

Prickly pear (*Opuntia ficus-indica* Mill.) Fruits : Characteristics And New Utilization

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ABSTRACT

The present study was conducted to estimate the suitability of the prickly pear fruits for preparing different edible products. Therefore the technological properties of fruits, physico-chemical and proximate composition of pulp were determined. Concentrate, jam and sheet were prepared from the strained pulp and their sensory characteristics were estimated. The results showed that the strained pulp of orange and spineless red ripe prickly pear fruits had 6.10 and 6.09 pH, 0.21 and 0.23 acidity as% citric acid 11.38 and 11.11 total soluble solids, 11.02 and 10.98 total sugars 26.90 and 28.61 mg/100g ascorbic acid. 0.82 and 1.06 mg/100g, B-carotene, 2.5 and 9.2 mg/100g total anthocyanine respectively. Also the pulp contained minor amounts of crude protein, ether extract, crude fiber and ash. The each spineless red fruit contains one fine seed. The panelists accepted the sensory properties of the processed concentrate, jam, sheet, and reconstituted Juice from such fruits.

Keywords: orange and spineless red prickly pear fruits, technological properties, physico-chemical, proximate composition, and sensory characteristics

INTRODUCTION

Prickly pear or Indian fig (*Opuntia ficus-indica* Mill.) trees belong to the Cactaceae family. The tree gives two edible products, leaves or nopales and fruits or tuna or fig. Nopales can eat fresh after adding to salad and/or after cooking as a vegetables. It has a slightly stringent taste and a green bean like odor (Mc Conn and Nakata, 2004). The fruit or tuna consists of thick peel with numerous prickles and delicately very seedy pulp. The presence of the prickles in the peels makes the hand peeling of the fruits uncomfortable (Russell and Felker, 1987). The pulp contains different types of nutrients including vitamins and minerals (Saenz, 2000). It can eat fresh and/or after processing into juice, jam, candies, and sheets (Joubert, 1993, Abd-Nabey 2001).

In Egypt, the cultivation of prickly trees are common in dry arid lands, some rocky places, desert and new arable soils. They play a role in erosion control and land rehabilitation particularly in arid and semi arid zones (Felker, 1996). They can also grow in dense planting layouts of up to 66,000 plants per hectare, not only for their fruits but also as fences and wind breaker. They do not need high cost for growing or field treatments. Generally no accurate data are available about annual production and total cultivation area of this plant in Egypt. Salah (2000) determined the annual above ground yield of this plant is by 45 ton per hectare. The fruits of this plant can be classified according to their peel and pulp color into orange and red types. Until now the only utilization of fruits in Egypt is eaten fresh as a snack food. Therefore the main objectives of this study were to identify the differences in

technological ,physical and chemical properties between both red and orange Egyptian prickly pear fruits and to estimate their suitabilites for processing into different products such as concentrate , jam, and sheets. The successful processing of such fruits will help in extending their utilization and rising from their economical value

MATERIALS AND METHODS

A-Materials- Orange and red ripe prickly pear (*Opuntia ficus-indica* Mill.) grown at light sandy soil in Antoniadis area near Alexandria ,Egypt; were purchased from the Ministry of agriculture in season 2004 and kept at 3-4C until used for chemical and technological studies .Other materials including sucrose pectin, citric acid, edible gelatin mango essence, glass bottles and jars, saran sheet ,and polyethylene bags were obtained from local markets at Alexandria city, Egypt.

B-Methods

1- Technological methods:- Fig (1)illustrates the production outline of prickly pear jam, paste and sheet. These products were prepared as described by Raya (1998)for jam and concentrate Chan (1983) and Chan and Cavaletto (1978) for sheet. Table(1) shows the percentage of the different ingredients used for preparing such products.

