Seed Mucilage from *Ocimum americanum* Linn. as Disintegrant in Tablets: Separation and Evaluation

D. M. PATEL*[1], D. G. PRAJAPATI[2] AND N. M. PATEL[2]

[1]Department of Pharmaceutics and Pharmaceutical Technology, Shri Sarvajanik Pharmacy College, Mehsana - 384 001, Gujarat, India. [2]Shri B. M. Shah College of Pharmaceutical Education and Research, College Campus, Modasa - 383 315, Gujarat, India.

Plant products serve as an alternative to synthetic products because of local accessibility, eco-friendly nature and lower prices compared to imported synthetic products. Natural gums and mucilage have been widely explored as pharmaceutical excipients. The present study was undertaken to separate mucilage from the seeds of *Ocimum americanum* Linn. and explore its use as a tablet disintegrant. Methods for extraction of mucilage from the seeds were developed and the yield by the method C was found to be 14%. The mucilage was evaluated for various parameters as per Indian Pharmacopoeia. The loss on drying, ash value and microbial load were well within the official limits. The disintegrating efficiency of separated mucilage was compared with that of the starch in tablets prepared using lactose, propranolol hydrochloride and polyvinyl pyrrolidone as model diluent, drug and binder, respectively. The disintegration time for tablet formulations prepared using mucilage (10% w/w) was less (154 s) than that of the tablet formulations prepared using starch as a disintegrant (269 s). The mucilage not interfered with the release of a drug from tablet formulations. Formulated tablets were found stable at 45° C for 4 weeks without significant change in hardness, disintegration time and *in vitro* drug release.

Key words: Seed mucilage, pharmaceutical excipients, disintegrant, tablets

Excipients are the additives used to convert active pharmaceutical ingredients into pharmaceutical dosage form suitable for administration to patients[1]. New and improved excipients continue to be developed to meet the needs of conventional drug delivery systems and to meet the needs of advanced tablet manufacturing.

Plant products serve as an alternative to synthetic products because of local accessibility, environment friendly nature and lower prices compared to imported synthetic products. Herbs are non-polluting renewable resources for sustainable supplies of cheaper pharmaceutical products. Today, we have a number of plant-based pharmaceutical excipients. A number of researchers have explored the utility of plant-based materials as pharmaceutical excipients[2-8]. Majority of investigations on natural polymers in drug delivery systems are centered on polysaccharides and proteins, due to their ability to produce a wide range of materials and properties based on their molecular structures[9].

***For correspondence**

E-mail: justdmpatel@rediffmail.com

The seeds of *Ocimum americanum* Linn, also known as *Takmariya* in Gujarati contain a high proportion of mucilage. The objective of present work was to isolate mucilage from *Ocimum americanum* Linn seeds and explore its use as a disintegrant in tablets.

MATERIALS AND METHODS

Ocimum americanum Linn was procured from a local market in form of very small black seeds. Lactose and propranolol hydrochloride were kindly gifted by Helios Pharmaceutical, Ahmedabad and were used as received. Lactose was purchased from S. D. Fine Chemicals, Mumbai. Polyvinyl pyrrolidone (PVP) was purchased from Ases Chemical Works, Ahmedabad. Hydrochloric acid was purchased from Laser Chemicals, Ahmedabad. All other materials used were of pharmaceutical grade. Instruments used were single punch tablet machine (Bhawani Eng. Ltd., Ahmedabad), Rimek rotary tablet machine (Karnavati Eng. Ltd., Ahmedabad), weighing balance- Shimadzu AX 2000 (Shimadzu Corporation, Japan), hot air oven, Monsanto hardness tester (Shital scientific industry, Mumbai), friabilator- Model EF2 (Electrolab,

Mumbai), disintegration apparatus- Model ED2 (Electrolab, Mumbai) and dissolution apparatus- Model TDT-06T (Electrolab, Mumbai).

Isolation of mucilage:

The seeds of *Ocimum americanum* Linn contain the mucilage around the outer layer. The major problem in isolation of mucilage is that it swells but does not separate from the seeds. Because of this, general methods of separation of mucilage are not applicable to separate the seed mucilage and hence, different procedures were tried for the separation of mucilage. In first method (method A) the seeds (100 g) were boiled with distilled water (1l) for 15 min and the mass was filtered through Buckner funnel without filter paper. The retained residues were boiled with distilled water (0.5l) for 15 min and the combined liquid was passed through eight folds of muslin cloth. The mucilage was precipitated from the filtrate by adding ethanol. The precipitated mucilage was dried in an oven at 45°C till it was completely dried. The powder was passed through 80 # sieve and weighed to calculate the yield. In the second method (method B) the seeds (100 g) were soaked for 12 h in distilled water (1l) and then added to a blender to separate mucilage from seeds. After blending for 15 min the mass was passed through eight folds of muslin cloth. The mucilage was precipitated from the filtrate by adding 1 l of acetone. The powder was passed through 80 # sieve and weighed to calculate the yield after drying at 45° for 6 h. In third method (method C) the seeds (100 g) were soaked for 12 h in distilled water (1l) and crushed in blender for 15 min. The dispersion was boiled for 30 min and the mass was passed was passed through eight folds of muslin cloth. The mucilage was precipitated from the filtrate by adding acetone. The powder was passed through 80 # sieve and weighed to calculate the yield after drying at 45° for 6 h.

