International Journal of Pharmaceutical Research and Development (IJPRD)
Platform for Pharmaceutical Researches & Ideas
www.ijprd.com

EXTRACTION AND CHARACTERIZATION OF MUCILAGE OBTAINED FROM *LINUMUSITATISSIMUM* AND ITS USE AS A BINDER IN TABLET FORMULATION

Vandana K. Wankhede[1*], Rashmi S. Srivastava[1]

[*1]MET Institute Of Pharmacy, MET Complex, Bandra Reclamation, Bandra, Mumbai-400050

ABSTRACT

The basic aim of present work was to extract the mucilage from Linum usitatissimum seeds using suitable method and to check its suitability as tablet binder. The mucilage was extracted from the seeds by maceration technique using water and then precipitated with acetone in 1:3 proportion (yield 9-12 % w/w). The physicochemical properties of mucilage i.e. moisture content, solubility, pH, swelling index, water absorption capacity and ash values were determined. The granules were prepared by Wet Granulation technique using Ibuprofen as model drug and mucilage as binder in concentrations ranging from 1-9 % w/w. The prepared granules were free flowing and the compressed tablets showed good hardness and friability as compared to starch and thereby confirming the mechanical resistance of the tablets. In-vitro dissolution profiles of tablets were carried out in phosphate buffer pH 7.2 and were compared with starch (10%w/w) as standard. The evaluation data suggested that the tablets prepared using Linum usitatissimum mucilage showed good binding ability and comparable dissolution profile as that of the standard. The evaluation parameters also comply with pharmacopoeial limits. Hence an attempt was made to formulate conventional tablets using mucilage obtained from natural source with better binding ability.

Key words: *Linum usitatissimum, mucilage, binder, Ibuprofen, conventional tablets*

Correspondence Author

Vandana K. Wankhede

MET Institute Of Pharmacy, MET Complex, Bandra Reclamation, Bandra, Mumbai-400050

Email: w_vandana@yahoo.com

INRODUCTION

Binders are added to tablet formulation to impart plasticity and thus increase the interparticulate bonding strength within the tablet. Binders are agents employed to impart cohesiveness to the granules. This ensures the tablet remains intact after compression as well as improves the flow properties by the formulation of granules of derived hardness and size. The choice of a suitable binder for a tablet formulation requires extensive

knowledge of the relative importance of binder properties, for enhancing the strength of the tablet and also of the interactions between the various materials constituting a tablet. Fillers usually do not have good binding capacity, binder is either added in dry mix or in granulating liquid, binder forms a matrix with the fillers and drug gets embedded in it, on drying binder forms glue which holds the particles together. The wet binder is the most important ingredient in the wet granulation process; most binders are hydrophilic & majority of them are soluble in water[1].

Flaxseed, also known as linseed, is derived from the flax plant (*Linum usitatissimum*), of the family Linaceae, which is cultivated worldwide for its fiber and oil. Flaxseed contains 6% mucilage or soluble fibers, insoluble fibers 18%, 25% proteins, and 30-40% oil, with alpha-linolenic acid (ALA) making up about 50-60% of the total fatty acids[2]. These plants contain natural polysaccharides which have been employed as food and pharmaceutical excipients because of their biocompatibility, biodegradability, easy availability and low cost. Flax seeds produce high viscosity mucilage at low concentration levels[3]. The present study involves extraction of mucilage from seeds and its use as binder in tablets. The *in vitro* drug release studies were compared with standard binder.

The study involves Ibuprofen as a model drug to formulate tablets. It is a non steroidal anti inflammatory drug (NSAID) used in pain, fever reduction and swelling. It has analgesic and anti pyretic properties. The drug is weakly acidic with high permeability because it remains 99.9% unionized in stomach. It is well absorbed orally and its half life is 1.8 – 2 hrs[4].

MATERIALS AND METHODS:

The seeds of *Linum Usitatissimum* were purchased from local market from Mumbai and authenticated at Ramnarain Ruia College, Matunga. Model drug Ibuprofen was obtained as gift sample from Aarti drugs limited, Tarapur. Lactose, talc, starch and magnesium stearate were obtained from S.D Fine Chemicals Pvt. Ltd.

