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FORMULATION, EVALUATION AND OPTIMIZATION OF AMLODIPINE BESYLATE MELT IN MOUTH TABLETS PREPARED BY DIRECT COMPRESSION METHOD USING NATURAL AND SYNTHETIC SUPER DISINTEGRATING AGENTS.

S.JANAKIDEVI*

A.U. College of Pharmaceutical Sciences, Andhra University, Visakhapatnam-530003, Andhra Pradesh, India.

ABSTRACT

The objective of the present study was to formulate Melt in Mouth Tablets of amlodipine besylate by comparing natural (Modified Tragacanth Gum) and synthetic polymers (Crospovidone) as super disintegrating agents to achieve quick onset of action, to increase water uptake with in shorter wetting time and there by decrease the disintegration time of the tablets by simple and cost effective direct compression technique. Amlodipine Besylate is a Calcium channel blocker used in the treatment of hypertension and angina. Formulations FMT1-FMT5 are prepared with Modified Tragacanth Gum, FCP1-FCP5 are prepared with Crospovidone. Pre, post-compression parameters were evaluated, the results were within specifications. When compared all ten formulations, FMT5 and FCP5 shows better results. Therefore formulation FMT5 and FCP5 was selected as the optimized formulations as it showed good in-vitro disintegration time, in-vitro drug release, wetting property. When an increase in the concentration of super disintegrating agent (natural, synthetic) improves the drug release.

KEYWORDS:Melt in Mouth Tablet, Natural polymer, synthetic polymer, superdisintegrants, and Disintegration time.

S.JANAKIDEVI
A.U. College of Pharmaceutical Sciences, Andhra University, Visakhapatnam-530003, Andhra Pradesh, India.

INTRODUCTION

Difficulty in swallowing is the common problem of many patients such as elderly, pediatrics, mentally retarded, uncooperative, patients suffering from nausea, and vomiting[1]. Many elderly persons face difficulties in administering conventional oral dosage forms because of hand tremors and dysphasia[2]. Swallowing problem is common in children because of their under developed muscular and nervous systems[3]. These problems led to the development of a novel type of solid oral dosage form called Melt-in-mouth tablet which disintegrative/dissolve rapidly in saliva without the use of drinking water[4]. The Melt-in-mouth dosage form containing active ingredients disintegrates rapidly, usually in a matter of seconds, without the need of water, providing optimal convenience to the patient. Melt in mouth tablets is also called as Mouth dissolving tablets, Orodispersible tablets, fast dissolving tablets, rapi melts, porous tablets, quick dissolving tablets etc [5]. The objective of formulating Amlodipine besylate Melt in Mouth Tablets is faster disintegration and dissolution with increased bioavailability. Amlodipine Besylate is a Calcium channel blocker used in the treatment of hypertension and angina. In the present study formulation of Melt in Mouth Tablets of amlodipine besylate by comparing natural (Modified Tragacanth Gum) and synthetic polymers (Crospovidone) as super disintegrating agents to achieve quick onset of action, to increase the water uptake within shorter wetting time and thereby decrease the disintegration time of the tablets by simple and cost effective direct compression technique[6, 7]. Direct compression is the easiest method to manufacture mouth dissolving tablets MDTs. The great advantage of direct compression is its low manufacturing cost. It uses conventional equipment, commonly available excipients and a limited number of processing steps. In many cases the disintegrating agents used have a major role in the disintegration and dissolution process of fast disintegrating tablets made by direct compression method[8]. The choice of a suitable type and an optimal amount of disintegrating agent is important for ensuring a high disintegration rate. The addition of other formulation components such as water-soluble excipients or effervescent agents can further enhance dissolution or disintegration properties[9].Therefore, in the present study an attempt will be made to design Melt in mouth tablets Amlodipine Besylate of with a view to provide a convenient means of administration to those patients suffering from difficulties in swallowing such as pediatric and geriatric patients and uncooperative mentally ill patients[2,3]. This mouth disintegrating tablet of Amlodipine Besylate will disintegrate rapidly in the patient mouth without the need of water or chewing and released its drug contents instaneously[1], so this dosage form is more comfortable for pediatric, geriatric patients.

MATERIALS AND METHODS

Materials

Amlodipine Besylate Gift Sample from Bright Labs, [Hyd, India], Modified Tragacanth gum, Talc, mannitol purchased from Loba Chem., [Mumbai, India], Crospovidone Ozone international , [Mumbai, India], Microcrystalline cellulose, Magnesium stearate purchased from [Sd Fine Chem. Limited, Mumbai] .

Preparation of modified tragacanth gum[10]

5gms of Tragacanth, 0.05gms tween80 and 1ml solution of hydrogen peroxide (30% w/v) were taken in 100ml of purified water and boiled for 15min. The mixture was allowed to cool and settle. The clear supernatant fluid was decanted and the sediment was washed repeatedly with water. Finally the sediment was collected by centrifuging at 2500RPM and dried at 80^0C for 4hrs. The dried product was ground to fine powder and passed through sieve no.200.

