**African Journal of Biological Sciences**

**Research Paper**                                                                 **Open Access**

# Formulation and Evaluation of Fast Disintegrating Tablets of Herbal Powder Extracts for Headache

**Preeti Sharma[1], Dr. Anandkumar K. Patel[2], Yasmin Bano[3], Sravani Boyapati[4],**

**Priyanka Gupta[5], Jaya Verma[6], Navneet Tiwari[7], Dr. Rajeshree Panigrahi\***

[1]Assistant Professor, PSIT-Pranveer Singh Institute of Technology,  Pharmacy, Kanpur UP
[2] Professor, Saraswati Institute of Pharmaceutical Sciences, Gandhinagar.
[3] Assistant Professor Pharmacology, SCPM College of Pharmacy Haripur, Gonda.
[4] Associate Professor, Avanthi Institute of Pharmaceutical Sciences, Cherukupally, Bhogapuram (Mandal), Vizianagaram (District), Andhra Pradesh.
[5] Assistant Professor, College of pharmacy shivalik campus Dehradun.
[6] Assistant Professor, M.Pharm (Pharmacology)
Six Sigma Institute of Technology and Science, Rudrapur
[7] Assistant Professor, M.pharm (Pharmaceutics)
College of Pharmacy Graphic Era Hill University Bhimtal Campus Uttarakhand
**Corresponding Author \***
Dr. Rajeshree Panigrahi, Professor , Royal college of pharmacy and health sciences, and hapasara road-760002
ranuroyal@gmail.com

## ABSTRACT

**Background:** Oral medication administration is perhaps the most common method of the dosage form. Researchers have been encouraged by recent technological advancements to produce Fast disintegrating tablets (FDTs) to enhance patient compliance and accessibility. The study was designed to evaluate the composition and efficacy of herbal fast disintegrating tablets for headache care. Herbal powder extracts of *Salix alba L* (White Willow bark), *Tinospora cordifolia* (Guduchi), *Achyranthes aspera* (Latjira), *Cyprus rotundus* (Nagarmotha), and *Withania somnifera* (Ashwagandha) are produced and processed into fast disintegrating tablets using a super disintegrant including cross povidone, sodium starch glycolate, and micro-crystalline cellulose in various ratios.

**Methods:** Several pre-formulation batches (F1-F9) were formed using the direct compression method with various excipient ratios and evaluated pre and post-compression. Weight variation, hardness, friability, thickness, disintegration time, wetting time, content uniformity, in-vitro release, stability study, and IR compatibility were all evaluated on those tablets. According to ICH standards, a stability study was undertaken, and all formulations were determined to be stable. Increased solubility is observed in the UV absorption spectra.

**Conclusion:** F7 and F9 show excellent performance with a disintegration time of 26sec and 24sec, Content uniformity of 98.75 ± 0.04% and 98.65±0.43%, and greater dissolution rate 97.04% and 98.93% at 30 min.

**Keywords:**  Fast disintegrating tablet, Herbal formulation, Headache, Cross povidone, Superdisintegrants, Disintegration time.

# 1.    Introduction

Fast disintegrating tablets (FDTs) have attracted a lot of attention over the last three decades because of their higher patient compliance, increased solubility, and stability characteristics compared to traditional tablets and capsules. For quick disintegration, FDTs are solid dosage forms potential implementation ingredients. to increase bioavailability and patient compliance, quick dissolving drug delivery methods are widely employed. A wide range of pharmaceutical and patient requirements are being addressed by new FDT technologies, from improved life-cycle management to comfortable dosing for dysphasic patients in pediatrics, geriatrics, and psychiatry. Because of this, the scientific and industrial communities have been spurred on to develop novel Fast dissolving formulations and technical techniques [1].

Fast disintegrating tablets (FDTs) are also known as quick disintegrating, rapid dissolve, fast dissolving, mouth dissolving, quick dissolving, rapimelt, orodispersible, orally disintegrating, effervescent drug absorption system [2].

It is estimated that these non-allopathic medical systems are used by more than 70% of India's 1 billion people. The Indian Medications Act currently does not distinguish between herbal drugs and dietary supplements. Many natural medications, on the other hand, have a large body of empirical data to support their efficacy. There is a well-established business that manufactures evidence-based herbals in accordance with pharmacopoeial recommendations. In a number of Institutes/Universities, there has been a significant amount of fundamental and clinical study on medicinal plants and their formulations [3].

As the "science of life and longevity" in Sanskrit, Ayurveda is one of the oldest medical systems focused on lifestyle, nutrition and herbs. Ayurveda, Siddha, and Unani, as well as natural goods utilized for their pharmacological activities, have all employed medicinal plants and minerals for thousands of years in various forms. Different powders developed by ayurvedic firms are commonly recommended by ayurvedic doctors [4].

Headache is a continuous symptom in everyone and is an eminent issue in youth and puberty, for what it's worth in adulthood. Headache is originated by cough, sneezing, straining, fever, or sleep; there are unusual signs on assessment and neurological or visual symptoms. An abundance or absence of sleep could cause a headache. Headache is a general and worldwide symptom with a complicated and miscellaneous set of origin. The headache itself could be hurting and disabling aspects that cause substantial levels of incapacity [5, 6].

FDTs were developed in this work to have reasonable mechanical integrity and to disintegrate in the mouth more quickly without water. MCC is utilised as a diluent in tablet formulations to accomplish this purpose. Superdisintegrants like Cross povidone, microcrystalline cellulose (MCC), sodium starch glycolate (SSG), and mixtures of cross povidone, sodium starch glycolate, and microcrystalline cellulose have been used in the formulation of tablets in an attempt to increase the dissolution rate and speed up disintegration. This composition makes use of herbal powder extracts (Table 1). It's a natural remedy for headaches [7].

| Plant Name | Botanical Name | Active Constituents | Mechanism of Action | Reference |
|---|---|---|---|---|
| White Willow bark | Salix alba L (Salicaceae) | Salicylic glycosides, salicin, and salicortin | Inhibition of prostaglandins(PGE$_2$), cyclooxygenase(COX-2) | 8, 9, 10 |
| Latjira | Achyranthes aspera (Amaranthaceae) | Linalool, Oleanolic acid glycosides, amino acids ,flavonoids, and saponins | Inhibits phospholipase A, (COX-1, COX-2) | 11, 12 |
| Guduchi | Tinospora cordifolia (Menispermaceae) | Tinosporine, isocolumbin, flavonoids, terpenoids, glycosides, and alkaloids | Down-regulation of prostaglandins (PGE$_2$), and proinflammatory cytokines (IL-1b, IL-6, TNF- α) | 13, 14, 15 |
| Nagar-motha | Cyprus rotundus (Cyperaceae) | α-cyperone, salicylic acid, catechin, quercetin, | Inhibition of cyclooxygenase (COX-2), and interleukin (IL-6) | 16, 17 |
| Ashwa-gandha | Withania somnifera (Solanaceae) | Withaferin A, withanine, quercetin, kaempferol, and flavonoids | Inhibition of interleukin (IL-6) and tumor necrosis factor (TNF- α) | 18, 19 |

**Table 1: List of commonly recommended Ayurvedic plants in Headache.**

## 2.        Materials and Methods

The herbal powder extracts of Salix *alba L, Tinospora cordifolia , Achyranthes aspera, Cyprus rotundus, and Withania somnifera* was collected from Vital Herbs, Uttam nagar, Delhi, 110059. Cross povidone, Sodium starch glycolate and Microcrystalline cellulose, Citric acid monohydrate, Sodium bicarbonate, Beta-cyclo dextrin, Tartaric acid, Magnesium stearate, and Talc were obtained as gift sample from Loba Chemie Pvt Ltd Mumbai 40002.All other chemicals and reagent was of analytical grade.

### 2.1.        Method for Preparation of Herbal Fast Disintegrating Tablets:

Direct compression technique was used to prepare herbal tablets of powder extracts using various concentrations of Microcrystalline cellulose (MCC), Cross povidone, Beta-cyclo dextrin,  Sodium starch glycolate (SSG), Magnesium stearate, Sodium bicarbonate, Tartaric acid, Citric acid monohydrate, and Talc. In a glass mortar, the materials were evenly mixed. Drug and other components were well mixed before being squeezed with 0.5-mm punches in an automated tableting machine. [20, 21, 22].

