Total Phenolic Contents and Antioxidant Properties of Pulp and Skin of Prickly Pear (*Opuntia ficus indica*) Fruits: Application on Juice and Jam

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Abstract:

The nutritional and health-promoting properties of prickly pear fruit has attracted attention and can may contribute to their increased consumption in the future being rich in bioactive compounds (polyphenols and ascorbic acid).

Skin considers the major by-product of the fruit. The main objective of the study was to evaluate the bioactive compounds content, antioxidant activity and sensory quality of prickly pear (pulp, skin and whole fruit) juice and jam. Proximate composition, pH, acidity, total phenols, total flavonoids, antioxidant activity using (DPPH) and sensory evaluation of pulp, skin, whole fruit juice and jam were evaluated. The data revealed that the moisture content ranged from 90.01% ±0.13 to 90.98% ±0.18 for prickly pear skin juice and pulp juice, respectively. Prickly pear skin juice and jam had the highest values of ash 1.347 ±0.02 and 1.00 ±0.03, respectively. Total soluble solid of juice and jam ranged from 8.50% to 8.90% and 68.00% to 67.5% for juice and jam, respectively. The pH values of juice (5.68 – 5.78) were higher than that of jam (4.05 -4.34). Prickly pear skin juice and jam significantly ($P \leq 0.05$) had the highest values of total flavonoids and total phenols which recorded (379.67 ±9.5 and 204.03 ±5.10 mg/100g) and (152.08 ±5.93 and 151.33 ±1.70 mg/100g), respectively and subsequently high significantly ($P \leq 0.05$) values of antioxidant activity using DPPH. Jam processed from skin and whole fruit significantly ($P \leq 0.05$) had the highest sensory scores. In conclusion, prickly pear pulp, skin and whole fruit juice can be used successful for producing jam content bioactive compounds and antioxidant activity with acceptable sensory characteristics.

Key Words: Prickly pear, juice, jam, chemical composition, acidity, total phenols, antioxidant activity, DPPH.

Introduction

Prickly pear *(Opuntia ficus-indica)* is a tree originating in Mexico and yields an edible fruit, belongs to the family *Cactaceae*. It is widely distributed in Latin America, South Africa and the Mediterranean area including Egypt. The fruit is usually consumed fresh, during the ripening

period, July–October and well appreciated by consumers because they are flavorsome good (**Albano *et al.*, 2015; Elhassaneen *et al.*, 2016 and Khatabi *et al.*, 2016).** The prickly pear fruit also called cactus pear fruit grow in areas with poor soil, extremely high daytime temperatures and limited water supplies, is an oval elongated berry with enveloped by peel (skin) with thorns, pulp fruit have number of seed and pulp of fruit is fleshy edible and a juicy. Fruit have a different color such as green, canary yellow, lemon yellow, red, cherry-red or purple hues. These are the betalains present in the epidermis and the pulp of the prickly pear confers on it its color varying from yellow to purple **(Stintzing *et al.*, 2001; El-Mostafa *et al.*, 2014 and Du Toit *et al.*, 2018).**

Prickly pear is considering a functional food because it is an important source of nutrients such as fibers, amino acids vitamin E, ascorbic acid, carotenoids sugars, organic acids, minerals and seeds (oil composition) (**Stintzing *et al.*, 2003; El-Mostafa *et al.*, 2014**; **Anwar and Sallam, 2016** and **Elhassaneen *et al.*, 2016**). Several studies that have been investigated the composition of pulp in the cactus pear fruit and considered as a good source of minerals, in particular phosphorous, calcium and magnesium make cactus pear juice useful in prevention of osteoporosis and cramps**(Abou-Zaid *et al.*, 2013 and Cota-Sanchez, 2016).**

