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Article

Isolation and preliminary evaluation of *Mulva Neglecta* mucilage: a novel tablet binder

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The aim of this study was to evaluate binding potential of *Mulva neglecta* mucilage (MNM) with subsequent comparison to PVP K30. Eight batches of Diclofenac sodium tablets were prepared by wet granulation technique keeping different concentrations (4, 6, 8 & 10% w/w) of *Mulva neglecta* mucilage (extracted from leaves of *Mulva neglecta*) and PVP K30 as standard binder. The granules of formulated batches showed bulk density (g/mL) 0.49 ± 0.00 to 0.57 ± 0.00, tapped density (g/mL) 0.59 ± 0.01 to 0.70 ± 0.01, Carr's index 09.27 ± 0.95 to 19.65 ± 0.59, Hausner's ratio 1.12 ± 0.00 to 1.24 ± 0.01 and angle of repose 30.37 ± 2.90 °C to 36.86 ± 0.94 °C. Tablets were compressed to hardness 7.50 to 7.95 kg/cm^2. The tablets showed 0.39 ± 0.02 to 0.39 ± 0.01% friability and 7:20 to 14:00 min disintegration time. Granules and post-compression evaluation revealed that parameters assessed were all found to be within the pharmacopoeial limits. The results (hardness, disintegration and dissolution) proved that *Mulva neglecta* mucilage has better binding capacity for preparation of uncoated tablet dosage form as compared to PVP K30. Among all the formulations, MN-1 to MN-4 showed slow release as compared to PV-1 to PV-4 and thereby *Mulva neglecta* mucilage exhibited satisfactory drug release phenomenon tablets of diclofenac sodium.

Uniterms: *Mulva neglecta*/mucilage. *Mulva neglecta*/use as binder. Binders. Diclofenac sodium/tablets/drug release.

O objetivo deste estudo foi avaliar o potencial de ligação de mucilagem de *Mulva* neglecta (MNM), com posterior comparação ao PVP K30. Oito lotes de comprimidos de diclofenaco de sódio foram preparados pela técnica de granulação úmida, mantendo diferentes concentrações (4, 6, 8 e 10% w/w) de mucilagem de *Mulva neglecta* (extraída de folhas de *Mulva neglecta*) e PVP K30 como ligante padrão. Os grânulos de lotes formulados mostraram densidade aparente (g/mL) 0.49 ± 0.00-0.57 ± 0.00, densidade compactada (g/mL) 0.59 ± 0.01-0.70 ± 0.01, índice de Carr 09.27 ± 0.95-19.65 ± 0.59, a relação de Hausner 1.12 ± 0.00-1.24 ± 0.01 e ângulo de repouso 30.37 ± 2.90 °C a 36.86 ± 0.94 °C. Os comprimidos foram prensados à dureza de 7.50-7.95 kg/cm^2. Os comprimidos apresentaram 0.39 ± 0.02-0.39 ± 0.01% friabilidade e 7:20-14:00 min de tempo de desintegração. A avaliação de grânulos e pós-compressão revelou que todos os parâmetros estavam dentro dos limites da farmacopeia. Os resultados (dureza, desintegração e dissolução) provaram que a mucilagem de *Mulva neglecta* tem maior capacidade de ligação na preparação da forma de dosagem de comprimido não revestido em relação à PVP K30. Entre todas as formulações, MN-1 e MN-4 mostraram liberação lenta em comparação com PV-1 e PV-4 e, assim, a mucilagem de *Mulva neglecta* exibiu liberação do fármaco satisfatória para os comprimidos de diclofenaco de sódio.

Unitermos: *Mulva neglecta*/mucilagem. *Mulva neglecta*/uso como aglutinante/avaliação. Aglutinantes. Diclofenaco de sódio/comprimidos/liberação do fármaco.

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INTRODUCTION

Natural plant drugs and excipients have gained attractiveness over synthetic materials due to their non-toxic nature, free availability and low cost (Zohra *et al.,* 2012). Mucilages are widely used in pharmaceutical preparations as thickening, disintegrating, binding, suspending, emulsifying, gelling and stabilizing agents (Malviya *et al*., 2010). *Mulva neglecta* Wallr. (Mulvaceae), commonly known as Mallow and locally 'Sonchal' in Mansehra, Pakistan. This is a perennial plant having leaves very shallowly lobed, crenate and pilose (Akcin, Ozbucak 2006; Shah, Khan, 2006). The plant is used as food and to treat acne, broken bones, dermatitis, burns and throat infection (Imtiaz *et al*., 2012). Diclofenac sodium is a non-steroidal anti-inflammatory drug (NSAID), which is poorly soluble in water and freely soluble in organic solvent like methanol. It is commonly used as analgesic, antipyretic, anti-inflammatory for the long-term treatment of rheumatoid arthritis. Its structure is shown in Figure 1 (Ganesh *et al*., 2010).