Methods

1. Drug and polymer compatibility studies

Drug Excipient Compatibility Study is done by Fourier transform infrared (FT-IR) spectroscopy. FTIR spectra were obtained by using an FTIR spectrometer – 410 (Jasco-Japan). The samples were previously ground

and mixed thoroughly with KBr, an infrared transparent matrix, at 1:100 (sample/KBr) ratio respectively. The KBr discs were prepared by compressing the powders at a pressure of 5tons for 5mins in a hydraulic press (40 scans were obtained at a resolution 4cm^{-1} from 4600-300cm^{-1}). The sample of amlodipine besylate procured for study was identified by Infrared spectrum. All the samples were scanned at the resolution of 4 cm^{-1} over the wave number region 4000-400 cm-1 using the KBr disk method. This KBr disks are formed by taking Drug and KBr in a ratio of 1:100 respectively. Then this mixture was mixed well with mortar for three to five min. A very small amount of this mixture was uniformly spread and sandwich between the pellets and pressed using the KBr pellet press at a pressure of 20,000 psi for 1 min. The pressure was then released and the pellet was placed into the pellet holder and thus scanned in the IR region.

2. Pre - compression evaluation

i.Bulk density and Tapped density[11]

Bulk density is the ratio of the total mass of powder to the bulk volume of powder. It was measured by pouring the weighed powder (passed through a standard sieve # 20) into a measuring cylinder and the initial volume (bulk volume) was noted. From this, the bulk density is calculated. Tapped density is the ratio of the total mass of powder to the tapped volume of powder. It was measured by pouring the weighed powder into a measuring cylinder and then it was subjected to 500 tappings from a height of 2 inches. The volume was measured, tapped density is calculated. Three determinations were done for each formula.

ii.Hausners Ratio and Compressibility index or Carr's index (%)[11]

Hausner's ratio is the ratio of tapped density to bulk density. It was measured by pouring the weighed powder into a measuring cylinder and the initial volume was noted and then it was subjected to 500 tappings from a height of 2 inches. Hauser's ratio was calculated by noted tapped density and poured density values. Carr's index was calculated as 100 times the ratio of the difference between tapped density and bulk density to the tapped density. It was measured by calculated tapped density and poured density values. Three determinations were carried out in triplicate.

Iii Angle of repose (ɵ)[12]

It is defined as the maximum angle possible between the surface of a pile of powder and the horizontal plane; it was measured by pouring the weighed powder mixture into the funnel which was fixed to stand at a definite height (h). The drug excipient blend was allowed to flow through the Funnel freely on to the surface and placed on a graph sheet. Then the height and diameter of the heap formed were noted down, the angle of repose was calculated. Three determinations were performed.

3. Preparation of Melt in mouth tablets by direct compression method[13]

Melt in mouth tablets of Amlodipine besylate are prepared by direct compression as per the formula given in table1, 2.individual ingredients were passed through sieve no.60 separately. Required quantity of each ingredient was weighed accurately and mixed thoroughly for 5 min. The resulting mixture is compressed into tablet using 9 mm size flat round edge punch to get tablet using Multi Station rotary punch tablet compression machine.

Table 1
Formulation of Amlodipine besylate Melt in mouth tablets containing Modified Tragacanth gum prepared by direct compression method

Ingredient (mg)	FMT1	FMT2	FMT3	FMT4	FMT5
Amlodipine Besylate	10	10	10	10	10
Modified Tragacanth gum	2	4	6	8	10
Microcrystalline cellulose	100	100	100	100	100
Magnesium stearate	1.5	1.5	1.5	1.5	1.5
Talc	2	2	2	2	2
Mannitol	84.5	82.5	80.5	78.5	76.5

Table 2
Formulation of Amlodipine besylate Melt in mouth Tablets containing Cross povidone Prepared by direct compression method

Ingredient (mg)	FCP1	FCP2	FCP3	FCP4	FCP5
Amlodipine Besylate	10	10	10	10	10
Cross povidone	2	4	6	8	10
Microcrystalline cellulose	100	100	100	100	100
Magnesium stearate	1.5	1.5	1.5	1.5	1.5
Talc	2	2	2	2	2
Mannitol	84.5	82.5	80.5	78.5	76.5

4. Post compression evaluation for formulated Melt in mouth tablets:

i.Hardness[14]

Hardness or tablet crushing strength is the force required to break a tablet in a diametric compression. Hardness of the tablet was determined using the Monsanto hardness tester (Shreeji Chemicals).The hardness was computed by deducting the initial pressure from the final pressure. Three tablets were randomly picked up from each formulation and the mean and standard deviation values were calculated.

ii.Weight variation[14]

This test was carried out according to European pharmacopoeia. Twenty tablets were selected at random and average weight was determined. Then individual tablets were weighed and the individual weight was compared with an average weight.

iii.Thickness[14]