Prickly pear fruit juice is a source of betaxanthin pigments which can be used as water-soluble natural colorants in foods and rich in phenolic compounds, that consumption may play a vital role in health through the regulation of metabolism, weight, chronic disease **(Maataoui and Hilali, 2004; Cory *et al.*, 2018 and Fernández-López *et al.*, 2018).** Betalains and polyphenols are antioxidants that contribute to nutritional prickly pears quality and to their products of transformation. Another important antioxidants in prickly pear fruits include pectin and flavonoids including kaempferol, quercetin (**Anwar and Sallam, 2016, Cota-Sanchez, 2016 and Khatabi *et al.*, 2016).**

Notably, natural cactus pear fruit compounds and derivatives have biologically activities such as antiulcerogenic, anticancer, antimicrobial, neuroprotective, hepatoprotective, anti-inflammatory, antioxidant properties that may help in preventing chronic pathologies such as diabetes

(Madrigal-Santillán *et al*., 2013, El-Mostafa *et al*., 2014 and Albano *et al*.,2015) and also in many countries over the world used it for treating number of diseases such as hypertension, burns and indigestion Prickly pear is an important source of bioactive compounds, where it is considered an important source of bioactive compounds (**Elhassaneen *et al*., 2016).**

In the food industry, there is a continuous search for ingredients that might provide advantageous properties to food products, either considering their nutritional value or bioactivity (**Chahdoura *et al*., 2017**). Prickly pear fruit is consumed directly or after being processed to products such as fruit purees or jams **(Javanmard and Endan, 2010).** Low acidity and fairly high sugar content in the fruit make it very sweet and delicious and can be prepared recipes range from appetizers desserts, drinks from prickly pear (**Abou-Zaid *et al*., (2013).**

Jam is a semi-solid mixture, prepared by cooking the fruit soft tissue, jam production requires right proportion of the right ingredients to get the desired result, which are; sugar, acid and pectin to a balance thick. Jam should include more than 68.5% total soluble solids (TSS) plus at least 45% fruit. As mentioned, the codex alimentations commission identify that the finished jam be supposed to contain more than 65% TSS. In jam production, pectin can be obtained from fruit peels like orange which increases the dietary fiber of the end product and also reduces blood sugar when consume **(Gimenez *et al*., 2001; Ozdogan and Yilmaz, 2011 and Awolu *et al*., 2018).** Furthermore, this fruit is usually consumed as a fresh fruit or juice and to a lesser extent as jams **(Madrigal-Santillán *et al*., 2013)**. Therefore, the objective of this study was to take advantage and integrate whole fruit of prickly pear to produce jam product to be acceptable in nutritional quality and sensory attributes.

Materials and Methods

Prickly Pear Fruit Samples

Fresh fruits of prickly pear were obtained from local market at Minia Governorate, Egypt. After washed with running water well and remove thorns with knife and manual separation of the skin from the pulp, portioned and stored at -20° until analysis and juice and jam preparation.

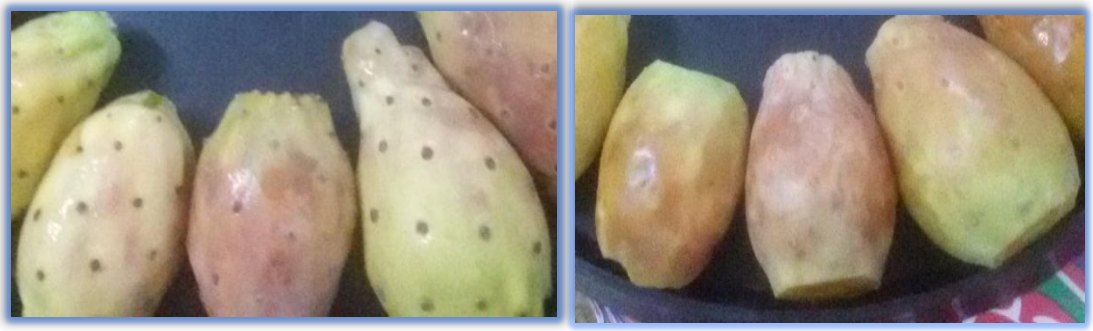

Figure (1) Raw fruits and fruits without thorns

Prickly Pear juices Preparation

Prickly pears juices were extracted in laboratory conditions (Figure 1). Prickly pear pulp (PPP), skin (PPS) or whole fruit (PPW) in a blender (Kenwood, Classic Blender AT337, japan, 1200 W, 220V).This extracted was again passed through the 60 mesh sieves to remove the undesirable portion.