### 2.1.1.   Formula for herbal extracts tablet preparation:

| Herbal powder extract | Quantity in mg |
|---|---|
| *Salix alba L.* | 85 mg |
| *Tinospora cordifolia* | 85 mg |
| *Achyranthes aspera* | 60 mg |
| *Cyprus rotundus* | 60 mg |
| *Withania somnifera* | 60  mg |
| Total | 350 mg |

**Table 4.5: Herbal extracts tablet formula**

### 2.2.        Formulation of herbal tablet by Direct Compression Method:

It is necessary to conduct a formulation design research in order to determine the most suitable excipients for manufacturing tablets. To test the varied concentrations of Microcrystaline cellulose (MCC), Sodium starch glycolate (SSG), Cross povidone, Beta-cyclo dextrin, Tartaric acid, Citric Acid Monohydrate, and sodium bicarbonate, we made a batch of tablets with varying concentrations of these ingredients. The experimental batches

of tablets were made utilising the direct compression technique and various excipients that were generally available at the time.

| Ingredient | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 |
|---|---|---|---|---|---|---|---|---|---|
| Extract powder of herbs | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 |
| Cross povidone | 100 | 100 | 70 | 60 | 60 | 60 | 50 | 50 | 50 |
| Beta-cyclo dextrin | 100 | 80 | - | - | 70 | - | - | - | - |
| Sodium starch glycolate | - | - | - | - | 70 | - | - | - | - |
| Poly vinyl pyrolidone | - | - | - | - | - | - | - | - | - |
| Tartaric acid | - | - | - | - | - | 70 | - | - | - |
| Citric acid monohydrate | - | - | 70 | 80 | - | - | 80 | 75 | 70 |
| Sodium bi carbonate | - | - | 70 | 70 | - | 70 | 80 | 75 | 70 |
| Micro crystalline | 50 | 70 | 40 | 40 | 50 | 50 | 40 | 50 | 60 |
| Magnesium stearate | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% |
| Talc | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% |
| Total | 600 | 600 | 600 | 600 | 600 | 600 | 600 | 600 | 600 |

**Table 4.6: Fast-disintegrating tablet ingredients include**

### 2.3.    Preparation of standard stock solution:

After dissolving 100mg of powdered herbal extract in 100ml of water, the final concentration was determined. Aliquots of the stock mixture were diluted to create concentrations between 100 and 500 μg/ml by diluting them with 0.01N HCl. At wavelengths between 200 and 400 nanometers, the absorption peaks were found [23].

### 2.3.1. Determination of analytical wavelength:

The final solution, which contained 100 μg/ml, was scanned at wavelengths between 200 and 400 nanometers. The analytical wavelength for lambda max was determined to be 281nm.

## 2.4. Evaluation of powder blend (Preformulation study):

Preformulation characteristics such as angle of repose, bulk density, tapped density, Hausner ratio, Carr's index, and FTIR investigations were performed on the herbal powder mix. [24, 25, 26].

**2.4.1. Angle of repose**: It was estimated using a funnel. A funnel collected the weighted powder. The funnel's tip now almost reaches the powder heap's apex. The funnel let the powder freely stream over the surface. The powder cone's area was calculated using the equation below.

$$\theta = \tan{-1}\ h\ /\ r$$

Where h and r are the powder cone's height and radius, respectively.

| Angle of repose | Flow property |
|:---:|:---:|
| 25-30 | Excellent |
| 31-35 | Good |
| 36-40 | Fair |
| 41-45 | Passable |
| 46-55 | Poor |
| 56-65 | Very poor |
| >65 | Extremely poor |

**2.4.2. Bulk Density:** It's the mass-to-volume ratio of powder. It was computed by weighing powder and noting the beginning weight. The bulk volume was generated initially. Using the formula below, the bulk density was calculated.

**Bulk density (Db) = Mass (M) / Bulk volume (Vb)**

Where,
M is the powder's mass.

Vb is the powder's bulk volume.

**2.4.3.  Tapped density:**  It's the ratio of powder mass to tapped volume. The powder's volume was determined by tapping it 750 times and recording the tapped volume if the variation was less than 2%. It is documented if it is larger than 2%. The tapping was repeated until the loudness difference between taps was less than 2%. (in a bulk density device) It is supplied in gm/ml.

$$\text{Tapped density (Dt)} = \text{Mass (M) / Tapped volume (Vt)}$$

Where,
M - Mass of powder.
Vt - Tapped volume of the powder.

**2.4.4.  Carr's Index:**     It's a simple, rapid way to estimate powder flow parameters. Following is the formula used to determine the % compressibility of bulk medicine.

$$\text{\% compressibility index} = \frac{\text{Tapped bulk density} - \text{Initial bulk density}}{\text{Tapped bulk density}} \times 100$$

| Carr's Index | Type of flow |
|:---:|:---:|
| 5-15 | Excellent |
| 12-18 | Good |
| 18-23 | Poor |
| 35-38 | Very poor |
| >40 | Extremely poor |

**Table : Carr's Index**

**2.4.5.  Hausner's ratio:** The Hausner ratio compares tapped to bulk density. It measures how easily a powder flows. The formula is as follows.

$$\text{Hausner ratio} = \text{Tapped density (Dt) / Bulk density (Db)}$$

| Hausner's ratio | Type of flow |
|:---:|:---:|
| Less than 1.25 | Good flow |
| 1.25 - 1.5 | Moderate |

| More than 1.5 | Poor flow |
|---|---|

**Table : Hausner's ratio**

## 2.5.   Evaluation of tablets (Post compression study) : [25]

**2.5.1.  Hardness test:** In a diametric compression test, hardness is defined as the force necessary to crack a tablet. The Monsanto hardness tester was used to measure it. It's measured in kg / cm². In each formulation, three tablets were chosen at random and the mean and standard deviation values were determined.

**2.5.2.  Friability test:** To test a tablet's friability, it is exposed to varied friction and shocks. The tablet was friable using the Roche friabilator. A pre-weighed sample of tablets was placed in the friabilator and spun for 100 revolutions at 25 rpm. The pills were 100 times weighed.

$$F = \frac{W\ initial - W\ final}{W\ initial} \times 100$$

**2.5.3.  Weight variation test:** The weight variation test consisted of weighing 20 tablets separately, calculating the average, and comparing the average to the ideal.

**2.5.4.  Thickness:** A vernier calliper from an Electro lab type was used to measure the thickness of the tablets. Five pills are randomly selected from each batch. The units of measurement are millimetres, and average values have been calculated.

**2.5.5.  Content uniformity:** This test ensures that each batch has the same amount of active medicine. Each batch included 10 crushed pills. Then 100 ml of 0.1N HCl with 100 mg powdered herbal extract. To filter this solution, 1 ml was taken and diluted 100 times with 0.1N HCl. The drug concentration was determined using a UV visible spectrophotometer at 281 nm.

**2.5.6.  Wetting time:** The time taken to completely moisten a pill was recorded. Each group had three trials, with the standard deviation computed.

**2.5.7.  Disintegration test:** The time it took for the FDT to disintegrate completely was used to compute the disintegration time. Water temperature was used to track the disintegration period of six FDTs in each tube of the disintegration test device while it was 37±2°C. Results for each concentration were provided as the mean standard deviation for six pills.

**2.5.8. Dissolution Studies:** At 37±2ºC, 50 rpm, and 900 ml distilled water, the release rate of the produced tablets was measured using the USP type 2 (Paddle) procedures. The dissolving medium is replenished with 10 ml of blank media once the samples in 10 ml have been removed. A UV-Spectrophotometer at a wavelength of 281 nm collects samples every five minutes throughout the duration of the experiment and analyses them. Measuring and documenting the rate of disintegration is a need. A standard calibration plot was used to assess the herbal extract's concentration.

**2.5.9. Kinetic data analysis:** Using such data from an in vitro diffusion investigation, the kinetics and technique of herbal extract drug release were analysed by graphing the following kinetics (zero order, first order, and Higuchi equation) and calculating release using Korsmeyer-Peppas equations.

➢ **Zero-Order Kinetics:** The cumulative drug concentration released over time was plotted.

$$C = K_0 t$$

Where K0 is the zero-order rate constant and t is time in hours. A straight line with K0 slope would intersect the axis origin on a concentration vs time graph.

➢ **First order kinetics:** The first order logarithm of the cumulative remaining drug concentration vs passing time is used. To better understand how drugs are released from formulations, we'll look at this kinetics.

.

$$Log\ C = Log\ Co - kt\ /\ 2.303$$

Where $C_0$ represents the initial drug concentration, k represents the first order constant, and t represents the time.

➢ **Higuchi's Model:** Higuchi's model as cumulative percentage of drug released vs square root of time.

$$Q = Kt^{1/2}$$

Where,

K- The system's design variables

T- Time in hours. This model represents drug release from a swellable matrix as a square root of time dependant mechanism.

➢ **Korsemeyer-Peppas Equations:** After plotting the first 60 percent of drug release on a log-log graph using the Korsemeyer equation, the exponent may be calculated from the slope of the line.

$$Mt\ /\ M\infty = Kt^n$$

Where,

Mt/M∞ - Fractional solute release,

t - Release time,

K - Kinetic constant.