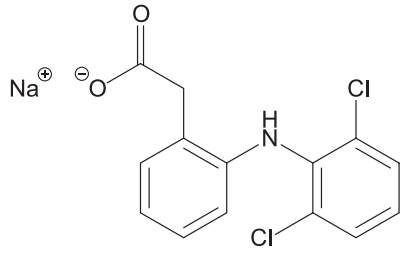

FIGURA 1 - Chemical structure of diclofenac sodium.

In view of the easy availability of plant, the mucilage from the leaves of the plant was investigated for its use in tablets formulation and evaluates its efficiency as binder.

MATERIAL AND METHODS

Material

Diclofenac sodium, Avicel pH 101, Aerosil, magnesium stearate and PVP K30 were provided by Prays Pharmaceuticals (Pvt) Ltd, Islamabad, Pakistan. *Mulva neglecta* mucilage was extracted from leaves of plant (*Mulva neglecta*).

Extraction of the mucilage

Fresh *Mulva neglecta* plants (10 kg) were purchased from local market. The plant was identified by Prof. Dr. Jehandar Shah, Ex-Vice Chancellor, Shaheed Benazir Bhutto University, Sheringal (Dir Upper) Khyber Pakhtunkhwa, Pakistan. The specimen sample (PM-06-12) was kept in Department of Pharmacy, University of Malakand, Chakdara, Dir Lower, Khyber Pakhtunkhwa, Pakistan. The fresh leaves of the plant were collected, washed with water to remove dirt and debris, and dried. The powdered leaves were soaked in water for 4-5 h, boiled for 30 min and then kept aside for 1 h for complete release of the mucilage into water. The material was squeezed, to remove extraneous materials, by straining through a muslin cloth. The mucilage was then precipitated from the solution using absolute acetone. The precipitate was separated, dried in oven at 50 °C and stored in tightly closed container for future use in tablets formulations.

Preliminary phytochemical of mucilage

The phytochemical properties for the presence of carbohydrates, proteins, flavonoids, sterols, alkaloids, tannins, saponins, resins, phenols and terpenoids were determined as per standard tests (Cokate, 2010).

Physicochemical characterization

The isolated mucilage was evaluated for solubility in water, acetone, chloroform and ethanol in accordance with the official monograph specifications, swelling index, loss on drying, total ash and acid-insoluble ash determination (Patel *et al*., 2012).

Toxicity studies of *Mulva neglecta* mucilage

Toxicity studies were carried out according to the method of Knudsen and Curtis. The animals used in the toxicity studies were sanctioned by the Experimental protocols were in compliance with "Animals Byelaws 2008 of the University of Malakand". Ethical Committee of the Department of Pharmacy, University of Malakand approved the experimental protocols. The male albino rats of Wistar strain with average weight of 160-200 g were divided into different groups comprising of six animals in each group. The control group received normal saline 20 mL/kg intraperitoneal (i.p). The other groups received 500, 1000, 2000, 3000 and 4000 mg/kg of mucilage suspension in normal saline orally. The animals were observed continuously for the behavioral changes for the first 4 h and then observed for mortality for 48 h (Shah, Patel, 2010).

Preparation and evaluation of granules

The compositions of tablets are given in Table 4. Diclofenac sodium and Avicel pH 101 were thoroughly mixed and the solutions of the mucilage and PVP K30 (prepared by dispersing the mucilage and PVP K30 in water) of different concentrations (4, 6, 8 & 10% w/w) were used for moistening the powder mixture to prepare tablets. The wet mass was then passed through sieve No. 16 and dried at temperature not exceeding 60 °C in hot air oven up to LOD NMT 5%. The dried granules were re-sieved through sieve No. 20. The same procedure was followed for preparation of granules using PVP K30 as binder.

Bulk density

Granules of known weight were poured in 10 ml graduated cylinder, bulk volume (V_0) was noted and bulk density was calculated (g/cc) by the given formula (Ganesh, Sureshkumar *et al*. 2010):

$$\text{Bulk Density} = \frac{\text{Weight of granules}}{\text{Bulk volume}}$$

Tapped density

The graduated cylinder (10 ml) containing known weight of granules was tapped on a hard surface until no further change in volume was observed. The tapped volume (V_T) was noted and tapped density was calculated by putting values in formula, Weight of granules/ V_T (Ganesh *et al*., 2010).

Compressibility index

It was determined by Carr's compressibility index, by formula:

$$\text{Compressibility index} = \frac{T_d - B_d}{T_d} \times 100$$

where T_d is tapped density and B_d is bulk density.

