# Formulation And Evaluation Of Mouth Dissolving Tablet Of Nitrendipine

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**ABSTRACT**
Mouth dissolving tablets constitute an innovative dosage form that overcomes the problems of swallowing and provides a quick onset of action. In view of enhancing bioavailability an attempt has been made to study two different methods direct compression and sublimation in formulation of mouth dissolving tablets of clozapine. Total nine formulations using various superdisintegrants agents were prepared. All prepared formulations were evaluated for physico-chemical parameters. The formulations exhibited good disintegration properties with total disintegration time in the range of 25 to 35 s. In vitro cumulative percentage drug release for formulations prepared by direct compression with Doshion superdisintegrants shows 99.76% release in 15 min. Kinetic studies indicatedthat all the formulations followed first order release with diffusion mechanism.

**KEYWORDS:**Nitrendipine, Mouth dissolving tablet, direct compression, Antihypertensive, Doshion, SuperD33.

## INTRODUCTION

The oral route of administration is considered as the most widely accepted route. 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 [1]. Thus, a new delivery system known as oral fast dissolving/disintegrating (FDDS)/melt-in-mouth tablets gaining importance. These oral dosage forms dissolve rapidly in saliva and can be swallowed without the need of drinking water [2]. Elimination of bitterness is an important criterion in product formulation of mouth dissolving tablets [3].
Superdisintegrants added in the formulation increase the dissolution characteristics thus increasing the bioavailability of drug [4]. Mouth dissolving tablet disintegrate in mouth and are useful for potent drugs where fast absorption is required. Nitrendipine is given to hypertensive individuals in 20 mg oral tablets every day.[5] This amount is effective in reducing blood pressure by 15–20% within 1–2 hours of administration.[6] With long-term treatments, the dosage may rise to as much as 40 mg/day; in elderly individuals, a lower dosage of up to 5 mg/day may be equally effective (this reduction in drug amount is attributed to decreased liver function or "first pass" metabolism).[7] Once digested, nitrendipine is absorbed into the blood and binds to plasma proteins. The majority (98%) is bound to plasma proteins and 70-80% of its inactive polar metabolites are also bound to plasma proteins.[8] Following hepatic metabolism, 80% of the 20 mg dose can be recovered in the first 96 hours as inactive polar metabolites. The specific volume of distribution of the drug is 2-6 L/kg. In terms of drug half-life, nitrendipine has a half-life of 12–24 hours.[5] In the present study, an attempt has been made to develop mouth-dissolving tablets of nitrendipine by direct compression methods using suitable superdisintegrants agents.

## 2. MATERIALS AND METHODS

Nitrendipine was procured from Sun Pharmaceuticals Pvt. Ltd. Vadodara, India. Dosion was obtained from Gujarat Micro Wax Ltd. Indore, India. Sodium starch glycolate was obtained from Signet Chemical Corp. Mumbai. SuperD33 was obtained from Forum Bioscience, London. Talc and MCC were obtained from S. D. Fine Chemicals, Mumbai. All other ingredients were of analytical grade.

**Determination of Analytical Wavelength(λmax):**A standard stock solution of nitrendipine was prepared by dissolving accurately weighed 5 mg of nitrendipine in water in a 50 ml volumetric flask and the volume was made up to 50 ml with water to obtain a stock solution of 100 µg/ml. From the standard stock solution, 10 ml was pipetted into 100 ml volumetric flask. The volume was made up to 100 ml with water. The resulting solution containing 10 µg/ml was scanned between 200 and 400 nm.

**Drug and Drug-Excipients physical compatibility studies:**To study the physical compatibility of various formulation excipients with nitrendipine, solid admixtures were prepared by mixing the drug with excipients separately in the ratio

of 1:1 and were filled in 2 ml glass vials and sealed. And they were kept in stability chamber at room temperature and 30±20C/65±5%RH. The samples were withdrawn and analysed for colour change for every 10 days.

**3. PHYSICOCHEMICAL CHARACTERIZATION:**

**Density measurement:**Granules density may influence compressibility, tablet porosity, dissolution and other properties. Different types of density calculation were done to characterize the drug and its flow property. Generally two types of density are determined i.e., bulk density and tapped density. The methods followed for calculation of the above two densities are determined by the following ways.

**2.3.2 Bulk density:**It is a measure used to describe the packing of particles or granules. An accurately weighed quantity of powder, which was previously passed through sieve #40 [USP] and carefully poured bed, was made uniform without disturbing. Then volume measure was called as the bulk volume and the bulk density is calculated by following formula.

Bulk density= weight of powder / Bulk volume

**Tapped density:**After measuring the bulk volume the same measuring cylinder was set into tap density apparatus. The tap density apparatus was set to300 taps drop per minute and operated for 500 taps. Volume was noted as (Va) and again tapped for750 times and volume was noted as (Vb). If the difference between Va and Vb not greater than 2% then Vb is considered as final tapped volume. The tapped density is calculated by the following formula.

Tapped density= Weight of powder /Tapped volume

**Flow properties:**The flow properties from a material result from many forces. There are many types of forces hat can act between solid particles: frictional forces, surface tension forces, mechanical forces caused by interlocking of particles of irregular shapes, electrostatic forces and cohesive or vander vaals forces. These forces can effect granule properties such as particle size, particle size distribution, particle shape, surface texture or roughness, residual surface energy and surface area.

**Compressibility index:**Pharmaceutical powders are broadly classified into free flowing and cohesive. Powders are more often compressed into tablets using a pressure of 5kg/cm$^2$. This is called compression or compaction. During this process the porosity of the powder changes. The compression properties of most drugs are very poor. Therefore compression vehicles such as lactose, calcium phosphate and microcrystalline cellulose are included in tablet formulations. Normally low dose drugs (<50mg) are prepared by direct compression. Tablet materials should be plastic that is capable of undergoing permanent deformation yet exhibit brittleness. Percentage compressibility also known as Carr's consolidation index is indirectly related to the relative flow rate, cohesiveness and particle size. It is a simple, fast and popular method for predicting powder flow characteristics.

Carr's consolidation index = [(Tapped density-Fluff density)/tapped density]*100

Compressibility index can be a measure of the potential strength that a powder could build up in its arch in a hopper and also the ease with which such an arch should be broken.

**Angle of repose:**The angle of Repose is defined as the maximum angle possible between the surface of a pile of powder and the horizontal plane.

θ= Tan-1 (h/r)

Where'h' = height of the pile and 'r' = radius of the pile

Values of Θ are rarely less than 200, and values of up to 400 indicate reasonably flow potential. Above 500, however, the powder flows only with great difficulty. In general, the angle of repose increased with decreasing particle size. The addition of talk in low concentration decreases the repose angle, but in higher concentration it increases the angle.