Physicochemical characterization of mucilage:

The separated mucilage was evaluated for solubility[10,11], swelling index[12], loss on drying[10,11], ash value[10,11], microbial load[12], density and compressibility index and angle of repose. The evaluation was carried out as per the procedures described below and the results obtained are shown in Table 1. Solubility is expressed in terms of "parts" representing the number of milliliters (ml) of the solvent in which 1 g of the solid is soluble. Solubility of the powder was determined in different solvents at 20° as per IP 96.

Swelling characteristics of the separated mucilage powder was studied in different media such as 0.1 N hydrochloric acid, pH 7.4 phosphate buffer and distilled water. One gramme of powder was moistened with 0.5 ml ethanol (95%) and volume was made up to 10 ml with respective medium. The cylinder was shaken vigorously every 10 min for 1 h and allowed to stand for 3 h. The volume occupied by mucilage powder was measured. The test was carried out in triplicate and the average value of swelling index was recorded as shown in Table 1.

As the inherent moisture in disintegrant may influence the stability of the tablet dosage form containing moisture sensitive drugs, moisture content of the separated mucilage was detected by loss on drying method. The sample (1 g) was heated at 105° until constant weight in a hot air oven and percentage loss of moisture on drying was calculated using the formula, LOD (%)= (weight of water in sample/weight of dry sample)×100.

TABLE 1: RESULTS OF PHYSICOCHEMICAL CHARACTERIZATION

Parameters		Results
Solubility		Slightly soluble in water. Practically insoluble in ethanol, acetone, ether and chloroform.
Swelling ratio	In 0.1 N hydrochloric acid	6.9
	In phosphate buffer pH 7.4	5.1
	In distilled water	34
Loss on drying		1%
Total ash		4.1%
Acid insoluble ash		0.3%
Microbial load	Bacteria (CFUs/g)	97
	Fungi (CFUs/g)	8
Density of powder	Bulk density (g/cc)	0.59
	Tapped density (g/cc)	0.72
Compressibility index		18.05%
Angle of repose		35°

CFUs: Colony forming units

The total ash was determined by placing 3 g of the ground air-dried material in a crucible, spreading the material in an even layer and igniting it by gradually increasing the temperature to 550°C until it is white, indicating the absence of carbon. The crucible was cooled in a desiccator, weighed and the content of total ash in mg per g of air-dried material was calculated. Acid-insoluble ash is the residue obtained after boiling the total ash with dilute hydrochloric acid and igniting the remaining insoluble matter. To the crucible containing the total ash, 25 ml of hydrochloride acid TS was added, covered with a watch glass and boiled gently for 5 min. The watch glass was rinsed with 5 ml of hot water this liquid was added to the crucible. The insoluble matter on an ash less filter paper was collected and washed with hot water until the filtrate is neutral. The filter paper containing the insoluble matter was transferred to the original crucible, dried on a hot plate and ignited to constant weight. The residue was allowed to cool in a desiccator for 30 min, weighed without delay and the content of acid insoluble ash in mg per g of air-dried material was calculated.

Microbial count for separated mucilage powder was performed as outlined in IP 96 for total aerobic microbial count using plate count method. The plate count for bacteria and fungi were measured and shown in Table 1.

Bulk density was measured by taking accurately weighed powder into a graduated cylinder of tapped density apparatus and the volume was measured and recorded as bulk volume. The cylinder was tapped until powder bed volume reached a constant value and the volume was recorded as tapped volume. The bulk density, tapped density and compressibility index were calculated using the equations, bulk density= mass/bulk volume; tapped density= mass/tapped volume; and compressibility index= [tapped density–bulk density]/tapped density. The angle of repose is used to characterize a flow property of powder material. It was determined by fixed height funnel method.

Preparation of tablets using separated mucilage:
Tablet formulations each containing 40 mg of propranolol hydrochloride were developed as per formulae given in Table 2 by conventional wet granulation technique using PVP as a binder. The wet mass was passed through 30 mesh and the resulting granules were dried at 50° for 3 h in a hot air oven. The dried granules were sized through 40 mesh and blended with glidant-lubricant mixture. This uniformly mixed blend was compressed into 200 mg tablets using flat face round tooling on a Rimek-I rotary tablet machine (Karnavati Eng. Pvt. Ltd., Ahmedabad). The tablets were stored in tightly closed glass container and evaluated for following parameters in triplicate.

