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Preparation of Jelly from Dietary Fiber Isolated from *Cassia fistula* and *Tamarindus indica* seeds

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ABSTRACT
The increase in diabetic, obesity and gastrointestinal disorder has increased the demand of dietary fiber products. Five jelly formulations were prepared using Pectin, *Tamarindus indica* soluble fiber (TSF) and *Cassia fistula* soluble fiber (CSF) either combination or alone and stored at 4°C and 43° C from first to sixty days for evaluation of shelf life. Jelly samples were evaluated for physical and sensory properties. Pectin and the combination of dietary fibers had reduced syneresis as compared to the TSF jelly. The combination of TSF with CSF resulted into an appreciably higher moisture content and lower total soluble content in comparison of pectin combinations. The overall acceptability, odour, taste, texture, spreadability and sensory attributes for TSF and CSF combination averaged 4.5-4.75 in a 5-point hedonic scale consumer acceptance study.
KEYWORDS: *Cassia fistula*, Soluble fiber, Sensory evaluation, *Tamarindus indica*.

INTRODUCTION
The traditional market of jams and jellies has been stable during the last few years as a consequence of changes in consumption habits and the appearance of alternative products such as breakfast cereals, on the market. Traditionally, pectin's are used as gelling agents in the fruit processing industry to produce jellies and jams (1). A number of typical hydrocolloids used as ingredients in other food systems have also been proposed for confectionery use: carrageenans, xanthan gum, gellan gum and alginates (2). Therefore, the jam and jelly industry needs to improve its competitivity and developing high dietary fiber (DF) jams and jelly may be a way of achieving this objective. There are medical studies about the benefits of DF consumption such as falling serum cholesterol concentration, lowering the risk of coronary heart disease, reducing blood pressure, aiding weight control, improving glycemic control, reducing the risk of certain types of cancer and improving gastrointestinal functions (3). As a result, fibers from different sources and compositions are being obtained and DF fortification of foods is increasing. The use of a DF, which combines the physiological properties of the fiber with other properties such as a high water holding capacity (WHC), provides an interesting area of application (4).

Cassia fistula seeds are one of the higher water-soluble gums (36.8%). All seeds of Cassia genera are found safe for internal use in various food formulations (5-6). *Tamarindus indica* seeds can be peeled, roasted, or boiled are considered famine food. Tamarind seed contain polysaccharide (xyloglucans), which are extensively used as food thickeners, stabilizers and jelling agents in Japan. In the USA, its major industrial use has been as a wet end additive in the paper industry, replacement for starches and galactomannans (7). According to Marathe et al., (8) the polyose from *Tamarindus indica* seed blends with pectin at different concentration gives good jelly. It is also used more effectively in combination of others gum. Our aim was to study the jelly forming capacity of soluble dietary fibers isolated from *Tamarindus indica* and *Cassia fistula* seeds and evaluation of its physical and sensory quality in comparison of pectin jelly.

MATERIALS AND METHODS
Materials
C. fistula was collected from adjoining areas of Birla Institute of Technology, Mesra, Ranchi. It was identified by Dr. S. Jha, Department of Pharmaceutical Sciences B.I.T, Mesra Ranchi. The specimens were deposited in the departmental museum. Powder of *Tamarindus indica* seed was procured from Arvind Industries, Bilsapur (India). The dietry fibre kit was purchased from Sigma Aldrich India, pectin from SD Fine Pvt. Ltd India, citric acid and sucrose from CDH India.

Isolation of Dietary Fiber

Dietary fiber from *T. indica and C. fistula* defatted seeds were isolated through the recommended procedure of AOAC methods 985.29 [9] with some modifications. Isolation of dietary fiber was carried out within three step of digestion procedure: (i) Incubated in 0.2 molar phosphate buffer 6 pH, at the 95°C temperature for 15min, in the presence of heat stable α-amylase. (ii) Incubated at pH 7.5 at 60°C for 30min, in the presence of protease and (iii) Incubated at pH 4.5, at a temperature 60°C, in the presence of amyloglucosidase. Each sample was fractionated into soluble and insoluble portion through centrifugation and precipitation through alcohol.