**Hausner's ratio:**It is the ratio of bulk volume or tapped density to bulk density. Hausner's ratio is an important character to determine the flow property of powder and granules. This can be calculated by the formula

Hausner 's ratio=Tapped density/Bulk density

**Particle size distribution:** Particle size distribution is a very important in process technique of final blend after blending. It is an important parameter to determine the amount of fines as well as particle with larger particle size in final blend. It also helps in keeping a check over uniformity of distribution of blend over various sizes while carrying out consecutive batches. Particle size determination was carried by arranging various sieves of sizes #20, #40, #60, #80, #100, #140, #200 and Pan (for finer particles which passes even #200 sieve) in ascending order (i.e.,#20 sieve lies on top and pan at the bottom). Then the final blend of accurately weighed quantity was placed on the top sieve. And the sieves are placed in vibrosifter and allowed to run at1.0 amplitude for 10 minutes.After the procedure difference of initial and final weight of sieves were noted to calculate the percentage retention of the blend in various sieves.

**4 FORMULATION DEVELOPMENT**

Mouth dissolving tablets of Nitrendipine were prepared by direct compression method according to the formula given in table no 2.3. All the ingredients were passed through 60 mesh sieves separately. The drug and microcrystalline cellulose were mixed by small portion of both each time and blending it to get a uniform mixture kept aside. Then the ingredients were weighed and mixed in geometrical order and tablets were compressed of 8mm sizes flat round punch to get tablet using Rimek Compression Machine.

**Table 1: Composition of unit dose of various Formulations Characteristics of final blend**

| **Mat.** | **NF1 (mg)** | **NF2 (mg)** | **NF3 (mg)** | **NF4 (mg)** | **NF5 (mg)** | **NF6 (mg)** | **NF7 (mg)** | **NF8 (mg)** | **NF9 (mg)** |
|---|---|---|---|---|---|---|---|---|---|
| Drug | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| DS | 5 | 7.5 | 10 | - | - | - | - | - | - |
| SSG | - | - | - | 5 | 7.5 | 10 | - | - | - |
| SD33 | - | - | - | - | - | - | 5 | 7.5 | 10 |
| AS | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| Talc | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| MCC | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| Mg. stearate | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| D-Mannitol | 49.5 | 47 | 42 | 49.5 | 47 | 42 | 49.5 | 47 | 42 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

DS= Doshion; SSG – Sodium Starch Glycolate; SD33= Super D33; AS-Aspartame
*Average of three determination

**5. EVALUATION PARAMETERS**

**Physical appearance:** The physical appearance of a tablet, its visual identity and over all "elegance" is essential for consumer acceptance. Included in this category are tablet sizes, shape, colour, presence or absence of any odour, taste, surface texture, physical flaws and consistency and legibility of any identification marking.

**Weight variation:**Twenty tablets were selected randomly from the lot and weighed individually to check for weight variation. Each tablet weight was then compared with average weight variation. Each tablet weight was then compared with average weight to ascertain the weight of the tablets within the permissible limits. Not more than two of the individual weights should deviate from the permissible limits. Not more than two of the individual weights should deviate from the average weight by more than 5% for >300mg tablets and none by more than double that percentage.
Percentage deviation= [(Tablet weight- Average weight)/tablet weight] ×100

**Loss on drying:** Loss on drying is an important parameter to determine the moisture intake by blend during processing. Limit on loss on drying is established from the sum of percentage moisture intake values of each excipient used in the process. Percentage moisture in take was determined during in process by using Ohaus Moisture Analyser. In which 1gm of blend was placed after tarring the instrument at 105°C in auto mode.

**Friability:** Friability test is performed to assess the effect of friction and shocks, which may often cause the tablet to chip, cap or break. Roche friabilator was used for the purpose. This device subjects number of tablets to the combined effect of abrasion and shock by utilizing a plastic chamber that revolves at 25 rpm dropping the tablets at a distance of 6 inches with each revolution. Pre-weighed sample of tablets were dusted and reweighed. Compressed tablets should not lose more than 1% of their weight.
Percentage friability = $[(w_2-w_1)/w1]\times100$
Where, W1 = Weight of tablets before test; W2= Weight of tablets after test

**Thickness:** The thickness was measured by using vernier calliper and values were tabulated. Ten tablets of each batch were measured. Average and standard deviation was calculated.

**Hardness:** The hardness of tablet is an indication of its strength. Measuring the force required to break the tablet across tests it. The force is measured in kg and the hardness of about 3-5 kg/cm$^2$ is considered to be satisfactory for uncoated tablets. Hardness of 10 tablets from each formulation is determined by Erweka hardness tester.

**Disintegration test:** Breaking of tablets into smaller particles or granules is known as disintegration and time taken for breaking of tablets in a suitable medium is called disintegration time (DT). This test is not applicable to modified-release tablets and tablets for use in the mouth. For those tablets for which the dissolution test is included in the individual monograph, the test for disintegration is not required. It is determined by USP apparatus (Electro lab Disintegration Tester). It consists of 6 glass tube each 3 inches long, open at top and has 10 mesh screens at the bottom

end of basket rack. One tablet is placed in each tube and placed in a one litre beaker of water, simulated gastric fluid or simulated intestinal fluid at 37 ± 2oC. It moves up and down through a distances of 5 to 6 cm at 28 to 32 cpm.
**Content uniformity:** Uniformity of contend is a pharmaceutical analysis parameter for the quality control of tablets or capsules. Multiple capsules or tablets are selected at random and a suitable analytical method is applied to assay the individual content of the active ingredient in each tablet or capsule.

**Stability Studies:** The optimized formulation of MDTs is subjected to stability study as per ICH guidelines to assess their stability with respect to their physical appearance and release characteristics.

**Table 2: Dissolution parameters**

| | |
|---|---|
| **Apparatus** | USP Apparatus 2 (paddle) |
| **RPM** | 50 RPM |
| **Dissolution medium** | pH 6.8 Phosphate buffer, 500 mL |
| **Time** | 10, 20 and 30 minutes |
| **Sample collection volume** | 10 mL |
| **Temperature** | 37.0±0.5°C |

**Drug release kinetics:**Various models were tested for explaining the kinetics of drug release. To investigate the mechanism of drug release rate kinetics from the dosage form, the obtained data were fitted with zero-order, first-order, Higuchi and Korsmeyer – Peppas release model.

**3. RESULTS AND DISCUSSION**
**Determination of analytical wavelength (λmax) of nitrendipine:**By using UV-Spectrophotometer nitrendipine drug solution in water was scanned between the range of 200-400 nm using water as the blank and a sharp peak was observed at nm which reports that the analytical wavelength is 235 nm. The value found was lies in the range 235 specified in official monograph and it has shown in Fig 1.

**Calibration Curve Of nitrendipine:**The absorbances of solution of nitrendipine in 0.1N HCl and in pH 6.8 buffer solution at 315 nm have been taken and it was found that the solutions show linearity in absorbance at a concentration of 0-10 μg/ml and obey beer-lamberts law. The values are illustrated in Fig 2 and 3.

**Physical compatibility studies of drug and excipients:** Physical compatibility study of drug and excipients is necessary for the stable and effective solid dosage form which is performed on visual basis. The study reveals that the drug, polymer and other excipients were physically compatible with one another as there was no change in physical description.

