Extraction of Pectin from Tamarind Fruits (*Tamarindus indica* L.) And it's Utilization in Jam Production

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ABSTRACT

In the present work, pectin was extracted from tamarind fruit pulp and used for jam production. The pectin yield in one kg tamarind pulp was 3.7 grams. The average chemical composition of tamarind pulp was: 5.44 % protein, 2.44 % ash, 18.21 % moisture, 1.99 ± 0.8% fat, 13.05 ± 0.7% fiber and 55% available carbohydrates. The tamarind fruit pulp also contained appreciable amounts of minerals as follows: 134 (mg/100g) sodium, 74 (mg/100g) potassium and 88 (mg/100g) calcium. The chemical, microbiological and sensory quality characteristics of the extracted pectin jam (A) as well as commercial pectin jam (B) were also determined. (A) contained: 8.5 % total sugar, 5 % reducing sugar, 67 % total soluble solid, 36 mg/100g sodium, (60 mg/100g potassium, 80 mg/100g calcium and had a pH value of 3.3. On the other hand, (B) contained: 12 % total sugar, 1.3 % reducing sugar, 68 % total soluble solid, 44 (mg/100g) sodium, 43 (mg/100g) potassium, 64 (mg/100g) calcium and had a pH value of 3.5±0.1. Microbiological analysis of (B) had shown high levels of yeast and mould, however, the counts of yeast and mould was highly reduced in (A). The sensory analysis indicated that all types of jams were accepted by panelists who generally preferred (B) than (A) due to its appealing colour and flavour.

Key Words: Tamarind, Pectin, Jam Production

INTRODUCTION

Tamarind (*Tamarindus indica* L.) is a member of the dicotyledonous family *fabaceae* (*leguminosae*) and it can be found throughout most of the tropics. The tree is long lived, magnificent, evergreen or semi-evergreen and, up to 30 m tall. Moreover, it is easy to cultivate, free of any serious pests and diseases (Storrs, 1995).

The tree is grown in backyards roadsides or wastelands. However, these unimproved trees now are commercially exploited in most of the producing countries as a roadside tree, for agro-forestry systems or as protective firebreaks for forest margins. Also, the valuable species are widely used for making furniture, tool handles, charcoal, oil mills, rice bounders and fuel wood. Besides, that the leaves are considered as important sources of food and herbal medicine, while the edible pulp of ripe fruits is used as a flavoring agent in cooking, soups, jams, chutneys, sauces, juices etc. However, pulp of tamarind fruit is the richest natural source of tartaric acid (8-18%) and is usually used as a chief acidulated during food preparation in India and many other Asian countries (Gunasena and Hughes, 2000)

Pectin is a natural carbohydrate in plant cell walls and it can be extracted from the inner peel of many fruits. It is considered as the main ingredient responsible for gel formation in jams and jellies. Also, pectin has according to the literature antibacterial and fungicidal properties, lower cholesterol levels in humans, is used commercially for its gel-forming property in jams and jellies, and is therapeutically used to control diarrhea (Internet, 2007).

Jams are thick, sweet spreads made by cooking crushed, or chopped fruits with sugar. The product is commonly tend to hold its shape and is generally more firm than jelly. However, the main objectives of this investigation were to extract pectin from tamarind fruit pulp in order to use it in jam and to evaluate the quality of the end product.

MATERIALS AND METHODS

Materials

Tamarind (*Tamarindus indica* L.) and pumpkin (*cucurbita sp*) fruit samples were obtained from Wad-Medani local market (during autumn), and then transported to the Department of Food Science and Technology , Gezira University.

The tamarind samples were cleaned from foreign materials, washed, soaked in water for 24 hours, and the seeds were removed from the pulp by centrifugation.Whereas, pumpkin samples were cleaned, peeled, cut and the seeds were removed.

Methods

Physical and physico-chemical methods

Fruits and seeds physical characteristics including fruit length, fruit width, seed length and seed width were measured using a Vernier Caliper: while the fruit weight, pulp weight and seed weight were determined using a sensitive balance. The hydrogen ions concentration (pH) in the different samples was determined as mentioned in the AOAC (1990).

The percent of moisture, ash, protein, crude fibre and available carbohydrates were determined in tamarind pulp samples according to the AOAC (1990) methods, while the fat content was determined according to the AOCS (1981) method. The total soluble sugars, reducing sugars and non-reducing sugars were estimated according to Nelson's method (1994). Potassium (K), sodium (Na) and calcium (Ca) concentrations were measured according to the AOAC (1970) by using of a flame photometer (model Corning, 400).

