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Formulation and In-vitro Evaluation of Paracetamol and Ibuprofen Immediate Release Tablets by Solid Dispersion Technique

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ABSTRACT
Paracetamol (PARA) and Ibuprofen (IBU) comes under BCS class II drugs basing on its low solubility and high permeability characteristics, these drugs having its oral bio availability is dissolution rate limited. The aim with an objective of this study was to formulate immediate release (IR) tablets by direct compression method by using solid dispersion technique to enhance dissolution rate of drugs (PARA and IBU). The IR tablets of PARA (500mg) and IBU (200mg) was prepared by using super disintegrants like cross providone and SSG. Dissolution enhancers like PVP K-30, PEG 4000, PVA, SLS, hydroxypropy β-cyclodextrin were used. Drug and excipients compatibility studies were carried out through FTIR analysis. FTIR studies revealed that there is no incompatibility between the drugs and different excipients used in the formulation of tables. All formulations were subjected to preformulation and post formulation studies. The powder mass of the tablet is evaluated by assessing precompressional parameter such as angle of repose (25.98-35.06θ), bulk density (0.254-0.318g/cc), tapped density (0.31-0.375g/cc), Hausner's ratio (1.11-1.75%) and Carr's compressibility index (6.1-15.5%). All the results are within the specifications and indicated that all formulations have good flow properties. The post compressional parameters of the tablet like hardness (3.3-4.9 kg/cm^2), friability (0.6-0.95%), Weight variation (894-906 mg), and thickness (3.96-4.88mm) are within the acceptable limits. The IR tablet was designed in such a way to achieve complete release of the dose within a 30 min. The drug content in all formulations was in the range 96.33-102.20% for PARA and 97.74-101.92% for IBU within the disintegration time (2-11mins). In vitro release studies were carried out in USP II paddle type dissolution apparatus for all formulations and the formulation F10 containing PARA (55.5%), IBU (22.2%), SSG (3.8%), SLS (11.1%) and cross providone (3.8%)gives best release profile (PARA and IBU released at the end of 5min is 80.6 & 72.6 respectively) due to their solubilizing capacity.
KEY WORDS: Direct compression method, Immediate release tablets, Ibuprofen, paracetamol, solid dispersion technique,

1. INTRODUCTION

Oral drug delivery is the most popular, desirable and widely accepted (upto 50-60%) route of administering therapeutic agents among all the routes that have been explored for systemic delivery of drugs in different dosage forms. Oral route is considered as most natural, simple, versatile, uncomplicated, convenient and safe due to its ease of administration, patient acceptance and convenience and cost effective manufacturing process.

Physical problems with swallowing (dysphasia) can occur at any age group of patients particularly in geriatric, pediatric and psychiatric patients (1,2) and also require quick onset of action in particular therapeutic condition and consequently IR of medicament is required. (3)

Tablets are defined as solid unit dosage forms containing medicament and excipients compressed or molded into solid cylindrical shape having either flat or biconvex surfaces.

Based on the desired therapeutic efficacy, oral DDS may be divided into three categories (1-3); Immediate, Controlled and Targeted release preparations. Among these 3, IR formulations provide clinically effective therapy while maintaining the required balance of pharmacokinetic and pharmacodynamic profiles with an acceptable level of safety to the patient. In this formulations should dissolve or disintegrate in the stomach within a short period when compared to other types (4, 5).

Excipients are the inert substance used in the pharmaceutical preparations. Excipients used for tablets includes various sub-groups such as diluents or fillers, binders or adhesives, disintegretes, lubricants, glidants or flavours, fragrances and sweeteners (6, 7).

There are three different methods for preparation of tablet. They are direct compression, wet granulation and dry granulation method. Among these 3, direct compression method is used to formulate tablets (8). Tablets prepared by direct compression method fastly disintegrate into individual drug particles instead of granules that directly come

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into contact with dissolution fluid and exhibits faster dissolution and bio availability when compared to wet granulation method.

Most of the drugs oral bio availability is dissolution rate limited and hence various approaches like Solvent Deposition / Evaporation , solid dispersion technique are used to increase solubility, dissolution rate and bio availability of the drug. Among all the approaches solid dispersion technique is majorly preferred technique to formulate tablets (9, 10).