Hausner's ratio

It is the ratio of tapped density to bulk density and was calculated by the following formula (Chakraverty, 2011):

$$\text{Hausner's ratio} = \frac{T_d}{B_d}$$

where T_d is tapped and B_d is bulk density.

Angle of repose (°)

It was determined by filling 10 g of powder in a funnel. Then the funnel was opened to release the powder on the paper to form a conical heap. The values were calculated by the given formula (Chakraverty, 2011).

$$\tan\theta = \frac{h}{r} \quad \text{or} \quad \theta = \tan^{-1}\frac{h}{r}$$

Compression of Granules/ Preparation of tablets

The granules were then into tablets using rotary machine (ZP19 Rotary Tablet Press, Shanghai, China).

Evaluation of tablets

Thickness

The thickness of a tablet can vary without any change in its weight. This is generally due to the difference of density of granules, pressure applied for compression and the speed of compression. The thickness of the tablets was determined by using a Digital Caliper (Shingala *et al*., 2010).

Uniformity of weight

Twenty tablets were weighed by analytical balance (Sartorius BL 2105, Germany) after compression, then average weight and standard deviation was determined. Then determine the percentage of weight variation of each tablet by using following formula (Rahim *et al*., 2014).

$$\text{Percentage of weight variation} = \frac{\text{Average weight} - \text{Individual weight}}{\text{Average weight}} \times 100$$

Drug contents determination

Tablets (10) were accurately weighed and powdered. Powder amount equivalent to 50 mg diclofenac sodium was shaken with 60 mL of methanol in a 200 mL volumetric flask and final volume was make up with methanol, 5 mL of this solution was further diluted to 100 mL with methanol and absorbance was measured using spectrophotometer (UV-1601 Shimadzu, Japan) at 276 nm. The content was determined by preparing same concentration of sodium diclofenac in the same solvent and absorbance was measured at 276 nm. The % content was determined by formula (Rahim *et al*., 2014):

$$\%\ \text{Drug content} = \frac{\text{Absorbance of sample} \times \text{Average weight of tablet}}{\text{Absorbance of standard} \times \text{weight of sample}} \times 100$$

Friability

The friability of tablets was determined using Roche Friabilator. Ten tablets were initially weighed (W_1) and

transferred into the friabilator. The friabilator was operated at 25 rpm for 4 min, or alternatively was run up to 100 revolutions. The tablets were weighed again (W_2) and the % friability was calculated (Chakraverty, 2011).

$$\%\text{Friability} = \frac{(W_1 - W_2)}{W_1} \times 100$$

where W_1 = initial weight of 10 tablets, and W_2 = weight of 10 tablets after 100 revolutions

Disintegration time

The method specified in the USP/NF (2007) was followed for disintegration time, medium used was 100 mL of 0.1 N HCl maintained at temperature between 37 ± 2 °C throughout the experiment. Five tablets were randomly selected from each batch and were placed one in each of the cylindrical tubes of the basket using disintegration test apparatus (DT-0607, Curio) but no disc was used. The time taken for each tablet to break up into small particles and pass out through the mesh was noted (Satyam *et al*., 2010).

In vitro dissolution studies

An *in vitro* release study was carried out using USP XXIV 8 station dissolution rate test apparatus, using 900 mL of phosphate buffer pH 6.8 for a period of 1 h at 50 rpm with maintained temperature at 37 ± 0.5 °C. Samples (5 mL) were withdrawn at pre determined intervals over 1 h using a syringe filter of 0.2 micron and 5 mL of fresh dissolution medium was replaced after each sampling in order to maintain sink condition The collected samples were analysed by spectrophotometer at 276 nm (Rajesh, Venkataraju, Gowda, 2009).

FTIR studies

To study any possible interaction between drug and the plant mucilage used, FTIR spectroscopic analysis was carried out. The drug, plant mucilage and formulation blend (mixture containing Diclofenac sodium, *Mulva neglecta* mucilage, Avicel pH 101 and magnesium stearate) compatibility were studied by using IR spectrophotometer (Nicolet FTIR spectrophotometer, Thermoscientific Nicolet, USA). A small amount of Diclofenac sodium, plant mucilage and formulation blend were respectively placed directly on the germanium piece of the infrared spectrometer with constant pressure applied and data of infrared absorbance collected over the wave number ranged from 4000 cm^{-1} to 400 cm^{-1} and was expressed in cm^{-1} (Bobby, Wesely, Johnson *et al*., 2012).

RESULTS AND DISCUSSION

Phytochemical screening

Phytochemical investigation of the isolated mucilage showed the presence of carbohydrates and flavonoids while absence of proteins, tannins, saponins, sterols, alkaloids and glycosides. The results are shown in Table I.