Pectin extraction method

The pectin in tamarind fruit pulp was extracted according to MC-comb and MC-cready (1952) method with minor modification, and the pectin was determined as g/100g sample. The raw material was soaked in water for 24 hrs, 300 ml of 95% ethanol were added to each 100 grams raw material, the mixture was centrifuged, then left for one hour and filtered through buchner funnel. Acidified ethanol was added to the residue (75.0 ml ethanol, 200 ml distilled water and 50 ml HCl), left for one hour and then filtered. The residue was washed with 200 ml acetone (for drying) and filtered again. The residue was dried at room temperature for 24 hours and the product was ground into fine powder and sieved through a 40 mesh sieve to separate pectin from fiber.

Jam processing method

Jam was prepared according to the traditional method using pumpkin as a raw material. The formula consisted of pumpkin fruit pulp (1 kg), sugar (1 kg) and pectin (8 g). The fruits were washed, peeled and cut into small pieces of similar size. Then, the prepared fruit pulp and 0.5 g sugar was placed in a cooker and mixed well. The mixture was cooked under continuous stirring for 12-15 minutes during which the remaining sugar was added. When the total soluble solids reached 60 Brix. Then 8 grams of the extracted pectin powder or commercial pectin were added. Then the mixture was cooked until the total soluble solids reached 67 Brix. After that, the heat was turned off and the Jam was cooled to 87^{o}C, filled in sterilized dry jars, labeled and stored for about 2 weeks at room temperature 37^{o}C.

Microbiological methods

For microbial viable counts of jam samples, appropriate dilutions in 1 mL aliquots were cultured in pre-poured plates of Nutrient agar for bacterial total plate counts, MacConkey agar for the enumeration of coliform, Baired- parker agar for *Staphyllococci* and salmonella shigella agar for *Salmonella*. Then the plates were incubated for 24-48 hrs and the characteristic colonies appearing on the respective selective agar media were counted and multiplied by the dilution factor and expressed as colony forming units per milliliter (cfu/ ml).

The yeast and mould count was enumerated by culturing on Potato Dextrose agar (PDA) medium. After incubating for 72 hours at 25^{o}C, the yeasts and moulds were counted, plates containing between 30 and 3000 colonies were counted as colony forming units per ml of the sample (cfu).

Sensory evaluation

Jam products were sensory evaluated by using 10 trained panelists. The panelists were asked to assess each sample for consistency, flavor, overall acceptability and colour, using a questionnaire designed by the Department of Food Science and Technology. The results were recorded and statistically analyzed.

RESULTS AND DISCUSSION

Physical characteristics of tamarind fruit

The data presented in Table (1) shows some of the physical characteristics of tamarind fruit. The fruit length, width and weight were found to range between 12.0-17.5 cm, 0.7-1.2 cm and 7.0-19.0, respectively. The average pulp weight was found to be 54.9 g per 100 g raw fruit material. The physical analysis also, indicated that the amount of pectin extracted from 1.0 kilogram tamarind pulp was only 37.03 grams which represents about 3.7% from the total tamarind pulp.

Table 1. Physical characteristics of tamarind fruits.

Parameters	Value
Fruit length (cm)	12.0-17.5 ± 0.3
Fruit width (cm)	0.7-1.2 ± 0.3
Weight of fruit (g)	7.0-19.0 ± 0.4
Weight of pulp /100g fruit	54.4
Pectin yield (%)	3.7

Chemical composition of tamarind fruit pulp

Table (2) indicates the chemical composition of tamarind fruit pulp. The moisture, protein, fat, crude fibre, available carbohydrates and ash were found to be 18.21, 5.44, 1.99, 13.05, 58.7 and 2.44, respectively in the raw fruit pulp. The levels of moisture, available carbohydrates and ash found in this study were slightly lower than those reported by Morton (1987) and Gursharan *et al.*, (2006). In contrast, the contents of protein (5.44%), fat (1.99%) and crude fibre (13.05%) found in this study were higher than those reported also, by Morton (1987) and Gursharan *et al.*, (2006) which were 3.1%, 0.99% and 5.6%, respectively.

In-regard to minerals content in tamarind fruit (Table, 2), the pulp was found to contain 134 mg/100g sodium, 74 mg/100g potassium and 88 mg/100g calcium per 100 g fruit pulp. However, the concentration of calcium (88 mg/100 g) reported to be within the range (35 – 170 mg/100g) that previously found by Morton (1987). While, the concentration of sodium (134/ 100 g) and potassium (74 mg/ 100 g) are markedly differ from those reported by Morton (1987) which were 24.0 mg/100 g and 375 mg / 100 g fruit pulp, respectively.