Solid dispersion is defined as a dispersion of active ingredients in an inert carrier prepared by the melting (fusion), solvent or melting solvent method. In solvent method, drug and polymers are dissolved in little amount of solvent and solvent is removed by evaporation under reduced pressure (11).

PARA and IBU comes under NSAIDs act as non-selective inhibitors of the enzyme cyclooxygenase (COX), inhibiting both the (COX-1) and (COX-2) isoenzymes involved in prostaglandin (PG) synthesis. Paracetamol having analgesic, antipyretic action, they inhibit cyclooxygenase enzyme involved in prostaglandin (PG) synthesis but not in peripheral tissue but Ibuprofen inhibit prostaglandin (PG) synthesis in peripheral tissue so in this research combination of Paracetamol and Ibuprofen were used for analgesic, anti-pyretic and anti-inflammatory action simultaneously.

2. MATERIALS AND METHODOLOGY

2.1 MATERIALS

In this present research ,the paracetamol ibuprofen IR tablets were prepared by using solid dispersion tech. paracetamol and ibuprofen pure drugs were purchased from Divis Pharma Pvt. Ltd.potassium dihydrogen phosphate, sodium hydroxide, sodium starch glycolate, poly vinyl alcohol, SLS, PVP K 30, Lactose were purchased from Loba Chemie Pvt. Ltd. β- Cyclodextrin and MCC were obtained from Merck Pvt. Ltd.; PEG 4000 was obtained med from Oxford Laboratory. Talc was from Molychem.

2.2 Preparation of pH 5.8 Phosphate Buffer

Add 250mL of 0.2M [27.218 in 1000ml] Potassium di hydrogen phosphate and 18mL of 0.2M [8g in 1000ml] Sodium hydroxide and make volume up to 1000ml with Distilled water this gives 1000ml of 5.8 phosphate buffer.

2.3 Preparation of pH 7.2 Phosphate Buffer

Add 250ml of 0.2M [27.218 in 1000ml] Potassium dihydrogen phosphate and 173.5ml of 0.2M [8g in 1000ml] Sodium hydroxide and make volume up to 1000ml with Distilled water this gives 1000ml of 7.2 phosphate buffer.

2.4 Construction of calibration curve for paracetamol and Ibuprofen in Phosphate Buffers

Paracetamol (10mg) was dissolved in 10ml of methanol and the volume was made upto 100ml mark with 5.8 phosphate buffer. From this stock solution, aliquots of 0.4, 0.6, 0.8, 1 and 1.2ml were withdrawn and diluted upto 10ml in volumetric flask to give concentrations of 4, 6, 8, 10 and 12µg/ml. Absorption of each solution was measured at 257.00 nm using UV Visible double beam spectrophotometer and 5.8 phosphate buffer as a reference standard. The same procedure was repeated for Ibuprofen using pH 7.2 buffers and analyzed at 222nm.

3. Preparation of Paracetamol and Ibuprofen IR Tablets

The tablet was prepared by the direct compression method using tablet punching machine in 12.5 mm die. The required quantities of paracetamol, ibuprofen, lactose, cross providone, MCC, SLS, PVP, SSG, PEG, PVA then finally magnesium state and talc were added. The compositions used in this study were tabulated in table 1. The physical mixtures were prepared by geometric mixing method. The product was collected and triturated thoroughly for uniform mixing. Powder equivalent to 900 mg of paracetamol and ibuprofen was accurately weighed and filled in the die cavity and tablets were compressed. (14, 15, 16)

4. METHODOLOGY

4.1 Preformulation studies

Preformulation testing is the initial step in the development of novel dosage forms. It can be defined as investigation of physical and chemical properties of a drug substance alone and when combined with exicipients. The objective of preformulation studies is to generate information useful to the formulator in developing stable and bio available dosage forms which can be mass produced(12, 13).

The API was tested for the following properties:

a) Determination of melting point

Melting point of Paracetamol and ibuprofen was determined by capillary method. Fine powder of Paracetamol and Ibuprofen was separately filled in a glass capillary tube (previously sealed on one end). The temperature at which the drug starts melting was noted and recorded.

b) Solubility

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The solubility of Paracetamol and Ibuprofen was determined by using various solvents.

c) Drug- excipients Compatability studies

Compatability studies was carried out in order to establish, that there would be no interaction between the drug and Excipients (eg: polymers) used in the formulation. These studies were carried out by FT-IR spectroscopy. FTIR spectroscopy studies were performed at wavelength ranging from 4000 cm^{-1} to 400 cm^{-1} is shown in Figures: 1.