Three tablets were selected randomly from each batch and thickness was measured by using Vanier Calipers. The tablet was placed between two arms of Vanier Calipers and thickness was measured.

iv.Friability[14]

The Roche friability test apparatus (Roche Rich Pharma, Mumbai) was used to determine the friability of the tablets. This device chamber revolves at 25 rpm. About 10 tablets were selected randomly, dedusted and weighed. Then they were placed in a drum and rotated for 100 times. Then tablets were dedusted to remove loose dust and were reweighed. The percentage loss in weight was calculated and taken as a measure of friability.

v.Drug content uniformity[14]

Four tablets weighted and crushed in a mortar then weighed powder contain equivalent to 10 mg of drug was taken and dissolved in 100 ml methanol, from this 1 ml of solution was diluted to 10 ml methanol

again 1 ml solution from this diluted up to 10 ml with methanol and assayed for drug content at 237.5 nm.

vi.In-vitro Disintegration time[14]

Disintegration test was performed with six tablets; these are collected randomly and introduced each tablet into each tube. Suspended the assembly in the beaker containing a medium of 500ml of distilled water at temperature 37± 0.5^{0C}. Operated the disintegration apparatus (VanKel Industries, Chatham) and the time required for complete dispersion of a tablet was measured.

vii.Wetting time[15]

A small piece of tissue paper was folded twice and placed in a small petri dish (internal diameter 5 cm) containing 6 ml of water. A pre weighed tablet was put on the paper and the time required for complete wetting was measured, the wetted tablet was then weighed. The water uptake characteristic allows the evaluation of both the intrinsic swelling and the wettability of the super disintegrating agents' water uptake were performed at room temperature. Three tablets from each formulation were performed and standard deviation was also determined.

viii.Modified disintegration test[16]

In this test a mesh of size 10 screen was placed at the bottom of the cylinder which was helping to keep the tablet at a water level of 4 ml to which water from above was added at a rate of 2ml/min. the time taken for disintegration (complete dispersion of a tablet from the screen) is noted.

ix.In-vitro Release studies[14]

In vitro dissolution of melt in mouth tablets of Amlodipine besylate was studied in USP type-II dissolution apparatus (lab India) employing a paddle stirrer at 50 rpm. 900 ml of 7.4 pH phosphate buffer solution was used as dissolution medium. The temperature of dissolution medium was maintained at 37± 0.5^{0C} throughout the experiment. One tablet was used in each test. Samples of dissolution medium (5ml) were withdrawn by means of syringe fitted with pre-filter at known intervals of time and analyzed for drug release by measuring the absorbance at 237 nm. The volume withdrawn at each time interval was replaced with the fresh quantity of dissolution medium. The dissolution studies were carried out in triplicate. A cumulative percent drug released was calculated and plotted against time.

Dissolution test parameters for melt in the mouth tablets of Amlodipine besylate

Medium : 900 ml of 7.4 pH phosphate buffer solution
Rpm : 50
Time : 5, 10,15,20,25 min.
Apparatus : Paddle
λ_{max} : 237 nm
Temperature : 37^0 C ± 0.5^0 C

RESULTS AND DISCUSSION

1. Drug and polymer compatibility studies

Drug Excipient Compatibility Study is done by Fourier transform infrared (FT-IR) spectroscopy. FT-IR spectroscopy was used to ascertain the compatibility of Amlodipine Besylate with polymers. The individual drug and drug with polymers were separately scanned. The horizontal axis indicates the wave numbers (cm^{-1}) and the vertical axis indicates the transmittance (z). FT-IR spectrums for pure drug, pure drug with modified tragacanth gum, and the pure drug with crosspovidone were showed in figure no 1, 2, and 3.different characteristic peaks of respective spectrums were tabulated in table no 3, 4 and 5.

FT-IR Spectra data of Amlodine Besylate and polymers

Table 3
Different Peaks for Pure Amlodipine besylate

Functional Group	Characteristic Peak		Observed Peak	
	Stretching	Bending	Stretching	Bending
C-N	1350-1000 cm^{-1}		1187.72	
N-H	3500-3300 cm^{-1}	1500 cm^{-1}	3012.67	1491.02
C=C	1600 cm^{-1} and1475 cm^{-1}		1610.87 and1437.25	
Aromatic C-H	3150-3050cm^{-1}	900-690 cm^{-1}	2942.71	842.32

Table 4
Different Peaks For Amlodipine with Modified tragacanth gum

Functional Group	Characteristic Peak		Observed Peak	
	Stretching	Bending	Stretching	Bending
C-N	1350-1000 cm^{-1}		1178.83	
N-H	3500-3300 cm^{-1}	1500 cm^{-1}	3617.50	1491.02
C=C	160cm^{-1} and1475 cm^{-1}		1662.83 and1503.60	
Aromatic C-H	3150-3050cm^{-1}	900-690 cm^{-1}	3010.51	844.37