The tracers' release mechanism is described by the exponent and in the drug/polymer system. The drug release mechanism is called Fickian diffusion if the exponent n is equal to or less than 0.45 for cylindrical matrix tablets, and non-Fickian or anomalous diffusion if n is more than or equal to 0.89.

**2.5.10. Stability studies:**  The capacity of a certain formulation to retain its physiological, biochemical, pharmaceutical, and toxicological features in a given environment is characterized as drug stability in the pharmaceutical business.

Stability testing aims to demonstrate how diverse environmental factors such as light, temperature, and humidity affect a medicine product's quality over time.

| **Study** | **Storage condition** | | **Time period (Months)** |
|---|---|---|---|
| | **Temperature ($^0$C)** | **Relative humidity (%)** | |
| Long term | $250^0C \pm 20^0C$ | 60% $\pm$ 5% RH | 12 |
| Intermediate | $300^0C \pm 20^0C$ | 65% $\pm$ 5% RH | 6 |
| Accelerated | $400^0C \pm 20^0C$ | 75% $\pm$ 5% RH | 6 |

**Table.ICH guidelines for stability study**

# 3.    Result

**3.1.    Characterization of extract powder:** The basic characterization of powder and micromeritic properties of formulations containing polyherbal extracts powder used for preparing fast disintegrating tablets mentioned in table.

**3.2.     UV spectrophotometric study:** UV Spectrophotometric study was conducted in 0.1N HCL pH 1.2 and examine range was set between 200-400nm. Absorption maximum ($\lambda$max) obtained in 0.1N HCL pH 1.2 was 281nm (Fig.1). The linear correlation was found to be 0.999 (Fig.2).
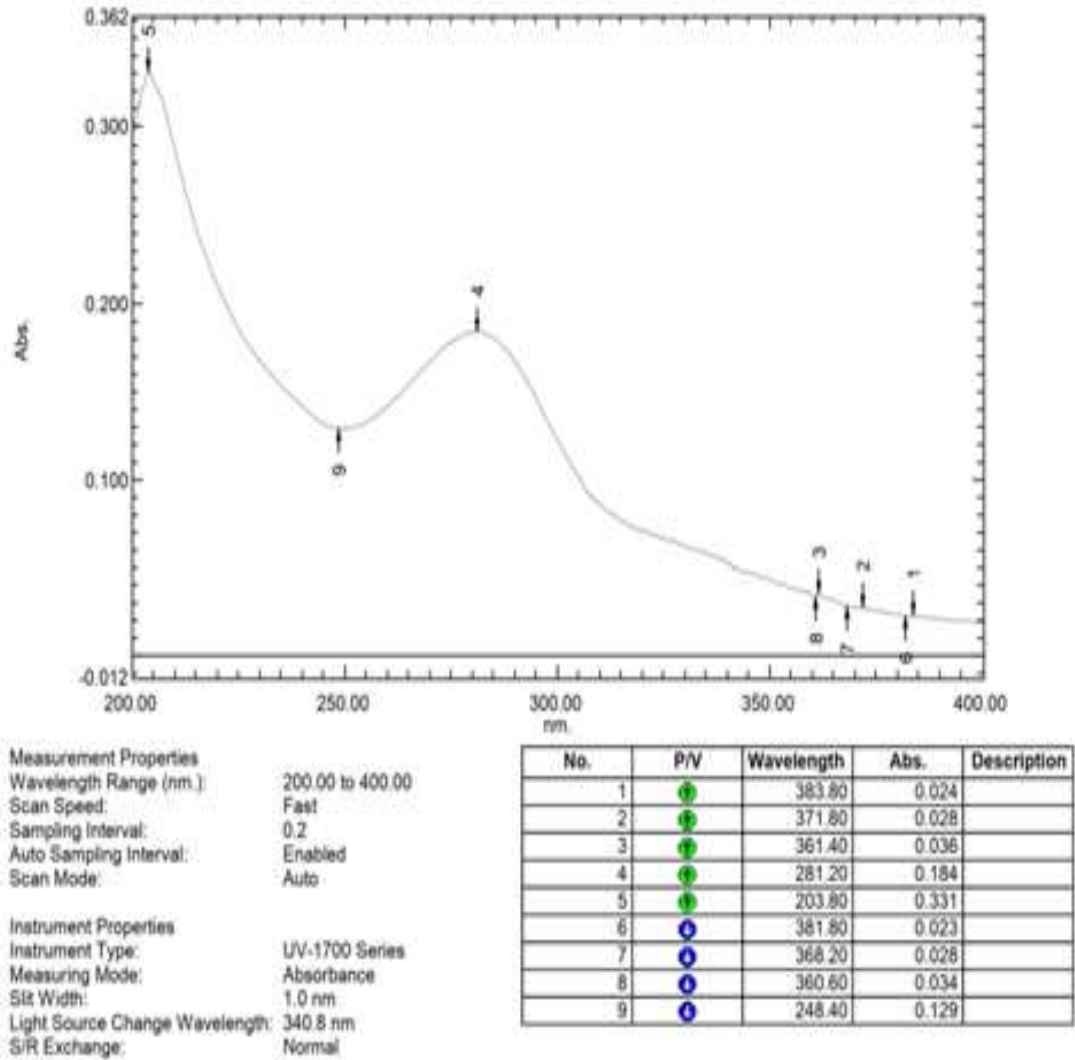
| No. | P/V | Wavelength | Abs. | Description |
|-----|-----|-----------|------|-------------|
| 1 | ● | 383.80 | 0.024 | |
| 2 | ● | 371.80 | 0.028 | |
| 3 | ● | 361.40 | 0.036 | |
| 4 | ● | 281.20 | 0.184 | |
| 5 | ● | 203.80 | 0.331 | |
| 6 | ○ | 381.80 | 0.023 | |
| 7 | ○ | 368.20 | 0.028 | |
| 8 | ○ | 360.60 | 0.034 | |
| 9 | ○ | 248.40 | 0.129 | |

**Measurement Properties**
Wavelength Range (nm.): 200.00 to 400.00
Scan Speed: Fast
Sampling Interval: 0.2
Auto Sampling Interval: Enabled
Scan Mode: Auto

**Instrument Properties**
Instrument Type: UV-1700 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.8 nm
S/R Exchange: Normal

**Fig.1: λmax scan for DVS at 281nm in 0.1N HCL**


**Standard Calibration curve of herbal extract (Each value represents mean n=3, ±S.D)**

| S.No. | Concentration (µg/ml) | Absorbance |
|-------|----------------------|------------|
| 1 | 0 | $0 \pm 0$ |
| 2 | 100 | $0.184 \pm 0.01$ |
| 3 | 200 | $0.386 \pm 0.014$ |
| 4 | 300 | $0.598 \pm 0.016$ |
| 5 | 400 | $0.793 \pm 0.019$ |
| 6 | 500 | $1.001 \pm 0.02$ |