ISOLATION OF MUCILAGE:

100 gm flaxseeds were soaked in distilled water for 48 hrs for complete release of mucilage in water. The thick slimy solution was then boiled till there is formation of thick mass and separation of mucilage from the seeds. The solution is then vacuum filtered. Acetone was added to the filtrate for the precipitation of mucilage from the solution. The separated mucilage was then dried at 50 °C for 2 to 3 hrs. It was then passed through sieve no. 60 and stored in dessicator until further use[5].

EVALUATION OF MUCILAGE:

I. **Chemical characterization of mucilage:** The chemical characterization of mucilage was done by Molisch test, ruthenium red test, iodine test and enzyme test[6].
II. **Physicochemical characterization of flaxseed mucilage:** Description**,** odour, taste, texture**,** solubility, pH, loss on drying, water holding capacity, ash value, acid insoluble ash, swelling index[7].
III. **Pharmaceutical characterization of flaxseed mucilage:** Bulk density, tapped density, angle of repose, Hausners ratio, compressibility index.

FORMULATION AND EVALUATION OF IBUPROFEN TABLET:

Formulation of ibuprofen tablets

For the comparison of the flaxseed mucilage as binder, starch was used as a disintegrant in the prepared ibuprofen tablet. The composition of tablet formulation containing ibuprofen is given in table 4.

Wet granulation and compression

Tablets of ibuprofen were prepared by wet granulation method as per formula given in Table 4. Calculated amount of ibuprofen and excipients were blended and granulated using aqueous solution of mucilage. The wet mass was passed through no. 8 mesh. The wet granules were dried at 50°C for 3 h. the dried granules were again passed through sieve no. 12 to get uniform granules. The granules were then blended with magnesium stearate as lubricant and talc as glidant

and compressed using 12-mm punches in tableting machine[5].

EVALUATION OF GRANULES:

Angle of repose (θ)

It is the maximum angle possible between the surface of pile of the powder and the horizontal plane. Fixed funnel method was used. A funnel was fixed with its tip at a given height (h), above a flat horizontal surface on which a graph paper was placed. Powder was carefully poured through a funnel till the apex of the conical pile just touches the tip of funnel. The angle of repose was then calculated using the formula,

θ = tan-1(h/r) Where,

θ = angle of repose, h = height of pile, r = radius of the base of the pile.

Bulk density (D_b)

It is the ratio of mass of the powder taken to its bulk volume. The bulk density depends on particle size distribution, shape and cohesiveness of particles. Accurately weighed quantity of powder was carefully poured into graduated measuring cylinder through large funnel and volume was measured which is called initial bulk volume. Bulk density is expressed in gm/cc and is given by,

Db = M/Vo where,Db = Bulk density (gm/cc), M =Mass of powder (g),

V_o = Bulk volume of powder (cc)

Tapped density (D_t)

Ten grams of powder was introduced into a clean, dry 100 ml measuring cylinder. The cylinder was then tapped 100 times from a constant height and tapped volume was read. It is expressed in gm/cc and is given by,

D_t = M/Vt Where, D_t = Tapped density (gm/cc), M = Mass of powder (g), V_t = Tapped volume of powder (cc)

Compressibility Index

An indirect method of measuring powder flow from bulk densities was developed by Carr. The percentage compressibility of powder was a direct measurement of the potential powder arch or the bridge strength and stability. Percent Compressibility Index of each formulation was calculated according to equation given below

% Compressibility index = $[(D_t – D_o)/D_t] \times 100$.

Where, D_t = Tapped density, D_o = Bulk density

Hauser's ratio

Hausner's ratio is an index of ease of powder flow; it is calculated by the following formula. Hausner's ratio = D_t/D_o, Where D_t = Tapped density, D_o = Bulk density.

Evaluation of Powder Blends is shown in Table 6.