Table 5
Different peaks for Amlodipine with Crospovidone

Functional Group	Characteristic Peak		Observed Peak	
	Stretching	Bending	Stretching	Bending
C-N	1350-1000 cm^{-1}		1178.41	
N-H	3500-3300 cm^{-1}	1500 cm^{-1}	3616.62	1491.02
C=C	1600cm^{-1} and 1475 cm^{-1}		1663.18 and 1503.12	
Aromatic C-H	3150-3050cm^{-1}	900-690 cm^{-1}	3011.22	846.24

FTIR Spectrums

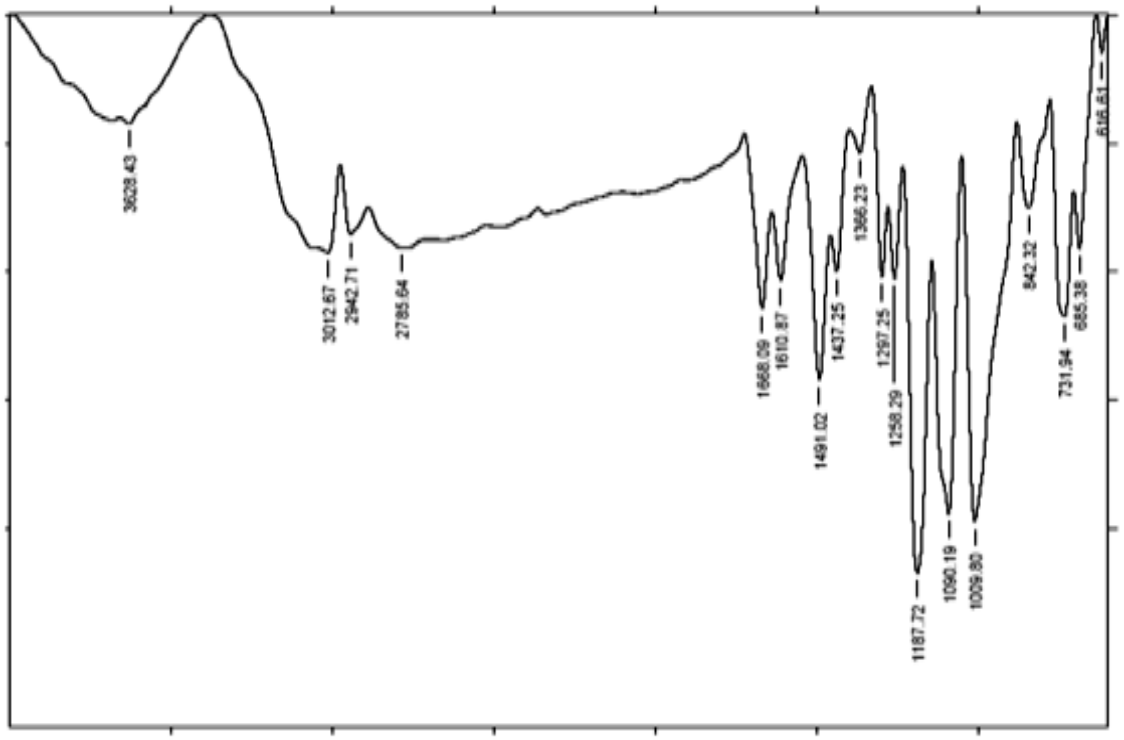

Figure 1
FTIR Spectrum of Amlodipine Besylate

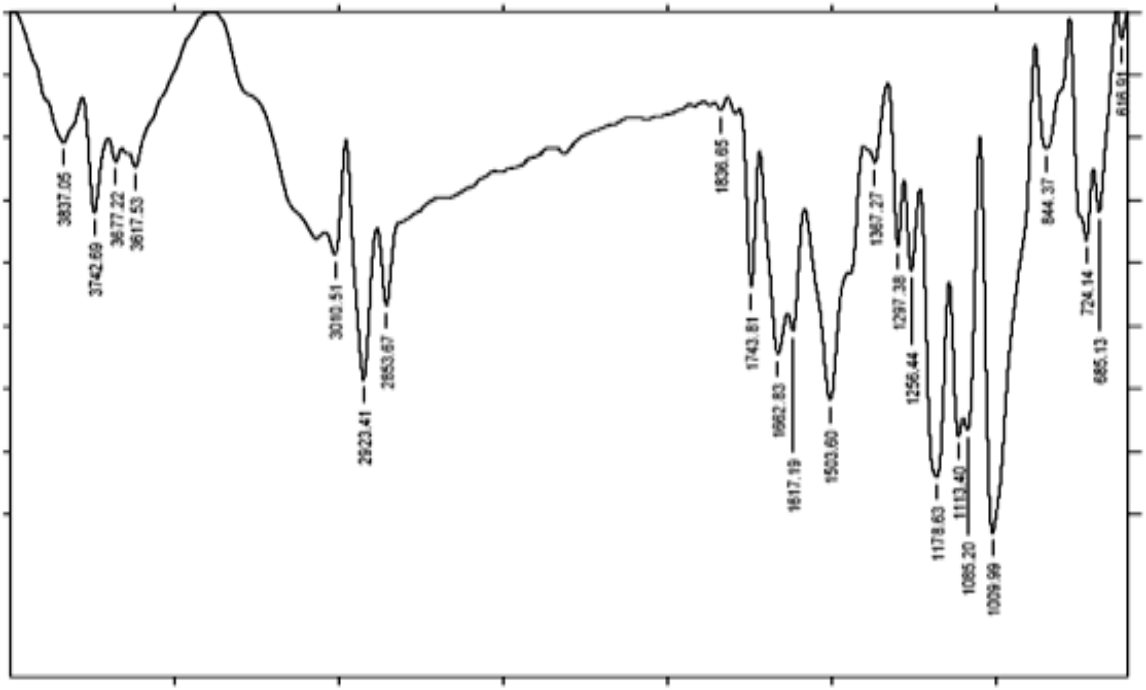

Figure 2
FTIR Spectrum of Amlodipine besylate with Modified Tragacanth Gum

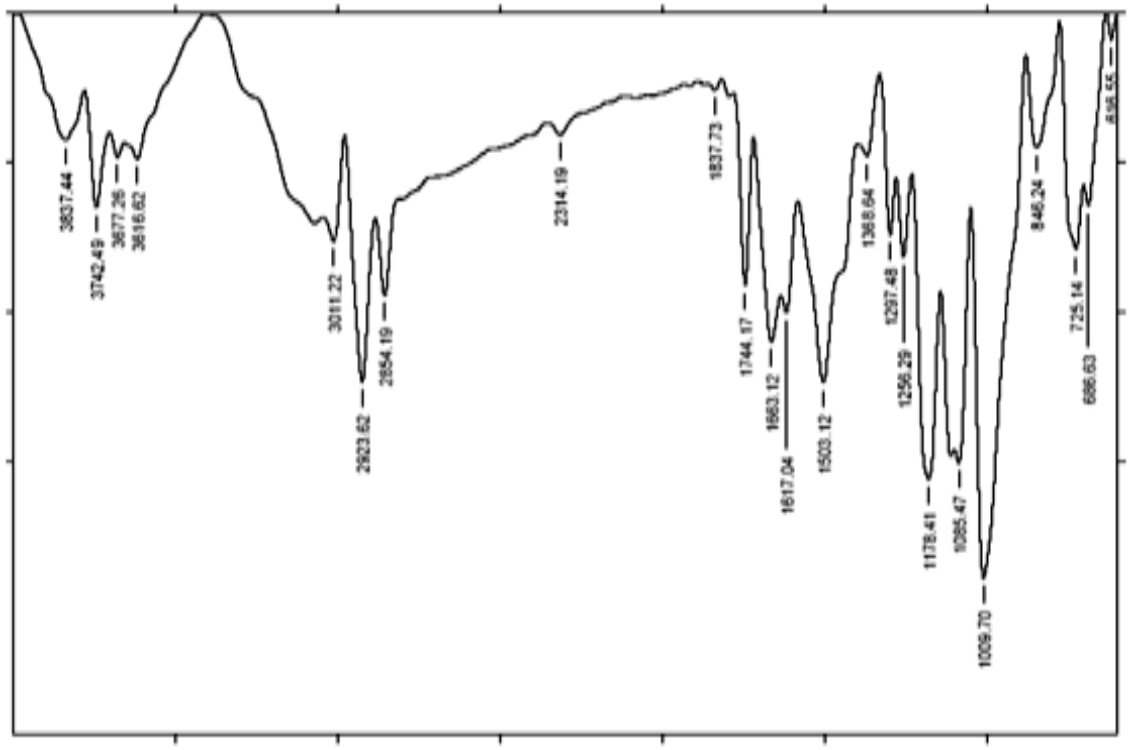

Figure 3
FTIR Spectrum of Amlodipine besylate with CrosPovidone

All the spectra were compared for confirmation of common peaks. Amlodipine besylate with polymers showed no significant variation in height, intensity and position of peaks, suggesting that drug and excipients were compatible. There is no interaction between drug and polymer. Hence, it can be concluded that the drug is in Free State and can release easily from the formulation.

2. Pre - compression evaluation:

i.*Bulk density and Tapped density*: The bulk densities of the powder blends of all the formulations ranged from 0.50 to 0.55 gm/cc. The Tapped densities of the powder blends of all the formulations ranged from 0.61 to 0.65 gm/cc. (Table 6, 7).

