Enhancement of Guava Nectar Characteristics by Reducing Heat Processing and Addition of Juniper (*Juniperus communis*) Extracts

El-Gendy, Manal A. and Eshak M. El-Hadidy*
Food Technology Research Institute, Agric. Res. Center, Giza, Egypt

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Abstract: Guava is known to play a significant role in several diseases due to presence of numerous antioxidant polyphenols and flavonoids which damage during the postharvest and processing. The guava (*Psidium guajava* L.) nectar prepared by guava pulp supplemented with leaves or berries juniper (*Juniperus communis* L.) in water extracts (50 and 100 mg/L) were added in the final product then pasteurized and stored for 10 months at 4ºC. During storage, antioxidants contents (total polyphenols, total flavonoids, carotenoids, vitamin C, volatile oil, saponins and tannins), antioxidant activity, TSS and pH of guava nectar products were evaluated every 2 months till ten months storage. The sensory parameters of colour, flavour, taste and overall acceptability were also evaluated. It could be conclude that, the nectar containing juniper berries extract showed excessive antioxidant activity compared to guava nectar prepared at 70ºC/20 min without addition, also to other supplements after 10 months. In addition, it increased palatability of guava nectar for consumers. Moreover, the content of antioxidant at temperature of 70ºC for 20 min was observed to be stable and it enhanced sensory scores of the prepared nectar during storage as well as decreased energy costs.

***Keywords*:** Antioxidant, Guava nectar, Heat processing, Juniper leaves and berries, organoleptic evaluation, storage.

INTRODUCTION

The utilization of fruit and vegetable juice has been increasing day by day due to their health benefit to human beings. Guava (*Psidium guajava* L.) is known to play a significant role in several diseases due to presence of numerous antioxidant polyphenols and flavonoids. Guava fruits are consumed in fresh form or processed (beverages, syrup, ice cream, jams and jellies). Guava is a fruit highly perishable and susceptible to damage during the postharvest. One strategy to overcome this problem is its processing by using techniques that preserve its organoleptic, nutritive and functional properties (Samson, 1986).

The above-ground parts, especially leaves and berries of *Juniperus* species are rich in essential oil that has characteristic aromatic flavour and bitter taste. Due to its diuretic and gastrointestinal properties, common juniper (*Juniperus communis*) is used as medicinal plant for centuries (Orav *et al.,* 2010). The oils are used in the pharmaceutical and cosmetic industries, for food and beverages, as well as for the production of perfumes. *J. excelsa* is a medicinal plant that has been used in folk medicine to treat dysmenorrhea, cough, bronchitis and colds, jaundice and tuberculosis and to induce menses and expel fetus (Emami *et al.,* 2011).

The content of total phenols in Juniper species leaves determined by Folin-Ciocalteu method ranged from 96.18-122.91 mg Gallic acid/g dry weight (water extraction) while the content of total flavonoids ranged from 2.05-11.91 mg catechin/g dry weight (ethanol extraction). Both water and ethanol extracts possessed radical scavenging activity against DPPH radical. Water extracts were more powerful with % of inhibition of DPPH ranging from 64.52% to78.23% (Karapandzova *et al.,* 2014).

The yields of the leave and fruits of *J. excelsa* and *J. horizontalis* essential oils were 0.79 to 4.15% and 1.08 to 2.70%, respectively. There were about 15 and 27 components in the essential oil of *J. excelsa* and *J. horizontalis*, respectively. The predominant compound in the essential oils obtained from the leaves and fruit of *J. excelsa* was α-pinene (79.95% and 89.49%, respectively). The main compound in the essential oils obtained from the leave and fruits of *J. horizontalis* was sabinene (30.21% and 38%, respectively). In addition, bornyl acetate (10.66%) and delta-cadinene (3.79%) were identified as major components in the essential oils of the leaves obtained from *J. horizontalis* (Ehsani *et al.,* 2012).

The oil content obtained by hydro-distillation of the aerial parts of *J. horizontalis* representing 0.75% v/w was analyzed using GC/MS showing a total of 60 compounds (Ghaly *et al.,* 2016). Bornyl acetate was seen as a major component representing 41.17% followed by 10-epielemol representing 8.44% and β-myrcene 5.94%, sabenine 5.51% and thujone 4.8%. Also, juniper essential oils evaluated by Ehsani *et al.* (2012) for the antibacterial activity against thirteen bacterial species by disk diffusion and micro dilution method. Juniper essential oils showed more antibacterial activities against Gram-positive as compared to Gram-negative bacteria species. The antibacterial activity of essential oils may be related to presence of α- pinene, limonene, and sabinene which are known to have antibacterial properties.

Fruit juices are pasteurized in order to achieve a reduction of microbes and to inactivate undesirable enzymes. The most popular way to achieve these goals is by thermal pasteurization. Thermal processing was initially thought to cause an overall decrease in the antioxidant activity of the fruit or vegetables. Thermal destruction of microorganisms is a preservation method frequently used in food industries. Yeasts and molds are considered the primary spoilage microorganisms in foods and beverages with high levels of sugars and low pH (Tchango-Tchango *et al.,* 1997).