EVALUATION OF TABLETS:

Thickness and Diameter

Control of physical dimension of the tablet such as thickness is essential for consumer acceptance and tablet uniformity. The thickness and diameter of the tablet was measured using vernier calipers. It is measured in mm.

Weight uniformity test

Twenty tablets from each batch were selected randomly and weight individually using a highly sensitive electronic balance. Their mean weights were calculated for each batch.

Hardness

The Monsanto hardness tester was used to determine the tablet hardness. The tablet was held between a fixed and moving jaw. Scale was adjusted to zero; load was gradually increased until the tablet fractured. The value of the load at that point gives a measure of hardness of the tablet. Hardness was expressed in kg/cm^2. Three tablets were randomly picked and hardness of the tablets was determined

Content Uniformity

Twenty tablets were weighed individually and powdered in mortar pestle, and an amount equivalent to 150 mg of Ibuprofen was extracted with 100 mL of phosphate buffer (pH 7.2) and sonicated for 10 min. The solution was filtered through a 0.45-µm syringe filter, and the content of ibuprofen in the solution was determined by UV spectrophotometer (Shimadzu V 630) at 221 nm after suitable dilution.

Friability

Tablet strength was tested by using Roche Friabilator. 20 tablets were weighed and placed in the friabilator and operated for 100 revolutions at 25 rpm for 4 min, tablets were taken out and

dedusted. The percentage weight loss was calculated by reweighing the tablets. The % friability was then calculated by,

F = {(Wt initial) – (Wt final)/(Wt initial)} x 100

Disintegration time

One tablet from each batch was taken in disintegration assembly and time taken for the tablets to pass through the mesh was observed.

***In Vitro* Release Study:**

The *in vitro* release studies were conducted using USP type II apparatus; the dissolution media is comprised of phosphate buffer pH 7.2 (900 mL) kept at 37.0±0.5°C and 100 rpm. An aliquot of 5 ml was withdrawn and replaced with another 5 mL of fresh dissolution medium at various time intervals. The contents of ibuprofen in sample were determined by measuring absorbance at 221 nm in a UV-Visible spectrophotometer after suitable dilutions. The release study was performed in triplicates[8].

RESULTS AND DISCUSSION:

Flaxseed mucilage consists of dark brownish particles having characteristic odour which hydrate rapidly on contact with water to swell but is sparingly soluble in water. The pH of 1% (w/v) aqueous dispersion of the mucilage was found to be 6.0–6.5. The swelling index of mucilage was found to be 7.5 % (v/v). The mucilage showed a loss on drying of 11.11 % (w/w), the total ash contents were found to be 40% (w/w) and acid-insoluble ash 18% (w/w), respectively. The bulk density, tapped density, Carr's index, and Hausner ratio of the mucilage were 0.4630 g/ml, 0.602 g/ml, 0.2308 and 0.76. The loss on drying was well within official limits. The compressibility index and angle of repose indicated that the powder is having good flow with moderate compressibility

Table (5) presents the results of characterization of granules of ibuprofen tablets. The angle of repose of the prepared granules remained between 28 and 30°, indicating satisfactory flow properties. The other parameters for granules were also calculated and found to be within the acceptable limits. The compressed tablets showed good hardness and friability as compared with starch thereby confirming the mechanical resistance of tablets.

The physical appearance, hardness, friability, weight variation, and drug content of all the tablet formulations were found to be satisfactory and reproducible (Table 6).

It was observed that the increase in the concentration of mucilage in the formulation showed corresponding increase in the hardness of tablets, which may be attributed to the formation of stronger bonds and increase in binding capacity of mucilage. The drug content uniformity amongst different batches of tablets was found to be good and was more than 97%.

CONCLUSION:

The extraction process of mucilage from seeds of *Linum Usitatissimum* was easier, cheap and economical. It was observed from the results that tablets prepared using the flaxseed mucilage as binder showed significant hardness and friability. Thus, on the basis of the studies it can be concluded that the mucilage obtained from *Linum Usitatissimum* possesses significant binding properties and can be used as binder in pharmaceutical formulations.