TABLE I - Phytochemical screening of *Mulva neglecta* mucilage

Active Constituent	MNM
Carbohydrate	+ve
Protein	–ve
Flavanoids	+ve
Tannins	–ve
Saponins	–ve
Sterols	–ve
Alkaloids	–ve
Glycosides	–ve

+ve means Present, –ve means Absent

Organoleptic and physicochemical properties

The Organoleptic properties were found acceptable and are summarized in Table II. It showed the presence of mucilage by ruthenium red test with 10-20% yield, yellowish brown colour, bland taste and coarse appearance. The solubility analysis reveals that *Mulva neglecta* mucilage is sparingly soluble in cold water however it showed solubility when the temperature of water was increased. The mucilage was completely insoluble in the tested organic solvents including ethanol, chloroform, acetone and benzene. Physicochemical screenings indicate pH (1% w/w solution) of the isolated mucilage was found 5.45 at 28 °C which indicate that this mucilage was less irritating in GIT and suitable for uncoated tablet. The moisture content, swelling index and loss on drying were 7, 35 and 11% respectively. The total ash and acid insoluble ash value of MNM was found to be 0.974 ± 0.011 and 0.013 ± 0.003% w/w respectively. Ash values reflect the level of adulteration of drug. Adulteration by sand or earth is immediately detected as the total ash is normally composed of inorganic mixtures of carbonates, phosphates, silicates and silica.

The physicochemical properties of granules of *Mulva neglecta* mucilage are shown in Table III. The prepared granules were evaluated for flow properties. The

TABLE II - Organoleptic properties of *Mulva neglecta* mucilage

Parameters	Results
Test for mucilage (Ruthenium Red test)	+ve
Yield (%)	10–20
Color	Yellowish Brown
Taste	Bland
Texture	Moderately coarse
Solubility	Sparingly Soluble in cold water, soluble in hot water forming viscous colloidal solution, insoluble in ethanol, chloroform, acetone and benzene
Moisture content (%)	7
Swelling index (%)	35
pH (1% w/w solution) at 28°C	5.45
Viscosity (1% w/w solution) m Pas	3.80
Loss on drying (%)	11
Total ash (%)	0.974 ± 0.011
Acid insoluble ash (%)	0.013 ± 0.003

All values are mean ± S.D. for n=3

Carr's index values were found in range from 09.27 ± 0.59 to 19.65 ± 0.59 while angle of repose values resulted were 30.37 ± 2.90 to 36.86 ± 0.94. The results showed that granules have good flow properties.

To determine the safety level of the extracted *Mulva neglecta* mucilage, acute toxicity study was carried out. In this study, the mucilage revealed no behavioral changes for first four hours and no mortality was observed in animal being tested. Toxicity studies showed no mortality, no toxic manifestations were observed and behavioural pattern was unaffected. The mucilage is therefore safe to be used in formulations.

Formulation of diclofenac sodium tablet by wet granulation method containing *Mulva neglecta* mucilage as a binder is shown in Table IV.

Three batches of the tablets prepared for each gum in different concentrations were evaluated for parameters like hardness (kg/cm^2), friability (%), weight variation (%), disintegration time (min), thickness (%) and drug content (%). Hardness was found in range of 7.50 ± 0.63 to 7.9 ± 0.68 kg/cm^2. The friability values were in the range from 0.39±0.02 to 0.69 ± 0.01%, i.e. values are less than 1% and are in the acceptable range. Weight variation (200.80 ± 3.24 to 202.15 ± 1.32%) were within limit (±7.5%), disintegration time was less than 15 min fulfilling the pharmacopoeial limits for uncoated tablets and the drug content ranged from 99.44 ± 0.70 to 100.99 ± 1.10 (limit is 90-110%). *Mulva neglecta* based tablets showed increase in hardness as compared to PVP K30 as binder. Rapid disintegration was observed in PVP K30 containing batches of tablets when compared with *Mulva neglecta* as binder. All these results are summarized in Table V.