**Chemical compatibility studies by FTIR:** The IR spectral analysis of the nitrendipine, polymer and other excipients was carried out by using KBr pellet method and the spectra were shown from Fig 4 to Fig 6. All the characteristic peaks appear for the pure nitrendipine and its physical mixture indicating no interaction between nitrendipine and excipients.

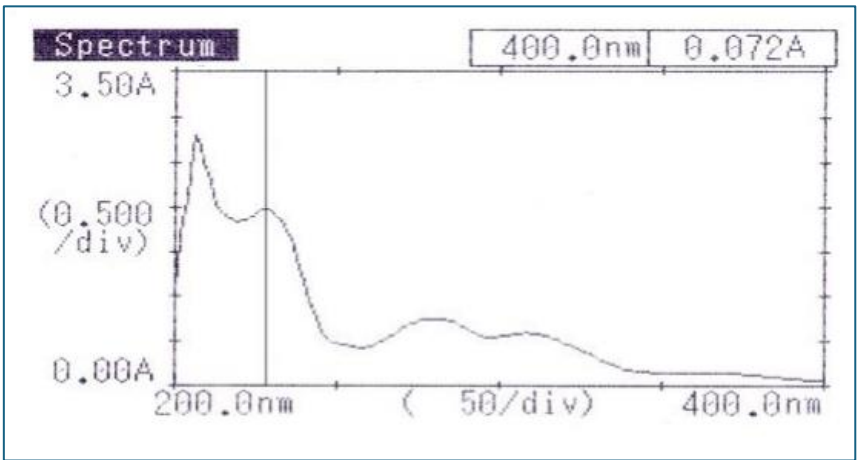


**Figure 1: UV Spectra**

**Table: 3: Concentration of Nitrendipine in 0.1N HCl and phosphate buffer pH 6.8**

| Sr. No. | Con. In µg/ml | Abs. at 0.1N HCl | Absorbance at Phosphate buffer pH 6.8 |
|---|---|---|---|
| 1 | 2 | 0.261 | 0.161 |
| 2 | 4 | 0.470 | 0.320 |
| 3 | 6 | 0.672 | 0.587 |
| 4 | 8 | 0.794 | 0.794 |
| 5 | 10 | 1.035 | 0.956 |
| 6 | 12 | 1.271 | 1.016 |
| 7 | 14 | 1.501 | 1.112 |
| 8 | 16 | 1.766 | 1.456 |
| 9 | 18 | 1.928 | 1.674 |
| 10 | 20 | 2.117 | 1.876 |

