Research Article

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Comparative Evaluation of Flaxseed Mucilage, Gum Acacia and Peach Gum as Pharmaceutical Excipients.

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Abstract: The study aims at comparing mucilage obtained from flaxseed (*Linum usitatissimum)*(FXM),gum acacia (*Acacia arabica*) (GA) and peach gum (*Prunus dulcis*) (PG). These plants have been used since very long time for their medicinal values. All these plants contain natural polysaccharides which have been employed as food and pharmaceutical excipients because of their biocompatibility, biodegradability, easy availability and cost effective. The dried mucilage powder obtained was characterized and compared for their physicochemical properties such as bulk density, tapped density, Carr's index, viscosity, swelling capacity, pH, moisture content, solubility in water and alcohol, TLC and spectroscopic data from FTIR. This knowledge of mucilage powder properties will help to explain their role in tablet excipients. They can be incorporated as a binder, disintegrant, suspending agent, emulsifying agent, direct compression polymer, matrixing agent in novel drug delivery systems.

Keywords: Flaxseed, gum acacia, peach gum, pharmaceutical excipients, mucilage.

INTRODUCTION:

Plant gums originating from many countries have been an important item in international trade for centuries in food, pharmaceutical, paper textile and other industries. Depending upon their major use, plant gums may be broadly classified as 'food' and 'non-food' or 'technological grade' gums.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 alphalinolenic acid (ALA) making up about 50-60% of the total fatty acids. There are only few studies on the health benefits of flaxseed mucilage, such as reduction of total cholesterol and blood glucose levels. Gum acacia is a potent drug having diverse pharmacological effects and wide therapeutic potential. It is used for diarrhea and dysentery, irritations and ulcers of the stomach and intestine . It is also used in haemoptysis, bleeding piles, menorrhagia, leucorrhoea and spermatorroea [1]. Gum acacia's main food-related uses are in confectionery, soft and alcoholic beverages. Its non-food applications include pharmaceutical, cosmetic, lithographic and offset preparations. It was extensively used as an adhesive, but this use has almost entirely yielded to synthetics. The peach gum, a kind of transparent gum, is extracted from the trunk of *Prunusdulcis* under environmental stress and belongs to edible gum of original peach gum. Traditional Chinese physicians consider that the peach gum has many medical functions for stranguria due to hematuria, urolithic stranguria, dysentery, diarrheoa, concretion and diabetes[2,3]. So in order to develop peach gum as a kind of new medicine, it is necessary to study its properties.

These gum are biocompatible, cheap and easily available. Natural materials have advantages over synthetic ones since they are chemically inert, nontoxic, less expensive, biodegradable and widely available. They can also be modified in different ways to obtain tailor-made materials for drug delivery systems and thus can compete with the available synthetic excipients. Recent trend toward the use of plant based and natural products demands the replacement of synthetic additives with natural ones [4].The aim of the present work is to isolate mucilage from flax seeds, and compare the physiochemical and spectroscopic properties of flaxseedmucilage (FXM), gum acacia (GA) and peach gum (PG). Studies are done for FXmucilage, gum acacia and peach gum to be used as binder.

MATERIALS AND METHODS:

The flaxseeds (*Linum usitatissimum*), gum acacia (*Acacia nilotica)* and peach gum (*Prunus dulcis)* used in study were procured from a company in Chennai, India. Acetone, absolute alcohol of AR grade was used. Double distilled water was used throughout the experiment. The extraction of mucilage of flax seeds (FXM) was done [5-7]. A batch 100gm of crushed flax seeds was soaked in 500ml of double distilled water and boiled at 80°C using water bath for 4 hours with occasional stirring or till thick mass was obtained. It was kept aside at room temperature for 4 hrs stirred intermittently and then kept aside overnight below 20°C. The hydrated mucilage was separated by using muslin cloth. The mucilage was then precipitated with 300mL of absolute alcohol. The precipitated mucilage was filtered using vacuum filtration. The filtered mucilage was then dehydrated with 200ml of acetone. This treatment also removes any oil present in hydrated mucilage. After filtration, precipitated mass was dried in hot air oven at 50°C for 12 hours. The dried mucilage was then powdered using mortar and pestle. All the three gums were subjected to different pharmacotechnical evaluation in order to study their characteristic and usefulness as a tablet excipient [8]. Physico-chemical parameters were also carried out.