Preparation of Jelly

The jelly was prepared from the combination of sugar, citric acid and isolated dietary fiber. The formulations were first prepared by slowly mixing the soluble dietary fibers (SDF) into 50-60°C distilled water in a direct addition method as described by Downing (10). In a separate bowl, pectin, TSF and CFS were combined after proper mixing in water with continuous stirring. The sucrose was dissolved in hot-distilled water and immediately poured in the solution. Then the pH of solution was adjusted with citric acid and preservative sodium benzoate (0.04%) was added at the same time (Tab. 1). The solution was boiled at 102°C upto the Ladle test positive. The products were hot filled at 95°C in food grade plastic containers and capped with lids. The containers were inverted approximately for 5min to sterilize the lids (11). The containers were left undisturbed at room temperature for 24hrs. The containers of each treatment were placed in a refrigerator at 4°C for further studies (12).

Initial Work

A 16 trained panellists from Birla Institute of Technology; Mesra Ranchi reached a consensus on the appropriate sensory evaluation of dietary fiber jelly by comparing with pectin jelly. From the preliminary work, *Tamarindus indica* soluble fiber (TSF) was more efficient for gel strength and texture; however, the combination of TSF and Cassia fistula soluble fiber improved mouth feel and reduction of syneresis.

Physical and Chemical Measurements

Syneresis (Weeping)

Syneresis of the jelly samples were determined at days 15, 30 and 60 at ambient temperature. The amount of the separated liquid from the jelly was determined by inverting the jelly jars, allowing the separated liquid to fall in 10 ml graduated cylinder. Syneresis percentage was calculated using the following equation (12):

$$Syneresis\ \% = \frac{Total\ weight\ of\ \ Seprated\ \ Liquid(g) \times 100}{Total\ weight\ of\ \ jelly(g)}$$

Soluble Solids Content (°Brix)

The soluble solids content of the jelly was determined using a BM Hand Refrectometer (India). The instrument prism was covered with 1-2 drops of cooled jelly and the reading was taken on the basis of refraction of shaded area on the scale bar (13).

Moisture Content

Eight g of jelly was weighed and placed in a Petridish. The samples were dried in a conventional oven (Scientific instrument Services, India) at 104°C till the weight constant. To reduce moisture absorption during weighing, the dried samples were cooled in a desiccator containing solid silica gel for at least 30 min. Moisture content was calculated using the following equation:

$$Moisture\ \% = \frac{Wet\ Weight\ (g) - Dry\ Weight\ (g) \times 100}{Wet\ Weight\ (g)}$$

pH Measurements

The pH of the jelly was measured using a pH meter (μ-pH meter-model 361, Systronic). The pH meter was calibrated with two buffer solutions of pH 4.0 and pH 7.0. All measurements were performed at ambient temperature.

Sensory Evaluation

A total of 16 untrained panellists participated in a consumer study. Panellists were pre-screened for potential food allergies and on the basis of having consumed jellies. Before starting the sensory evaluation, all panellists signed an informed consent statement.

Sensory evaluation was conducted in the Pharmacognosy laboratory in the department of Pharmaceutical Sciences, Birla Institute of Technology, Mesra, Ranchi-India. Because pectin is the most popular jelly-forming agent for jams and jellies so for the comparison pectin jelly were used against the soluble fiber. Each panellist evaluated two samples of jelly at one session. One sample was the target of this study, which is dietary fiber jelly, and the other sample was pectin jelly, which was used as a control. Jelly samples were offered to panellists on odourless plastic plates. Samples were served to panellists monadically. Bread pieces, 6.0 g/sample, were used as carriers because jams and jellies are normally consumed with bread (14-15). Questionnaires were

Table 1: Ingredients proportion used in jelly formulation

Ingredient	*Pectin*	*TSF*	*TSF+CSF*	*P+TSF*	*P+CSF*
Water	40ml	60ml	50ml	50ml	55ml
Pectin	800mg			300mg	600mg
TSF		1gm	500mg	300mg	-
CSF			150mg	-	200mg
Artificial yellow colour	0.1ml	0.1ml	0.1ml	0.1ml	0.1ml
Artificial pineapple flavour	0.2ml	0.3ml	0.2ml	0.2ml	0.2ml
Citric acid solution (50%)	700mg	800mg	700mg	700mg	700mg
Sucrose	40gm	40gm	40gm	50gm	45mg
Sodium benzoate	0.04%	0.04%	0.04%	0.04%	0.04%

TSF+CSF, *Tamarindus indica* soluble fiber with *Cassia fistula* soluble fiber; P+TSF, Pectin with *Tamarindus indica* soluble fiber; and P+CSF, Pectin with *Cassia fistula* soluble fiber jellies.