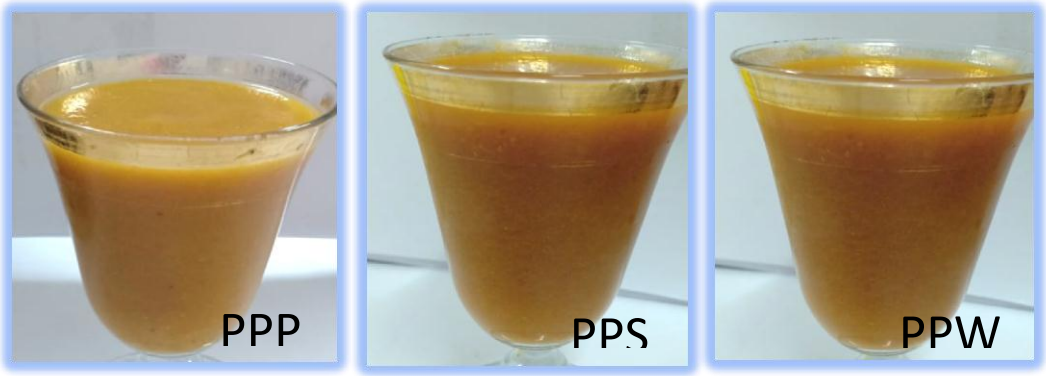

Figure (2): Prickly pears juices

Prickly Pear Jam Preparation

Prickly pear fruits jams were prepared in laboratory conditions (Figure 2). Prickly Pear juices with pectin transferred to a cooking pot with controlled heating of 100°C, being constantly homogenized. Sugar was added after 10 min to the pulp and pectin solution. Citric acid was later added to the mixture and the heating proceeded until the ending cooking point at 67°Brix. The mixture was poured directly into a sterilized can, lid. Afterwards, the jams allowed to cool at room temperature and then cooled in refrigerator **(Corrêa *et al.*, 2014 and Awolu *et al.*, 2018)**. Jam Formulation were prepared as follow:

T_1 = 50 % prickly pear pulp (PPP) juice + 50 % sugar + 0.3 % pectin (from juice weight) + 0.3 % citric acid (from sugar weight).

T_2 = 50 % prickly pear skin (PPS) juice + 50 % sugar + 0.3 % pectin (from juice weight) + 0.3 % citric acid (from sugar weight).

T_3 = 50 % whole prickly pear pulp (PPW) juice + 50 % sugar + 0.3 % pectin (from juice weight) + 0.3 % citric acid (from sugar weight).

Figure (3): Prickly pear jams

Proximate chemical composition of Prickly pears

Moisture and ash were determined according to the methods of AOAC, (2000). Total carbohydrates were determined by using phenol sulphuric acid according to the method of (**Dubois *et al.*, 1956** and **Krishnaveni *et al.*, 1984)**. **Total soluble solids** (TSS %) was determined using refract meter (Jon way, UK). pH value was determined by using pH-meter with glass electrode (model 41250, ICM, OR, USA) according to the method of **(Peter, 2013).** Total acidity was determined according to **(AOAC, 2005)** and results were expressed as g citric acid per 100g. Ascorbic acid was determined using the official titrimetric method **(AOAC, 2000),** and expressed as mg/100g fresh sample