2 Physical and chemical analysis:-: The average fruit weight, percentage of fruit peel ,seed and flesh were determined. –as described by Abdel –Nabey (2001). Color of prickly pear pulp and it's products was measured using Lovibond Schofield Tentionmeter as described by Mackinnery and Little (1980) .Brookfield viscometer was used to determine the viscosity of the seedless pulp .Moisture ,pectin ,crude fiber ,ash, titrable acidity as citric acid, ascorbic acid and minerals were determined according to AOAC methods(1990)Total soluble solid (T.S.S)) using Abbe refractometer at 20Cand pH by coleramer digital pH meter were assayed .Total and reducing sugars were estimated according to Malik and Singh (1980).B-carotene and total anthocyanine were estimated as reported by Rangana (1977)

3- Sensory evaluation: - Sensory properties of prickly pear products, were subjectively assessed by ten panelists of Food Science and Technology Department, Faculty of Agriculture, Alexandria University, Egypt using hedonic scale as mentioned by Rangana (1977)

Table (1): Ingredients used for preparing prickly pear products

Ingredients	Prickly pear products		
	concentrate	jam	Sheet
prickly pear pulp(%)	77.2	44.5	78
Sucrose(%)	22.5%	44.24	20
Pectin(%)	---	0.5	2
Citric acid(%)	0.3%	.0.5	
Mango essence	Trace	Trace	trace
Sodium etabisulfhite ppm)	-200ppm	-	500