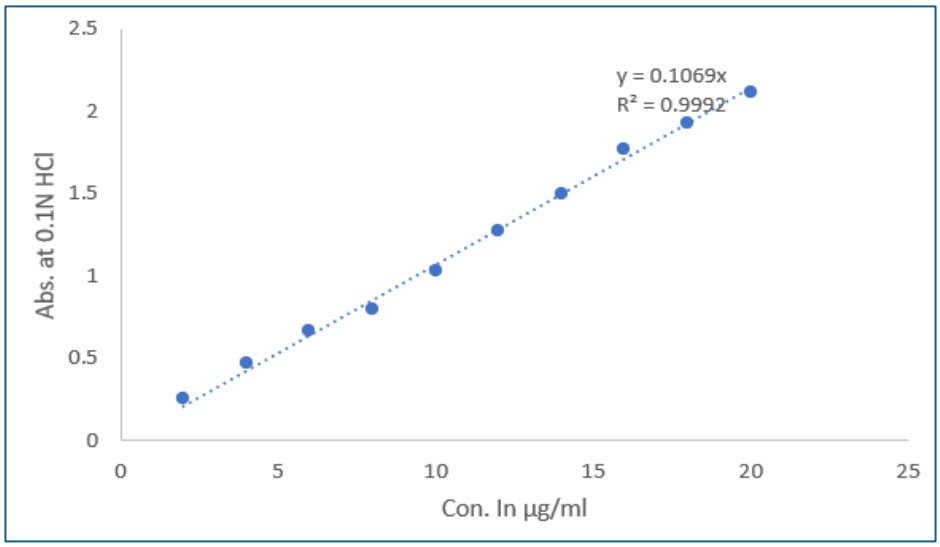


**Fig.2: Curve in 0.1 N HCl**

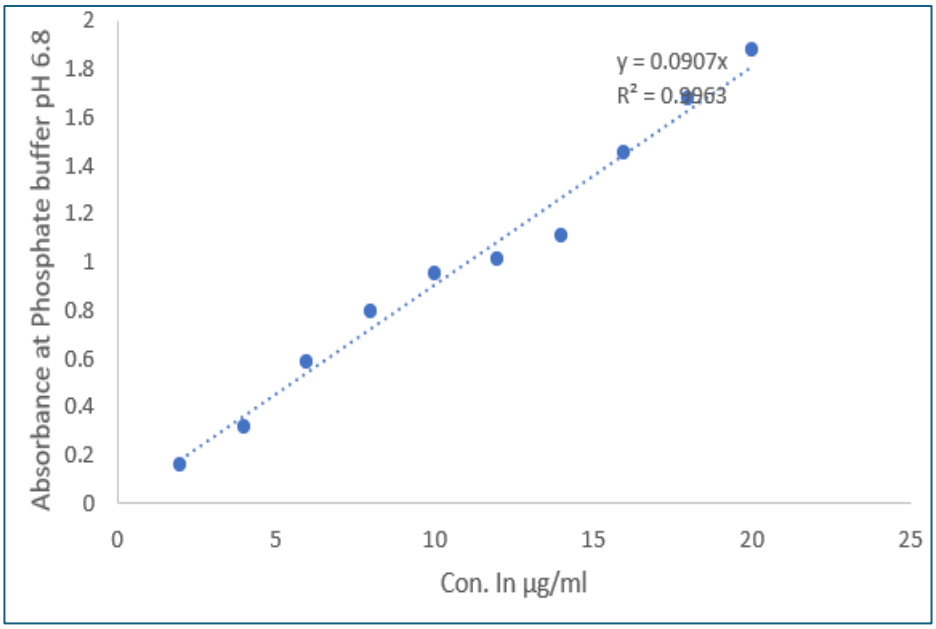


**Fig.3 Curve in Phosphate buffer pH 6.8**

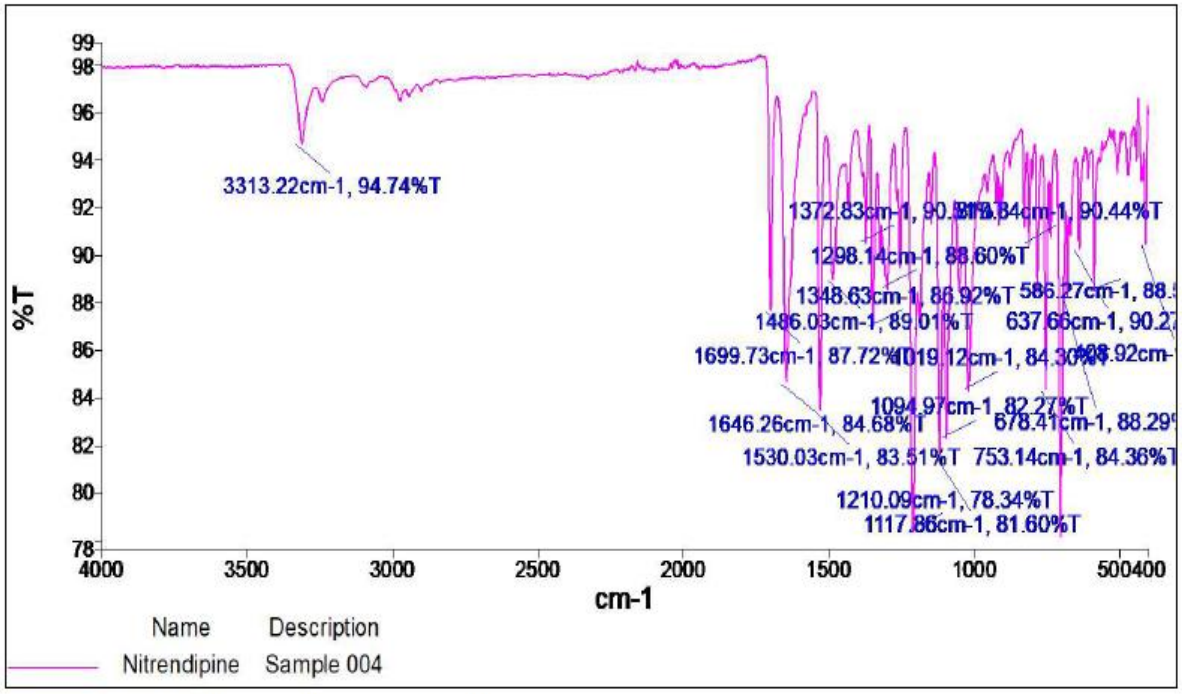


**Figure 4: FTIR Spectra of Nitrendipine**

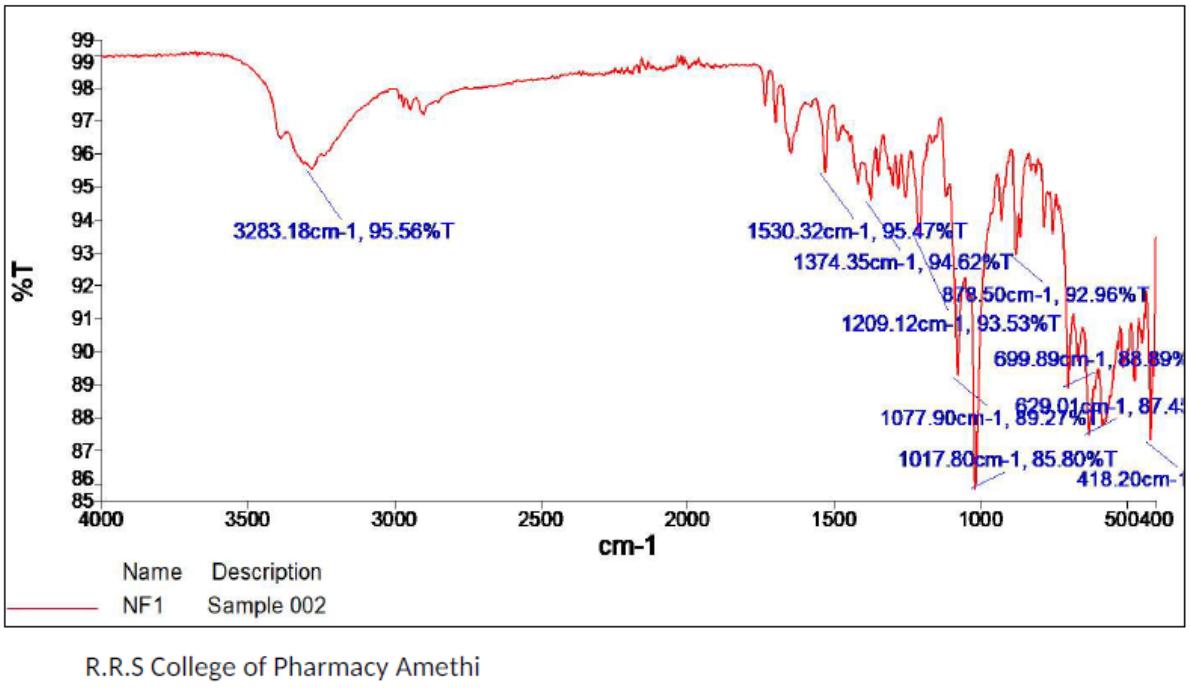