Preparation of Prickly pears phenolic extract

Prickly pears phenolic extract was prepared as follow: 10 g of juice or jam was extracted with 95% ethanol at a ratio of 1part of pepper fruit: 3parts of 95% ethanol W/V using a Vortex, Model B-4, Waring products Co., Winsted CONN. The extraction was filtered through filter paper No. 1 with Buchner funnel and the residue was re-extracted two

times under the same conditions. The combined of filtrate for each sample was transferred to 50ml volumetric flask and completed with 95% ethanol. All extracts were kept in brown bottle at 4ºC and used for evaluation of total phenol, flavonoid and antioxidant activity**.**

Determination of total phenolic

Analysis was performed by adding 3.5 ml of deionized water, 50µL of sample extract and Folin-Ciocalteu reagent and 300µL of sodium carbonate 20% to cuvette. The reaction was left for 15 minutes and then the absorbance was measured in triplicate at 730nm using a UV/VIS spectrophotometer (Shimadzu, Kyoto, Japan). The blank consisted of all reagents excluding the sample extract. A standard curve was fashioned using Tannic acid at concentrations of 0.2, 0.4, 0.6, 0.8, and 1.0mglmL diluted in ethanol. Total phenolic concentration was expressed as mg of tannic acid equivalents via the standard curve **(Singleton and Rossi, 1965).**

Determination of total flavonoids

The total flavonoids content of pepper extract was determined use a colorimetric method described by **(Zhishen *et al.*, 1999).** A 0.5 ml of pepper sample extract was mixed with 2 mL of distilled water and subsequently with 150 µL of a 5% NaNO2 solution. After 6 min, 150µL of a 10% AlCL3 solution was added and allowed to stand for 6 min and then 2 mL of 4% NaOH solution was added to the mixture. Immediately, water was added to bring the final volume to 5 mL, and then the mixture was thoroughly mixed and allowed to stand for another 15 min. Absorbance of the mixture was determined at 510 nm versus prepared blank. Quercetin was used as standard compound for the quantification of total flavonoids. All values were expressed as milligrams of quercetin equal per 100 gram of fresh pepper. Data were reported as means (SD) for three replications.

Determination of total antioxidant activity

Total antioxidant activity was determined following the method of **(Su and Silva, 2006)**. A 100µM 2.2-diphenyl-1-picrylhydrazyl (DPPH) was prepared by dilution of 32mg of DPPH with 800mL of ethanol. 500µL of

sample extract was added to 3.0mL of DPPH solution in a cuvette. After 10 minutes the absorbance of the reaction mixture was measured in triplicate at 517nm in a spectrophotometer. The control solution was prepared by adding 500µL of ethanol to the DPPH solution and ethanol was used as blank. The antioxidant activity (%) was determined by the following formula:

$$\text{Activity (\%)} = [(\text{Abs}_{\text{control}} - \text{Abs}_{\text{sample}}) / \text{Abs}_{\text{control}}] \times 100.$$

Where Abs is the absorbance determined at 517nm. A 1.4mg/mL quercetin dehydrate standard was prepared for comparison.

Sensory evaluation of jam

Jam samples were presented with bread present from to thirty panelists who were asked to rate each sensory attribute. Were asked to rate the samples parameters flavor, colour, taste and overall acceptability on a 10-point hedonic scale and indicate their observations.

Statistical analysis

Data were analyzed with GLM (General le\Linear Model) program using statistical analysis system **(SAS, 2003)**. Mean values were compared by Duncan's Multiple Test.

Results and Discussion

Proximate chemical composition of prickly pear (juice and jam)

Data of proximate composition of prickly pear (juice and jam) is presented in Table (1). Moisture has important effect on the shelf life of products (**Eke-Ejiofor and Owuno, 2013).** So we determine the moisture in prickly pear (juice and jam) and found a significance ($p \leq 0.05$) difference between the prickly pear juice sample and the prickly pear jam (pulp, skin and whole fruit). It was the moisture content was high in juice than the jam product which range from 90.01 to 31.04 % respectively. Result came close to the results from **(Abou-Zaid *et al.*, 2013)** who reported that moisture in prickly pear juice was (87.72%). The decrease in moisture is expected because of the heating process during producing jam which leads to water removal and thus concentration of food nutrients **(Saka *et al.*, 2007 and Awolu *et al.*, 2018).**