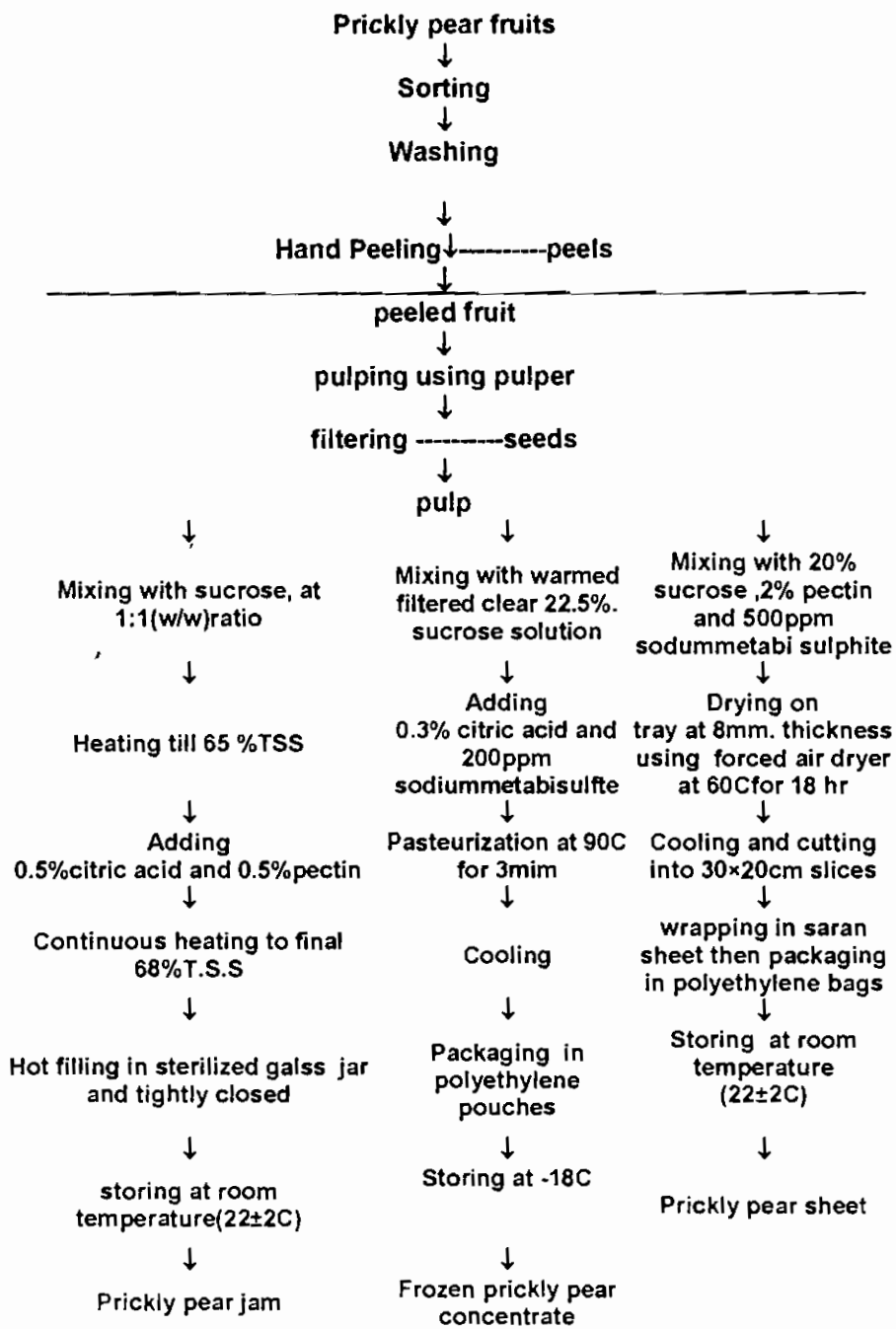


Fig (1): Outline production of Prickly pear products

RESULTS AND DISCUSSION

1-Prickly pear fruits properties: The data in table (2) showed that the weight average, size (length and diameter), percentage of flesh, pulp, and seeds of the orange prickly pear fruits were higher than the spineless red ones. Also the number of seeds and weight average of seed were lower in spineless red fruits than orange ones. Only one seed with low weight was found in peeled spineless red fruit. Such differences suggest that the orange and spineless red fruits followed two different varieties. It is known that each variety is pregnancy of a single seed. The ability to consistently reproduce the original characteristics of such fruits is mainly due to variety Mondragon (1999) and Silos *et al*(2003) found differences in fruit size, texture, and pulp percentage between the fruits of prickly pear varieties. From the technological viewpoint, the main constraints for processing such fruits are the presence of prickles in the peel, the low size and high number of seeds in fruit pulp. Screening the pulp of the peeled fruits after pulping through 1mm mesh screen followed by filtration through suitable filter may be useful to remove seeds and to obtain clear prickly pear pulp.

Table(2): Technological properties of prickly pear fruits

Property	Prickly pear fruits	
	Orange	spineless red
Fruit weight(g)	55.30±8.54 0.01	15.30±4.14 0.01
Fruit length(cm)	7.10± 1.01	3.53± 0.91
Fruit diameter(cm.)	4.66± 0.55	2.1± 0.47
Peeled fruit(g)	37.33± 0.10	10.33± 0.32
Seed weigh (g)	2.61± 0.11	0.15± 0.08
Seed(number/fruit)	120.30± 0.01	1.00± 0.00
Peel (%)	45.15± 0.41	58.8± 0.01
Seed (%)	8.9± 0.11	1.25± 0.71
pulp (%)	45.95± 0.19	39.95± 0.39

Mean ±S.D

Meanwhile fruit peeling needs to design a proper machine to overcome the presence of prickles and also to give high yield of flesh. Plant breeders can also in share in solving such problems by developing new varieties free or low in prickly and seed. As seen from table (2) in spite of the high number and percentage of seeds in orange prickly fruits their yield of the pulp was higher than that of spineless red ones which contain one seed and sequentially small percentage of seeds. Badr (2004) reported the importance of continuous researches on horticulture to serve the food technology processing. She recommended the red fruits for processing as it contains only one fine seed.

1-a-physical and physico-chemical properties :-As seen from table((3) the Lovibond color values of pulp differed between the two types of prickly pear fruits. The dominant and complementary color were yellow and red in case of an orange prickly pear pulp. The opposite was observed for the red one. In

both, blue color responsible of color dullness. Ewaidah and Hassan(1992) and Abdel -Nabey (2001) described the color of pulp of prickly pear as light brown .The pH of the pulp of both types of the prickly pear fruits was nearly similar .This fruit follows the low acid foods .It's level of total titratable acidity was very low ,0.21-0.23%as citric acid .Citric acid addition is very important when the pulp of such fruits use for preparing juice, concentrate and jam. .In other hand and due to the presence of pectin, the viscosity of the strained pulp was considered relatively high 166-170cp.Most T.S.S of the pulp. formed from soluble sugars. Most of sugars 47.5%,found in reducing from .Comparing with other vegetables and fruits, pulp of prickly pear contains low level of vitamin C. The considerable amount of B-carotene in pulp of this fruit was mainly responsible of it's orange and spineless red color. Remarked increase of Total anthocyanine content was found in spineless red than orange fruit. Preparing jam or sheet from the strained pulp of this fruits needs to increase it's content of pectin . Generally except B-carotene and lovibond color values, the other's determined properties were very closed in pulp of both type of prickly pear fruits. .The results in this part of the study agree with those stated by other investigators such as Wills *et al* (1986) for B-carotene Joubert (1993)for vitamin C., pH and acidity and Abd-Nabey (2001)for pectin, TSS and sugars