**Figure 5: FTIR Spectra of Formulation NF1**

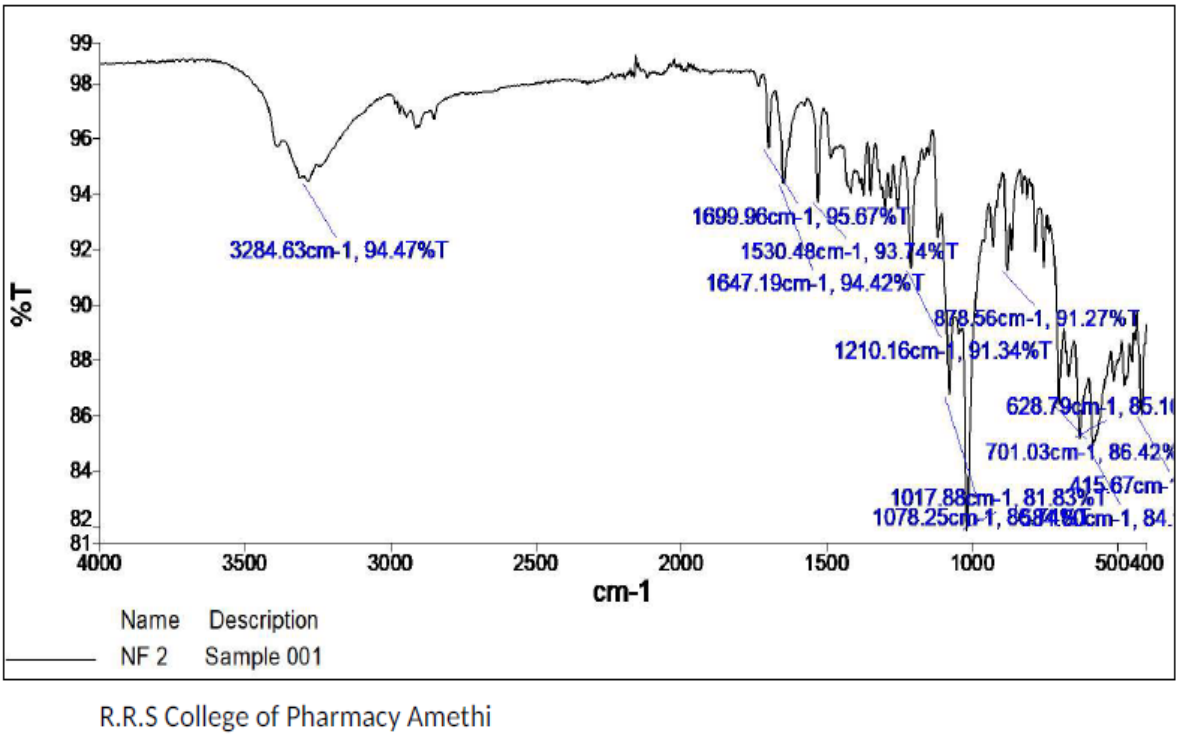


**Figure 6: FTIR Spectra of Formulation NF2**

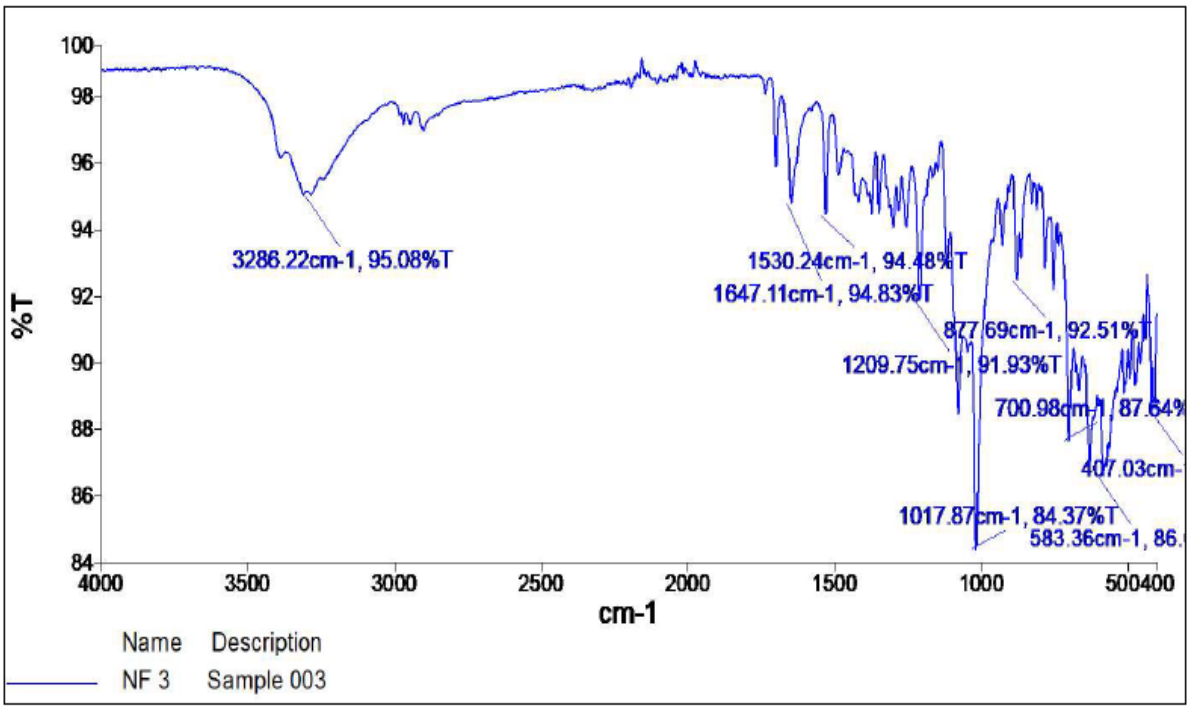


**Figure 7: FTIR Spectra of Formulation NF3**

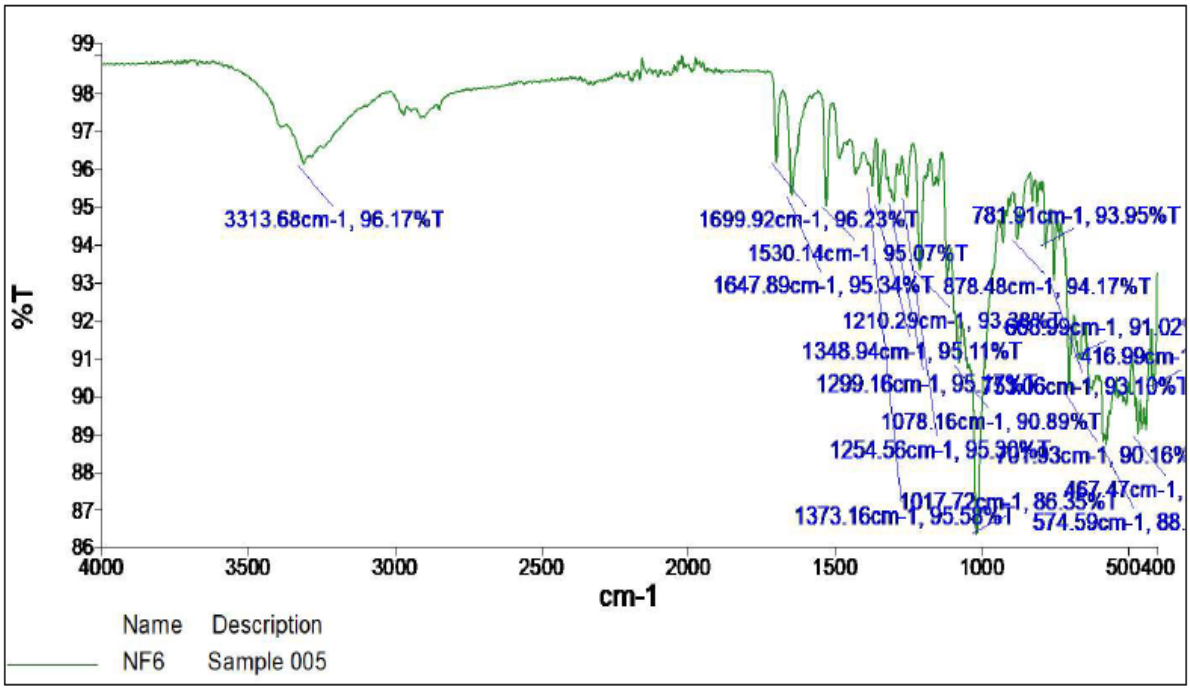


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**Figure 8: FTIR Spectra of Formulation NF6**