5. Evaluation of Paracetamol and Ibuprofen Powder Blend

5.1 Angle of repose

The angle of repose of powder blend was determined by the funnel method. Accurately weighed powder blend was taken in the funnel. The height of the funnel was adjusted in such a way the tip of the funnel just touched the apex of the powder blend (17). The powder blend was allowed to flow through the funnel freely on to the surface.Flow Properties and Corresponding Angles of Repose was given in table 3.The diameter of the powder cone was measured and angle of repose was calculated using the formula

$$\mathbf{Tan\ \theta = h/r,\ \theta = tan^{-1}\ h/r}$$

Where θ = angle of repose, h = height, r = radius

5.2 Bulk Density

a) Loose Bulk Density (LBD)

Weigh accurately 5gms of lubricated powder blend which was previously passed through 20 # sieve and was transferred into 50mlgraduated cylinder. Powder was carefully leveled without compacting, and read the unsettled apparent volume (Vo). Apparent bulk density in gm/ml was calculated by the following formula:

Loose bulk density (LBD) = Weight of powder/ Bulk volume

b) Tapped bulk density (TBD)

Weighed accurately 5gms of lubricated powder blend which was previously passed through 20# sieve was transferred in 50mlgraduated cylinder. Then the cylinder containing the sample was mechanically tapped by raising the cylinder and allowing it to drop under its own weight using mechanically tapped density tester that provides a fixed drop of 14 ±2 mm at a nominal rate of 300 drops per minute. Cylinder was tapped for 500 times initially and then measured the tapped volume (V1) to the nearest graduated units, tapping was repeated for an additional 750 times and tapped volume (V2) was measured to the nearest graduated units. If the difference between the two volumes is less than 2% then final the volume (V2) should be taken. Calculate the tapped bulk density in gm/ml by the following formula:

Tapped bulk density (TBD) = Weight of powder/ Tapped volume

5.3 Compressibility Index

The compressibility index is measure of the propensity of the powder to be compressed. As such, they are measures of the relative importance of inter-particulate interactions. Effect of Carr's Index and Hausner's Ratio on flow property was checked.The compressibility index is calculated using measured values for bulk density (D_b) and tapped density (D_t) as follows.

$$\mathbf{Compressibility\ Index = [D_t\text{-}D_b/D_t x\ 100]}$$

5.4 Hausner's Ratio

The Hausner's ratio is a number that is correlated to the flow ability of a powder or granular material.

Hausner's Ratio = TBD / LBD

6. EVALUATION OF TABLETS

6.1. General appearance

The formulated tablets were assessed for its general appearance and observations were made for shape, color, texture and odour.

5.2. Thickness

The tablet thickness is determined by the diameter of the die, the amount of fill permitted to enter the die and the force or pressure applied during compression. The thickness of the tablet may be measured manually or by automatic equipment. The thickness of the tablets was measured by Vernier calipers. It is expressed in mm.

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5.3. Hardness

Hardness of the tablet was determined by using the Monsanto hardness tester. The lower plunger was placed in contact with the tablet and a zero reading was taken. The plunger was then forced against a spring by turning a threaded bolt until the tablet fractured. As the spring was compressed a pointer rides along a gauge in the barrel to indicate the force.

5.4. Weight Variation

20 tablets were selected and weighed collectively and individually. From the collective weight, average weight was calculated. Each tablet weight was then compared with average weight to ascertain whether it was within the permissible limits or not. Not more than two of the individual weights deviated from the average weight by more than 5% for 850 mg tablets and none by more than double that percentage.USP limits for weight variation was tabulated in table 4.

5.5. Friability test

20 previously weighed tablets were placed in the roche friabilator apparatus, which was given 100 revolutions at 25 rpm. The tablets were de- dusted and reweighed. By using the following formula calculate the % friability express the loss of weight and it should be not more than 1 % w/w of the tablets is being tested.