**Table : Standard Calibration curve of herbal extract**



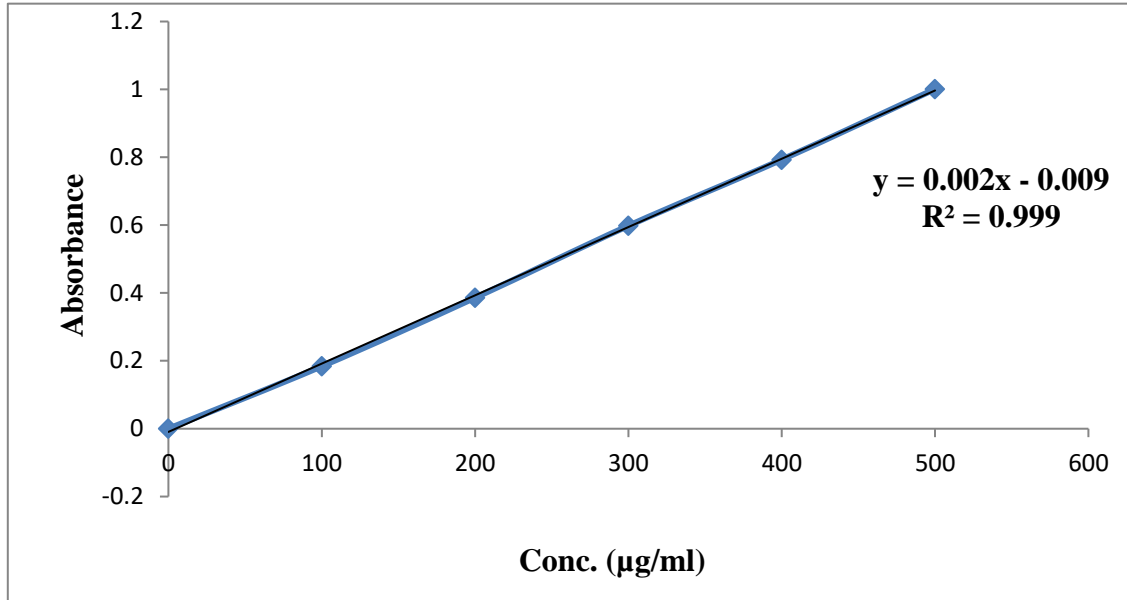$y = 0.002x - 0.009$
$R^2 = 0.999$

**Fig.2 : Calibration curve in 0.1N HCL**

### 3.3.    FTIR Spectral analysis:

| S. no. | Plant  name | Chemical Constituent | Functional group Standard range (cm$^{-1}$) | Observed range (cm$^{-1}$) |
|---|---|---|---|---|
| 1 | *Salix alba (Fig.3)* | Salicin, and Salicortin | C-O   (1150-1060) <br> O-H   (3200-2700) <br> C=C   (1650-1566) <br> C-H    (2000-1650) | C-O (1013.18) <br> O-H(3243.2) <br> C=C (1614.8) <br> C-H (1670.6) |
| 2 | *Tinospora* | Tinosporine and | C-O (1150-1060) <br> C=O (1690-1650) <br> O-H(3700-3584) | C-O (1015.87) <br> C=O (1622.7) <br> O-H(3299.2) |

| | | | | |
|---|---|---|---|---|
| | *cordifolia (Fig.4)* | Isocolumbin | C=C (1650-1566)<br>C-H (2000-1650)<br>CH3 (2830-2695) | C=C (1570)<br>C-H (1680)<br>CH3 (2920) |
| 3 | *Achyranthes aspera (Fig.5)* | Oleanolic acid and Linalool | C-O (1150-1060)<br>O-H(3700-3584)<br>C=C (1650-1566)<br>C-H (2000-1650)<br>COO(1770-1780)<br>CH3 (2830-2695) | C-O (1023.57)<br>O-H(3765.7)<br>C=C (1596.9)<br>C-H (1432)<br>COO(1733.2)<br>CH3 (2824.90) |
| 4 | *Cyprus rotundus (Fig.6)* | Quercetin and Salicylic acid | C-O (1150-1060)<br>O-H(3700-3584)<br>C=C (1650-1566)<br>C-H (2000-1650)<br>C=O (1690-1650) | C-O (1020.02)<br>O-H(3310)<br>C=C (1514.4)<br>C-H (1490)<br>C=O (1618.4) |
| 5 | *Withania somnifera (Fig.7)* | Withaferin A and Withanine | C-O (1150-1060)<br>O-H(3700-3584)<br>C=C (1650-1566)<br>C=O (1690-1650)<br>C-H (2000-1650)<br>CH3 (2830-2695) | C-O (1019.99)<br>O-H(3224.52)<br>C=C (1420.34)<br>C=O (1656.08)<br>C-H (1515)<br>CH3 (2850) |

**Table: FTIR Spectral analysis**
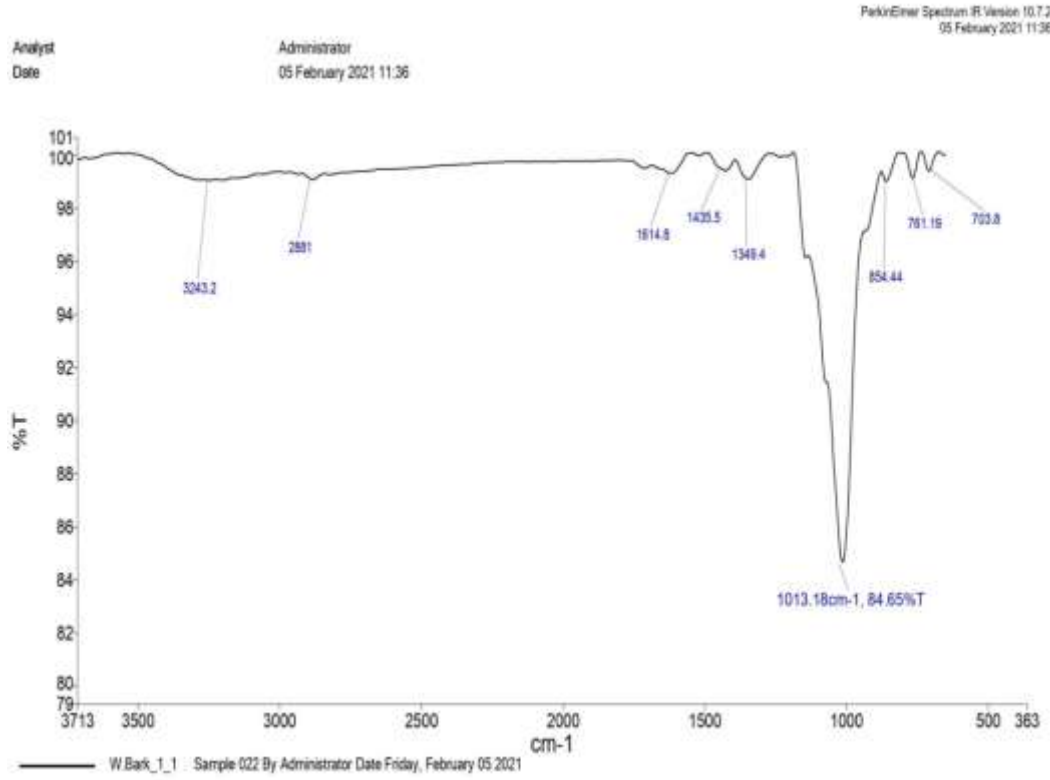
**Fig.3 : FTIR of *Salix alba L***
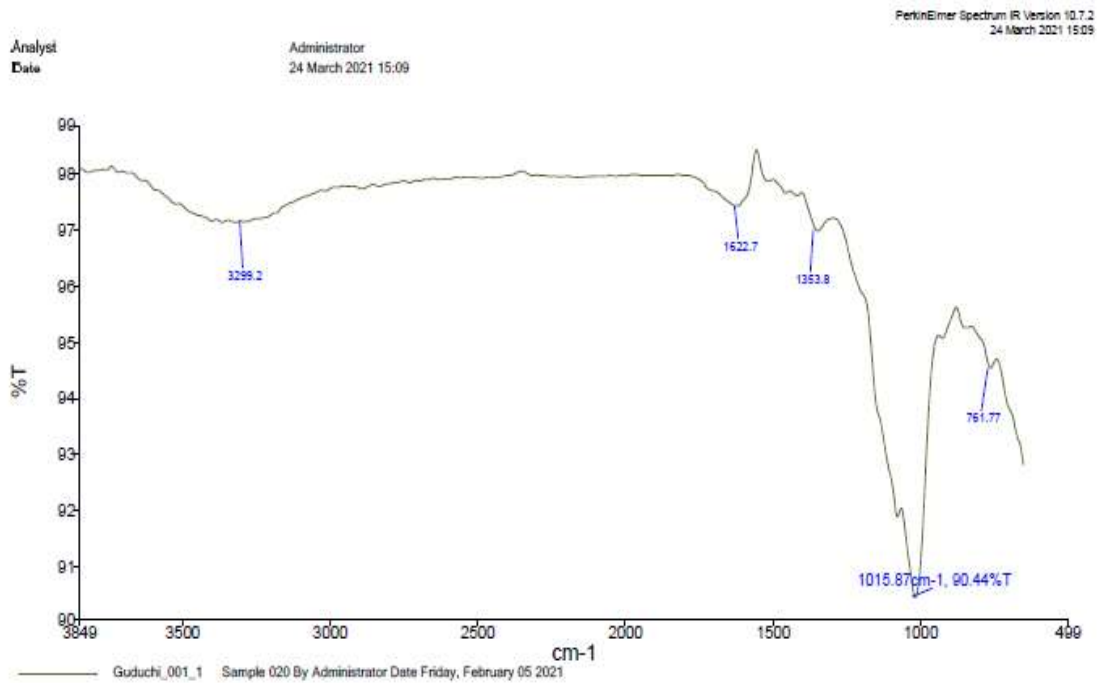