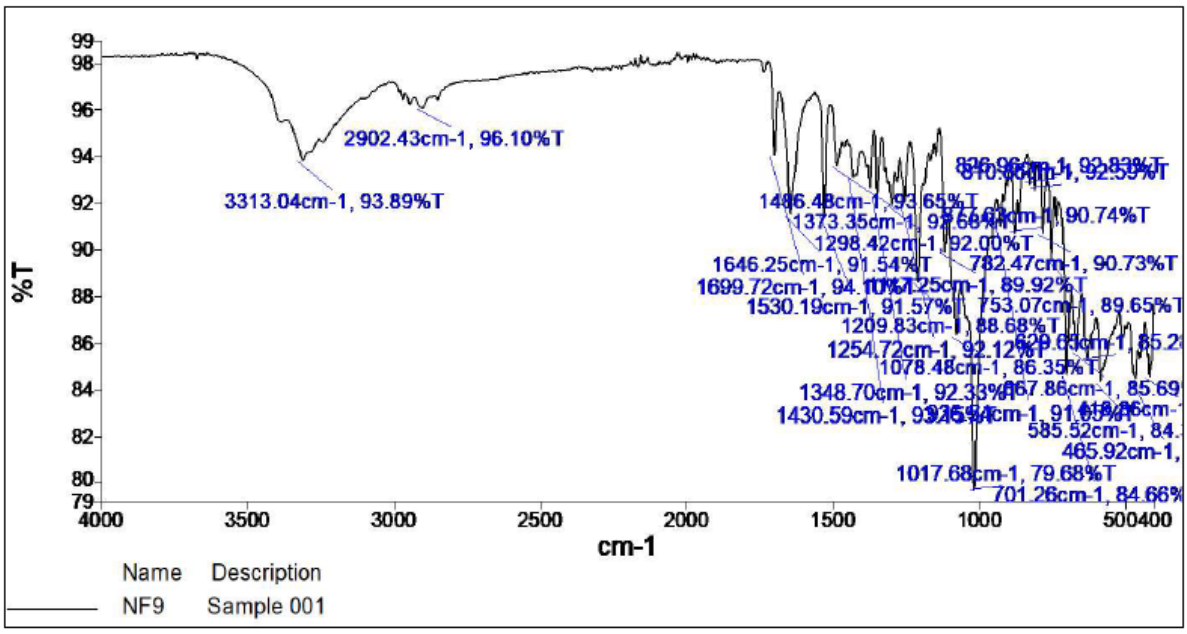


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**Figure 9: FTIR Spectra of Formulation NF9**

**PRE COMPRESSION STUDIES ON POWDER BLEND:**

**Bulk density:**The bulk density of the formulation mixture of drug with different superdisintegrants was measured by graduated cylinder. The bulk density was found in the range from 0.5 – 0.522 g/ml. The results are illustrated in Table 4.

**Tapped density:**The tapped density of the formulation mixture of drug with different superdisintegrants was measured by measuring cylinder. The tapped density was found in the range of 0.583 – 0.598 g/cm3.The results are shown in Table 4.

**Compressibility index:**Compressibility index (Carr's index) indicates the flow property of the granules or the powders. Flow property plays a major role in the dosage forms especially in tablet dosage forms because improper flow of powders or granules may cause weight variation. Values of compressibility index below 15% indicate good flow

whereas the values above 15% indicate poor flow property. The compressibility index of various formulation mixture of drug with different superdisintegrants was calculated by using bulk density and tapped density results and it was found in the range of 12.35 – 13.58 % which reveals that the formulations exhibit good flow property. The results are shown in the Table 4.

**Hausner ratio:**It is an indirect index of ease of powder flow. Lower Hausner ratio i.e., <1.25 specifies good flow property than the higher Hausner ratio i.e., >1.25. The Hausner ratio of various formulation mixture of drug with different superdisintegrants was calculated by using bulk density and tapped density data. It was found in the range of 1.2 – 1.18 which designates that that the formulation powders having better flow properties. The results are shown in Table 3.2.

**Angle of repose (θ):**Angle of repose is direct index of the flow property. The angle of repose of various formulation blends of drug with different superdisintegrants was measured by using funnel method. The range of results is lie in between the 21.8 – 23.270 which indicates that the powders having good flow property. The results are illustrated in Table 5.

**Particle Size Distribution**Particle Size Distribution for final blend of the trial batches were performed and the results are tabulated below.

**Table 4: Precompression parameters of MDT Formulations**

| Formulation Code | Angle of repose | Hausner ratio | Tapped density | Bulk Density |
|---|---|---|---|---|
| NF1 | 25°.12 ± 0.12 | 1.112 ± 0.05 | 0.74± 0.03 | 0.56 ± 0.01 |
| NF2 | 22°.21 ± 0.11 | 1.116 ± 0.05 | 0.75± 0.02 | 0.61 ± 0.02 |
| NF3 | 23°.87 ± 0.10 | 1.104 ± 0.06 | 0.81± 0.02 | 0.48 ± 0.02 |
| NF4 | 24°.78 ± 0.12 | 1.121 ± 0.04 | 0.76± 0.03 | 0.67 ± 0.01 |
| NF5 | 25°.67 ± 0.13 | 1.124± 0.05 | 0.75± 0.03 | 0.71± 0.01 |
| NF6 | 23°.56 ± 0.12 | 1.121± 0.03 | 0.81± 0.02 | 0.53± 0.02 |
| NF7 | 24°.32 ± 0.11 | 1.117± 0.04 | 0.83± 0.03 | 0.44± 0.03 |
| NF8 | 25°.90 ± 0.12 | 1.118± 0.04 | 0.91± 0.02 | 0.71± 0.01 |
| NF9 | 24°.64± 0.11 | 1.119± 0.05 | 0.83± 0.02 | 0.75± 0.03 |

Results are mean of 3 observation ±SD

**Table 5: Precompression parameters of MDT Formulations**

| Formulation Code | Compressibility index | Loss on drying |
|---|---|---|
| NF1 | 13.12 ± 0.12 | 2.02 ± 0.05 |
| NF2 | 12.21 ± 0.11 | 3.16 ± 0.05 |
| NF3 | 12.87 ± 0.10 | 2.10 ± 0.06 |
| NF4 | 12.48 ± 0.12 | 3.21 ± 0.04 |
| NF5 | 13.67 ± 0.13 | 1.99± 0.05 |
| NF6 | 12.56 ± 0.12 | 3.79± 0.03 |
| NF7 | 13.32 ± 0.11 | 2.17± 0.04 |
| NF8 | 12.90 ± 0.12 | 3.10± 0.04 |
| NF9 | 12.64± 0.11 | 4.09± 0.05 |

Results are mean of 3 observation ±SD

**Table 6: Particle size distribution of final blend**

| Sieve Size # | NF1 | NF2 | NF3 | NF4 | NF5 | NF6 | NF7 | NF8 | NF9 |
|---|---|---|---|---|---|---|---|---|---|
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 3 | 2 | 1 | 1 | 0 | 0 | 0 | 0 |
| 60 | 5 | 10 | 12 | 13 | 12.5 | 8.5 | 15 | 14 | 11.5 |
| 80 | 30 | 5 | 7 | 7.4 | 5.6 | 5 | 5 | 20 | 14 |
| 100 | 10 | 5 | 7.6 | 9.3 | 8.9 | 15.5 | 10.2 | 17.5 | 20 |
| 140 | 10 | 34 | 41 | 44 | 42.5 | 43 | 6 | 20 | 27 |
| 200 | 7.5 | 15 | 17.5 | 15 | 18 | 17.5 | 20 | 17.5 | 15 |
| Pan | 27.5 | 15 | 11 | 12 | 15 | 35 | 24 | 10 | 12 |

**Blend Uniformity:** Percentage content of samples from final blend of trial batches were analyzed and the results are tabulated below