Table (3): Physical and physico-chemical properties of orange and red prickly pear pulp

Property	Prickly pear fruits Property	
	Orange	spineless Red
Lovibond color :-units		
Red	2.2± 0.09	1.2 ± 0.02
Yellow	6.4± 0.11	9.7± 0.32
Blue	2.0± 0.01	3.4± 0.41
pH	6.10± 0.07	6.09± 0.08
Acidity as (% citric acid)	0.21± 0.31	0.23± 0.08
Viscosity (centipoise)	170.74± 0.08	166.12± 0.04
Total soluble solids (%)	11.38± 0.11	11.11± 0.41
Total sugars (%)	11.02± 0.08	10.98± 0.07
Reducing	10.74± 0.11	10.71± 0.31
Ascorbic acid (mg\100g)	26.90± 0.01	28.61± 0.01
Pectin (%)	00.21± 0.01	00.23± 0.01
B-carotene (mg\100 g)	1.06± 0.31	0.82± 0.06
Total anthocynine mg/100g)	2.5± 0.017	9.2± 0.05

Mean ±S.D fresh weight basis

b-Proximate composition and mineral contents:-As seen from table (4),ash , ether extract and crude fibers were relatively more in orange prickly pear pulp than spineless red ones. The other determined components were nearly similar in pulp of both fruits .except carbohydrate. The same observation was stated by Abd-Nabey (2001) .Analysis of minerals showed

that potassium found in highest level and sodium in lowest value in pulp of prickly pear fruits. This is an important for the people suffering from hypertension. Calcium, magnesium, and phosphorus also present in a considerable level in pulp of the this fruits. Except phosphorus, the other's determined minerals were higher in red pulp of the prickly pear comparing with orange one. The fore mentioned data were similar with those stated by Facciola and Cornucopia. (1990

Table (4): Proximate composition and minerals content of prickly pear pulp

Component (%)	Prickly pear pulp Property	
	Orange	spineless Red
Moisture	86.35± 0.11	81.74±0.04
Crude protein(N*6.25) %	0.53±0.21	0.53±0.07
Ether extract(%)	0.12±0.03	0.08±0.11
Crude fibers (%)	1.0 ±0.41	0.8±0.16
carbohydrate) (%)	11.6±0.01	11.4±0.61
Ash (%)	0.45±0.11	0.42±0.13
Minerals(mg/100g)		
Potassium	163.0±0.01	169.0±0.09
Calcium	39.5.0±0.03	60.0±0.005
magnesium	25.5.0±0.12	35.0±0.014
Phosphorus	27.0±0.51	21.0±0.114
Sodium	0.93±0.016	1.19±0.01

Mean ±S.D fresh weight basis

3- Prickly pear products

a) Concentrate As noticed in Table (5)and (6) prickly pear concentrate of (orange and spineless red fruits) was acceptable by panelists. Oh and Park (1997) stated that prickly pear juice used as a healthy drink in Korea. Addition of traces of mango essence increased acceptability of this product to very acceptable. Generally, concentrate had thin cleared homogenized consistency. Addition mango essence led to improve the flavour acceptability of prickly pear concentrate from acceptable to very acceptable

b) Jam: According to data in Table(5)and (6) prickly pear jam had an, acceptable jelly texture, sweet taste and slightly accepted flat odor, Addition of mango essence improved the flavor of this product to very acceptable.

c) Sheet: As noticed in Table (5)and (6)the total acceptability of this product by panelists was moderately acceptable and improved to acceptable by adding mango essence. prickly pear sheet had an dark colour, chewy texture, and slightly acceptable flat flavor before adding mango essence.