Table 1: Chemical characterization of mucilage

Test	Procedure	Observation	Inference
Molisch test	Take 100 mg dried mucilage powder. Add molisch reagent and conc. H_2SO_4 on sides of the test tube.	violet green colour is observed at the junction of two layers.	carbohydrate present
Ruthenium red test	Take small quantity of mucilage powder and mount it on a slide with ruthenium red solution and observe under microscope	Pink color develops	mucilage present

Iodine test	take 100 mg dried mucilage powder and add 1ml of 0.2N iodine solution.	No color is observed in solution	Polysaccharide present
Enzyme test	dissolve 100 mg dried mucilage powder in 20 ml distilled water. Add 0.5 ml of benzidine in alcohol (90%). Shake and allow to stand for few minutes	No blue color change	Enzyme absent

Table 2: Physicochemical Characteristics of mucilage from seeds of *Linum usitatissimum*

Sr. No.	Tests	Observations
1	Description	Light brown powder
2	Solubility	Forms colloidal solution, soluble in lukewarm water, Practically insoluble in ethanol, soluble in chloroform
3	Odour	Characteristic.
4	Appearance	Lustrous.
5	Identification a. Mounted in 96% ethanol b. Mounted in water	Transparent angular masses. Particles swell
6	Melting range	Decomposes above 2000c
7	PH (1%w/v)	6.2
8	Loss on drying	11.11%
9	Ash value	40
10	Acid insoluble ash.	18
11	Swelling index(ml)	7.5
12	Test for Tannins (Ferric chloride test)	–
13	Test for chloride (Silver-nitrate test)	–
14	Test for Sulphate (Barium chloride test)	–
15	Test for Saponin	+
16	Test for steroid	+
17	Test for foreign matter	NMT 0.1 %
18	Percentage Yield	12%w/w
19	Water holding capacity	1.1gm/gm of water
20	Microbial load	passes

Table 3: Pharmaceutical characteristics of mucilage of seeds of *Linum usitatissimum*

Sr.no	Parameter	Result
1	Loss on drying	11.11%
2	Angle of repose	28.35°
3	Tapped density	0.602
4	Bulk density	0.4630
5	Compressibility Index	23.08

Table 4: Formulation of Tablets

Formulation code (mg)	F1	F2	F3	F4	F5
Ibuprofen	400	400	400	400	400
Flaxseed mucilage (%)	1	3	5	7	9
Lactose	156.5	144.5	132.5	120.5	108.5
Starch	25	25	25	25	25
Magnesium stearate	10	10	10	10	10
Talc	2.5	2.5	2.5	2.5	2.5
Total (mg)	600	600	600	600	600

Table 5: Evaluation of Granules

Formulation code	Angle of repose (Degrees)	Bulk density (gm/ml)	Tapped density (gm/ml)	Hausners ratio	Compressibility index (%)
F1	28.72	0.60	0.71	0.84	15.0
F2	26.32	0.52	0.60	0.866	15.0
F3	28.48	0.51	0.59	0.864	13.5
F4	29.35	0.49	0.53	0.92	7.0
F5	30.12	0.49	0.53	0.92	7.0