Table 6
Pre-compression parameters of powder blend Containing ModifiedTragacanth gum

Formulation code	Bulk Density* (g/cc)	Tap Density* (g/cc)	Angleof Repose* (º)	Carrs Index* (%)	Hausner ratio*
FMT1	0.52±0.007	0.63±0.01	28 º42′	17±1	1.21±0.03
FMT2	0.53±0.007	0.63±0.01	24 º65′	15±1.51	1.18±0.04
FMT3	0.53±0.007	0.64±0.01	27 º44′	17±1.20	1.20±0.03
FMT4	0.55±0.007	0.65±0.01	26 º41′	15±2.51	1.18±0.03
FMT5	0.50±0.007	0.63±0.01	24 º52′	20±1.58	1.26±003

Average of three determinations

ii. *Hausners Ratio and Compressibility index or Carr's index (%):* The Hausners ratio values ranged from 1.14 to 1.25. Evaluated values were Less than 1.25 Indicating Good flow. It means that the powder flow properties were within the pharmacopoeias limits. The Carr's index values ranged from 13±1 to 20±1 %. 12-16

Carr's index value indicates a good flow, 18-21 Carr's index value indicates fair. It means that the powder flow properties were within the pharmacopoeias limits (Table 6, 7).

iii.*Angle of repose (ɵ):* It is defined as the maximum angle possible between the surface of the pile of powder and the horizontal plane. Values ranged from 24 º30′ to 30 º01′ angle of repose (< 30) indicate good flow properties of granules, and it was observed to be within the pharmacopoeias limits (Table 6,7).

Table 7
Pre-compression parameters of powder blends containing Crospovidone

Formulation Code	Bulk Density* (g/cc)	Tap Density* (g/cc)	Angle of Repose* (º)	Carr's Index*	Hausner's Ratio*
FCP1	0.51±0.007	0.65±0.01	30 º61′	17±1	1.30±0.03
FCP2	0.52±0.007	0.62±0.01	28 º60′	16±1.51	1.19±0.04
FCP3	0.53±0.007	0.61±0.02	27 º10′	13±1.20	1.15±0.03
FCP4	0.53±0.007	0.64±0.01	26 º30′	17±2.51	1.14±0.03
FCP5	0.50±0.007	0.63±0.01	24 º30′	20±1.58	1.26±0.03

**** Average of three determinations***

3. Post compression evaluation for formulated ODT

i. Hardness

The hardness of all the formulations ranged from 2.7 to 3.3 kg/cm^2.The pharmacopoeias limit for hardness is 3-5 kg/cm^2. Hence all the formulations passed the test for hardness (Table-8, 9).

ii.Weight variation

The weights of the tablets were between 199 to 201 mg, as the weight of the tablet is 200mg, the weight variation limit is ± 7.5%.The pharmacopoeias specification for weight variation limit is ±7.5%, for uncoated tablets weighing more than 80mg but less than 250mg.Hence all the formulations passed the weight variation test (Table-8, 9).

Table 8
Post-compression parameters for Formulations containing Modified Tragacanth gum

Formulation code	Hardness* (Kg/cm²)	Friability (%)	Thickness*(mm)	Average Weight* (mg)
FMT1	2.9±0.22	0.29±0.12	2.92±0.55	199±0.65
FMT2	2.8±0.55	0.42±0.25	2.73±0.24	200±0.55
FMT3	2.8±0.51	0.51±0.58	2.83±0.32	201±0.58
FMT4	3.1±0.69	0.58±0.36	2.9±0.33	199±0.69
FMT5	2.8±0.25	0.52±0.64	2.96±0.85	199±0.28

* ***Average of three determinations***

Table 9
Post-compression parameters for Formulations containing Crospovidone

Formulation Code	Hardness*(Kg/cm²)	Friability (%)	Thickness*(mm)	Average Weight *
FCP1	2.7±0.32	0.69±0.02	2.83±0.55	199±0.65
FCP2	3.2±0.33	0.72±0.03	2.94±0.24	201±0.69
FCP3	3.3±0.65	0.77±0.09	2.98±0.63	199±0.44
FCP4	3.28±0.69	0.79±0.12	3.1±0.66	199±0.32
FCP5	3.3±0.58	0.83±0.09	3.3±0.98	201±0.54

** Average of three determinations*

i.Thickness

The thickness of all the formulations was between 2.7 to 3.3 mm which was, according to the pharmacopoeias specifications. Tablet mean thickness was almost uniformly in all the formulations (Table-8, 9).

ii.Friability

The friability of all the formulations was determined, and the values were in the range from 0.29 to 0.83 %.Friability below 1% were an indication of good mechanical resistance of the tablets. Hence all the formulations were within the pharmacopoeias limits (Table-8, 9).

iii. Drug content

The drug content uniformity was performed for all the 10 formulations and results are tabulated in Table-10, 11. Three trials from each batch were analyzed by using spectrophotometer. The average value and standard deviations of all the formulations were calculated.

iv.Wetting time

All the formulations were evaluated for wetting time and the values ranged from 18 and 55 seconds. Among the ten formulations, FMT5 and FCP5 were found to be better and showed a dispersion time of 18 and 21 seconds (Table-10, 11).