Table (1): Proximate composition in prickly pear (juice and jam)

Samples		Moisture (%)	Ash (%)	Carbohydrate (%)	Total soluble solids (%)
Juice	(PPP)	90.98 ± 0.18^{a}	0.297 ± 0.01^{e}	8.39 ± 0.28 ^{b}	8.5^{e}
	(PPS)	90.01 ± 0.13^{b}	1.347 ± 0.02^{a}	8.87 ± 0.34^{b}	8.9^{c}
	(PPW)	90.53 ± 0.05^{ab}	0.713 ± 0.02^{c}	8.67 ± 0.04^{b}	8.8^{d}
Jam	(PPP)	31.95 ± 0.39^{d}	0.29 ± 0.01^{e}	67.00 ± 0.81^{a}	67.5^{b}
	(PPS)	31.04 ± 0.66^{e}	1.00 ± 0.03^{b}	67.92 ± 0.94^{a}	68^{a}
	(PPW)	32.93 ± 0.11^{c}	0.453 ± 0.01 ^{d}	67.33 ± 1.08^{a}	67.9^{a}

*PPP, prickly pear pulp; PPS, prickly pear skin; PPW, prickly pear whole fruit. Mean value followed by different letter in the same column are significantly different at $P \leq 0.05$

Data indicated that the juice sample of prickly pear contain ash ranged from 0.297to 0.1347%, while in jam sample ranged from 0.29 to 1.00%; prickly pear skin had the highest ash content in the both (juice and jam). Several studies have documented that cactus have the plenty of vitamins and minerals **(Stintzing *et al.*, 2003).** The results also show high amount of T. carbohydrate content in prickly pear skin (juice and jam). These result agreed with the results mentioned by **(El-Mostafa *et al.*, 2014)** who reported that the prickly pear a good source of fiber and sugar.

Total soluble solids (TSS) is one of the most important characteristics for the fresh fruit which measures the sugar content and it is a different chemical substances found in soluble form **(Oelofse *et al.*, 2006 and Kanwal *et al.*, 2017)**. Data in Table (1) shown the mean values of TSS recorded of PP juice were (8.5**%**, 8.9**%** and 8.8**%**) for prickly pear (pulp, skin and whole fruit) respectively. There was a significance ($p \leq 0.05$) difference in total soluble solids between the prickly pear juice sample and the prickly pear jam (pulp, skin and whole fruit), the TSS values for prickly pear (pulp, skin and whole fruit) jam were (67.5, 68 and 67.9) respectively. The increasing in TSS may be due to acid hydrolysis of polysaccharides especially pectin and gums (**Kanwal *et al.*, 2017)**. From the results explained, it can be concluded that the incorporation of skin in prickly pear jam can improve the nutritional quality.

Physicochemical properties of prickly pear (juice and jam)

Results in Table (2) are shown that the antioxidants compounds in prickly pear (juice and jam) which that include ascorbic acid, total phenols and another important constituent in prickly pear is flavonoids. Data showed that flavonoids content, ascorbic acid, total phenols and antioxidant activity in prickly pear juice of was higher than jam. Data in Table (2) showed that vitamin C content in prickly pear juice (pulp, skin and whole fruit) was (28.86, 3.31 and 15.60 mg/100g) respectively. These results are agreed with the results mentioned by **(Stintzing *et al.*, 2001)** who decided that, the cactus pear fruit has content vitamin C about (18-23 mg/100 g fresh weight) and with the results reported by **(Feugang *et al.*, 2006)** who confirmed that vitamin C, is the third major vitamin in prickly pears fruits and was found in fruit pulp ranged from 12-81 mg/100 g fresh weight. On other hand results shows significant decrease in ascorbic acid content of prickly pear jam (pulp, skin and whole fruit) was (3.19, 0.16 and 1.64 mg/100g) respectively, this is due to exposed fruit to more severe heat treatment during manufacturing to jam and the cooking time which considered as important factors effect on the loss rate of vitamin C. In this context, **Jawaheer et *al.*, (2003)** confirmed that when temperature rise of 10 ◦C usually increases the rate of degradation and the longer the processing time, the higher the increase in ascorbic acid loss because ascorbic acid is water soluble and unstable to highly heat.

