Ltd.,Mumbai, India ,Talc Nikita Chemicals, India, Mg.Stearate S.D. Fine Chem icals Ltd, Mumbai., Mannitol Rubicon Research Pvt. Ltd., Mumbai, India,Lactose Merck Specialities Pvt Ltd, Mumbai, India

METHODOLOGY:

Buffer preparation:

Preparation of 0.2 M Potassium dihydrogen orthophosphate solution: Accurately weighed 27.128 gm of monobasic potassium dihydrogen orthophosphate was dissolved in 1000 ml of distilled water and mixed.

Preparation of 0.2 M sodium hydroxide solution : Accurately weighed 8 gm of sodium hydroxide pellets were dissolved in 1000 mL of distilled water and mixed.

Preparation of pH 6.8 phosphate buffer : Accurately measured 250 mL of 0.2 M potassium dihydrogen orthophosphate and 112.5 mL of 0.2 M NaOH was taken into the 1000 mL volumetric flask. Volume was made up to 1000 mL with distilled water.

Analytical method development for Selegiline :

a) Determination of absorption maxima

A spectrum of the working standards was obtained by scanning from 200-400 nm against the reagent blank to fix absorption maxima. The λmax was found to be 270 nm. Hence all further investigations were carried out at the same wavelength.

b) Construction of standard graph

100 mg of Selegiline was dissolved in 100 mL of pH 6.8 phosphate buffer to give a concentration in 1mg/mL (1000µg/mL) 1 ml was taken and diluted to 100 ml with pH 6.8 phosphate buffer to give a concentration of 0.01 mg/ml (10µg/ml). From this stock solution aliquots of 1.0 ml, 2.0ml, 3.0 ml, 4.0 ml, 5 ml, were pipette out in 10 ml volumetric flask and volume was made up to the mark with pH 6.8 phosphate buffer to produce concentration of 10, 20, 30, 40 and 50µg/ml respectively. The absorbance of each concentration was measured at respective (λmax) i.e., 270 nm.

Formulation development:

Drug and different concentrations of super disintegrants (Croscarmellose Sodium, Crospovidone and Sodium starch glycolate) and required ingredients were accurately weighed and passed through a 40-mesh screen to get uniform size particles and mixed in a glass motor for 15 min.

- The obtained blend was lubricated with magnesium stearate and glidant (Talc) was added and mixing was continued for further 5 min.
- The resultant mixture was directly compressed into tablets by using punch of rotary tablet compression machine. Compression force was kept constant for all formulations.

Table 1 : Formulation table showing various compositions

INGREDIANTS	FORMULATIONS								
	F1	F2	F3	F4	F5	F6	F7	F8	F9
Selegiline	5	5	5	5	5	5	5	5	5
Primojel	15	30	45	-	-	-	-	-	-
Ac-di-Sol	-	-	-	15	30	45	-	-	-
Polyplasdone XL10	-	-	-	-	-	-	15	30	45
Talc	3	3	3	3	3	3	3	3	3
Mg.Stearate	4	4	4	4	4	4	4	4	4
Mannitol	10	10	10	10	10	10	10	10	10
Lactose	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S
Total weight	100	100	100	100	100	100	100	100	100

All the quantities were in mg

RESULTS AND DISCUSSION:

Preparation of calibration curve of Selegiline:

The regression coefficient was found to be 0.998 which indicates a linearity with an equation of y=0.011 x-0.008. Hence Beer-Lambert's law was obeyed.

