J. Product. & Dev.,29(4):281-294 (2024)

PHYSICOCHEMICAL AND SENSORIAL OF JUICE FROM MIXTURES OF PERSIMMON WITH PRICKLY PEAR FRUITS

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ABSTRACT

The persimmon and prickly pear fruits are packed with bioactive components that are for good health, such as fiber, minerals, vitamins, and antioxidants. Therefore, the present study carried out on different fruit juice blends were prepared as persimmon juice with prickly pear juice in 75: 25; 50:50 and 75:25 ratios to improve its quality and flavor.

These juice blends were packaged in 250 ml. colorless glass bottles and tested for physico-chemical, minerals, vitamin C and sensory evaluation. The chemical composition of juice prepared from Persimmon and prickly pear at different storage periods indicated that these blends were chemically stable during three months of storage in the refrigerator; this meant the high shelf life of these functional juices, while, the ascorbic acid content decreased gradually.

Furthermore, no heavy metals like lead, cobalt, or cadmium were found in the juices. Overall, the sensory evaluation showed that the different juice blends had varying levels of acceptability.

Key words: Persimmon, Prickly pear, juice blends, physico-chemical, minerals, vitamin C, sensory evaluation.

INTRODUCTION

The annual production of persimmon fruit in Egypt, 2022 was notable. The country produced approximately 8,516 tons of persimmons, cultivated over an area of about 1,420 feddans; this production level highlights the significance of persimmons in Egypt's agricultural sector **(Gabr and Rabie 2023).** In 2021, Egypt produced approximately 25,391 tons of prickly pear fruits; the cultivated area for prickly pears was around 3,395 feddans **(Faried and Fahmy 2023).** The consumption of fruits and vegetables has become very important for the protection of health, because the presence of different bioactive components that show activity in the prevention of many pathologic illness **(Teodoro 2019).**

Opuntia fruits are rich in fiber, minerals, vitamins, and a wide variety of compounds with antioxidant capacity, such as phenolics, flavonoids, and betalains, which have a potential preventive effect against chronic diseases and contribute to the control of hyperglycemia or high blood cholesterol levels (**Hernández *et al*., 2005, and Gómez *et al*., 2021)**. Furthermore, recent research has reported that the antioxidants from pink, orange, and white prickly pear varieties native to the Canary Islands maintain stability as they pass through the gastrointestinal tract and are readily absorbed by the human body (**Gómez *et al*., 2020).**

Persimmons are not only delicious but also packed with numerous health benefits and essential nutrients. Vitamins and Minerals, persimmons are rich in vitamins A, C, and E, as well as B6 and K. They also contain important minerals like potassium, manganese, and copper **(Hosseininejad *et al*., 2022, and Murali *et al*., 2023).** A single persimmon (≈140 gm.) provides about 6 grams of dietary fiber, which is beneficial for digestive health; they are high in antioxidants such as beta-carotene, which helps reduce the risk of chronic diseases **(Jackson 2020 and El Makhzangy *et al*., 2023)**.

The antioxidants and fiber in persimmons help lower bad cholesterol levels and blood pressure, reducing the risk of heart disease, high levels of vitamin C boost the immune system and help protect against infections, the soluble fiber in persimmons slows the digestion of carbohydrates, preventing spikes in blood sugar levels **(Murali *et al*., 2023).** Vitamin A and other antioxidants in persimmons support healthy vision and protect against eye damage **(Butt *et al*., 2015).**Low in fat and calories, persimmons can be a healthy addition to a weight management diet, the flavonoids and tannins in persimmons have anti-inflammatory effects, which can help reduce inflammation in the body **(Hosseininejad *et al*., 2022).** Persimmons can be enjoyed fresh, dried, or cooked, making them a versatile addition to your diet (**El Makhzangy *et al*., 2023)**.