Table 2. Chemical composition of tamarind fruit pulp.

Chemical composition	Value
Moisture (%)	18.21 ± 0.5
Protein (%)	5.54 ± 0.5
Fat (%)	1.99 ± 0.8
Ash (%)	2.44 ± 0.4
Crude fiber (%)	13.05 ± 0.7
Available carbohydrate (%)	58.7 ± 0.1
Sodium (mg/100g)	134 ± 0.1
Potassium (mg/100 g)	74 ± 0.2
Calcium (mg/100g)	88 ± 0.1

Chemical and physico-chemical properties of jam

The chemical and physico-chemical properties of pumpkin jam made with extracted tamarind pectin (A) and commercial pectin (B) are presented in Table (3). The pH values of (A) (3.5 ± 0.1) was slightly higher than that of (B) (3.3 ± 0.1). The result was in agreement to that reported by Saeed and ELMubarak (1974) who found that the pH of jam should range from 3.2 to 3.4, and also agreed with the range of normal pH (3.1 to 3.3) as reported by Durward (2006). It is known that insufficient acid causes failure of pectin action in production of jam. The total sugar of (B) (12 ± 0.1%) was greater than that of (A) (8.5 ± 0.1%). The reducing sugar of jam made from (A) (5 ± 0.1%) was much higher than that of (B) (1.3 ± 0.1%). The total soluble solid (T.S.S) of (A) (67 ± 0.1%) was similar to that of (B) which was 68 ± 0.1%. These values agreed with that reported by Durward (2006) who found that the (T.S.S) of jam was 68%. The obtained T. S.S values are acceptable since it is known that when T.S.S % of jam exceeds 70 % may lead to crystallization of sugar and hence reduce the quality of jam (Durward, 2006).

The mineral content (mg/100g) of jam made from extracted pectin or commercial pectin were also presented in Table (3). The potassium (60±0.1 mg/100g) and calcium (80±0.5 mg/100g) of the EPJ were slightly higher than those of the (B) which were found to be 43±0. And 64±0.2, respectively, but the sodium content of the (A) (36 ±0.2 mg/100g) was slightly lower than that of the (B) (44±0.8 mg/100g). This difference in the mineral contents between (A) and (B) is obviously due to difference in the pectin source.

Table 3. Chemical and physico-chemical properties of pumpkin jam.

	Pumpkin Jams	
Parameters	(A)	(B)
pH	3.3 ± 0.1	3.5 ± 0.1
T.S.S (%)	67 ± 0.1	68 ± 0.1
Total sugar (%)	8.5 ± 0.1	12 ± 0.1
Reducing sugar (%)	5 ± 0.1	1.3 ± 0.1
Sodium (mg/100g)	36 ± 0.2	44 ± 0.8
Potassium (mg/100g)	60 ± 0.1	43 ± 0.2
Calcium (mg/100g)	80 ± 0.5	64 ± 0.2

A = Pumpkin jam made with extracted tamarind pectin.

B = Pumpkin jam made with commercial pectin.

Microbial analysis of jam

The microbiological analysis of jams made with commercial pectin (B) and extracted pectin (A) is shown in Table (4). The analysis revealed the presence of 4 x 10^4 and 2 x 10^4 c.f.u/g of total viable counts in (A) and (B), respectively. The increase of total microbial load in (A) could be attributed to post contamination or cross-contamination during the extraction process. Moreover, usually heat treatments employed during production of commercial pectin reduces the microbial load and eliminates the spoilage and pathogenic bacteria (Fraizier and Westhof, 1978).

Table 4. Microbial load of pumpkin jams

Jam sample	Total viable counts (c.f.u/g)	Coliforms counts (c.f.u/g)	Staphy lococci counts (c.f.u/g)	Yeast and moud counts (c.f.u/g)
(A)	4×10^4	Nil	Nil	5×10^2
(B)	2×10^4	Nil	Nil	3×10^2

A = Pumpkin jam made with extracted tamarind pectin.
B = Pumpkin jam made with commercial pectin.