Table 2: Syneresis (V/V)

Jelly	*15 day*	*30day*	*60day*
Pectin	0.400± 0.06	0.600 ±0.06	0.76±0.07
TSF	1.533±0.03	1.800±0.06	2.23±0.03
TSF+CSF	0.433±0.03	0.64±0.07	0.73±0.07
P+TSF	0.467±0.03	0.54±0.03	0.68±0.044
P+CSF	0.347±0.16	0.57±0.03	0.60±0.06

The values represent the means ±SEM for four per group. TSF+CSF, Tamarindus indica soluble fiber with Cassia fistula soluble fiber; P+TSF, Pectin with Tamarindus indica soluble fiber; and P+CSF, Pectin with Cassia fistula soluble fiber jellies.

Table 3: Soluble solid content (Brix)

Jelly	*1 day*	*15 day*	*30day*	*60day*
Pectin	70.00±1.00	71.37±0.18	71.37±0.12	71.67±0.09
TSF	63.23±0.14	63.53±0.09	63.67±0.09	63.77±0.09
TSF+CSF	63.33±0.12	63.47±0.033	63.59±0.12	63.79±0.055
P+TSF	67.13±0.09	67.23±0.15	67.37±0.09	67.63±0.12
P+CSF	70.20±0.12	70.36±0.12	70.500±0.057	70.56±0.28

The values represent the means ±SEM for four per group. TSF+CSF, Tamarindus indica soluble fiber with Cassia fistula soluble fiber; P+TSF, Pectin with Tamarindus indica soluble fiber; and P+CSF, Pectin with Cassia fistula soluble fiber jellies.

Table 4: Moisture content

Jelly	*1 day %(w/w)*
Pectin	27.25±0.59
TSF	33.73±0.31
TSF+CSF	34.61±0.43
P+TSF	34.14±0.35
P+CSF	26.94±0.35

The values represent the means ±SEM for four per group. TSF+CSF, Tamarindus indica soluble fiber with Cassia fistula soluble fiber; P+TSF, Pectin with Tamarindus indica soluble fiber; and P+CSF, Pectin with Cassia fistula soluble fiber jellies.

Table 5: pH measurements

Jelly	1 day	15 day	30day	60day
Pectin	2.34±0.02	2.38±0.08	2.30±0.006	2.38±0.015
TSF	2.45±0.01	2.51±0.03	2.50±0.03	2.57±0.014
TDF+CSF	2.51±0.01	2.52±0.02	2.54±0.015	2.53±0.04
P+TSF	2.59±0.03	2.60±0.009	2.61±0.055	2.66±0.038
P+CSF	2.49±0.03	2.53±0.018	2.45±0.09	2.55±0.06

The values represent the means ±SEM for four per group. TSF+CSF, Tamarindus indica soluble fiber with Cassia fistula soluble fiber; P+TSF, Pectin with Tamarindus indica soluble fiber; and P+CSF, Pectin with Cassia fistula soluble fiber jellies.

Table 6: Sensory evaluation

*Sensory evaluation	Pectin	TSF+CSF	Pectin +TSF	Pectin+CSF	TSF
Overall acceptability	4.50±0.29	4.75±0.25	3.75±0.25	3.00±0.41	2.50±0.29
Colour	4.00±0.41	4.75±0.25	3.75±0.48	3.25±0.48	3.75±0.25
Odour	4.00±0.41	4.50±0.29	3.25±0.48	3.25±0.63	2.75±0.25
Taste	4.25±0.48	4.75±0.25	3.25±0.63	4.00±0.41	2.25±0.25
Mouth Feel	3.75±0.48	4.75±0.25	3.75±0.25	3.00±0.41	2.50±0.29
Texture	3.75±0.48	4.50±0.29	3.50±0.29	3.00±0.41	4.75±0.25
Spread-ability	4.00±0.41	4.75±0.25	3.75±0.25	3.00±0.41	3.00±0.41

Sensory analysis was performed once on 1-day old jelly.