Modified disintegration test

The tablets were subjected to the evaluation of modified disintegration time and the results ranged from 1 to 3.9 min. Among these results formulations FMT5 and FCP5 were shows a lesser dispersion time of 1 and 2 min respectively (Table-10, 11).

Table 10
Post-compression parameters for Formulations containing Modified Tragacanth gum

Formulation Code	Modified disintegration time*(min)	Wetting time* (sec)	Drug Content* (%)
FMT1	3	45	99.61±0.45
FMT2	2.6	33	101.31±0.25
FMT3	2.1	29	99.54±0.55
FMT4	1.9	22	99.79±0.58
FMT5	1	18	99.82±0.54

** Average of three determinations*

Table 11
Post-compression parameters for Formulations containing Crospovidone

Formulation Code	Modified disintegration time* (min)	Wetting time* (sec)	Drug Content* (%)
FCP1	3.9	55	99.44±0.06
FCP2	3.2	42	99.31±0.41
FCP3	2.9	36	99.48±0.52
FCP4	2.3	28	100.11±0.44
FCP5	2	21	99.82±0.21

**** Average of three determination***

i.In-vitro Disintegration time

In this test the Time required for complete dispersion of a tablet was measured. The tablets were subjected to the evaluation of disintegration time and the results ranged from 32 to 120 seconds. Based on the in-vitro disintegration time, formulation FMT5 and FCP5 were found to be promising and showed a dispersion time of 38 and 32 seconds respectively. Disintegrating study showed that the disintegrating time decreased with a decrease in the concentration of Modified tragacanth and Crosspovidone in the tablets (Table-12).

Table 12
In-vitro disintegration time of Formulations

Formulation code	In-vitro Disintegration time (Sec)	Formulation code	In-vitro Disintegration time (Sec)
FMT1	120	FCP1	95
FMT2	110	FCP2	84
FMT3	75	FCP3	76
FMT4	55	FCP4	58
FMT5	38	FCP5	32

i.In-vitro Release studies

Tablets were Prepared with modified Tragacanth (FMT1-FMT-5), Crospovidone (FCP1 to FCP5), respectively. Hence, when compared to all ten formulations, FMT5 and FCP5 shows better results. It was observed that all the Melt in mouth tablets showed an in vitro release of 80-100% by the end of 15 min. The in-vitro dissolution profile indicated faster and maximum drug release from formulations FMT5 and FCP5.The in-vitro drug release profiles were plotted in Figures 4, 5 and tabulated in Table-13, 14.

Table 13
Release profile of amlodipine besylate tablets containing Modified Tragacanth gum

Time in Min	% Drug Release				
	FMT1	FMT2	FMT3	FMT4	FMT5
5	37.22	40.72	35.11	38..21	42.22
10	46.24	48.01	43.34	47.89	52.11
15	61.91	63.12	68.44	70.17	74.27
20	70.94	72.10	76.82	78.11	81.36
25	86.13	89.69	87.12	91.62	94.18
30	93.90	95.75	94.11	96.64	98.23

Table 14
Release profile of amlodipine besylate tablets containing Crospovidone

Time in Min	% Drug Release				
	FCP1	FCP2	FCP3	FCP4	FCP5
5	35.06	36.41	38.17	39.36	41.90
10	44.11	46.05	48.35	49.37	49.52
15	50.00	56.68	67.90	73.08	74.35
20	67.91	70.01	75.27	80.16	83.75
25	85.45	87.04	89.92	93.51	94.10
30	92.73	93.75	94.36	95.56	96.92