Evaluation of prepared tablets:
Compressed tablets were then evaluated for hardness, disintegration[13], friability[14], drug content and *in vitro* dissolution study[15,16]. Hardness was measured by Monsanto type hardness tester. For disintegration test, one tablet was placed in each tube of disintegration apparatus (model ED-2L, Electrolab) and the test was carried out using distilled water as a disintegrating media at 24±2°. Friability was determined in friabilator (model EF-2, Electrolab) by taking twenty tablets. For drug content analysis twenty tablets were accurately weighed and finely powdered. Quantity of powder equivalent to 40 mg of propranolol hydrochloride was taken into a 100 ml volumetric flask and dissolved in distilled water. Five ml of the filtrate was diluted to 100 ml with 0.1 N HCl and assayed for drug content at 291 nm using double beam UV/VIS spectrophotometer (Shimadzu, model-1601). *In vitro* dissolution study of tablets was conducted using USP dissolution apparatus II (model TDT-06T,

TABLE 2: FORMULATION OF TABLETS USING SEPARATED MUCILAGE

Ingredients (mg/tablet)	T1	T2	T3	T4	T5	T6	T7
Propranolol hydrochloride	40	40	40	40	40	40	40
Mucilage as disintegrant	4	8	12	16	20	24	-
Starch as disintegrant	-	-	-	-	-	-	20
Lactose	140	136	132	128	124	120	124
Polyvinylpyrrolidone	10	10	10	10	10	10	10
Magnesium stearate	4	4	4	4	4	4	4
Talc	2	2	2	2	2	2	2
Total weight (mg)	200	200	200	200	200	200	200

TABLE 3: EVALUATION OF FORMULATED TABLETS

Formulation	Hardness (kg/cm^2)	Friability (%)	Drug content (%)	DT (s)	CPR at 30 min
T1	4.5	0.48 (0.01)	97.2 (1.3)	480	92.4 (1.2)
T2	4.5	0.59 (0.02)	98.5 (0.7)	360	94.5 (1.4)
T3	4.0	0.71 (0.03)	98.8 (0.9)	324	96.6 (1.7)
T4	4.5	0.61 (0.02)	99.7 (1.1)	210	95.8 (1.3)
T5	4.0	0.67 (0.01)	98.6 (1.7)	154	97.6 (1.6)
T6	4.5	0.65 (0.01)	97.9 (0.9)	186	93.8 (0.9)
T7	4.0	0.73 (0.02)	98.6 (1.2)	269	92.3 (1.2)

Values in parentheses indicate standard deviation for three determinations. DT is disintegration time and CPR is cumulative percentage drug release.

Electrolab) at 100 rpm, using 900 ml of 0.1 N HCl as a dissolution media maintained at 37±0.5°. Samples were withdrawn at 30 min, filtered through a 0.45 µ membrane filter, diluted and assayed at 291 nm. The evaluation results are shown Table 3.

RESULTS AND DISCUSSION

Three different laboratory developed methods were tried for the separation of seed mucilage. The yield was 8%, 10% and 14% w/w for method A, method B and method C, respectively. The mucilage obtained by each method was a light brown powder. The mucilage powder that was obtained by method C was evaluated further because of highest yield.

The powder was slightly soluble in water and practically insoluble in organic solvents. Swelling characteristics studies revealed that the swelling was affected by pH of the medium (Table 1) and powder showed good swelling ratio in distilled water. The loss on drying, ash value and microbial count were well within official limits. The compressibility index and angle of repose indicated that the powder is having good flow with moderate compressibility.

The separated mucilage was evaluated for its performance as disintegrant in tablets at various concentrations (2, 4, 6, 8, 10, 12%w/w) and the optimum concentration found was 10%w/w. Its performance was compared with starch at optimum concentration and it was found better than starch in tablet formulations with less disintegration time (154 s) compared to that of starch (269 s). The hardness, friability and drug content were within limits. There was no effect of mucilage on drug release from tablets as all the formulations showed more than 90% drug release at 30 min.

In order to determine any change on storage, stability study of formulated tablets was carried out at 45° for 4 w. Tablets were withdrawn at the end of 4 weeks and evaluated for change in hardness, disintegration time and *in vitro* drug release. Appreciable change in hardness, disintegration time, as well as *in vitro* drug release from formulated tablets was not observed after stability study.

From the present study, it was concluded that the mucilage separated from *Ocimum americanum* Linn could be used as a disintegrant in the tablet formulations as it shows very good disintegrating property. The material showed good gelling property during isolation but after its isolation this property was lost. If the gelling property is retained by any other separation method, it may be studied as a gelling agent as well as matrixing agent in sustained release tablets.

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