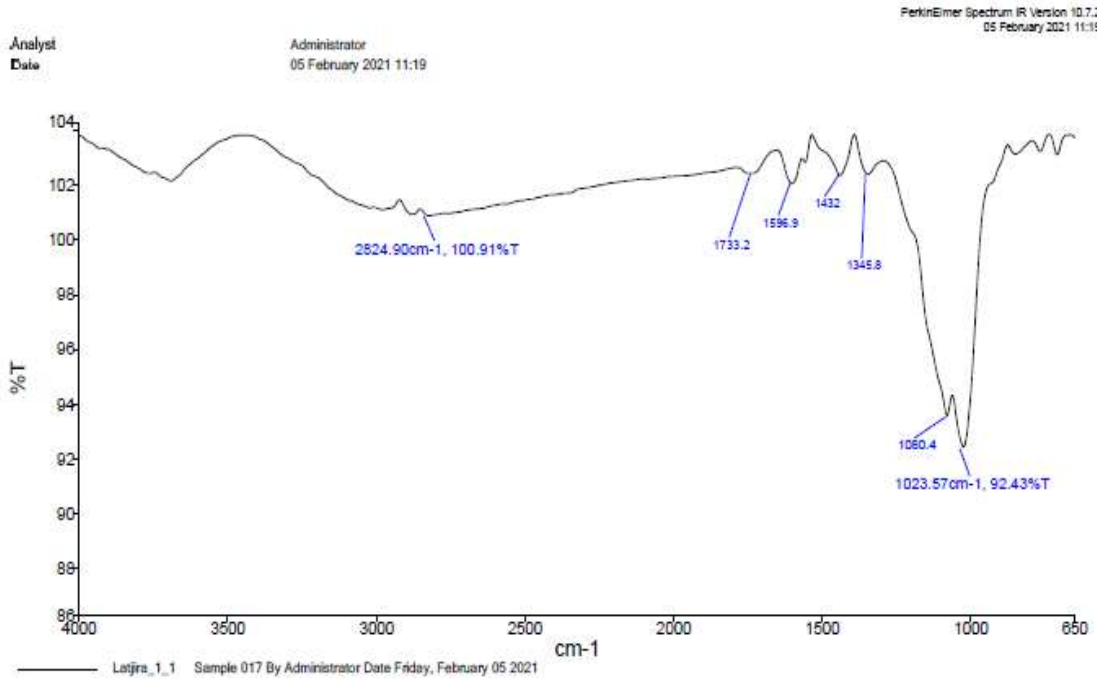**Fig.4 : FTIR of *Tinospora cordifolia***

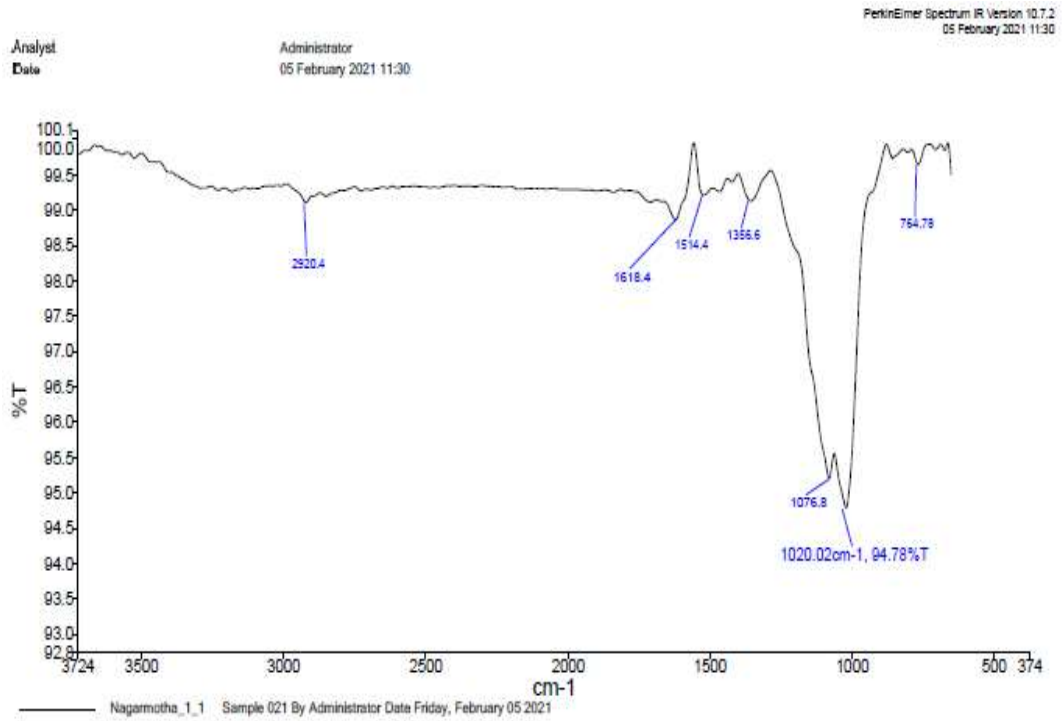**Fig.5 : FTIR of *Achyranthes aspera***
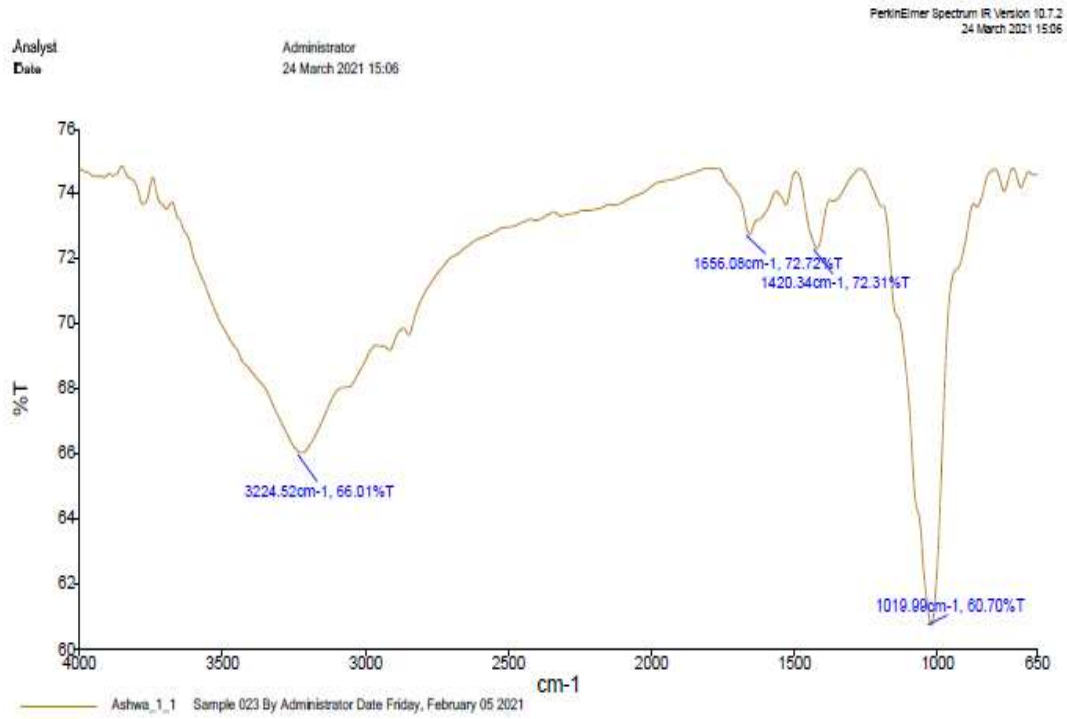