In vitro dissolution studies

In vitro release studies was carried out using USP XXIV 8 station dissolution rate test apparatus using 900 mL of phosphate buffer (pH 6.8) for a period of 1 h at 50 rpm and the temperature was maintained at 37 ± 1 °C. By withdrawing samples each of 5 mL at 10 min intervals over 1 h and analyzed using spectrophotometer at 276 nm. It is shown in the dissolution plot that MN-1 and

TABLE III - Physicochemical properties of granules

Formulations with Code	Parameters				
	Bulk density (g/mL)	Tapped density (g/mL)	Carr's index	Hausner's ratio	Angle Repose (°)
MN-1	0.49 ± 0.00	0.59 ± 0.01	16.19 ± 0.53	1.18 ± 0.00	31.30 ± 0.12
MN-2	0.53 ± 0.01	0.60 ± 0.00	10.96 ± 0.01	1.12 ± 0.00	34.76 ± 0.04
MN-3	0.56 ± 0.00	0.63 ± 0.00	10.98 ± 0.01	1.12 ± 0.00	35.14 ± 0.24
MN-4	0.57 ± 0.00	0.63 ± 0.01	09.27 ± 0.59	1.09 ± 0.01	32.10 ± 0.31
PV-1	0.52 ± 0.01	0.59 ± 0.00	12.00 ± 0.20	1.13 ± 0.01	33.44 ± 1.06
PV-2	0.57 ± 0.00	0.70 ± 0.01	19.65 ± 0.59	1.24 ± 0.00	36.86 ± 0.94
PV-3	0.54 ± 0.07	0.61 ± 0.01	10.00 ± 0.13	1.12 ± 0.01	32.43 ± 1.03
PV-4	0.56 ± 0.01	0.64 ± 0.03	11.99 ± 0.51	1.13 ± 0.01	30.37 ± 2.90

All values represent mean ± S.D, n = 3. Key: S.D means standard deviation

TABLE IV - Formulation of diclofenac sodium tablets by wet granulation method

Ingredients (mg)	MN-1	MN-2	MN-3	MN-4	PV-1	PV-2	PV-3	PV-4
Diclofenac sodium	50	50	50	50	50	50	50	50
Avicel pH 101	138	133	128	123	138	133	128	123
Aerosil	4	4	4	4	4	4	4	4
MNM	5	10	15	20	---	---	---	---
PVP K30	---	---	---	---	5	10	15	20
Magnesium stearate	3	3	3	3	3	3	3	3
Distilled water	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s
Total weight	200	200	200	200	200	200	200	200

TABLE V - Evaluation of diclofenac sodium tablets

Formulations	Hardness (kg/cm^2)	Friability (%)	Weight variation (%)	D. Time (min)	Thickness (mm)	Assay (%)
MN-1	7.50 ± 0.63	0.69 ± 0.01	200.80 ± 3.24	7.20	4.32 ± 1.04	99.44 ± 0.70
MN-2	7.88 ± 0.52	0.54 ± 0.03	200.30 ± 3.15	9.25	4.32 ± 1.08	100.00 ± 1.16
MN-3	7.95 ± 0.68	0.42 ± 0.04	200.80 ± 3.22	11.05	4.31 ± 1.12	100.34 ± 1.21
MN-4	7.91 ± 0.45	0.39 ± 0.02	200.90 ± 3.14	14.20	4.36 ± 1.13	99.65 ± 1.00
PV-5	7.83 ± 0.56	0.69 ± 0.01	201.50 ± 3.17	6.10	4.34 ± 1.03	100.00 ± 0.20
PV-6	7.94 ± 0.63	0.62 ± 0.02	200.75 ± 3.32	8.13	4.30 ± 0.91	100.99 ± 1.10
PV-7	7.77 ± 0.51	0.53 ± 0.01	200.15 ± 2.25	11.17	4.34 ± 1.09	100.82 ± 1.08
PV-8	7.65 ± 0.65	0.46 ± 0.02	202.15 ± 1.32	14.00	4.31 ± 1.13	100.37 ± 1.46

All the values are expressed as mean±SD

MN-2 released 95.21% and 76.88% respectively at the end of 30 min, and MN-3 and MN-4 released 78.11% and 68.47% respectively at the end of 50 min. PV-1 and PV-2 released 99.62% and 86.99% respectively at the end of 30 min while batches PV-3 and PV-4 released 94.80% and 89.26% respectively at the end of 50 min. All the results of *in vitro* release of diclofenac sodium tablets are represented in Table VI.

The data showed that increase in concentrations of binder retard the rate of dissolution of drug from tablets.

TABLE VI - *In vitro* release of diclofenac sodium tablets

Time (min)	MN-1	MN-2	MN-3	MN-4	PV-1	PV-2	PV-3	PV-4
10	32.850	24.283	15.338	13.070	32.850	27.212	19.181	17.448
20	62.803	50.110	32.692	25.259	62.803	52.629	40.251	36.913
30	95.212	76.881	49.511	41.228	99.622	86.992	56.188	52.976
40	99.811	98.645	63.842	56.598	99.811	99.023	77.858	73.039
50	99.811	98.645	78.110	68.472	99.811	99.023	94.803	89.259
60	99.811	98.645	94.803	84.409	99.811	99.023	99.559	99.779

By increasing the concentration (from 4% to 6%) of *Mulva neglecta* mucilage, the drug release retarded 8.56% in 10 min. While concentration of PVP K30 (from 4% to 6%) showed drug release delayed 5.63%. By comparing drug release from tablets batches containing *Mulva neglecta* mucilage and PVP K30, it is clarified that release retarded by *Mulva neglecta* mucilage efficiently as compared to PVP K30.