Prickly pear fruits, also known as cactus fruits or "tunas," are not only unique and flavorful but also offer a range of nutritional and health benefits. Prickly pears are rich in vitamins C, E, and K, as well as magnesium, potassium, and calcium **(Cota-Sánchez 2016 and García *et al*., 2020).** They are an excellent source of dietary fiber, which aids in digestion and helps maintain a healthy digestive system **(Al-Naqeb *et al*., 2021).** The fruits contain powerful antioxidants like betalains, which help protect cells from damage, the fiber and antioxidants in prickly pears can help lower cholesterol levels and reduce the risk of heart disease **(Albuquerque *et al*., 2020).** Prickly pears have

been shown to help regulate blood sugar levels, making them beneficial for people with diabetes,low in calories and high in fiber, prickly pears can be a great addition to a weight management diet, some studies suggest that prickly pears may help protect the liver from damage caused by toxins, the antioxidants and vitamins in prickly pears can promote healthy skin and reduce signs of aging **(Cota-Sánchez 2016).** Prickly pears can be enjoyed fresh, juiced, or used in various dishes; the anti-inflammatory compounds in prickly pears can help reduce inflammation in the body, which is beneficial for conditions like arthritis,high levels of vitamin C boost the immune system and help protect against infections **(García*et al*., 2020).**

Therefore, the present study was conducted to note the changes in physiochemical properties, minerals, vitamin C and sensory evaluation of juice blends from persimmon and prickly pear fruits during storage periods.

MATERIALS AND METHODS

Materials:

1. **Persimmon fruits collection:** Ripe mature seedless persimmon fruits (*Diospyros kaki var. Fuyu*) were purchased from a farm in Dakahlia Government; Egypt during the harvesting season (October 2022). The fruit had red-orange color, a spherical shape with an average weight of 140-170 gm. per fruit.
2. **Prickly pear collection:** (Opuntia ficus - indica) was obtained from El - Sharkia Governorate of Egypt's local market, during the harvesting season (August 2022). The fruits have a red -orange color, with an overage weight of 90 grams per fruit unit.

Methods:

Preparation of persimmon fruits (Diospyros kaki) juice:

The fruits were carefully selected and sorted using homogeneity criteria for color, and maturity. Low-quality fruits (defective, damaged, and darker, which were indicative of over-ripeness) were removed. Before juice extraction, all selected fruits were gently washed with water, peeled by hand, and blended for 30 s in a Moulinex blender (type LM2421 41, France). The persimmon juice was diluted with sterilized distilled water at ratio 1:1. The seeds were recovered from the resulting pulp juice and separated from the pulp. The juices were kept in the refrigerator at 4C degrees until used. The citric acid (0.1%) was added as

a solution to the strained pulp to prevent darkening during thermal processing according to **(Tonytantillo 2001).**

Pulp preparation of prickly pear fruits (Opuntia ficus -indica):

The fresh prickly pear fruits were gently washed with water, manually peeled, and blended for 10 Se in a Moulinex blender (type LM2421 41, France). The seeds were separated from the pulp using stainless wire strainers, the pulp storage in refrigerator at 4 C ° until use. Citric acid 0.1% was added as a solution to the strained pulp to prevent darkening during thermal processing according to **(Sulieman *et al*., 2015).**

***Preparing of different mixtures*:**

Different mixtures were prepared by blending the diluted persimmon juice with prickly pear juice (v/v) , the juice mixtures were sterilized using an autoclave at a temperature of 120°C for 20 minutes, and then filled into 250 ml colorless glass bottles. The juice mixtures were divided into 5 batches as shown in (Table 1).

Table (1): Blending ratio of prickly pear and persimmon juices.