TABLE 6: Evaluation of Tablets

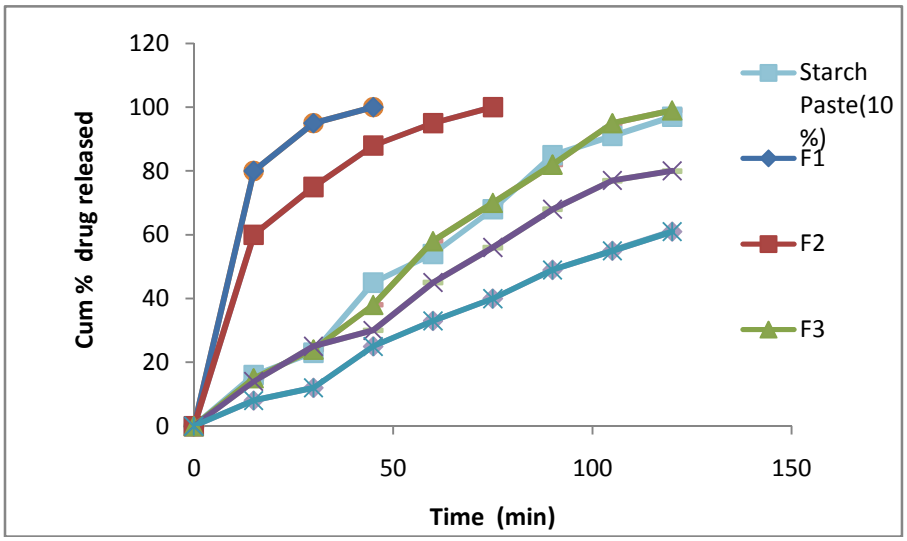
Formulation code	Weight variation (mg)	Thickness (mm)	Hardness (kg/cm^2)	Disintegration time (mins)	Friability (%)	Drug content (%)
F1	600±2	4.0	4.1	5	0.64	98.23
F2	600±4	3.8	4.6	10	0.55	97.55
F3	600±1	3.9	5.3	12	0.48	98.96
F4	600±2	4.1	5.5	25	0.45	95.44
F5	600±3	4.0	6	45	0.32	94.11

Table 7: *In vitro* dissolution of ibuprofen tablets containing different % of mucilage.

Time in Min.	Formulation Code					
	F1	F2	F3	F4	F5	Starch Paste (10%)
	% Cum drug released	% Cum drug released	% Cum drug released	% Cum drug released	% Cum drug released	% Cum drug released
0	0	0	0	0	0	0
15	80.12	60.23	15.14	14.44	8.98	16.47
30	95.06	75.33	24.33	25.35	12.14	23.52
45	100	88.57	38.14	30.32	25.63	45.69
60	-	95.08	58.98	45.63	33.47	54.58
75	-	98.21	70.65	56.78	40.44	68.47

90	-	-	82.78	68.32	49.98	85.78
115	-	-	95.96	77.98	55.63	91.63
120	-	-	99.43	80.06	61.33	97.07

Fig. 1*: In vitro* dissolution of ibuprofen tablets containing different % of mucilage. F3 containing 5 % mucilage shows similar drug release profile as that of 10% starch.



ACKNOWLEDGEMENTS:

The authors are thankful to Arti Drugs Pvt. Ltd. for gift sample of Ibuprofen drug. We also thank the Principal and Ms. Vrushali Keer, M.E.T. Institute of pharmacy, Bandra for immense help and support.

REFERENCES

1. Patel S, Agrawal S, Lodhi B, Natural Binding Agents in Tablet Formulation, International Journal of Pharmaceutical & Biological Archives, 3, 2012, 466-473.
2. Handa SS and Kapoor VS, Textbook of Pharmacognosy, 2nd edition, Vallabh prakashan, Delhi, 1989, 120, 257
3. Inamdar M, Abhang P, Abhang M, Isolation and evaluation of fenugreek, flaxseed, Mucilages and its use as a pharmaceutical binder, 4, Oct-2012, 4766-4777.
4. Bomepudi S, Deveswaran R, Bharath S, Basavaraj BV and Madhavan V, Studies on Vigna mungo mucilage as a pharmaceutical xcipient, Journal of Chemical and Pharmaceutical Research, 3, 2011, 18-25.
5. Shripad S, Amol A, Isolation of mucilage from flaxseeds and its use as a binder in manufacturing of tablet, International Journal of Pharmaceutical Research and Development, 4, November 2012, 064-069.
6. Girish K , Dhiren P, Vipul D, Vineet C, Gums And Mucilages : versatile excipients for pharmaceutical formulations, Asian Journal of Pharmaceutical Sciences, 4, 2009, 308-322.
7. Khandelwal KR, Practical Pharmacognosy, Techniques And Experiments, 9th edition, Nirali Prakashan, Pune, 2012, 26, 150,157,159
8. Indian Pharmacopoeia, 6th edition, Vol. 2, Govt. of India, Controller of Publications, New Delhi, 2010, 1482.

*****