Release kinetics

Different kinetic models (zero-order, first-order, Higuchi's, Hixson Crowell and Korsmeyer's equation) were applied to interpret the release profile (the order and mechanism of diclofenac sodium release) from tablet, as shown in Table VII. To study the mechanism of drug release from the tablets, the release data were fitted to zero-order, first-order, and Higuchi equation. However, two factors diminish the applicability of Higuchi's equation to matrix systems. This model fails to allow the influence of swelling of the matrix (upon hydration) and gradual erosion of the matrix. Therefore, the dissolution data were also fitted according to the well-known exponential equation (Korsmeyer equation), which is often used to describe the drug release behaviour from polymeric systems. The Korsmeyer's equation is given as follows:

$$\mathrm{Log}\left(\frac{\mathrm{Mt}}{\mathrm{Mf}}\right) = \mathrm{Logk} + \mathrm{nLogt}$$

where, Mt is the amount of drug release at time t, Mf is the amount of drug release after infinite time, k is release rate constant incorporating structural and geometric characteristics of the tablet and n is the diffusional exponent indicative of the mechanism of drug release.

To clarify the release exponent for different batches of matrix tablets, the log value of percentage drug dissolved was plotted against log time for each batch according to the Korsmeyer's equation. A value of n = 0.45 indicates Fickian (case I) release, > 0.45 but < 0.89 for non-Fickian (anomalous) release and > 0.89 indicates super case II type of release. Case II generally refers to the erosion of the polymeric chain and anomalous transport (non-Fickian) refers to a combination of both diffusion and erosion controlled-drug release (Gutti, Kalra, 2012).

Drug excipients compatibility studies

Drug and excipients compatibilities studies were carried out by using IR spectroscopy. IR Spectra of Drug (diclofenac sodium) and tablets formulations containing *Mulva neglecta* mucilage and tablet formulation blend were analyzed. The studies revealed that there was no significant interaction between drug and batches containing plant gums. The FT-IR spectrum of diclofenac sodium (drug) showed characteristic peaks at 3381.1, 3251.3, 1588.2, 1501.3, 1442.7 and 1346.9 cm^{-1} as shown in Figure 2. *Mulva neglecta* mucilage showed characteristic peaks at 3247.3, 2927.8, 1600.8, 1416.9 and 1018.5 cm^{-1} as shown in Figure 3. The FT-IR analysis of physical mixtures of diclofenac sodium including *Mulva neglecta* with other excipients is shown in Figure 4. Hence no major change in peaks of diclofenac sodium tablets formulations containing mucilage which confirm the compatibility of mucilage with drug and other excipients used.

TABLE VII - *In vitro* release kinetics of diclofenac sodium

Tablets using *Mulva neglecta* mucilage as binder							
Formulations	Zero Order	First Order	Higuchi	Hixson Crowell	Korsmeyer		Release mechanism
	r^2	r^2	r^2	r^2	r^2	N	
MN-1	0.7410	0.6890	0.7180	0.8570	0.8090	0.535	non-Fickian
MN-2	0.8520	0.7790	0.8190	0.8810	0.8760	0.696	non-Fickian
MN-3	0.9980	0.9180	0.6370	0.9420	0.6430	0.446	Fickian
MN-4	0.9980	0.9380	0.9900	0.9360	0.9820	0.913	non-Fickian
PV-1	0.7020	0.6660	0.6810	0.7360	0.7890	0.534	non-Fickian
PV-2	0.8030	0.7440	0.8830	0.8760	0.9200	0.761	non-Fickian
PV-3	0.9780	0.8960	0.9784	0.9580	0.5820	0.399	Fickian
PV-4	0.9930	0.9120	0.9820	0.9130	0.9730	0.853	non-Fickian