Percentage friability = [initial weight-final weight /initial weight × 100]

% Friability = [(Wo – Wf) / Wo] x 100

Wo – initial weight of tablets, Wf – final weight of tablets.

5.6. Disintegration test

The USP device to rest disintegration was six glass tubes that are "3 long, open at the top, and held against 10" screen at the bottom end of the basket rack assembly. One tablet is placed in each tube and the basket rack is poisoned in 1 liter beaker of distilled water at 37± 2 ℃, such that the tablets remain below the surface of the liquid on their upward movement and descend not closer than 2.5cm from the bottom of the beaker (18).

5.7. Drug content

The tablets were powdered, and 100 mg equivalent weight of Paracetamol was accurately weighted and transferred into 100 ml volumetric flask. To this 5 ml of alcohol was added and shaken for 10 min. Thereafter, the volume was made upto 100 ml with 5.8 pH buffer (18). Subsequently, the solution in volumetric flask was filtered and 1 ml of the filtrate was diluted and analyzed at 275nm using UV-visible spectrophotometer. The same procedure was repeated for Ibuprofen using pH 7.2 buffers and analyzed at 222nm.

5.8 In Vitro Dissolution Studies of Paracetamol and Ibuprofen IR Tablets

The dissolution rate testing of different paracetamol and ibuprofen formulations and tablets was studied using USP type-II dissolution rate testing apparatus, (paddle type) (LAB INDIA DISSO 2000). The paddle was rotated at a speed of 50 and 100 rpm and the dissolution fluid (900 ml pH 5.8 and 7.2 Phosphate buffer) was maintained at a temperature of $37.5^0 \pm 0.5\ ^0$C. At specific time intervals a 5 ml aliquot of dissolved medium was withdrawn and was replaced with fresh quantity of dissolution medium. The samples were suitably diluted with dissolution medium and assayed for paracetamol and ibuprofen content by measuring the absorbance at 257 and 222nm using U.V Spectrophotometer (19). The dissolution parameters were tabulated. The percent of paracetamol and ibuprofen dissolved at various time intervals was calculated and plotted against time.

6. RESULTS AND DISCUSSION

Preparation of PARA and IBU IR tablets

The PARA and IBU IR tablets were prepared by using formulation as given in the table 1.The IR tablets were prepared by using various excipients like SSG, SLS, PVP, PEG

6.1. Preformulation Studies

a) Determination of Melting Point

Melting points of Paracetamol was found to be 169^0cand the melting point of Ibuprofen was found to be in the range of $75\text{-}77^0$c as reported in literature, thus indicating purity of the drug sample as any impurity if present will cause variations in the melting point of a given drug substance.

b) Solubility

Paracetamol- freely soluble in acetone, alcohol and methanol and insoluble in water.

Ibuprofen - freely soluble in acetone, chloroform and methanol and practically insoluble in water.

II. Compatibility

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FT-IR studies

An FTIR spectroscopy study was carried out separately to check the compatibility between the drugs (PARA and IBU) and the excipients used for the preparation of tables. The spectra obtained from FTIR spectroscopy studies at wavelength ranging from 4000 cm^{-1} to 400 cm^{-1} are shown in Figures: 1(A-D). The drugs (PARA and IBU) shows characteristics peaks at 3624.40 cm^{-1} (O-H Stretching and 3319.15 cm^{-1} (N-H stretching) wave number showed in figure: 1(A &B). The spectra obtained for PARA and IBU well retained in physical mixtures shown in figure:1(D) indicates that there is no incompatibility between drugs and excipients used in the tablets.

6.3. Evaluation of Powder drug

Micromeritic Properties

The results of the micromeritic properties of prepared formulations are given in the table 3 on observation of the results, it is concluded that the formulations are having good micromeritic properties needed for compressing into tablets.

6.3.1. Angle of Repose (θ)

The values obtained for angle of repose all (F1- F10) formulations are tabulated in Table: 3. All formulation has value in the range of 25.98 to 35.06. This indicates good flow property of the powder blends.

6.3.2. Density

a) Loose bulk Density (LBD)

The values obtained for loose bulk density of (F1-F10) formulations are given in Table: 3. LBD value of all (F1-F10) formulations ranges between 0.254- 0.318 which indicates good flow property.

b) Tapped bulk density (TBD)

The values obtained for tapped bulk density of all (F1-F10) formulations are in Table: 3. TBD value of all (F1-F10) formulations ranges between 0.31-0.375.