Table (2): Content of vitamin C, flavonoids, total polyphenols and antioxidant activity in prickly pear (juice and jam)

Samples		Ascorbic acid (mg/100g)	Flavonoids (mg/100g)	Total polyphenols (mg/100g)	Antioxidant activity
Juice	(PPP)	28.86 ± 1.46^{a}	328.3 ± 4.9^{b}	151.33 ± 4.19^{c}	31.93 ± 0.56
	(PPS)	3.31 ± 0.72^{c}	379.67 ± 9.5^{a}	204.03 ± 5.10^{a}	28.23 ± 0.17
	(PPW)	15.60 ± 1.34^{b}	341.67 ± 4.5^{b}	194.33 ± 2.05^{b}	30.33 ± 0.21
Jam	(PPP)	3.19 ± 0.29^{c}	97.26 ± 3.01^{e}	94.06 ± 4.17^{d}	27.63 ± 0.24
	(PPS)	0.16 ± 0.03^{d}	152.08 ± 5.93^{c}	151.33 ± 1.70^{c}	26.47 ± 0.26
	(PPW)	1.64 ± 0.51^{d}	135.33 ± 4.18^{d}	146.67 ± 5.18^{c}	26.75 ± 0.33

*PPP, prickly pear pulp; PPS, prickly pear skin; PPW, prickly pear whole fruit. Mean values followed by different letter in the same column are significantly different at $P \leq 0.05$

Recently, increase interest of phenolic compounds because the potential health benefits of these compounds which antioxidant and anticancer, that

may help to prevent chronic disease. The total phenolic content and the antioxidant activity of the prickly pear (juice and jam) were evaluated. Data in Table (2) shows significant increase in total polyphenol and flavonoid content in prickly pear skin than prickly pear pulp and prickly pear whole fruit in (juice and jam). These results agree with data reported by **(El-Mostafa *et al.*, 2014**) who confirmed that all parts of the cactus plant are rich in members of the polyphenol family such as various flavonoids and phenolic acids.

Flavonoid content in prickly pear juice (pulp, skin and whole fruit) was (328.3, 379.67 and 341.67 mg/100g) respectively. While it content in prickly pear jam (pulp, skin and whole fruit) it was (97.26, 152.08 and 135.33 mg/100g) respectively.

Data present in the same Table explained that the polyphenol content in prickly pear juice (pulp, skin and whole fruit) was (151.33, 204.03 and 194.33 mg/100g) respectively. The result is agreed with data mentioned by **Khatabi *et al.*, (2016)**, who reported that that prickly pears whole fruit (pulp and seeds) contain a quantity of polyphenols. But there was occur decreased in the polyphenol content of prickly pear jam (pulp, skin and whole fruit) was dropped percentage (37.84%, 25.82 % and 24.53%) respectively about prickly pear juice may be due to increase expose of temperature during jam manufacturing. **Moldovan *et al.*, (2016),** who studied the influence of the temperature on the phenol content and reached that phenol content was stable at temperatures up to 22 °C but with increase temperature increase rate constants of the degradation.