**Table 7: Results of blend unifromity sample of final blend**

| Sl. N. | NF1 | NF2 | NF3 | NF4 | NF5 | NF6 | NF7 | NF8 | NF9 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 95.4 | 96.3 | 95.4 | 96.7 | 98.4 | 96.5 | 97.2 | 98.6 | 98.88 |
| 2 | 96.4 | 96.7 | 99.6 | 95.6 | 98.3 | 98.4 | 99.06 | 100.04 | 99.6 |
| 3 | 95.6 | 97.7 | 95.5 | 99.6 | 98.5 | 99.5 | 97.4 | 96.7 | 99.1 |
| 4 | 96.9 | 97.3 | 96.8 | 97.5 | 99.1 | 99.5 | 97.8 | 99.0 | 99.8 |
| 5 | 96.9 | 97.5 | 98.5 | 96.5 | 96.5 | 97.6 | 98.6 | 98.6 | 99.3 |
| 6 | 97.4 | 97.1 | 96.5 | 98.6 | 97.0 | 98.7 | 99.6 | 99.3 | 98.6 |
| 7 | 97.1 | 96.5 | 96.5 | 96.5 | 97.4 | 98.5 | 99.1 | 98.4 | 98.9 |
| 8 | 98.3 | 97.5 | 98.4 | 98.3 | 99.5 | 99.8 | 100.6 | 100.1 | 99.9 |
| 9 | 98.5 | 99.1 | 98.4 | 97.5 | 96.5 | 97.5 | 99.0 | 99.5 | 99.6 |
| 10 | 98.7 | 99.6 | 96.5 | 99.8 | 100.6 | 98.6 | 97.4 | 99.6 | 99.8 |
| Avg. | **98.5** | **96.4** | **97.6** | **98.4** | **98.8** | **97.6** | **98.4** | **98.7** | **98.5** |
| Max | 98.7 | 99.6 | 99.6 | 99.8 | 100.6 | 99.8 | 100.6 | 100.04 | 99.9 |
| Min | 95.4 | 96.3 | 95.4 | 95.6 | 97.4 | 96.5 | 97.2 | 96.7 | 98.6 |
| %RSD | 0.89 | 0.96 | 1.02 | 1.05 | 0.98 | 1.77 | 1.21 | 0.99 | 0.89 |

**TABLET CHARACTERIZATION**

**Weight Variation:**Weight variation of all the batches were evaluated and the results are tabulated below

**Table 8: Results for weight variations**

| Sl. N. | NF1 (mg) | NF2 (mg) | NF3 (mg) | NF4 (mg) | NF5 (mg) | NF6 (mg) | NF7 (mg) | NF8 (mg) | NF9 (mg) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 115.5 | 116.6 | 119.5 | 112.6 | 115.2 | 116.4 | 118.3 | 114.6 | 115.5 |
| 2 | 119.5 | 118.5 | 117.6 | 118.1 | 112.5 | 114.5 | 115.6 | 111.9 | 121.5 |
| 3 | 119.6 | 113.5 | 112.6 | 110.6 | 112.2 | 117.1 | 115.5 | 121.5 | 123.4 |
| 4 | 115.5 | 114.3 | 117.9 | 116.6 | 118.5 | 119.5 | 117.6 | 116.7 | 116.5 |
| 5 | 121.6 | 119.6 | 120.6 | 116.5 | 112.6 | 121.5 | 124.3 | 121.3 | 117.5 |
| 6 | 119.3 | 118.2 | 115.6 | 120.4 | 123.5 | 117.5 | 118.4 | 114.3 | 115.2 |
| 7 | 114.2 | 116.4 | 113.3 | 119.5 | 117.5 | 119.2 | 118.4 | 115.9 | 121.2 |
| 8 | 117.2 | 118.1 | 116.2 | 115.3 | 121.0 | 119.2 | 120.1 | 112.6 | 123.1 |
| 9 | 117.3 | 118.5 | 115.3 | 117.3 | 117.3 | 118.2 | 121.9 | 119.2 | 118.2 |
| 10 | 115.2 | 119.2 | 117.4 | 125.3 | 121.2 | 118.1 | 120.1 | 121.5 | 117.1 |
| Avg. | 115.6 | 117.6 | 114.9 | 117.5 | 115.7 | 114.8 | 118.9 | 118.5 | 119.1 |

**3.3.2 Thickness:** Thickness of ten tablets were evaluated from each batch and tabulated in the table below.

**Table 9: Results for Thickness**

| Sl. N. | NF1 (mm) | NF2 (mm) | NF3 (mm) | NF4 (mm) | NF5 (mm) | NF6 (mm) | NF7 (mm) | NF8 (mm) | NF9 (mm) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.64 | 2.86 | 2.76 | 2.91 | 2.86 | 2.78 | 284 | 2.91 | 2.88 |
| 2 | 2.63 | 2.84 | 2.78 | 2.88 | 2.84 | 2.84 | 289 | 2.94 | 2.94 |
| 3 | 2.67 | 2.86 | 2.79 | 2.85 | 2.81 | 2.77 | 286 | 2.88 | 2.89 |
| 4 | 2.70 | 2.85 | 2.77 | 2.86 | 2.80 | 2.85 | 284 | 2.91 | 2.93 |
| 5 | 2.68 | 2.81 | 2.80 | 2.90 | 2.85 | 2.84 | 290 | 2.95 | 2.90 |
| 6 | 2.65 | 2.87 | 2.83 | 2.89 | 2.84 | 2.85 | 282 | 2.90 | 2.86 |
| 7 | 2.71 | 2.88 | 2.83 | 2.92 | 2.86 | 2.80 | 289 | 2.93 | 2.89 |
| 8 | 2.67 | 2.84 | 2.80 | 2.89 | 2.83 | 2.79 | 290 | 2.89 | 2.91 |
| 9 | 2.66 | 2.83 | 2.77 | 2.88 | 2.87 | 2.78 | 288 | 2.88 | 2.92 |
| 10 | 2.70 | 2.82 | 2.78 | 2.91 | 2.80 | 2.80 | 281 | 2.87 | 2.88 |
| Avg. | 2.67 | 2.80 | 2.79 | 2.87 | 2.83 | 2.81 | 2.87 | 2.91 | 2.89 |
| Max | 2.71 | 2.88 | 27.6 | 2.92 | 2.87 | 2.85 | 2.90 | 2.95 | 2.94 |
| Min | 2.63 | 2.81 | 2.83 | 2.86 | 2.80 | 2.78 | 2.84 | 2.87 | 2.86 |