6.3.3. Carr's compressibility index

The values obtained for compressibility index for all (F1-F17) formulations are tabulated in Table: 3. Compressibility index of all formulations (F1-F17) was found between 6.1% - 15.5% indicating that the powder blends have good flow property.

6.3.4. Hausner's Ratio

The values obtained for Hausner's ratio for all (F1-F10) formulations are in Table: 3. Hausner's ratio value of all (F1-F10) ormulations ranges between 1.11 - 1.75 indicating that the powder blends have good flow property.

7. Evaluation of Paracetamol Ibuprofen IR Tablets

The tablets prepared by the direct compression method were evaluated for the following tests listed in table 4. All the post compression parameter results such as hardness (3.3-4.9 kg/cm^2), friability (0.6-0.95), Weight variation (894-906 mg), and thickness (3.96-4.88mm) are within the limits as specified.

7.1. Drug Content

Table 5 shows the result of percent drug content and disintegration time for all the formulations. The drug content was found to be in acceptable range for all the formulations. % Drug content in all ten formulations was in the range 96.33 – 102.20% for Paracetamol and 97.74-101.92% for Ibuprofen. The formulation F10 containing super disintegrants like SSG and Cross providone along with high concentration of SLS gave superior drug release with in 2mins when compared to other formulations. Even better drug release was observed than the marketed product (Combiflam tablets SANOFI) having the disintegration time of 2.38mins. The disintegration time for all ten formulations was in the range 2-11min.

7.2. Dissolution study

The percent of paracetamol and ibuprofen dissolved at the various time intervals was calculated and plotted against time. Graphical plots of percent paracetamol and ibuprofen dissolved versus time in figure 3. All dissolution studies were carried out in triplicate. The formulations F7, F8 containing PVP, PVA, PEG 4000 gave less dissolution values at the end of 5mins is 68 & 66.5. The cumulative % of paracetamol and ibuprofen released at the end of 5min is 80.6 & 72.6, for F10 respectively. Complete drug release from F10 is significantly higher i.e., about 85% of drug was released when compared to other formulations. In f10 formulation, MCC, SSG, cross providone, SLS (solubilizing agent) were added to the formulation gave superior dissolution properties when compared to other formulations.

CONCLUSION

The goal of the present study was to organize an efficacy and cost-effective method to formulate PARA and IBU IR tablets by using direct compression method to increase their dissolution efficiency and leads to improve its bio availability. The IR tablets of PARA and IBU in combination were prepared and evaluated. The formulation F10

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containing super disintegrants like SSG and Cross providone along with high concentration of SLS gave superior drug release when compared to other formulations even better than the marketed product (Combiflam tablets SANOFI). This can serve as a novel approach for anti antipyretic, anti inflammatory, analgesic treatment.

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CONFLICT OF INTEREST: The authors declare that they have no conflict of interest.

Abbreviations:

PARA- Paracetamol, IBU- Ibuprofen, IR -Immediate release, Na CMC - Sodium carboxy methyl cellulose, SLS - Sodium Lauryl Sulfate, PVP K 30 -Poly vinyl pyrrolidone, SSG - sodium starch glycolate, MCC - micro crystalline cellulose, PVP - poly vinyl alcohol, PVA – Poly vinyl alcohol, FT-IR - Fourier transform infrared spectroscopy.

TABLES

Table: 1 Composition for PARA and IBU IR tablets

S.NO	INGREDIENTS (%)	F1	F2	F3	F4	F5	F6	F7
1	Paracetamol	55.5	55.5	55.5	55.5	55.5	55.5	55.5
2	Ibuprofen	22.2	22.2	22.2	22.2	22.2	22.2	22.2
3	Lactose	16.6	11.1	11.1	11.1	8.8	2.2	-
4	Microcrystalline cellulose	4.4	10	7.7	3.3	3.3	3.3	3.3
5	PVP K30	-	-	4.4	4.4	4.4	4.4	3.3
6	Sodium Starch Glycolate	-	-	-	1.1	2.2	3.3	3.3
7	Cross providone	-	-	-	1.1	2.2	3.3	3.3
8	Hydroxypropy β-Cyclodextrins	-	-	-	-	-	4.4	3.3
9	PEG 4000	-	-	-	-	-	-	4.4
10	Polyvinyl Alcohol	-	-	-	-	-	-	-
11	Sodium Lauryl Sulfate	-	-	-	-	-	-	-
12	Magnesium stearate	0.5	0.5	0.5	0.5	0.5	0.5	0.5
13	Talc	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Continue table