Table 2: Calibration curve data of Selegiline in pH 6.8 phosphate buffer

Concentration	Absorbance
0	0
10	0.131
20	0.229
30	0.354
40	0.461
50	0.568

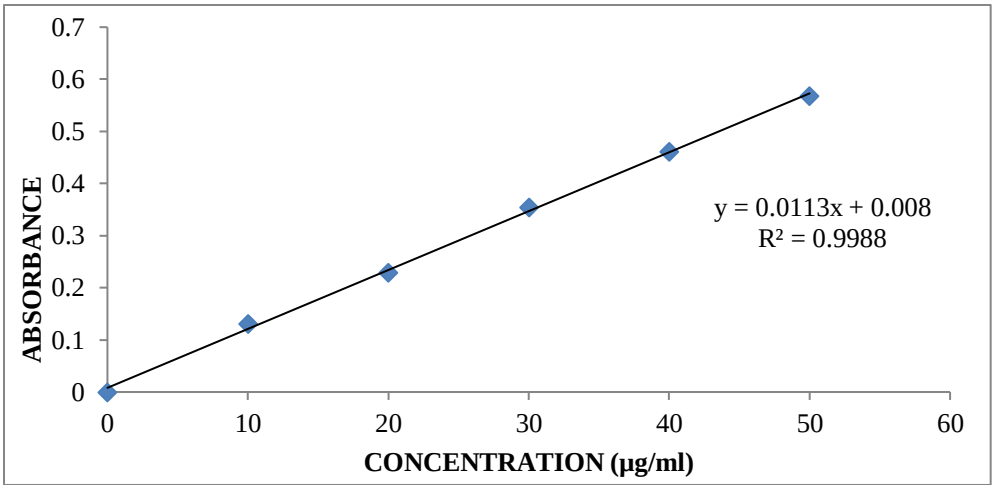

FIG 1 : Calibration curve data of Selegiline in pH 6.8 phosphate buffer

Table 3:Evaluation of pre-compression parameters of powder blend

Formulation code	Angle of repose	Bulk density(gm/mL)	Tapped density (gm/mL)	Carr's index(%)	Hausner's ratio
F1	26.20±0.32	0.465±0.026	0.523±0.034	11.08±0.44	1.12±0.05
F2	21.77±0.34	0.492±0.038	0.585±0.042	15.89±0.36	1.18±0.06
F3	20.81±0.41	0.437±0.015	0.534±0.034	18.16±0.57	1.22±0.04
F4	23.25±0.53	0.435±0.042	0.526±0.021	17.30±0.46	1.20±0.11
F5	21.46±0.34	0.423±0.010	0.515±0.025	17.86±0.49	1.21±0.07
F6	25.78±0.32	0.474±0.042	0.554±0.041	14.44±0.65	1.16±0.08
F7	24.86±0.44	0.456±0.019	0.543±0.037	16.02±0.64	1.19±0.14
F8	25.60±0.32	0.461±0.026	0.565±0.023	18.40±0.76	1.22±0.004
F9	22.45±0.38	0.459±0.017	0.545±0.027	15.77±0.47	1.18±0.02

All the values represent n=3

Quality control parameters for tablets:

Table4:Evaluation of post compression parameters of Selegiline Fast dissolving tablets

Formulation codes	Average weight(mg)	Hardness (kg/cm^2)	Friability (%loss)	Thickness (mm)	Drug content (%)	*In vitro* disintegration Time (sec)
F1	98.36	4.32	0.52	3.14	98.15	45
F2	97.25	4.96	0.33	3.65	96.52	36
F3	99.54	4.15	0.49	3.28	99.36	21
F4	98.25	4.87	0.86	3.49	98.47	62
F5	99.80	4.33	0.62	3.96	99.12	50
F6	95.82	4.61	0.41	3.47	97.86	34
F7	96.39	4.82	0.22	3.22	98.72	40
F8	98.72	4.95	0.48	3.41	96.25	35
F9	97.28	4.25	0.34	3.96	97.85	26

***In Vitro* Drug Release Studies**

Table5: *In vitro* Dissolution data of Selegiline

Time (mints)	F1	F2	F3	F4	F5	F6	F7	F8	F9
0	0	0	0	0	0	0	0	0	0
5	23.62	32.91	43.33	37.15	29.10	29.68	35.63	28.62	29.14
10	35.11	41.63	53.75	45.20	45.81	38.92	52.64	35.11	37.51
15	47.25	54.28	75.85	57.38	58.99	46.58	58.25	48.89	49.28
20	59.41	65.15	82.54	79.82	67.38	58.28	68.14	56.75	57.61
30	67.37	68.82	88.76	86.73	74.87	65.96	81.36	72.35	66.25
45	73.85	89.65	98.12	95.19	86.56	72.48	94.24	81.22	72.14