No.	Treatment	Persimmon diluted 1:1 (%)	Prickly pear (%)
1	T1	100	-
2	T2	75	25
3	T3	50	50
4	T4	25	75
5	T5	-	100

Chemical analysis:

The moisture, protein, fat, fiber and ash of the samples were determined according to the methods of **(AOAC 2005).** Carbohydrate was calculated by difference according to **Tadrus (1989).**

Mineral assay

Sodium (Na), Potassium (K), calcium (Ca), magnesium(Mg), phosphor(P), iron(Fe), zinc (Zn), lead (Pb), Cadmium(Cd) and Cobalt (Co)

were determined using perkin Elmer 2380, atomic absorption spectrophotometer according to the method of **AOAC (2005).**

Determination of vitamin C

Vitamin C (Ascorbic acid) using Spectrophotometer was determined according to **(AOAC 1990).**The sample (10 g) was blended and homogenized with an extracting solution containing met phosphoric acid (0.3 M) and acetic acid (1.4 M). The mixture was placed in a conical flask and agitated at 10,000 rpm for 15 min. The mixture was then filtered through a Whitman No. 4 filter, and samples were extracted in triplicate. The ascorbic acid standard was prepared by dissolving 100 mg of L - ascorbic acid in a Meta phosphoric acid (0.3 M)/acetic acid (1.4 M) solution at a final concentration of 0.1 mg/ ml. The calibration line was converted to a linear range based on four measured concentration levels. Quantification of ascorbic acid content was performed on an Agilent Spectrophotometer system, water (50: 50) at a flow rate of 1 ml/min. UV absorbance was recorded at 420 nm at room temperature.

Physiochemical analyses

Physicochemical characterization of all blends was done with measurements of pH, titratable acidity (TA), and total soluble solids (TSS). pH values were measured using a pH meter (Hanna pH-meter HI 9021 m Germany). Titratable acidity was determined by titration with 0.1 N NaOH in 10 g of sample and pH meter up to pH = 8.2, the results were expressed as citric acid. TSS was determined by measurement of the refractive index with a digital refractometer (JEN method) at 25±1 °C according to (**AOAC 2016).**

Organoleptic properties of juice:

The organoleptic evaluation of prepared juice was done according to the method described by **(Cansino *et al*., 2013).**Prepared juices were evaluated for color (20), odor (20), taste (20), appearance (20) and texture (20) and overall acceptability %. The sensory evaluation of juice carried out by 21 of well-trained panelists from the staff members of the Food and Dairy Science Department and Technology, Faculty of Technology and Development, Zagazig University, Egypt according to **(Larmond 1977).**

Statistical analyses:

The standard deviation (SD) was calculated using Excel 2010. Statistical analysis was performed using the Co-State program with a one-way analysis of variance (ANOVA). The statistical analysis of the results was conducted with triplicate replications, following the method outlined by **(Tudor, 2016).** The data was presented as means followed by ± (SD). Analysis of variance

(ANOVA) was used to determine significant differences between the results, and Duncan's test was used to compare the means with a significance level of 0.05 viscosity measurements**,** colour analysis, extraction of volatile aroma compounds, extraction of volatile aroma compounds analysis of volatile aroma components by gas chromatography (GC) and gas chromatography-mass spectrometery (GC -MS)**,** total phenolic content and antioxidant activity measurements.

RESULTS AND DISCUSSION

Table (1) shows the chemical composition of the functional juice prepared from different blends of Persimmon and prickly pear fruits at different storage periods. From this Table, it could be noticed that the moisture content of all blends ranged between 90.63 and 90.15 % at zero time. Meanwhile, carbohydrates ranged between 7.9 to 9.03 %; the maximum value was noticed in the treatment T4 (75:25) prickly: persimmon juice. The protein content was 0.94% in the blend T5 which was prepared with prickly juice only. Fat content in all treatments ranged between 0.20 to 0.23%. On the other hand, the maximum value of ash (0.73%) was noticed in the blend T1 which contained the diluted persimmon only.