**Hardness:**Hardness for ten tablets for the trial batches was evaluated and the observation was tabulated below.

**Table 10 Results for Harness**

| Sl. N. | NF1 ($kg/cm^2$) | NF2 ($kg/cm^2$) | NF3 ($kg/cm^2$) | NF4 ($kg/cm^2$) | NF5 ($kg/cm^2$) | NF6 ($kg/cm^2$) | NF7 ($kg/cm^2$) | NF8 ($kg/cm^2$) | NF9 ($kg/cm^2$) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.0 | 4.0 | 4.1 | 3.4 | 3.6 | 3.9 | 4.4 | 4.3 | 3.9 |
| 2 | 3.7 | 3.9 | 4.4 | 3.8 | 3.9 | 4.0 | 4.5 | 3.9 | 3.9 |
| 3 | 3.6 | 4.4 | 4.3 | 3.5 | 4.0 | 4.4 | 4.3 | 4.4 | 4.2 |
| 4 | 3.9 | 3.9 | 3.7 | 3.3 | 3.8 | 4.2 | 3.8 | 3.9 | 4.4 |
| 5 | 3.7 | 4.2 | 3.9 | 4.2 | 3.7 | 4.7 | 3.6 | 4.6 | 3.6 |
| 6 | 4.4 | 3.7 | 4.0 | 4.0 | 3.0 | 4.8 | 4.7 | 3.6 | 4.7 |
| 7 | 4.2 | 4.6 | 3.9 | 3.3 | 4.0 | 4.6 | 3.9 | 3.8 | 3.3 |
| 8 | 3.8 | 4.7 | 4.5 | 4.1 | 3.7 | 3.9 | 4.0 | 3.9 | 3.5 |
| 9 | 4.3 | 4.6 | 4.0 | 3.8 | 4.1 | 4.2 | 3.4 | 4.6 | 3.2 |
| 10 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 4.6 | 4.1 | 4.3 | 3.7 |
| Avg. | 3.9 | 4.1 | 3.9 | 3.6 | 3.5 | 4.3 | 4.1 | 4.0 | 3.6 |
| Max | 4.4 | 4.7 | 4.5 | 4.2 | 4.1 | 4.8 | 4.7 | 4.6 | 4.7 |
| Min | 3.6 | 3.7 | 3.7 | 3.3 | 3.4 | 3.9 | 3.4 | 3.6 | 3.2 |

**Content Uniformity:**Ten tablets from each batch were analyzed for content uniformity and the results are tabulated in percentage is beneath.

**Table 11: Results for Content uniformity**

| Sl. N. | NF1 (%) | NF2 (%) | NF3 (%) | NF4 (%) | NF5 (%) | NF6 (%) | NF7 (%) | NF8 (%) | NF9 (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 98.6 | 97.4 | 99.6 | 100.0 | 97.5 | 97.6 | 98.6 | 99.2 | 98.6 |
| 2 | 96.5 | 97.5 | 97.6 | 99.5 | 99.5 | 99.8 | 99.6 | 97.6 | 98.7 |
| 3 | 99.6 | 95.5 | 98.5 | 98.6 | 98.6 | 100.5 | 98.5 | 98.5 | 97.8 |
| 4 | 94.6 | 98.6 | 98.6 | 99.6 | 99.9 | 99.6 | 100.9 | 99.2 | 100.4 |
| 5 | 95.5 | 99.2 | 100.4 | 96.7 | 98.5 | 100.8 | 97.6 | 98.6 | 98.6 |
| 6 | 98.5 | 98.8 | 97.6 | 98.5 | 99.6 | 99.Y | 99.7 | 99.9 | 100.7 |
| 7 | 101.4 | 99.9 | 99.6 | 97.6 | 97.6 | 98.6 | 98.8 | 97.8 | 99.6 |
| 8 | 97.6 | 97.4 | 103.3 | 99.8 | 98.6 | 97.5 | 96.9 | 97.9 | 97.9 |
| 9 | 102.6 | 98.4 | 98.5 | 100.1 | 96.5 | 97.9 | 100.0 | 98.7 | 98.7 |
| 10 | 98.6 | 99.7 | 99.6 | 99.5 | 99.1 | 98.6 | 99.6 | 97.6 | 98.6 |
| Avg. | 98.7 | 98.54 | 97.86 | 99.5 | 97.6 | 98.6 | 97.6 | 96.6 | 98.6 |
| Max | 102.6 | 99.9 | 103.3 | 100.1 | 99.9 | 100.8 | 100.9 | 99.9 | 100.7 |
| Min | 94.6 | 95.6 | 97.6 | 96.7 | 96.5 | 97.5 | 96.9 | 97.6 | 97.8 |
| %RSD | | | | | | | | | |

**Friability:**Initial weight, final weight and percentage weight loss of tablets from each batch for checking whether they pass the test for friability. And the results are tabulated below.

**Table 12: Results for Friability**

| Parameter | NF1 | NF2 | NF3 | NF4 | NF5 | NF6 | NF7 | NF8 | NF9 |
|---|---|---|---|---|---|---|---|---|---|
| Wo | 6.6758 | 6.8965 | 6.7644 | 6.8955 | 6.7533 | 6.8986 | 6.6895 | 6.9746 | 6.7986 |
| W1 | 6.6368 | 6.7789 | 6.5433 | 6.6895 | 6.6896 | 6.7855 | 6.6543 | 6.8965 | 6.7453 |
| Percentage weight loss (%) | 0.34 | 0.23 | 0.32 | 0.22 | 0.32 | 0.12 | 0.54 | 0.22 | 0.32 |

W0-Initial weight (gm); W1-Final weight (gm)

**Disintegration Time:**Minimum and maximum time taken by the six tablets from each batch was noted and tabulated in the table below

**Table 13: Results for Disintegration time**

| Parameter | NF1 | NF2 | NF3 | NF4 | NF5 | NF6 | NF7 | NF8 | NF9 |
|---|---|---|---|---|---|---|---|---|---|
| Min Time (in min) | 0.32 | 1.53 | 0.43 | 0.24 | 0.54 | 0.34 | 0.52 | 1.40 | 0.44 |
| Max time (in min) | 0.42 | 1.67 | 0.57 | 0.33 | 1.21 | 0.48 | 0.59 | 1.49 | 0.58 |

**Dissolution:** Percentage release of drug was analyzed during 15 minutes of dissolution and the results for the respective batches were tabulated below.

**Table 14: Results for Dissolution time**

| Time (Inmin) | NF1 | NF2 | NF3 | NF4 | NF5 | NF6 | NF7 | NF8 | NF9 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 78.88 | 93.55 | 84.66 | 88.98 | 94.6 | 81.77 | 89.9 | 94.44 | 95.76 |
| 10 | 89.76 | 96.76 | 90.77 | 93.76 | 97.99 | 87.66 | 95.77 | 96.77 | 97.99 |
| 15 | 94.33 | 99.76 | 95.76 | 98.4 | 98.76 | 96.6 | 98.87 | 98.11 | 98.5 |

## CONCLUSION

In the current study various batches were prepared by using super disintegrants like microcrystalline cellulose, doshion,sodium starch glycolate and super $D_{33}$ were used to directly compressed mouth dissolving nitrendipine tablets. The study and result revealed that the method of preparation of formulation significantly affect the disintegration time,percentage friability and release of drug. In-vitro dissolution study of all the formulation was carried out for 15 minute and according to results formulation NF2 was found as the best formulation,which should 99.96% drug release at the end of 15 min.

It is thus concluded that by adopting systemic formulation approach and optimum point can be reached on shortest time with minimum effort and direct compression techniques would be effective alternative approach.

On the basis of experimental data, we can conclude that among all super disintegrants used doshion have given best result.

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