**Fig.6 : FTIR of *Cyprus rotundus***

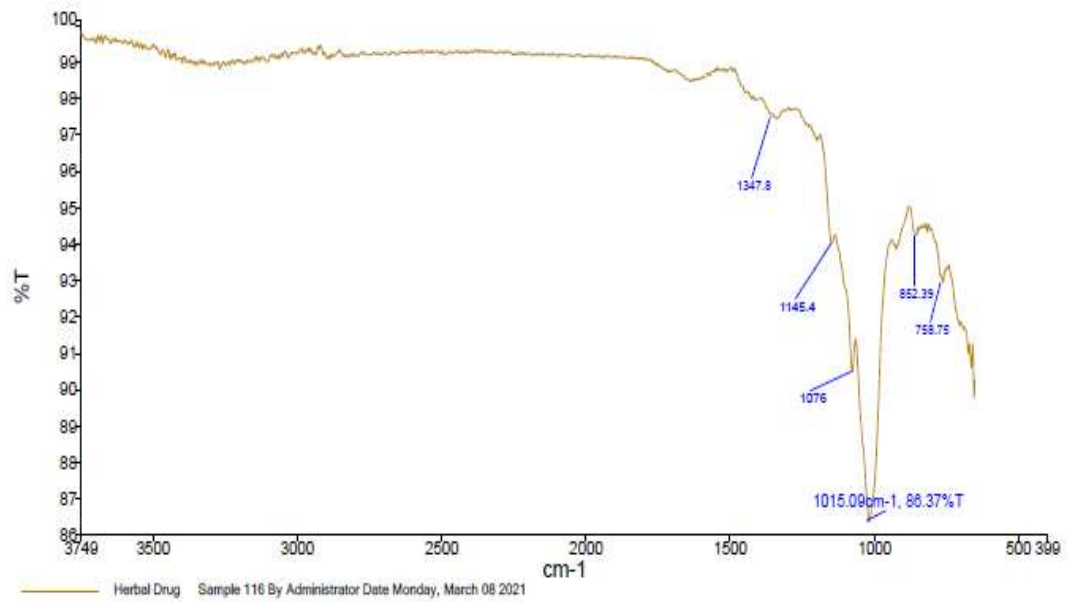**Fig.7 : FTIR of *Withania somnifera***
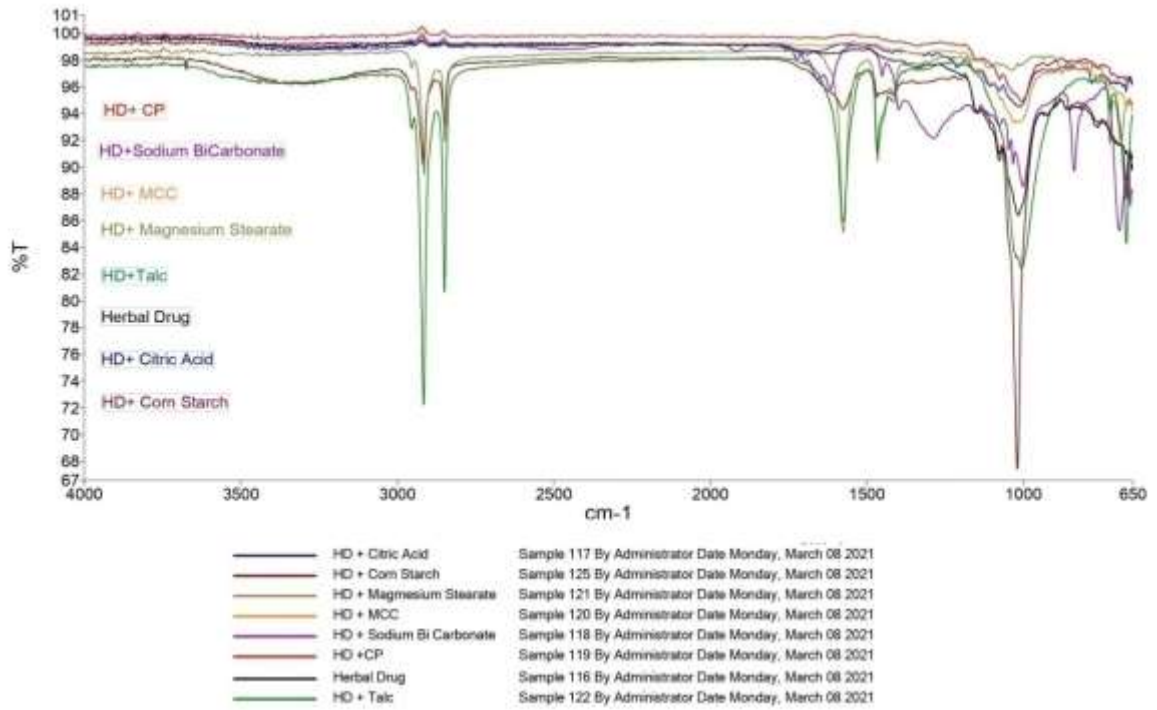


**Fig.8 : FTIR of all Herbal extract**

**Fig.9 : FTIR of all Herbal extract and Excipients (Cross povidone, Sodium bicarbonate, Micro crystalline cellulose, Magnesium stearate, Talc, Citric acid, and Corn starch)**
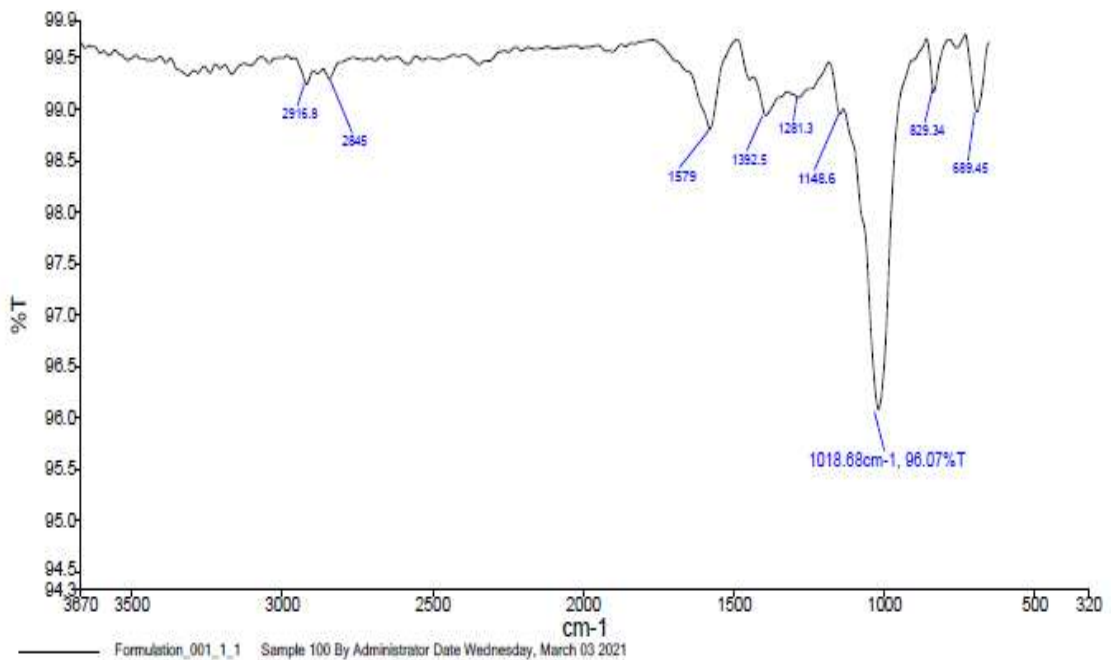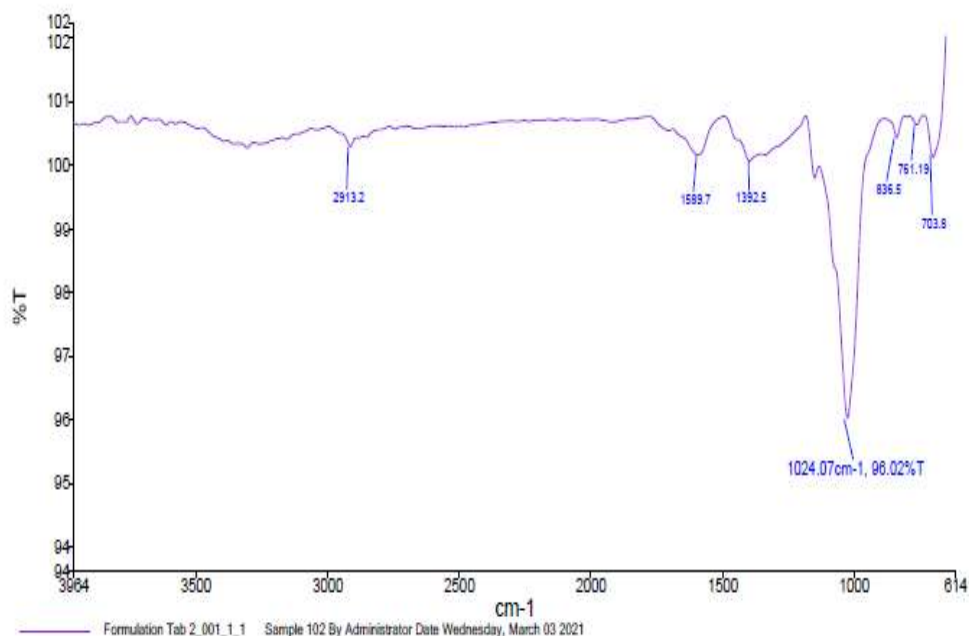


**Fig.10 : FTIR of F7**

**Fig.11 : FTIR of F9**

**3.4.** **Partition coefficient:** The partition coefficient of a mixture of Willow bark, Guduchi, Latjira, Nagarmotha, and Ashwagandha were calculated. In the oil phase, the concentration of the herbal extract was found to be 4.69mg while in the aqueous phase was 5.31mg. Hence, the partition coefficient of the herbal extract was 0.883.

**3.5.** **pH determination:** A pH of herbal extract was 2.8 reported in 1mg/ml concentration in a 0.1N HCl.

**3.6.** **Solubility analysis:** 0.1N HCl, ethanol, and methanol are all solvents that can dissolve herbal extract powder samples.