After one month of storage in the refrigerator, the chemical composition was almost the same. On the other hand, after two months of storage, there was a Sharpe decrease in protein content in the blend (T5); it was 0.64%. While the other components were nearly the same, the same results were observed after three months of storage periods. These results indicated that blends were chemically stable during three months of storage in the refrigerator; this meant the high shelf life of these functional juices. Our results were in line with the findings of **Dehbi *et al* (2014)** and **Diaz-Delgado *et al* (2024).**

Physicochemical properties of blended fruit juices

The effect of storage periods on pH, Total soluble solids TSS, acidity (as citric acid), and ascorbic acid of the mixture juice prepared from persimmon and prickly fruits as a functional juice are presented in Table (2). value of acidity (0.231) after 3 months of storage. The lowest value of acidity was 0.172 in the treatment T5 after 3 months. The same observations were found in TSS which decreased with increasing storage period. These results are in line with those obtained by **Ibrahim *et al* (2021).**

Table (1): Gross chemical composition of investigated fruit juices during storage period

Items / Treatment	Moisture (%)	Carbohydrates (%)	Protein (%)	Fat (%)	Ash (%)	Fiber (%)
at zero time						
T1	**90.15**	**8.29**	**0.38**	**0.22**	**0.73**	**0.23**
T2	**90.27**	**8.28**	**0.51**	**0.23**	**0.54**	**0.16**
T3	**90.29**	**8.28**	**0.58**	**0.21**	**0.48**	**0.15**
T4	**90.33**	**9.03**	**0.69**	**0.20**	**0.39**	**0.04**
T5	**90.63**	**7.90**	**0.94**	**0.21**	**0.30**	**0.02**
after one month						
T1	**89.85**	**8.67**	**0.44**	**0.35**	**0.43**	**0.26**
T2	**90.42**	**8.30**	**0.48**	**0.28**	**0.39**	**0.22**
T3	**89.76**	**8.05**	**0.52**	**0.22**	**0.32**	**0.17**
T4	**91.90**	**8.40**	**0.58**	**0.29**	**0.32**	**0.10**
T5	**91.62**	**8.04**	**0.94**	**0.25**	**0.29**	**0.06**
after 2 month						
T1	**90.01**	**8.68**	**0.41**	**0.31**	**0.36**	**0.23**
T2	**90.20**	**8.49**	**0.42**	**0.33**	**0.32**	**0.24**
T3	**89.97**	**8.82**	**0.49**	**0.25**	**0.30**	**0.17**
T4	**90.73**	**8.15**	**0.53**	**0.23**	**0.27**	**0.09**
T5	**90.94**	**7.93**	**0.64**	**0.21**	**0.24**	**0.04**
after 3 month						
T1	**89.85**	**9.09**	**0.34**	**0.23**	**0.30**	**0.19**
T2	**89.89**	**9.03**	**0.43**	**0.22**	**0.27**	**0.16**
T3	**90.05**	**8.76**	**0.49**	**0.22**	**0.27**	**0.21**
T4	**90.29**	**8.73**	**0.56**	**0.18**	**0.21**	**0.03**
T5	**90.63**	**8.43**	**0.57**	**0.16**	**0.20**	**0.01**

At zero time, the pH value of all blended was 6.4; after 30 days the pH value decreased to range between 5.6 to 5.9. The same observation was noticed in pH value after 2 and 3 months; while the treatment was recorded at 5.1; meanwhile T5 was recorded at 5.7. The reduction in pH value was an affinity with the results of acidy. The acidity was developed with increasing storage periods in all treatments; where the treatment T1 recorded the highest The ascorbic acid content in these formulas was 32.7, 26.4, 21.8, 16.3, and 14.2 (mg 100g) in treatments T1, T2, T3, T4, and T5; respectively. The treatment T1 (persimmon juice) only showed the highest value of ascorbic acid. On the other side treatment T5 (prickly juice only) showed the lowest value of ascorbic acid content. The ascorbic acid content was decreased during storage periods 1, 2, and 3 months. Overall, while prickly pear and persimmon juices are rich in ascorbic acid, their vitamin C content diminishes over time during storage.