S.NO	INGREDIENTS (%)	F8	F9	F10	F11	F12	F13	F14
1	Paracetamol	55.5	55.5	55.5	55.5	-	-	-
2	Ibuprofen	22.2	22.2	22.2	-	22.2	-	-
3	Lactose	-	-	-	-	-	-	-
4	Microcrystalline cellulose	3.3	2.2	2.2	-	-	-	-
5	PVP K30	3.3	-	-	-	-	-	-
6	Sodium Starch Glycolate	3.3	5.5	3.8	-	-	-	-
7	Crosspovidone	3.3	5.5	3.8	-	-	-	-
8	Hydroxypropyβ-Cyclodextrins	3.3	-	-	-	-	-	-
9	PEG 4000	-	-	-	-	-	-	-
10	Polyvinyl Alcohol	4.4	-	-	-	-	-	-
11	Sodium Lauryl Sulfate	-	7.7	11.1	-	-	-	-

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12	Magnesium stearate	0.5	0.5	0.5	-	-	-	-
13	Talc	0.5	0.5	0.5	-	-	-	-
14	Pure drug(F11 and F12)						-	-
15	Marketed tablets(F13 and F14)				-	-		

Table: 3 Pre-compression Parameters

S.NO	Formulation code	Angle of repose(θ) (mean±S.D)	Bulk density (g/cc) (mean±S.D)	Tapped density(g/cc) (mean±S.D)	Carr's index(%) (mean±S.D)	Hausner's ratio (mean±S.D)
1	F1	33.52±1.03	0.289±0.023	0.344±0.03	14.9±1.25	1.75±0.4
2	F2	30.23±1.258	0.309±0.021	0.348±0.012	12.5±1.4	1.74±0.3
3	F3	32.09±0.661	0.296±0.012	0.321±0.02	9.2±0.20	1.08±0.03
4	F4	27.74±1.364	0.293±0.023	0.316±0.023	6.1±0.20	1.32±0.09
5	F5	26.26±0.642	0.312±0.032	0.375±0.012	15.5±0.66	1.16±0.02
6	F6	35.06±1.00	0.295±0.014	0.342±0.021	13.3±0.98	1.12±0.02
7	F7	25.98±1.978	0.307±0.032	0.370±0.021	11.8±0.55	1.18±0.04
8	F8	33.83±0.615	0.281±0.041	0.324±0.012	8.05±0.56	1.23±0.15
9	F9	26.31±0.970	0.318±.021	0.347±0.024	7.2±0.3	1.23±0.15
10	F10	28.55±0.576	0.254±0.041	0.31±0.012	7.4±0.34	1.11±0.01

Table: 4 Post Compression Parameters

Formulations	Thickness(mm) (mean±S.D)	Hardness(kg/cm^2) (mean±S.D)	%Friability (mean±S.D)	Weight variation (mg) (mean±S.D)
F1	4.77±0.180	3.39±0.234	0.8±0.03	901.66±2.886
F2	4.88±0.120	4.9±0.1	0.9±0.01	894.66±4.509
F3	4.51±0.117	4.5±0.16	0.7±0.15	906.33±2.081
F4	4.59±0.375	4.3±0.1	0.86±0.05	902±2
F5	4.19±0.282	4.7±0.11	0.82±0.03	898±2.645
F6	3.96±0.068	4.59±0.108	0.72±0.04	900.33±1.527
F7	4.99±0.105	4.6±0.25	0.75±0.06	896.66±3.214
F8	4.17±0.125	4.4±0.28	0.9±0.03	902±2
F9	4.82±0.230	4.2±0.1	0.6±0.20	901±2.645
F10	4.736±0.267	4.07±0.04	0.95±0.015	905.66±2.081