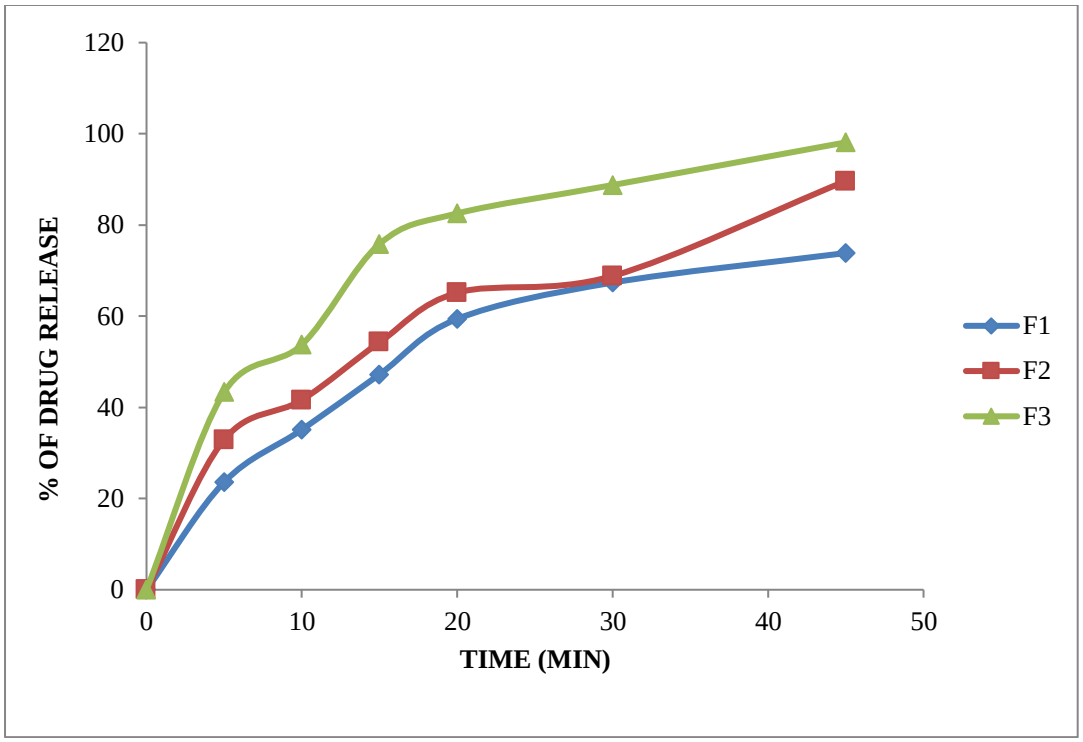

Fig 2: Dissolution profile of formulations F1, F2, F3

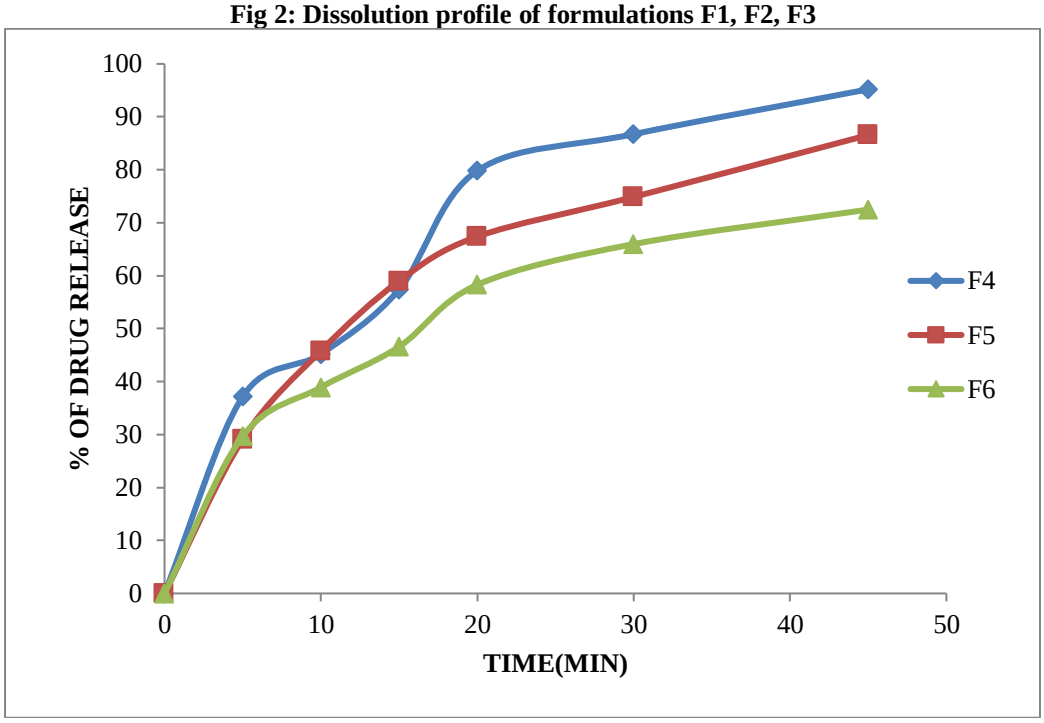

Fig 3: Dissolution profile of formulations F4, F5, F6

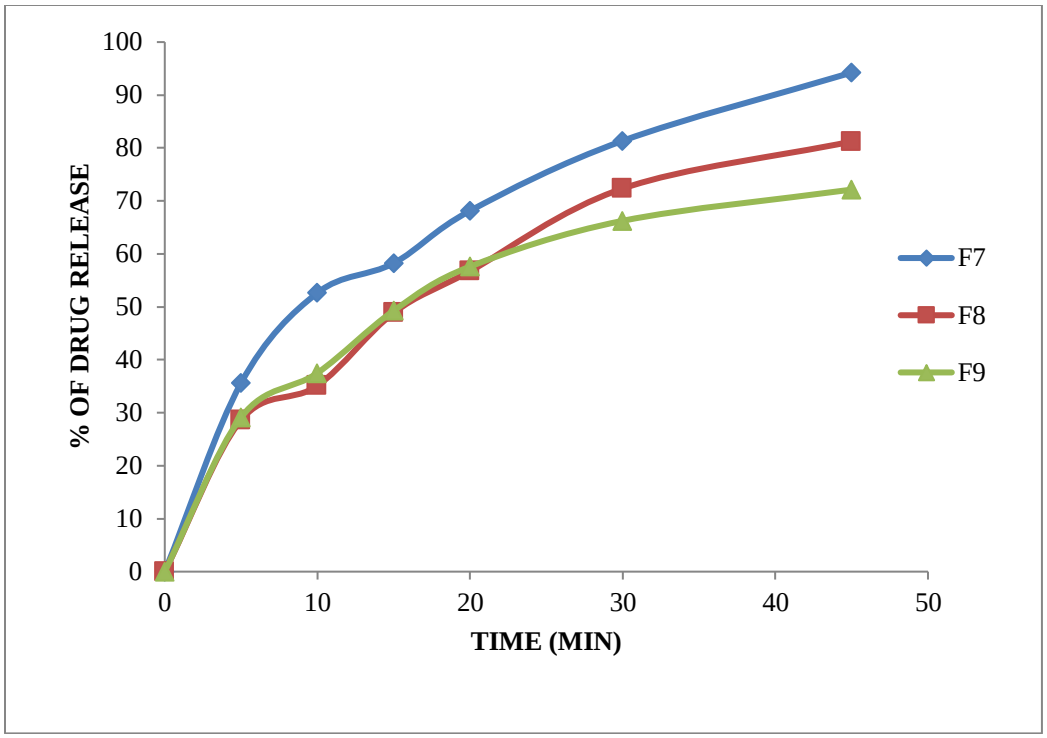

Fig 4: Dissolution profile of formulations F7, F8, F9

Drug – Excipient compatibility studies

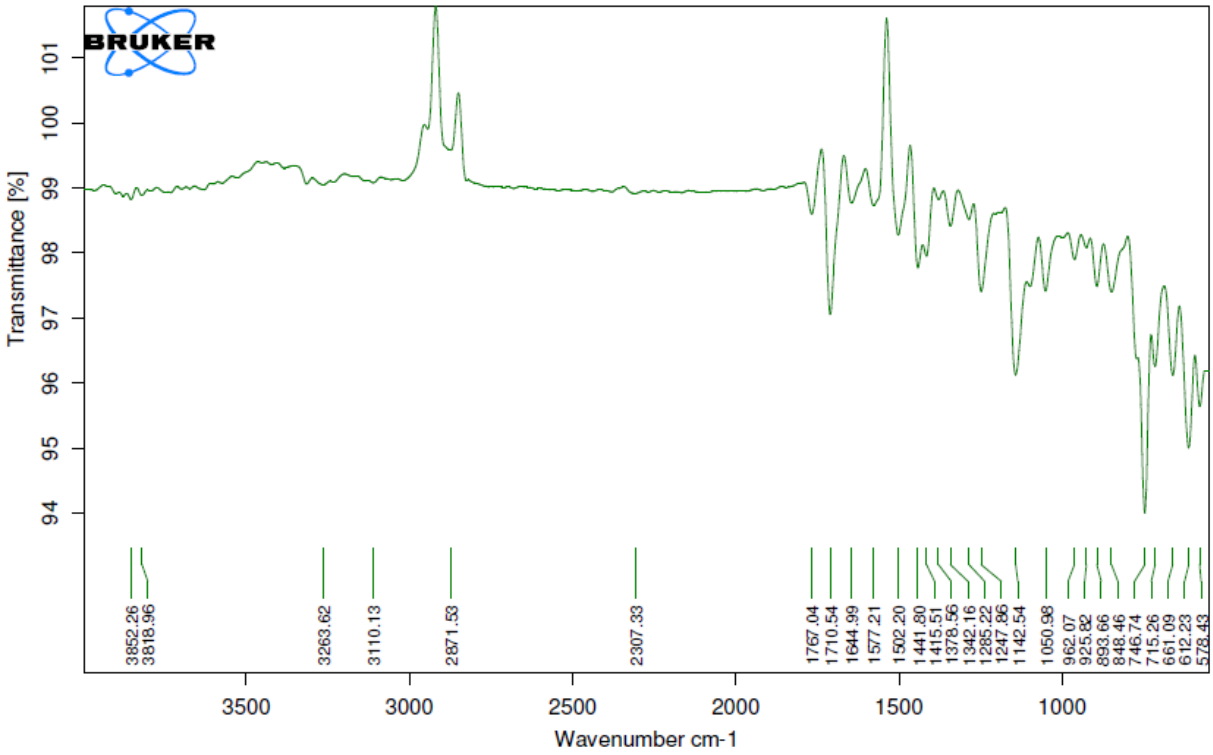

Fig 5 : FTIR of Selegiline Pure Drug