Similar to prickly pear juice, persimmon juice also experiences a reduction in ascorbic acid content during storage. The degradation rate can vary depending on temperature, light exposure, and packaging methods. For instance, after packaging, the ascorbic acid content can drop notably within the first 8 days, regardless of the initial storage period of the whole fruits **(Kgatla *et al*., 2010).**

Mineral contents of investigated fruit juices during storage period

The mineral content of different blend juices during storage periods is illustrated in Table (3). First of all, heavy metals such as lead (Pb), Cobalt (Co), and Cadmium (Cd) were found in all treatments during all storage periods. Meanwhile, the phosphorus (P) element increases with increasing of prickly juice addition. It was (160mg/100gm) in treatment (T1) and (210 mg/100gm) in (T5) after 3 months of storage period. In the case of potassium (K), it was (190mg/100gm) in treatment (T1); persimmon only at zero time; this value increased to 270mg/100gm in T5. After 3 months of storage; the value was decreased to 120mg/100gm in (T1) and 90 mg/100gm in (T5). Sodium content was 520 mg/100gm in (T1) at zero time, this value decreased with increasing prickly juice till 390 mg/100gm in (T5). The Na content increased with increasing storage period till 600 mg and 470 mg/100gm in (T1) and (T5); respectively after 3 months of storage periods. Calcium content in different blends of juice was measured during the storage period; it was 6.9 mg/100mg in (T1) and increased to 9.4 mg/100gm in (T5) at zero time; these values were decreased with the increase of storage period. The values were 4.9 mg/100gm in (T1) and 4.8 mg/100gm in treatment (T5). These results noted in this work are in harmony with the findings of **(El-Gharras *et al*. 2006, and Dehbi *et al*. 2014).**

Table (2): Physicochemical properties of blended fruit juices during storage period.

Treatments	pH value				TSS (%)				Acidity (as Citric acid) (%)				Ascorbic acid (mg/100g)			
	Storage periods															
	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3
T1	6.5	5.6	5.4	5.1	10	10	9.9	9.7	0.128	0.159	0.178	0.231	32.7	12.1	3.7	1.2
T2	6.4	5.7	5.6	5.3	10.7	9.8	9.8	9.4	0.147	0.157	0.157	0.201	26.4	9.7	2.8	0.8
T3	6.4	5.9	5.8	5.5	11.1	9.5	9.1	9.1	0.140	0.154	0.149	0.183	21.8	6.4	1.3	0.5
T4	6.4	5.8	5.7	5.5	11.4	9.3	8.7	8.5	0.147	0.147	0.159	0.194	16.3	4.6	1.1	0.2
T5	6.4	5.8	5.8	5.7	12	9.7	8.5	8.3	0.147	0.159	0.151	0.172	14.2	3.2	0.9	0.1

Table (3):Mineral contents of investigated fruit juices during storage period juices as functional foods during the shelf life of juices at 0, 1, 2, and 3 months.

Items / Treatment	P (mg /100gm)	K (mg /100gm)	Na (mg /100gm)	Ca (mg/100gm)	Pb	Co	Cd
at zero time							
T1	**160**	**190**	**520**	**6.9**	ND	ND	ND
T2	**170**	**160**	**440**	**5.5**	ND	ND	ND
T3	**150**	**270**	**400**	**6.2**	ND	ND	ND
T4	**180**	**210**	**340**	**8.2**	ND	ND	ND
T5	**210**	**270**	**390**	**9.4**	ND	ND	ND
after one month							
T1	**150**	**110**	**520**	**7.1**	ND	ND	ND
T2	**170**	**100**	**460**	**8.7**	ND	ND	ND
T3	**190**	**180**	**440**	**5.2**	ND	ND	ND
T4	**190**	**110**	**470**	**8.3**	ND	ND	ND
T5	**210**	**110**	**490**	**8.6**	ND	ND	ND
after 2 month							
T1	**170**	**190**	**540**	**5.1**	ND	ND	ND
T2	**160**	**120**	**490**	**6.3**	ND	ND	ND
T3	**160**	**110**	**430**	**6.0**	ND	ND	ND
T4	**180**	**110**	**420**	**7.0**	ND	ND	ND
T5	**230**	**190**	**430**	**6.9**	ND	ND	ND
after 3 month							
T1	**160**	**120**	**600**	**4.9**	ND	ND	ND
T2	**140**	**110**	**550**	**7.9**	ND	ND	ND
T3	**150**	**110**	**470**	**6.7**	ND	ND	ND
T4	**210**	**100**	**430**	**5.7**	ND	ND	ND
T5	**240**	**90**	**470**	**4.8**	ND	ND	ND