Table:5 Evaluation of Compressed tablets

Formulations	Disintegration time(min)	%Drug content	
		Paracetamol	Ibuprofen
F1	11.11±0.950	97.83±1.258	97.74±0.653
F2	9.033±0.510	96.33±1.527	98.58±0.522
F3	6.78±0.2910	101±1	99.04±1.002
F4	4.44±0.1824	99.18±0.737	101.92±0.138
F5	4.563±0.305	102.1±1.044	98.85±0.789
F6	3.226±0.294	98.33±2.081	99±1
F7	3±0.2	102.20±2.03	97.88±0.835
F8	3.34±0.295	104±1	101.37±1.515
F9	2.38±0.13	99.18±0.737	99.14±0.271
F10	2.04±0.173	100.16±1.267	100.81±1.59
F13 & F14	3.56±0.52	99.93±1.34	101.90±1.34

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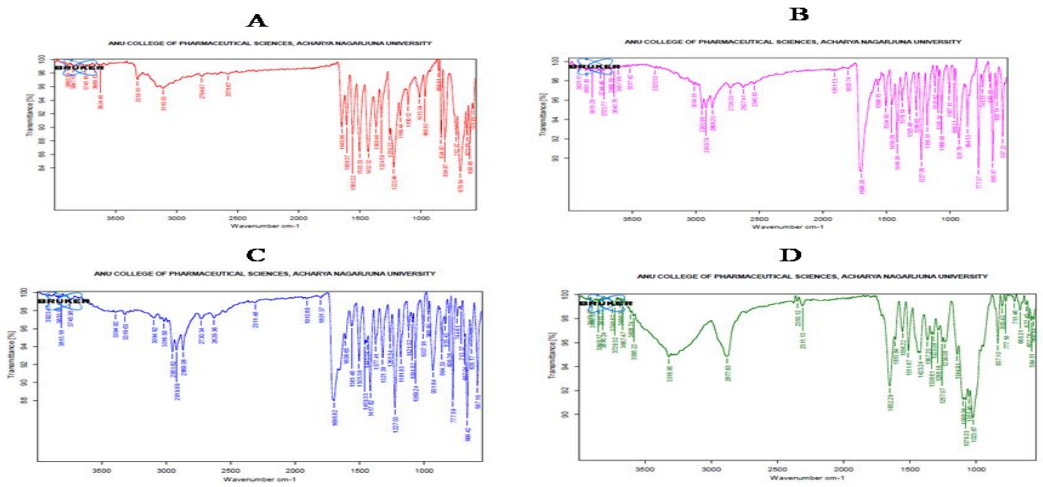

Figure 1: FT-IR Spectra of A-Paracetamol, B- Ibuprofen, C-paracetamol and ibuprofen, D-drugs with all Formulation Excipients

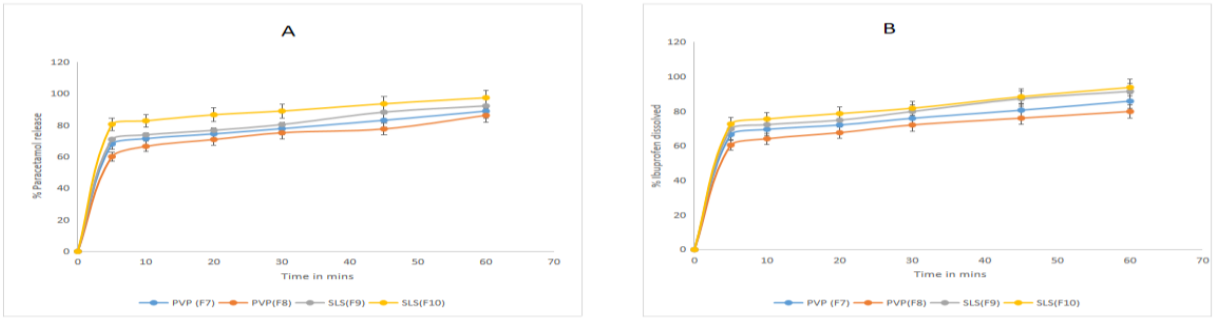

Figure 3 Comparative in vitro drug release profile of PARA and IBU from tablets (A) Effect of surfactant on paracetamol release (B) Effect of surfactant on ibuprofen release

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