The data revealed the value of antioxidant activity in prickly pear pulp was higher than prickly pear skin and whole fruit; the reason can be to that pulp contains seeds that are rich in polyphenols. Several studies have documented the abundance the nutrients and antioxidant compounds (ascorbic acid, carotenoids, phenols, flavonoids and betacyanin) in prickly pear fruit (**El -Mostafa *et al.*, 2014).** Many studies explained that the health beneficial effects of in prickly pears fruits polyphenols and flavonoids might be it plays a higher role in antioxidant and radical scavenging activities (**Galati *et al.*, 2003, Tesoriere *et al.*, 2004 and Khan *et al.*, 2000).** On other hand occur reduce in the value of antioxidant activity in prickly pear jam that may be due to loss of ascorbic acid and flavonoid. Also these results could be explained by a possible transformation in the phenolic compounds **(Corrêa *et al.*, 2014**).

Chemical properties of prickly pear (juice and jam)

Table (3): Chemical properties (pH, acidity and density) of prickly pear (juice and jam)

Samples		pH value	Acidity (%)	Density
Juice	(PPP)	5.78[a]	0.128 [d]	1.353[e]
	(PPS)	5.68[c]	0.132 [d]	1.354[d]
	(PPW)	5.72[b]	0.108[e]	1.352[f]
Jam	(PPP)	4.05[f]	0.162[c]	1.459[c]
	(PPS)	4.34[d]	0.202 [a]	1.461[a]
	(PPW)	4.09[e]	0.189[b]	1.460[b]

*PPP, prickly pear pulp; PPS, prickly pear skin; PPW, prickly pear whole fruit. Mean values followed by different letter in the same column are significantly different at $P \leq 0.05$

The pH value in food and jam was considering an important factor for directly related to the free hydrogen ions (**Kanwal *et al.*, 2017).** Data are present in Table (3) shown the lowest pH score was observed for prickly pear pulp jam was (4.05) and highest score was observed for prickly pear pulp juice was (5.78). These results we agreed well with data reported by **(Feugang *et al.*, 2006**) who found the pH values in cactus pear fruits ranging from 5.0 to 6.6.

Statistical analysis revealed significant results in acidity among all samples. The acidity values recorded for prickly pear juice (pulp, skin and whole fruit) were (0.128%, 0.132% and 0.108%) respectively. Data agreed well with result mentioned by **Feugang *et al.*, (2006)** cactus pear fruits exhibit acidity of 0.03–0.12% and results were close to the results documented by **Abou-Zaid *et al.*, (2013)** who found that the acidity content of the prickly pear juice was (0.65 %). While acidity values increase in prickly pear jam (pulp, skin and whole fruit) were (0.162, 0.202 and 0.189) respectively. The increase in acidity value of jam may be due to the organic acids present naturally, degradation of polysaccharides and oxidation of reducing sugars or by break down of pectin in to pectenic acid (**Kanwal *et al.*, 2017).** Data are present in Table (3) shown the lowest density was observed for prickly pear whole fruit juice was (1.352) and highest density was observed for prickly pear skin jam was (1.461). **Garza and Ibarz, (2010) and Cepeda and Villaran, (1999),** whom explained the density values were linearly correlated with soluble solids concentration and density of juices as functions of soluble solids content and temperature.

Sensory evaluation

Sensory evaluation is considering as the quality parameters for the jam products **(Hayes *et al.*, 1998).** So it was applied to 30 people to measurement the organoleptic attributes and acceptability of the jam products. In Table (4) are present comparative sensory evaluation of different products for prickly pear jam. Data revealed that evaluations for all samples don't have any significant differences in sensory evaluation with slightly differences in mean of scores. The mean score showed that prickly pear whole fruit jam was most acceptable from panelists and it is preferred, with considering all the points as colour, odor, taste, texture and overall acceptability followed by prickly pear skin. While prickly pear pulp jam was have lowest scored of the sensory characteristics. In general, the product presented good acceptability, because the overall liking mean scores obtained were between (8.97 and 9.13).