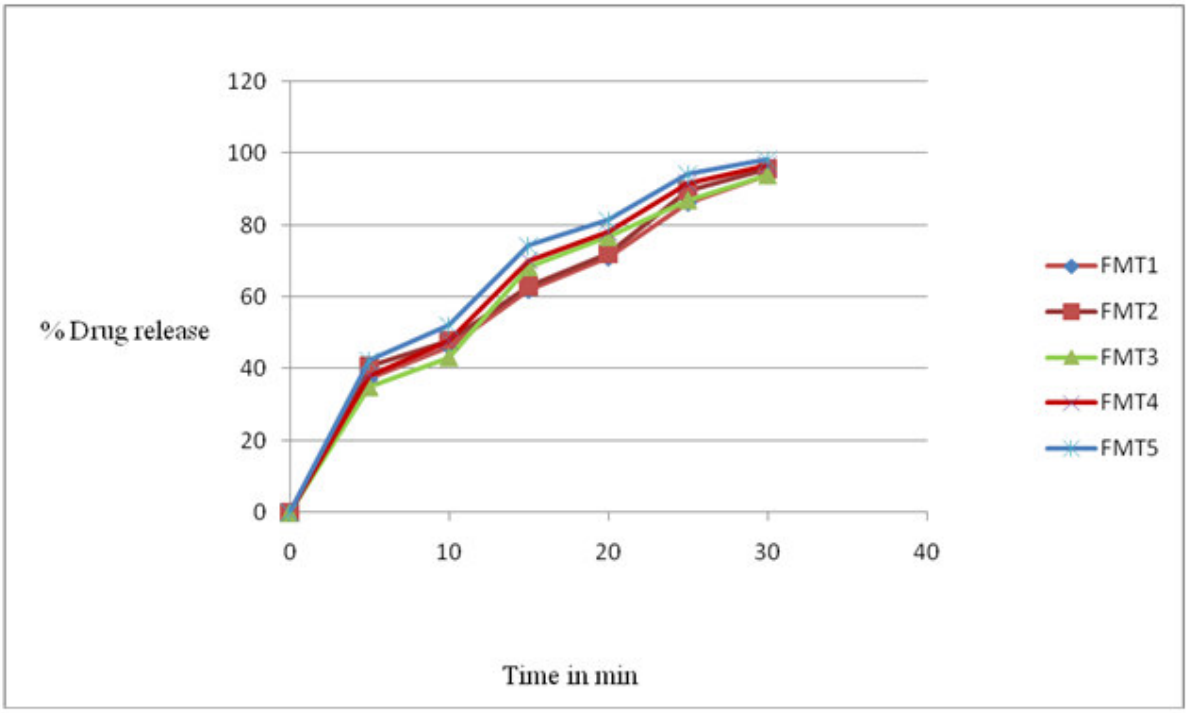

Figure 4
Release profile of amlodipine besylate tablets containing Modified Tragacanth gum

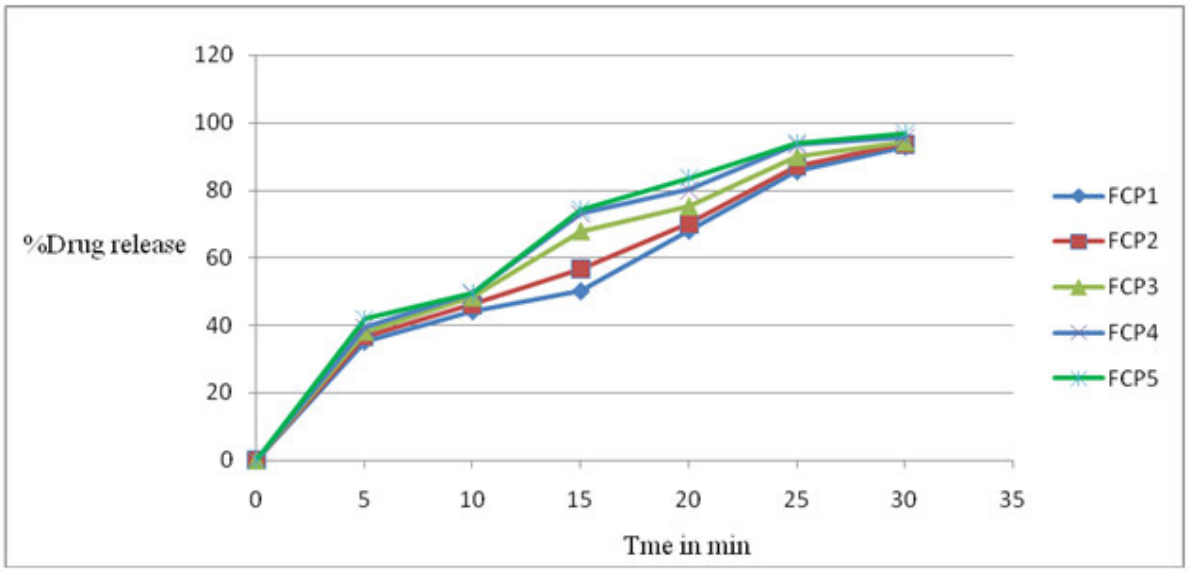

Figure 5
Release profile of amlodipine besylate tablets containing Crospovidone

As the concentration of the polymer increases, there was a decrease in the disintegration time and increase in dissolution of the drug. From drug release studies, it was observed that increase in concentration of the super disintegrating agent increases the drug release. Therefore formulation FMT5 and FCP5 was selected as the optimized formulation as it showed good in-vitro disintegration time, in-vitro drug release, wetting property, and pre compression and post compression results were within the specifications.

CONCLUSION

Melt in Mouth Tablets of amlodipine besylate prepared by direct compression, using natural (Modified Tragacanth Gum) and synthetic (crospovidone) polymers, for comparing its suitability as a super disintegrating agent. Formulations FMT1-FMT5 are prepared with Modified Tragacanth Gum, FCP1-FCP5 are prepared with Crospovidone. Tablets were evaluated for pre compression and post compression parameters,the results were within the specifications. When compared to all the ten formulations, FMT5 and FCP5 show better results. Therefore FMT5 and FCP5 were selected as the optimized formulations. When the concentration of the polymer increases either it is a natural or synthetic polymer there was a decrease in the disintegration time and increase in dissolution of the drug. From drug release studies, it was observed that increase in concentration of super disintegrating agent improves the drug release.

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