**3.7.** **Observation of morphological characters:**

| Name of the plant | Nature | Color | Odour | Taste |
|---|---|---|---|---|
| *Salix alba L* | Fine powder | Pale yellow | Characteristic | Bitter |
| *Tinospora cordifolia* | Fine powder | brown | Characteristic | Astringent |
| *Achyranthes aspera* | Fine powder | Pale green | Characteristic | bitter |
| *Cyprus rotundus* | Fine powder | Brown | Characteristic | Astringent |
| *Withania somnifera* | Fine powder | Yellow | Characteristic | Astringent |

**Table: Observation of morphological characters**

### 3.8.    Evaluation of powder characteristics:

| Formulation | Angle of repose (θ) | Bulk density (gm/cm³) | Tapped density (gm/cm³) | Carr's index (%) | Hausner's ratio |
|---|---|---|---|---|---|
| **F1** | 19.40±0.25 | 2.74±0.14 | 3.31±0.56 | 17.22±0.25 | 1.20±1.45 |
| **F2** | 19.53±0.78 | 2.67±1.56 | 3.23±0.86 | 17.33±0.89 | 1.20±0.36 |
| **F3** | 19.92±1.56 | 2.73±0.28 | 3.30±0.78 | 17.27±0.25 | 1.20±0.85 |
| **F4** | 19.50±1.29 | 2.68±1.56 | 3.25±0.71 | 17.53±1.03 | 1.21±1.15 |
| **F5** | 19.48±0.93 | 2.61±0.45 | 3.16±1.02 | 17.40±0.57 | 1.21±1.09 |
| **F6** | 19.26±0.37 | 2.64±0.52 | 3.19±1.58 | 17.24±1.01 | 1.20±1.15 |
| **F7** | 19.29±0.69 | 2.60±1.08 | 3.15±1.84 | 17.46±1.59 | 1.21±1.64 |
| **F8** | 19.54±0.53 | 2.69±1.43 | 3.26±0.98 | 17.48±0.14 | 1.21±0.95 |
| **F9** | 19.23±0.41 | 2.66±0.82 | 3.21±0.29 | 17.13±0.54 | 1.20±0.83 |

**Data as expressed as mean ± S.D. (n = 3)**

**Table: Evaluation of powder characteristics**

### 3.9.    Post compression evaluation of tablets:

| Formulation | Weight variation (mg) | Hardness kg/cm2 | Friability (%) | Thickness (mm) | Content uniformity (%) | Wetting time (sec) |
|---|---|---|---|---|---|---|
| F1 | 574±3.25 | 4.3±0.35 | 0.17±0.12 | 6.58±0.12 | 90.23±0.09 | 134 |
| F2 | 559±1.65 | 4.0±1.25 | 0.29±0.02 | 6.61±0.23 | 90.52±0.23 | 109 |
| F3 | 594±5.23 | 4.2±1.02 | 0.74±0.68 | 6.45±0.12 | 96.24±0.02 | 81 |
| F4 | 589±1.47 | 3.3±0.27 | 0.51±0.74 | 6.38±0.03 | 95.63±0.08 | 61 |
| F5 | 600±1.32 | 3.9±0.22 | 0.73±0.96 | 5.33±0.36 | 94.26±0.19 | 49 |
| F6 | 602±0.57 | 3.2±0.52 | 0.64±0.85 | 6.40±0.19 | 96.69±0.67 | 41 |
| F7 | 598±1.65 | 3.6±0.84 | 0.89±0.92 | 6.31±0.07 | 98.75±0.04 | 26 |
| F8 | 593±0.98 | 3.4±0.91 | 0.75±0.74 | 6.38±0.13 | 97.67±0.28 | 30 |
| F9 | 600±0.82 | 3.8±0.43 | 0.93±0.28 | 6.32±0.16 | 98.65±0.43 | 23 |

**Data as expressed as mean ± S.D. (n = 3)**

**Table 5.9: Post compression evaluation of tablets**

**Table Continued**

| Formulation | Disintegration time (sec) | Dissolution (% drug release in minute) | | | | | |
|:---:|:---:|:---:|:---:|:---:|:---:|:---:|:---:|
| | | 5 min | 10 min | 15 min | 20 min | 25 min | 30 min |
| F1 | 160 | 38.56 | 44.15 | 50.25 | 54.95 | 59.67 | 64.48 |
| F2 | 90 | 44.25 | 49.21 | 53.14 | 59.65 | 64.25 | 68.25 |
| F3 | 79 | 48.95 | 55.35 | 62.36 | 68.35 | 72.05 | 75.23 |
| F4 | 54 | 70.01 | 78.26 | 84.02 | 85.74 | 85.89 | 86.08 |
| F5 | 35 | 71.27 | 78.04 | 86.27 | 88.19 | 90.96 | 90.05 |
| F6 | 29 | 72.01 | 79.45 | 87.98 | 88.63 | 89.32 | 89.68 |
| F7 | 26 | 73.85 | 80.58 | 89.94 | 92.25 | 95.87 | 97.04 |
| F8 | 31 | 70.59 | 79.57 | 89.79 | 91.37 | 95.08 | 95.58 |
| F9 | 24 | 74.48 | 81.69 | 90.05 | 93.97 | 96.87 | 98.93 |

**Data as expressed as mean ± S.D. (n = 3)**

**3.10.   Kinetic data analysis of in-vitro herbal extracts release data of F7 and F9**

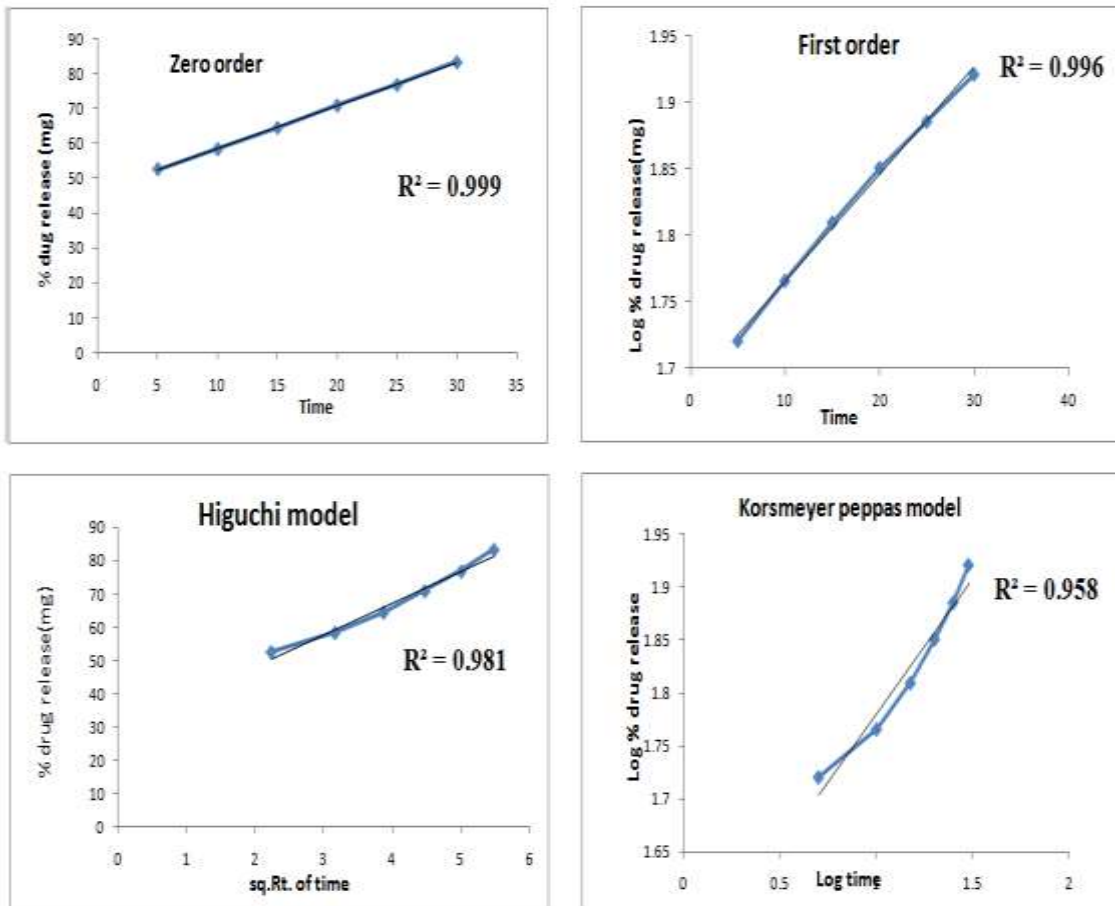| Formulation | Zero order $R^2$ | First order $R^2$ | Higuchi model $R^2$ | Korsemeyer peppas equation |
|:---:|:---:|:---:|:---:|:---:|
| F 7 | 0.999 | 0.996 | 0.981 | 0.958 |
| F 9 | 0.996 | 0.984 | 0.993 | 0.981 |