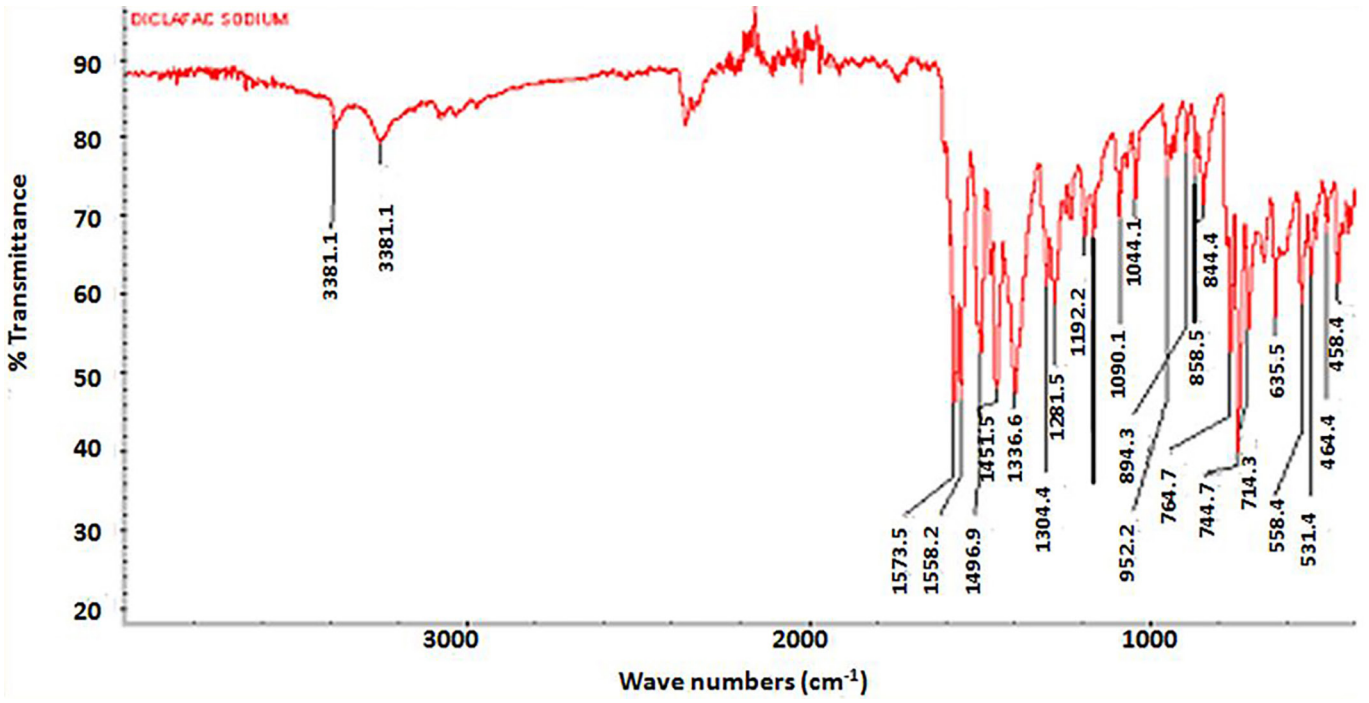

FIGURA 2 - FTIR Spectrum of diclofenac sodium.