The purpose of this study was to obtain fresh fruit nectar with juniper (*Juniperus communis* L.) extract. This mixture with highly expected antioxidant

*Corresponding author e-mail: emgelhadidy1973@gmail.com

activity will be determined in guava nectar, juniper leaves and berries. The bioactive phytochemicals were evaluated. Meanwhile, this study is an attempt to try decrease processing cost through reduction of exposure temperature during nectar process. Fortification of guava nectar matrix may be quite stable of antioxidant contents. The results of this study may benefit the researchers as well as industry, environment and consumers.

MATERIALS AND METHODS

Materials:

Guava fruits (*Psidium guajava* L.) were obtained from Egyptian commercial market. Juniper (*Juniperus communis* L.) was collected from Horticultural Research Institute, Agriculture Research Center, Giza-Egypt.

Juniper leaves and berries extraction:

Ground Juniper leaves and berries were soaked in hot water (60ºC) (1:100 w/v) in dark bottle for 48h. at ambient temperature (25ºC) to obtain extracts, then mixtures were filtered by filter paper (Whatman 1). Water solution was evaporated at 55ºC in oven under vacuum.

Nectar preparation

The guava pulp was extracted by using pulper machine and strained through 1 mm stainless steel sieves. Total soluble solid (TSS) of prepared nectar 20 brix in both of treatments at 85ºC/30 min. and 70ºC/20 min. Leaves and berries juniper water extracts (50 and 100 mg/L) were added into final product. The prepared nectar product was filled into the clean and sterilized glass bottle of 200 ml and sealed with crown cork. The filled bottle was pasteurized in boiling water bath for 90ºC/30 sec., then cooled down to 25ºC. The heat treatment was determined based on a research by Tchango-Tchango *et al.* (1997). The pasteurized guava nectar was kept for ten months in glass bottle in a refrigerated chamber at 4±1ºC.

The processed samples were evaluated for physico-chemical characteristics (total polyphenols, total flavonoids, carotenoids, vitamin C, saponins, tannins, DPPH activity, TSS and pH) as well as organoleptic evaluation periodically up to 10 months of storage, at an interval of two months *i.e.* 0, 2, 4, 6, 8 and 10 months.

Chemical analyses

Schopfer (1989) method was used to estimate the total carotenoid content as β-carotene. Also, volatile oils were determined by International Standard Organization method (ISO, 2009).

Total polyphenol contents were measured using Folin–Ciocalteu method described by Boligon *et al.* (2009). Gallic acid was used as standard and samples were read in triplicate at 730 nm by a spectrophotometer.

Total flavonoids were determined according to the methods of Nabavi *et al.* (2008). Sample (1 g) was mixed with 10 ml 80% methanol and shaking for 2 hr.

Total flavonoids extract (0.4 ml) was added to 4 ml of H_2O. Then 0.3 ml of 5% $NaNO_2$ was added. After 5 min, 0.3 ml of 10% $AlCl_3$ was added. After 6 min, 2 ml of 1 M NaOH was added and the total volume was made up to 10 ml with distilled water. The color was measured at 510 nm against a blank reagent. Catechin was served as standard compound.

The titrimetric method described as 3% metaphosphoric acid extraction and titrated against standard 2-6 dichlorophenol indophenol dye solution was adopted for determination of ascorbic acid (Ranganna, 1986).

Tannins were determined by the method described by Morrison *et al.* (1995) which uses vanillin as a reagent. The absorbance at 500 nm was measured with spectrophotometer. The data were expressed in mg catechin equivalent (CE) per g of each fraction, based on calibration curve of catechin.

Saponins content was estimated gravimetrically according to Obadoni and Ochuko (2001).

The antioxidant activity of guava nectar products was determined by 2,2 diphenyl-picrylhydrazyl (DPPH) method described by Yen and Chen (1995).

Total soluble solids (TSS) and the pH of guava-juniper mixture blends were determined according to AOAC (2005). TSS was measured with a refractometer (Mettler Toledo, Switzerland) and expressed as Brix degree.

Sensory evaluation:

The sensory parameters of colour, flavour, taste, appearance and overall acceptability were evaluated by 10 trained panelist based on 10 point Hedonic rating scale with maximum score considered as the best (Ranganna, 1986).

Statistical analysis:

The obtained sensory evaluation data were analyzed using SPSS 19.0 Program (2000). Means and standard deviations were determined using descriptive statistics. Comparison between means of samples was determined using analysis of one way variance (ANOVA) and multiple range tests. Statistical significance was defined at $P \leq 0.05$.

RESULTS AND DISCUSSION

The antioxidant contents in the untreated guava nectar, dried juniper leaves and juniper berries are presented in Table (1). The dried juniper leaves had higher total polyphenols than the juniper berries (63.73 vs. 43.22 mg/g). Also, dried juniper leaves had higher tannins of 41.32 mg/g than juniper berries that had 24.55 mg/g. However, juniper berries contained relatively higher levels of total flavonoids, total carotenoids, saponins, volatile oil than the dried juniper leaves. In addition, juniper berries contained almost twice (65.90 mg/g) of vitamin C of that found in the dried juniper leaves (32.54 mg/g). Also, juniper berries showed almost twice of antioxidant activity than that shown in dried juniper leaves (66.80 vs. 38.20 mg/g).