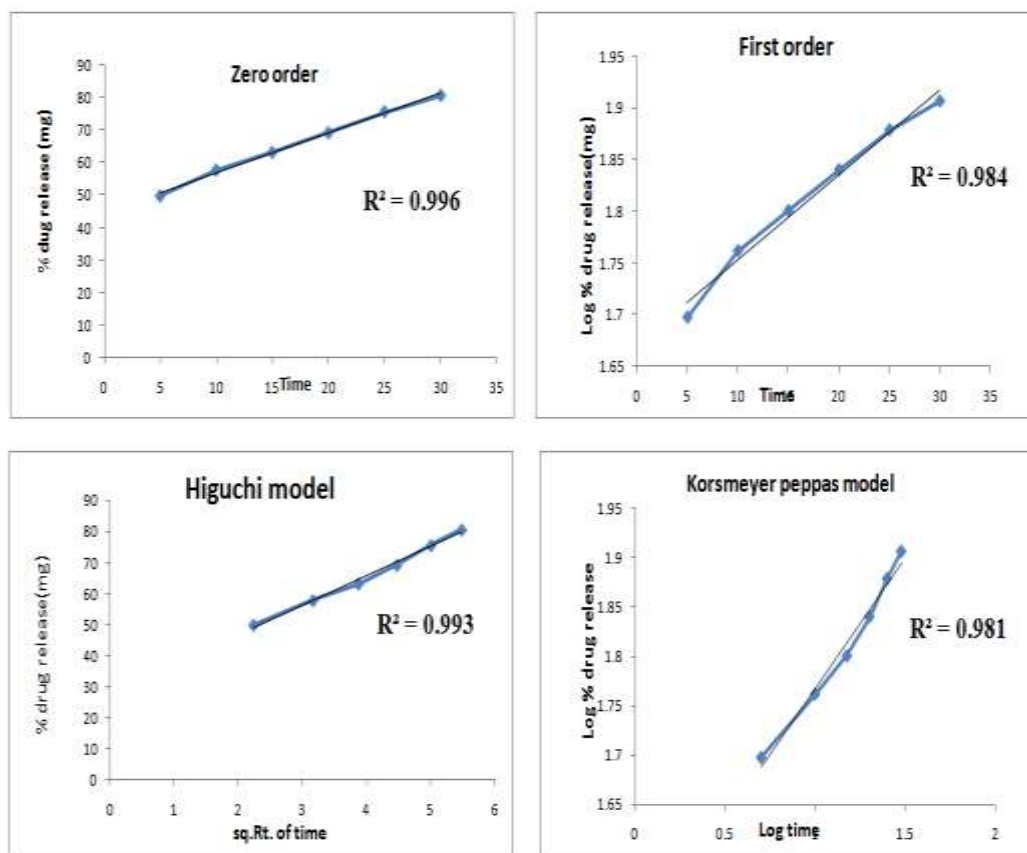**Fig.: Herbal extracts release kinetics of F7**

**Figure: Herbal extracts release kinetics of F9**

### 3.11.   Stability study of herbal fast disintegrating tablets:

| Parameter | Initial | 1 Month | 2 Month |
|---|---|---|---|
| Avg. weight   (mg) | 600 ± 0.82 | 601 ± 0.75 | 601 ± 0.98 |
| Hardness   (kg/cm2) | 3.8 ± 0.43 | 3.9 ± 0.52 | 3.9 ± 0.79 |
| Friability   (%) | 0.93 ± 0.35 | 0.94 ± 0.48 | 0.94 ± 0.43 |
| Disintegration time   (sec) | 24 | 25 | 25 |
| Wetting time (sec) | 23 | 25 | 26 |
| %  Content uniformity | 98.65 ± 0.43 | 98.78 ± 0.58 | 98.86 ± 0.67 |

**Data as expressed as mean ± S.D. (n = 3)**

**Table: Stability study of herbal fast disintegrating tablets**

## 4.      Discussion and Conclusion

Medicinal plants are considered to gold mine of components that are considered to be therapeutically active. These medicinal herbs are used since ancient time for treatment of many ailments. In most of the cases weather we are discussing traditional system of medicine, folklore practice or, Ayurveda combination of herbal components is one on of the widely used preparation. These preparations are intended to be used for treatment of various ailments and are considered to be polyherbal formulations.

Headache is one of the most common disorders in today's lifestyle. In this concern present study was designed to investigate analgesic potential of a polyherbal formulation consisting of three medicinal plant's extract that are reported to have good analgesic potential. *Salix alba L, Tinospora cordifolia, Achyranthes aspera, Cyprus rotundus, and Withania somnifera* were the medicinal plants that were selected for present study. A different combination of these medicinal plants plays an important role, providing synergistic activity against the disorders. Selected combination was fabricated to fast dissolving tablet and it was further evaluated and characterized on various parameters.

FDTs formulation containing 600 mg of all-herbal powder extract for headaches was the primary goal of this study, which included the development of FDTs containing excipients like Cross povidone, Citric acid monohydrate, Magnesium stearate, Beta-cyclo dextrin and Sodium starch glycolate as well as Talc as excipients. Fast disintegrating drug delivery system improved the bioavailability and therapeutic efficiency of herbal extract powder.

In the pre-formulation step, an FTIR analysis of pure herbal extract powder and excipients was performed. There hasn't been any interaction. As a result, it was discovered that herbal extracts powder is acceptable with excipients.

The direct compression method was used to prepare twenty-one batches of the formulation. The formulation angle of repose values ranges from 19.40±0.25 to 19.23 ±0.41. The compressibility index was calculated using bulk and tapped densities. Formulation bulk and tapped values vary from 2.74±0.14 to 2.66±0.82 and 3.31±0.56 to 3.21±0.29, consequently. For formulas, the car's index and Hausner's ratio values vary from 17.22±0.25 to 17.13±0.54 and 1.20±1.45 to 1.20±0.83, consequently. As a result, all of the formulations had good flow characteristics.

The thickness, weight variation, hardness, friability, and drug content consistency of the manufactured FDTs were all examined. Tablet thickness varied between 6.58±0.12 to 6.32±0.16 in all formulations. In all formulations, the weight variation of tablets ranged

from 574±3.25 to 600±0.82. All of the formulations F1-F9 had hardness and friability of 4.3±0.35 to 3.8±0.43 and 0.17±0.12 to 0.93±0.28, consequently. All of the formulations had drug content varying from 90.23±0.09 to 98.65±0.43. All of the formulations had different wetting times, varying from 23 sec to 134 sec.

Compared to all formulations F7 and F9 showed the best, the disintegration time for F7 and F9 were found to be 26sec and 24sec containing cross povidone, Citric acid monohydrate, Sodium bicarbonate, and Micro crystalline cellulose.

The manufactured tablets were then put through a dissolution test to see how well they released the medication in-vitro. The dissolution tests were performed at 37±0.5°C. in 0.1N HCl in a USP type-2 apparatus. The dissolution investigations revealed that the conc. of excipients had a significant impact on the herbal extracts release from the tablets. In comparison to the other formulations, F7 and F9 had better herbal extracts release and disintegration performances. It took 24 sec and 26 sec for this formulation to disintegrate.

The drug release followed zero-order kinetics followed by non-fickian diffusion in the F7 and F9 formulations, according to the kinetic analysis.

The formulation stability tests were carried out for two months at 45°C and 175 % RH. There was no discernible difference, according to the data.

According to the results of the study, F7 and F9 were the best formulations, with disintegration times of 26 sec and 24 sec, and drug release rates of 98.93 % and 97.04 % in 30 minutes, consequently. Yet, more in-vivo research can be done to back up the findings..

When compared to a Clove analgesic tablet [24], our herbal tablet has a disintegration time of 24 sec and a drug content of 98%, whereas the clove tablet has a disintegration time of 142 sec and a drug content of 95%.

When comparing the Diclofenac potassium fast dissolving tablet [27] to our five herbal extract tablets, the diclofenac potassium fast dissolving tablet dissolves in 25.33 sec with serious side effects, whereas our five herbal extract tablet dissolves in 24 sec with no or minor health consequences.

Overall, the FDTs are made from a combination of *Salix alba L, Tinospora cordifolia, Achyranthes aspera, Cyprus rotundus,* and *Withania somnifera* extract powder and excipients give a stable formulation that meets performance standards. In in-vivo studies, this formulation has strong analgesic promise for headaches.

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