Oppositely, the results in Table (4) show the absence of coliform and staphylococci *Staphylococcus spp.* in all tested jam samples (A, B). It is known that *Staphylococcus spp.* cannot grow in a medium with a higher sugar concentration. *Staphyloccoccus spp*. cause food poisoning from entertoxin B in food (Cliver, 1990). Total yeast and mould count of (A) and (B) were 5 x 10 and 3×10^2 (c.f.u/g), respectively. The increase of yeast and mould in (EPJ) may be correlated with the relatively higher pH values of (A) which might improve their growth as reported by Hill (1939). Yeasts and moulds are examples of fungi and mould which are responsible for food spoilage and produce mycotoxin. Yeast spoils food rapidly, and both yeast and mould grow well in acidic food with low water activity (Cliver, 1990). Yeasts and moulds are considered as spoilage organisms and namely responsible for discoloration, slime formation, flavour and texture deterioration in food.

Jam sensory evaluation of jam

The results of sensory evaluation for the two jam samples (A, B) are presented in Table (5). The panelists prefer the appearance of jam made from commercial pectin due to the dark color formation in jam made from extracted pectin. As indicated in the table there was none – significant difference in texture of the two jam samples. In contrast, the color and flavor were significantly different when different jam samples were compared. Moreover, there is insignificant difference in overall acceptability of the two samples (A, B).

Table 5. Jam sensory evaluation scores.

Sample	Color	Consistency	Flavor	overall acceptability
(A)	6.4b	6.8a	5.8b	7.1a
(B)	7.3a	6.3a	7.2a	6.9a

A = Pumpkin jam made with extracted tamarind pectin.
B = Pumpkin jam made with commercial pectin.

CONCLUSIONS AND RECOMMENDATIONS

The goal of the present study was the extraction of pectin from tamarind fruit pulp and using it in preparation of jam. The chemical analysis of tamarind fruit showed that the tamarind fruit pulp had a complex chemical composition. The resulting low pH value inhibits the growth of food spoiling bacteria, most of which are acid sensitive, in addition, other bacteria cannot successfully grow like Staphylococci, Salmonella, coliform and *E. coli*. The microbial load of jam was affected by the action of heat treatment, which reduced the total count of microorganisms and resulted in elimination of harmful microorganisms. The sensory evaluation indicated that all jams samples were accepted by the panelists and preferred with the order: commercial pectin jam and extracted pectin jam. Most panelists preferred the commercial pectin jam due to its flavor, appearance and color compared to the extracted pectin jam.

More studies are needed to remove the color of the extracted pectin which affects the color of jam. In addition, tamarind fruit pulp needs more attention to produce different types of products such as pickles and concentrates.

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استخلاص البكتين من ثمار العرديب واستخدامه في إنتاج المربى

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الخلاصة

تم في هذه الدراسة استخلاص البكتين من ثمار العرديب واستخدامه في إنتاج المربى. حصاد البكتين في الكيلوجرام الواحد من العريب كان3.7 جرام . كان متوسط المكونات الكيميائية لثمار العرديب كالأتي: (5.44%) بروتين،(2.44%)رماد ، (% 18.21) رطوبة، 1.99) دهون، (13.05%) ألياف و 55% كربوهيدرات. احتوت ثمار العرديب أيضاً على كميات كبيرة من العناصر المعدنية (ملجم/100جم) كالاتي: (134) صوديوم، (74) بوتاسيوم و(88) كالسيوم. الخصائص الكيميائية والميكروبيولوجية و الحسية للمربى التي انتجت باستخدام البكتين المستخلص و البكتين التجاري أيضاً تم تحديدها. احتوت المربى المنتجة باستخدام البكتين المستخلص على: (% 8.5) سكريات كلية، 1.3 % سكريات مختزلة ،67 مواد صلبة ذائبة، 36 ملجرام/ 100جرام صوديوم، 60 ملجرام/ 100جرام بوتاسيوم ، 80 ملجرام/ 100جرام كالسيوم و لها درجة حموضة 3.3. من جهة أخرى احتوت المربى المنتجة باستخدام البكتين التجاري على 12% سكريات كلية، 1ز3% سكريات مختزلة، 68% مواد صلبة كلية، 44 ملجرام/ 100جرام صوديوم، 43 ملجرام/ 100جرام بوتاسيوم، 64 ملجرام/ 100جرام كالسيوم و لها درجة حموضة 1ز3%. أظهر التحليل الميكروبي مستويات عالية من الخمائر و الأعفان في المربى المنتجة باستخدام البكتين التجاري، بينما انخفضت أعداد الخمائر و الأعفان كثيراً المربى المنتجة باستخدام البكتين المستخلص. أشار التحليل الحسي لقبول كل أنواع المربى بواسطة المحكمون و الذين عموماً فضلوا المربى المنتجة باستخدام البكتين التجاري على المربى المنتجة باستخدام البكتين المستخلص بسبب لونها الجذاب و مظهرها.