Pharmacotechnical evaluation of mucilage of flaxseeds, gum acacia and peach gum:

1. Bulk density (Bd): Bulk density refers to a measure used to describe a packing of particles. The bulk density of FXM, gum acacia and peach gum was obtained by dividing the mass of a powder by the bulk volume in cm^3(V) [9]. The sample of about 10 gm of each powder was carefully added into a 50 mL dried graduated cylinder. The bulk density of each sample was done as per method described in USP. It was calculated by using equation given below:

$$B_d = \frac{M}{V}$$

Where, M = weight of samples in grams, V= bulk volume of powder in cm^3

2. **Tapped density (Td):** The tapped density or poured density attained after mechanically tapping a container containing the powder sample [9]. The sample of about 10gm of each powder (60#) was carefully added into a 50 ml graduated cylinder and then done by method described in USP.
It was calculated by using equation given below:

$$T_d = \frac{M}{V_p}$$

Where, M = weight of samples in grams and Vp= final tapped volume of powder in cm^3

3. **Carr's Index**: An indirect method of measuring powder flow from bulk densities was developed by Carr. Carr's index is affected by the Particle shape, surface characteristics, particle size, size distribution and the packing configuration adopted by the powder during the bulk densities determination. A low Carr's index implies a good initial packing arrangement, with less volume of voids. As the value of these indices increases, the flow of the powder decreases. In general, however, Carr's index below 16% indicates good flowability while values above 35% indicate cohesiveness[9]. Carr's index of each sample was calculated according to equation given below:

$$CI = 100 \; \frac{(T_d - B_d)}{T_d}$$

4. **Hausner's ratio:** Hausner's ratio measures the powder ability to settle and permit an assessment of the relative importance of interparticulate interactions. Hausner's ratio is calculated as the ratio of bulk density to tapped density. The Hausner's ratio less than 1.25 indicates good flow; the valuesbetween1.25 to 1.5 assure that adding glidant will improve flow ability [9].

$$HR = V_0 / V_f$$

Where, V0: unsettled apparent volume, Vf: final tapped volume

5. **Moisture content determination**: The prepared dried powder mucilage are hydrophilic in nature. They have capacity to absorb and retain moisture. Hence, it is necessary to determine moisture content of prepared dried mucilage. The moisture content is the ratio, expressed as a percentage, of the mass of "pore" or "free" water in a given mass of powder to the mass of the dry solids. FXM, gum acacia and peach gum were subjected to moisture content test as per the following method. One gram (1g) of powder was weighed and then dried in an oven at 105°C for about 1 hour. Continue the drying and weighing at one hour interval until difference between two successive weighings corresponds to not more than 0.25 per cent. Constant weight is reached when two consecutive weighings after drying for 30 minutes and cooling for 30 minutes in a dessicator, show not more than 0.01 g difference [10-13].

6. **Determination of Alcohol Soluble Extractives**: 5g of each of the gum was added to 100 ml of Alcohol of the specified strength in a closed flask for twenty-four hours, shaken frequently during six

hours and allowing to stand for eighteen hours. It was filtered rapidly, taking precautions against loss of solvent, evaporate 25 ml of the filtrate to dryness in a tared flat bottomed shallow dish, and dry at 105ºC, to constant weight and weigh. The percentage of alcohol-soluble extractive with reference to the air-dried drug was calculated [11,12].