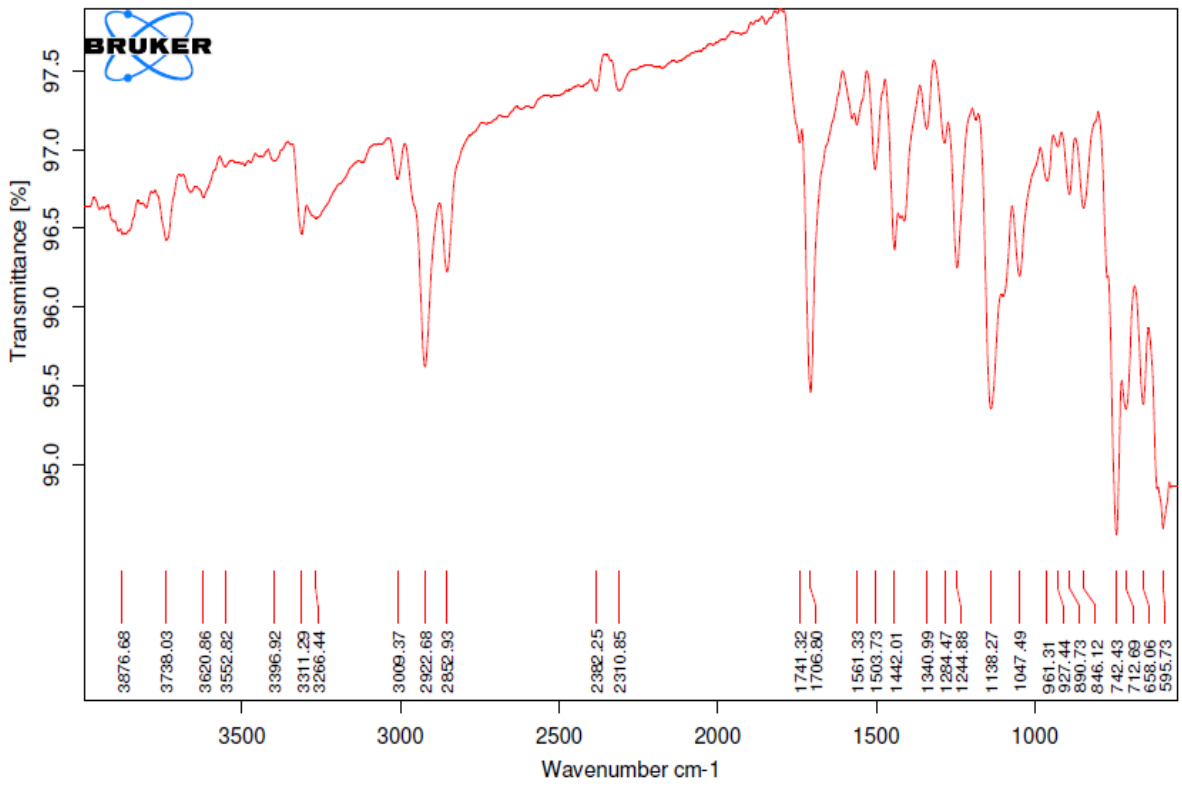

Fig 6: FTIR of Selegiline optimized formulation

CONCLUSION:

The Oral disintegrating tablets of Selegiline were formulated by using super disintegrants like Primojel, Ac-di-Sol and Polyplasdone XL10. FTIR study reveals that there is no drug-excipients interaction between Selegiline and excipients. The prepared tablets were shown good post compression parameters and they passed all the quality control evaluation parameters as per I.P limits. The use of super disintegrant Primojel at the concentration of 45 mg given better release of drug when compared to other superdisintegrants. The Optimized Formulation (F3) was showed Highest Drug Release (98.12%) in 45 minutes. The proposed ideal and reproducible characteristics of disintegration time and drug release profile.

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