The values represent the means ±SEM for four per group. TSF+CSF, Tamarindus indica soluble fiber with Cassia fistula soluble fiber; P+TSF, Pectin with Tamarindus indica soluble fiber; and P+CSF, Pectin with Cassia fistula soluble fiber jellies.

Hedonic Scale: 1, Dislike very much; 2, Dislike; 3, Neither like or dislike; 4, Like; 5, Like Very Much.

provided with samples. The panellists evaluated jelly on a 5-point hedonic scale [16] to determine the degree of liking for jelly products (Hedonic Scale: 1, Dislike very Much; 2, Dislike; 3, Neither like or dislike; 4, Like; 5, Like Very Much). The samples were rated for aroma, taste, texture, spreadability and overall acceptability on the same scale (17).

RESULT

Syneresis

Jelly formulations made with TSF shown higher Syneresis from 1.533±0.03 to 2.23±0.03 ml/100gm of jelly (Tab. 2). However, the pectin, combinations of pectin and CSF +TSF had significantly lowered the syneresis. Syneresis of pectin jelly and in combination with TSF and CSF, and TSF with CSF (5:1.5) was reduced 73.90%, 69.53%, 77.36%, and 71.5% respectably, compared with using TSF alone over 60 days of refrigerated storage. Similar results were obtained for the all treatments that were stored for 60 days at 43°C.

Total Soluble Solids Content

The total soluble solid (TSS) content in TSF (63.23±0.14) and TSF with CSF (63.33±0.12) were lower in respect of pectin (70.00±1.00) and its combination (Pectin with TSF, 67.13±0.09; Pectin with CSF, 70.20±0.12) (Tab. 3).

There were no significant differences in the soluble solids content among the soluble fibers and pectin treatment of jelly at 1 to 60 days in refrigerate and oven at 43°C.

Moisture Content

The TSF (33.73±0.31), Pectin with TSF (34.14±0.35) and TSF with CSF (34.61±0.43) had higher percentage of moisture contents than pectin (27.25±0.59) and pectin with CSF (26.94±0.35) treatment jelly. The differences in all the treated jellies were due to the TSS of the jelly (Tab. 4).

pH Measurements

The pH of the formulation did not significantly differ among days or treatments or treatment-day interaction during the 60 days of refrigerated storage or of oven at 43°C. The pH values of these treatments ranged from 2.33 to 2.7 (Tab. 5).

Sensory Evaluation

The demographics of the panellists were consumed jelly at least once a week. Mean values of overall aroma, taste, texture and spreadability liking are listed in (Tab. 6). The results of the acceptance panels exhibited significant differences between the pectin and soluble fibers treatment jelly in combination or alone. The TSF with CSF jelly had significantly higher scores than pectin and all combinations of jelly for all

sensory attributes. The mean values of all the sensory attributes for pectin added jelly TSF and CFS were between liked slightly and liked moderately, whereas the TSF was between neither liked nor disliked and liked slightly. The overall acceptability mean value for the pectin and TSF with CSF 4.5 and 4.75 was higher than all other treatment groups. TSF with CSF jelly was higher acceptable by consumers for all the sensory attributes than the jelly prepared from pectin and its combination.

DISCUSSION

In the present study found that the 2% *Tamarindus indica* soluble fiber alone had found good jellying property, however, *Cassia fistula* fiber did not shown a significant jellying forming behaviour as alone. All data showed that the jelly formed to blend the pectin with TSF or CSF and TSF with CSF soluble fiber had formed good jelly in comparison of pectin 1% and *Tamridus indica* 2% fiber jelly alone. Syneresis and sensory parameters were clearly affected by adding a combination dietary fibers or pectin. The dietary fiber combination *Tamarindus indica* and *Cassia fistula* soluble fiber jelly had higher scores than the pectin and its combinations for all the evaluated sensory attributes. This research showed that formulating a jelly with combination of soluble dietary fibers had high intensity with on acceptable sensory attributes achieved.

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