7. **Determination of Water Soluble Extractive:** 5 g of each of the gum, was added to 100 ml of double distilled water in a closed flask for twenty-four hours, shaking frequently during six hours and allowing to stand for eighteen hours. It was filtered rapidly, taking precautions against loss of solvent, evaporate 25 ml of the filtrate to dryness in a tared flat bottomed shallow dish, and dry at 105ºC, to constant weight and weigh. The percentage of water-soluble extractive with reference to the air-dried drug was calculated [11,12].

8. **Determination of Total Ash**: About 2 to 3 g of accurately weighed ground sample was taken in a tared silica dish and incinerated at a temperature not exceeding 450^0 until free from carbon, cool and weigh. The process was repeated until concordant weight was achieved. The percentage of ash with reference to the air dried drug was calculated [11-13].

9. **Determination of pH**: pH fundamentally represents the value of hydrogen ion activity in solutions. pH was determined by preparing 1% w/v of suspension in freshly prepared double distilled water. The dried powdered mucilage's was suspended in double distilled water for 4 hours. The solution was homogenized by mechanical stirrer for 1 hour. pH of the resultant solution was measured using electronic digital pH meter model L1120 made of Elico.

10**. Viscosity of mucilage**: Viscosity of flaxseed mucilage, gum acacia and peach gum was done by preparing 0.1% w/v suspension in double distilled water. The dried powdered mucilage's was suspended in double distilled water for 2 hours to prepare a uniform suspension. Viscosity was determined using an Ubbelholde viscometer [14,15].

11. **Thin Layer Chromatography**: Chromatography is used for the isolation and identification of various substances present in the drug. In the present study TLC was conducted for the separation of different components using the solvent system : Ethyl acetate: Acetic acid : Methanol : Water (10:3:3:2, v/v)and R_f values of developed spots were noted.

11. **Fourier Transform Infrared (FTIR) spectroscopy:** FTIR spectra were recorded by mixing dried mucilage powder with potassium bromide(KBr) of IR grade using a Shimadzu model. Pellets were prepared with KBr by means of hydraulic press. The scanning range was 400 to 4000 cm-1.

RESULTS AND DISCUSSION:

A lot of work has been done in exploring and incorporating natural plant based polysaccharides in different capacity in pharmaceutical formulations. Natural polysaccharides and dried mucilage have been widely explored as emulsifying, suspending, binding, and disintegrating agent and as sustained-release matrix by the pharmaceutical industry.

The aim of the present work is to isolate mucilage from flaxseeds and compare the properties of FXM, gum acacia and peach gum. Mucilage from flax seeds was isolated using absolute alcohol and precipitated with acetone. A cost effective method was adopted for isolation of mucilage. The resultant dried mucilage was subjected to comparative evaluation of basic pharmacotechnical parameters in order to study their suitability as a tablet excipient. The pharmacotechnical and physico-chemical parameters are presented in Table 1.

Dried mucilage isolated from the flax seed, peach gum and gum acacia was mixed with KBr to prepare the pellets for FTIR studies. The obtained FTIR spectra are shown in Fig. 1, 2and 3.The absorption bands at 1648cm^{-1} and 1743cm^{-1} (FXM), 1607cm^{-1} (GA), and 1741cm^{-1} (PG) indicates presence of carbonyl group. Strong absorption peaks at 2927cm^{-1}(FXM), 2926cm^{-1} (GA), and 2932cm^{-1} (PG) indicates –C-H stretching bands. The broad absorption bands between the region 3300cm^{-1} to 3450cm^{-1} in all the three gums indicates –OH stretching which appears due to presence of polysaccharides. The flow properties and compressibility of a powder are essential in determining its suitability as direct compression excipients. The Hausner's and Carr's indices are considered as indirect measurement of powder flowability. The dried powdered mucilage of flax seed, gum acacia and peach gum were subjected for bulk density, tapped density, Carr's index and Hausner's ratio. Bulk density and tapped density was higher in peach gum, then FXM and least was gum acacia. The Carr's Index and Hausner's Ratio are measures of the propensity of a powder to be compressed. As such, they are measures of the powder ability to settle and they permit an assessment of the relative importance of inter particulate interactions. In a free flowing powder, such interactions are less significant, and the bulk and tapped densities are closer in value. For poorer flowing materials, there are frequently greater inter particulate interactions, and a greater difference between the bulk and tapped densities will be observed. Hence, from the data depicted in result reveals that gum acacia and peach gum has better flow property than FXM based on its bulk density value and tapped density value. Carr's index was calculated according to the values prescribed in pharmacopoeia. It showed gum acacia has good flow than the other two gums(20.0,7.1373 and 4.5312 respectively). The TLC profile of the gums is shown in Fig. 4. The R_f and colour details of the TLC is shown in Table 2.