ND: Not detected

Sensory evaluation of investigated fruit juices during storage period

Data presented in Table (4) shows the effect of different blending juice from persimmon and prickly on sensory quality during the storage period (3 months). From this table was highly significant difference was noticed in the color in treatment T1; while the taste there was no significant difference noticed at zero,2, and 3 months. No significant difference was observed in Oder during the storage periods. Meanwhile, the texture was significant at zero and 3 months. Overall acceptability has no significant difference during the storage period. Treatment No.2 (T2) results referred to no significant difference after 1,

2, and 3 months of storage in the case of the color parameter. The same observation was noticed in the case of taste, while the Oder, texture, and appearance were highly significant during all storage periods. The overall acceptability has no significant difference in this treatment (T2) during all storage periods; the overall acceptability gradually decreased with increasing prickly juice and this decrease was not significant. These results are in line with the findings of **Ibrahim *et al* (2021).**

Treatment (T3) which contains 50:50 persimmons to prickly showed decreased values in all sensory characters during storage periods and that decrement was highly significant; overall acceptability was highest at zero time and the lowest value was noticed after 3 months (77.7%) these values was the lowest in all treatments during storage period. Treatment (T4) the data in this treatment showed highly significant differences in all sensory attributes. The same observation was shown in treatment (T5) which contained prickly pear juice only. Generally, the high value of all acceptability was noticed in treatment (T1) which contained persimmon only at zero time (92.45%) followed by treatment (T5) which contained prickly pear only (90.8%) at zero time. These results were in agreement with **Suliman *et al*. (2015).**

Conclusion

Based on the findings of this study, it is feasible to create juices by combining persimmon fruit juice (diluted with water at a 1:1 ratio) with prickly pear juice (at a 75:25 ratio) to achieve an overall acceptability rating of 84.2%. These juices can be stored for 3 months without any change in their overall quality.

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الخصائص الفيزيائية والكيميائية والحسية لعصير خليط ثمارالكاكي والتين الشوكي

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تحتوي ثمار الكاكي والتين الشوكي على مكونات نشطة بيولوجيًا مفيدة للصحة، مثل الألياف والمعادن والفيتامينات ومضادات الأكسدة. لذلك أجريت الدراسة الحالية على مخاليط مختلفة من عصائر الفاكهة تم تحضيرها كعصير الكاكي مع عصير التين الشوكي بنسب ٧٥: ٢٥؛ ٥٠:٥٠ و٧٥:٢٥ لتحسين جودتها ونكهتها. تم تعبئة مخاليط العصير في عبوات زجاجية عديمة اللون سعة ٢٥٠ مل واختبارها من حيث الخصائص الفيزيائية والكيميائية والمعادن وفيتامين سي والتقييم الحسي. أشار التركيب الكيميائي للعصير المحضر من الكاكي والتين الشوكي في فترات تخزين مختلفة إلى أن هذه المخاليط كانت مستقرة كيميائيًا خلال ثلاثة أشهر من التخزين في الثلاجة؛ وهذا يعني العمر الافتراضي الطويل (فترة الصلاحية) لهذه العصائر الوظيفية، في حين انخفض محتوى حمض الأسكوربيك تدريجيًا. علاوة على ذلك، لم يتم العثور على معادن ثقيلة مثل الرصاص أو الكوبالت أو الكادميوم في العصائر.

التوصية: بشكل عام، أظهر التقييم الحسي أن مخاليط العصير المختلفة لها مستويات متفاوتة من القبول.

الكلمات المفتاحيه: الكاكا، التين الشوكي، مخاليط العصائر، الخصائص الفيزيائية والكيميائية، المعادن، فيتامين سي، التقييم الحسي