Table (4): Sensory test values of the prickly pear jam products

Samples		Sensory Characteristics				
		Colour	Odor	Taste	Textures	Overall Acceptability
Jam	(PPP)	8.47 ± 1.02 [a]	8.07 ± 1.10 [a]	8.27 ± 1.10 [a]	8.43 ± 1.23 [a]	8.97 ± 0.95 [a]
	(PPS)	8.6 ± 0.66 [a]	8.27 ± 0.85 [a]	8.5 ± 1.06 [a]	8.73 ± 0.96 [a]	9.07 ± 0.77 [a]
	(PPW)	9.13 ± 0.81 [a]	8.93 ± 1.12 [a]	8.93 ± 1.09 [a]	8.83 ± 0.89 [a]	9.13 ± 0.72 [a]

*PPP, prickly pear pulp; PPS, prickly pear skin; PPW, prickly pear whole fruit. Mean values followed by different letter in the same column are significantly different at $P \leq 0.05$

Conclusion

Based on the findings that prickly pear skin which currently discarded as waste when blending with PP pulp can improving their products with vitamins, minerals and besides colour, flavour, taste and overall acceptability. So that highly recommended to take advantage and integrate the skin of prickly pear fruit to many product due to its nutritional value.

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محتوى المركبات الفينولية الكلية والخصائص المضادة للأكسدة في اللب والجلد لثمار التين الشوكى: تطبيقات على العصير والمربى

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المستخلص

لقد جذبت الإنتباه الخصائص الغذائية والمعزِّزة للصحة لفاكهة التين الشوكي والتي يمكن أن تسهم في زيادة استهلاكها في المستقبل، لكونها غنية بالمركبات النشطة حيويًا مثل البوليفينولات وحمض الأسكوربيك وكذلك إظهارها للخصائص المضادة للأكسدة. كما يشكل الجلد الناتج الثانوى الرئيسى للثمرة. لذلك تهدف الدراسة الحالية الى تقييم المركبات النباتية النشطة حيويًا والخصائص المضادة للأكسدة والجودة الحسية لعصير ومربى التين الشوكي (اللب، الجلد والفاكهة كاملة) والتى تشمل التركيب الكيميائي والحموضة والفينولات الكلية والفلافونويد الكلي والنشاط المضاد للأكسدة باستخدام (DPPH) والتقييم الحسي. ولقد أظهرت النتائج أن محتوى الرطوبة تراوح بين 90 ,01 ٪ ± 13, 0 لعصير الجلد للتين الشوكي إلى 90,98 ٪ ± 0,18 لعصير اللب، كما سجلت أعلى قيم من الرماد لعصير ومربى الجلد للتين الشوكي 1,347± 0,02 ، 1,00±0,03 على التوالي. كما تراوحت إجمالي المواد الصلبة الذائبة في العصير والمربى من 8,50 ٪ إلى8,90٪ للعصير و68,00٪ إلى67,50٪ للمربى. كانت قيم pH للعصير (5,68 - 5,78) أعلى من المربى (4,05 ـ 4,34). كما سجل عصير ومربى الجلد للتين الشوكي زيادة معنوية ($P\leq 0.05$) للفلافونويدات الكلية والمركبات الفينولية الكلية (379,67 ± 9,5 ، 204,03±5,10 ملجم / 100 جم) و (152,08 ± 5,93 و 151,33 ± 1,70 ملجم / 100 جم) على التوالي، و قابلها زيادة معنوية ($P\leq 0.05$) للنشاط المضاد للأكسدة باستخدام (DPPH). كما سجلت المربى المنتجة من جلد التين الشوكي والفاكهة الكاملة بشكل ملحوظ ($P\leq 0.05$) على أعلى الدرجات الحسية. ومن النتائج السابقة يمكن أن نستخلص أن عصير التين الشوكي (اللب ، الجلد والفاكهة الكاملة) يمكن استخدامهم بنجاح لإنتاج مربى تحتوي على مضادات أكسدة ذات خصائص حسية مقبولة.

الكلمات المفتاحية: التين الشوكي، العصير، المربى، التركيب الكيميائى، الحموضة، الفينولات الكلية، الخصائص المضادة للأكسدة ، DPPH.