CONCLUSION:

The study carried out reveals that gum acacia has better properties to be utilized in pharmaceutical industry compared to FXM and peach gum. Gum acacia can be used as a binder in tablets, stabilizer in emulsions and also for tablet coatings.

Table No 1:Comparative results of pharmacotechnical parameters of FXM, Gum Acacia and Peach Gum

SL.NO	PARAMETER	FXM	Gum Acacia	Peach Gum
1	Bulk density (g/ml)	0.6700	0.5000	0.7143
2	Tapped density (g/ml)	0.7018	0.6250	0.7692
3	Carr's index (%)	4.5312	20	7.1373
4	Hausner's ratio	1.0526	1.25	1.0769
5	Moisture content (%)	13.4376	11.3445	19.6503
6	Alcohol Soluble Extractive%	5.0	3.0	5.6
7	Water Soluble Extractive%	38.4	14.7	10
8	Ash Content%	11.06	3	14.13
9	pH (10%)	7	6.8	6.8
10	Viscosity 0.5%w/v	1.1527	0.9753	0.9753

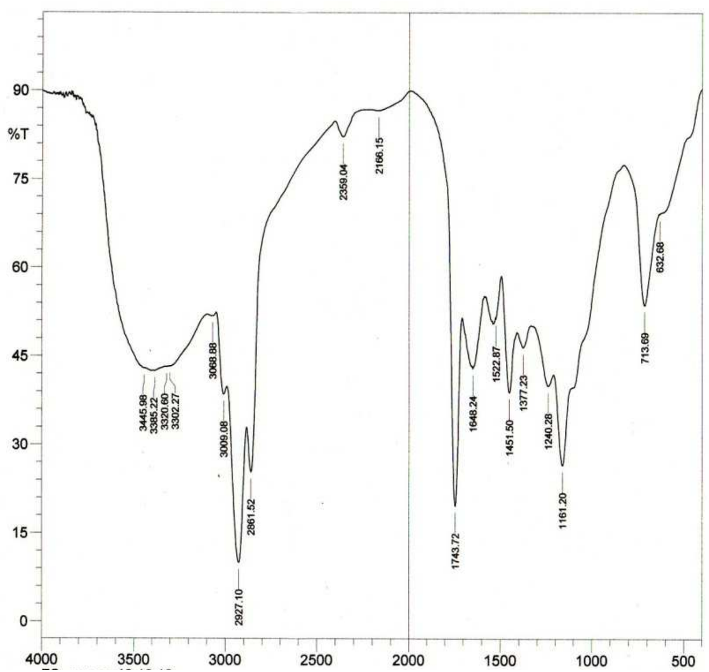

Fig. 1 FTIR of FXM

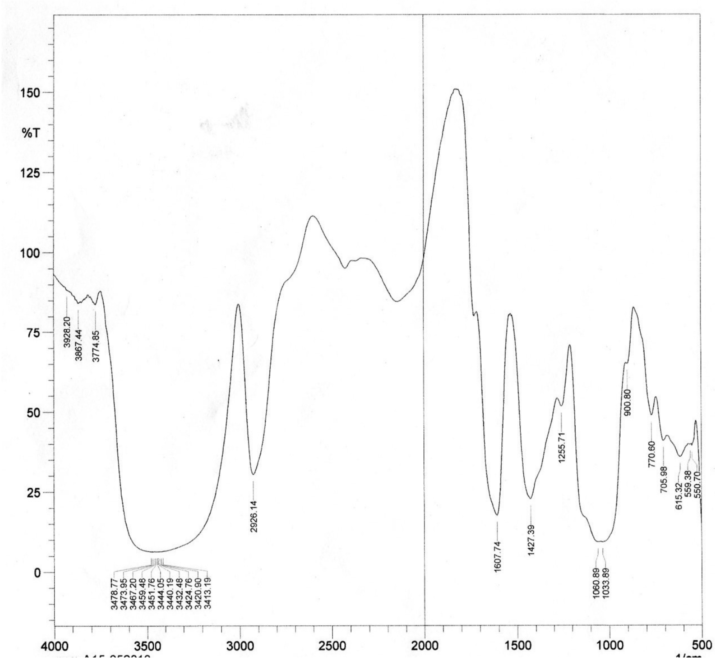

Fig. 2 FTIR of Gum Acacia

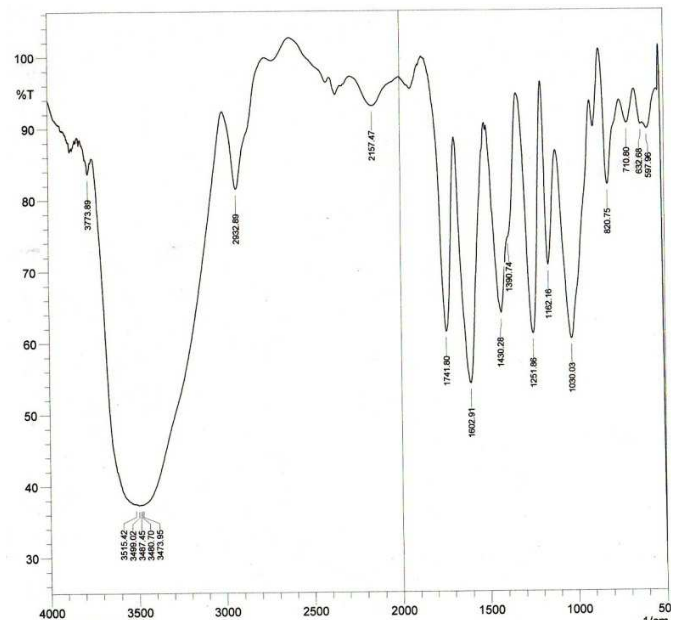

Fig.3 FTIR of Peach gum

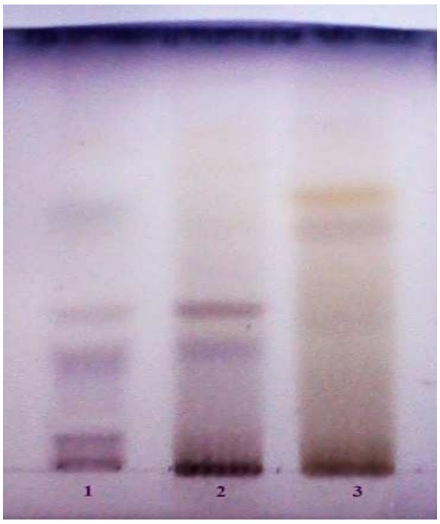

Fig. 4 TLC profile ethanol extract of processed extract of

1. Peach gum ; 2. Flax seed mucilage ; 3. Gum Acacia

Solvent system :: Ethyl acetate: Acetic acid : Methanol : Water (10:3:3:2, v/v)

Table 2.R_f and colour details of the TLC of gums

Peach Gum		Flax seed gum		Gum Acacia	
R_f value	Colour	R_f value	Colour	R_f value	Colour
0.07	Purple	0.27	Brown	0.55	Brown
0.26	Purple	0.36	Purple	0.63	Yellow
0.34	Purple	-	-	-	-
0.58	Grey	-	-	-	-

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