Table (5): Description and acceptability of sensory properties of orange prickly pear products

Prickly products	Organoleptic properties						Total acceptability
	Colour		Flavour		Texture		
	Description	Acceptability	Description	Acceptability	Description	Acceptability	
(a) concentrate	Yellow	Acceptable	Flat	Acceptable	Homogenized	Acceptable	Moderately acceptable
(a) Without essence	Yellow	Acceptable	Like mango flavour	Acceptable	Homogenized	Acceptable	Moderately acceptable
(b) Containing mango flavor	Yellow	Acceptable	Sweet taste & flat odor	Acceptable	Gel	Acceptable	Moderately acceptable
2- Jam	Yellow	Acceptable	Sweet taste & Like mango flavour	Acceptable	Gel	Acceptable	Acceptable
(a) Without essence	Yellow	Acceptable	Flat	Acceptable	Firm and elastic	Acceptable	Moderately acceptable
(b) Containing mango flavor	Dark yellow	Acceptable	Like mango flavour	Acceptable	Firm and elastic	Acceptable	Acceptable
3- Sheets	Dark yellow	Acceptable	Like mango flavour	Acceptable	Firm and elastic	Acceptable	Moderately acceptable
(a) Without essence	Dark yellow	Acceptable	Like mango flavour	Acceptable	Firm and elastic	Acceptable	Acceptable
(b) Containing mango flavor	Dark yellow	Acceptable	Like mango flavour	Acceptable	Firm and elastic	Acceptable	Acceptable

Table (6): Description and acceptability of sensory properties of red prickly pear products

Prickly products	Organoleptic properties						Total acceptability
	Colour		Flavour		Texture		
	Description	Acceptability	Description	Acceptability	Description	Acceptability	
1- concentrate	Brown red	Acceptable	Flat	Acceptable	Homogenized	Acceptable	Moderately acceptable
(a) Without essence	Brown red	Acceptable	Like mango flavor	Acceptable	Homogenized	Acceptable	Moderately acceptable
(b) Containing mango flavor	Brown red	Acceptable	Sweet taste & flat odor	Slight acceptable	Gel	Acceptable	Moderately acceptable
2- Jam	Brown red	Acceptable	Sweet taste & like mango odour	Acceptable	Gel	Acceptable	Acceptable
(a) Without essence	Dark Red	Acceptable	Flat	Acceptable	Firm and elastic	Acceptable	Moderately acceptable
(b) Containing mango flavor	Dark Red	Acceptable	Like mango flavor	Acceptable	Firm and elastic	Acceptable	Acceptable
3- Sheets	Dark Red	Acceptable	Like mango flavor	Acceptable	Firm and elastic	Acceptable	Moderately acceptable
(a) Without essence	Dark Red	Acceptable	Like mango flavor	Acceptable	Firm and elastic	Acceptable	Moderately acceptable
(b) Containing mango flavor	Dark Red	Acceptable	Like mango flavor	Acceptable	Firm and elastic	Acceptable	Acceptable

Conclusion

The above results showed the suitability and successful utilization of the strained pulp of prickly pear fruit in preparing concentrate, jam, and sheet.

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ثمار التين الشوكي :

الخواص والاستخدامات الجديدة

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هدفت الدراسة إلى بيان ملائمة ثمار التين الشوكي لإنتاج منتجات غذائية متنوعة لذلك تم تقدير كل من الخواص التكنولوجية للثمار و الصفات الطبيعية والفيزيوكيماوية لللب الثمار المصفى واستخدام هذا اللب في إنتاج مربى ومركز ورقائق جافة وقد بينت النتائج ان لب الثمار المصفى الناتج من الثمار البرتقالية والحمراء عديمة الأشواك للتين الشوكي لها أرقام الأس الهيدروجيني 6,1 و 6,09 و حموضة 2,1 و 2,3 و. كحامض سترك ومواد صلبة ذائبة كلية 11,38 - 11,10 وسكريات كلية 11,02 - 10,98 او 26,90 و 28,71 ملجم/100جم حمض الاسكوريك وبيتاكاروتين 1,06 و 0,82 ملجم /100جم وكانت كميات الانثوسيانين الكلى اعل بكثير في النوع الأحمر عديم الأشواك عن النوع الأصفر حيث كانت على التوالي 9,2 و 2,5 ملجم/100جم واحتوى اللب المصفى على كميات منخفضة من بروتين الخام و بكتين و دهون والألياف الخام والرماد وكانت ثمار التين الأحمر عديم الأشواك أفضل في عملية الإعداد لتصنيع حيث أنها احتوت على بذرة أثرية وحدة هذا وقد أوضحت النتائج الاختبارات العضوية الحسية للمنتجات المركزة والمربى والشرائح لكلا من النوع الأصفر والأحمر عديم الأشواك ر أنها مقبولة حسيًا بصورة كبير