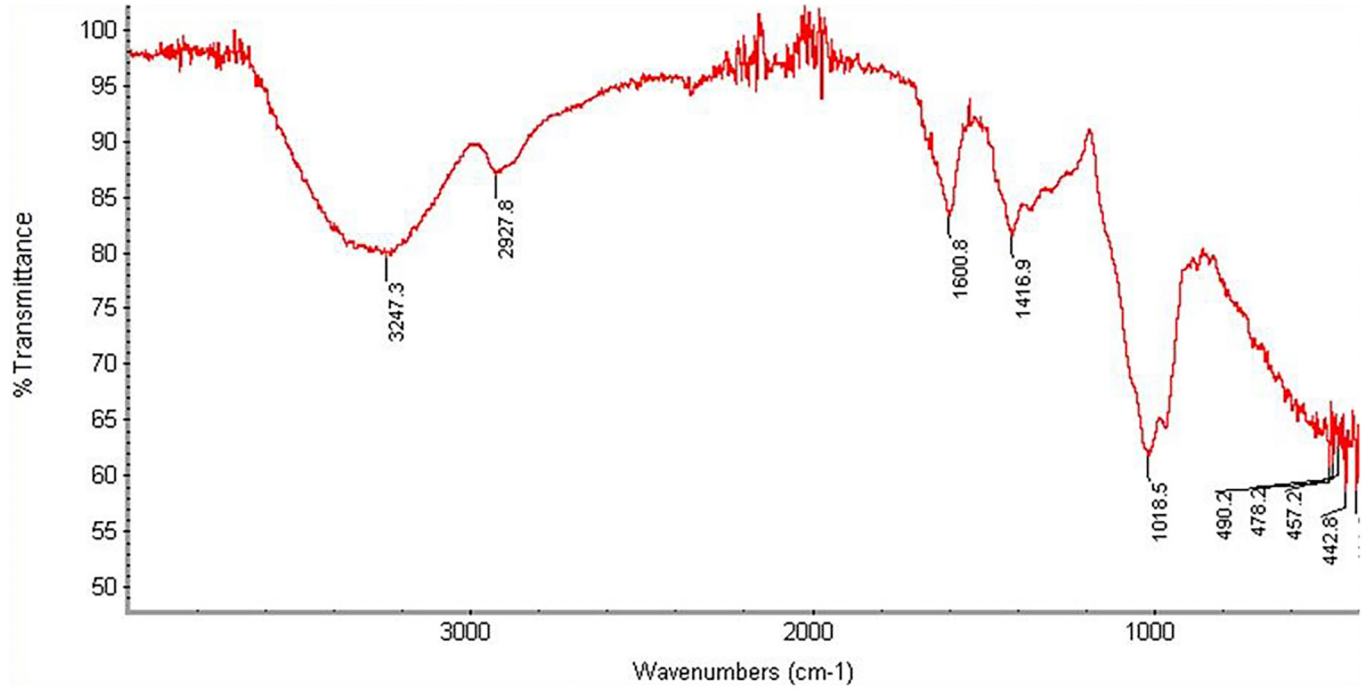

FIGURA 3 - FTIR Spectrum of Mulva neglecta mucilage.

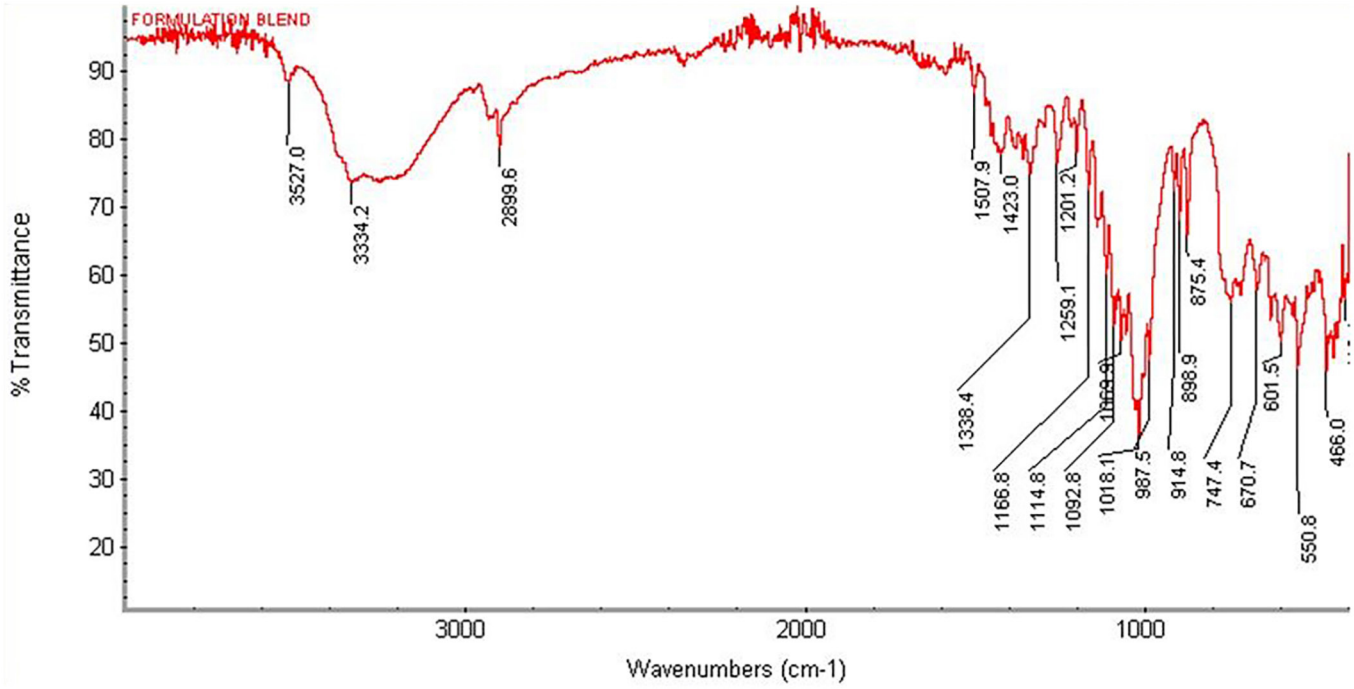

FIGURA 4 - FTIR Spectrum of formulation blend containing diclofenac sodium and *Mulva neglecta* mucilage.

CONCLUSIONS

These results showed that in comparison to PVP, the *Mulva neglecta* mucilage showed better binding capacity. It is concluded from the above study that *Mulva neglecta* mucilage is safe and can be used as binder in tablets formulation.

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