These data were adapted by Karapandzova *et al.* (2014), in juniper water extract. This activity of berries

is due to the high value of flavonoids, carotenoids, vitamin C and saponins.

The changes in total polyphenols and total flavonoids due to the treatments of guava nectar by dried juniper leaves or juniper berries are presented in Table (2). It is indicated that heating guava nectar at 70ºC for 20 minute resulted in changes in the total polyphenols and total flavonoids from 46.40 and 44.52 mg/100 ml at zero time with a decrease with storage to reach 38.62 and 36.80 mg/100 ml after 10 months of storage, respectively. This treatment proved to preserve the activity of polyphenolic and flavonoid compounds. Heating the guava nectar at 85ºC for 30 minutes caused more reduction in the total polyphenols and total flavonoids compared to their levels after heating at 70ºC for 20 minutes. The addition of dried juniper leave extracts by 50 mg/L increased the total polyphenols to 79 mg/100 ml at zero time with gradual decline to 68.66 mg/100 ml following the storage for up to 10 months. While, the addition of dried juniper leaves by 100 mg/L resulted in a remarkable increase in the total polyphenols to 131.42 mg/100 ml at zero time and 109.47 mg/100 ml after 10 months of storage. The activity of valuable compounds increase with increasing their concentrations. The addition of dried juniper leaves by 50 and 100 mg/L to the guava nectar, the total flavonoids increased to 53.50 and 63.42 mg/100 ml at zero time with slight declines to 46.45 and 56.34 mg/100 ml with the storage for 10 months.

Polyphenols content in the water extract was strongly correlated with that mentioned by the results of Karapandzova *et al.* (2014). Similar results, but with less magnitude, were found by the addition of juniper berries. The results indicate that the addition of juniper berries by 50 and 100 mg/L increased the total polyphenols to 74.03 and 99.64 mg/100 ml at zero time and 63.44 and 82.48 mg/100 ml, respectively within storage for 10 months, whereas the total flavonoids reached to 57.63 and 71.20 mg/100 ml at zero time and 48.22 and 61.08 mg/100 ml, respectively after 10 months of storage. Through all the determinations, the decrease in polyphenols and flavonoids looks like to be the greatest in leaves 100 mg/L in the storage period. That might be due to the metabolism of certain compounds in juniper leaves.

Table (3) presented the changes in carotenoids and vitamin C contents in the guava nectar due to the treatments by dried juniper leaves or berries. At zero time, heating guava nectar at 70ºC for 20 min resulted in carotenoids and vitamin C levels of 85.22 and 82.94 mg/100 ml respectively, however heating guava nectar at 85ºC for 30 min resulted in noticeable reductions for carotenoids and vitamin C levels to 82.49 and 76.21 mg/100 ml. During storage, the levels of both carotenoids and vitamin C decreased gradually and slightly to reach 83.99 and 80.34 mg/100 ml after 10 months of storage for the samples heated at 70ºC for 20 min. The results, also indicated that the addition of dried juniper leaves by 50 and 100 mg/L to the heated (70ºC/20 min) guava nectar samples resulted in noticeable increases of the carotenoids to 88.52 and 88.80 mg/100 ml at zero time, and slightly diminished with storage to reach 87.53 and 87.62 mg/100 ml after 10 months. The addition of dried juniper leaves by 50 and 100 mg/L to the heated (70ºC/20 min) guava nectar samples obviously increased vitamin C content to 84.23 and 87.76 mg/100 ml, respectively at zero time, and 83.43 and 86.82 mg/100 ml after 10 months of storage. The same trend was found, but on higher scale, in the carotenoids and vitamin C contents when the juniper berries was added to the heated (70ºC/20 min) guava nectar samples. The addition of juniper berries by 50 and 100 mg/l increased the level of carotenoids to 89.02 and 89.24 mg/100ml at zero time and 88.08 and 88.63 mg/100 ml after 10 months of storage, and increased the level of vitamin C to 92.21 and 95.53 mg/100 ml at zero time and 91.50 and 95.02 mg/100 ml after 10 months of storage, respectively. Berries contained higher amounts of vitamin C than that of leaves. That might be due to higher rate metabolism of vitamin synthesis in berries than that in leaves.

The changes in saponins and tannins contents in the guava nectar following different treatments are presented in Table (4). Heating guava nectar samples at either 85ºC for 30 min or 70ºC for 20 min resulted in no detection for saponins at zero time and also during the whole period of storage that extended for 10 months. The heating treatments at 85ºC for 30 min and at 70ºC for 20 min resulted in tannins level of 8.12 and 8.43 mg/100 ml at zero time and gradually diminished during storage to reach 8.03 and 8.31 mg/100 ml after 10 months, respectively. The addition of dried juniper leaves by 50 mg/L to the heated (70ºC/20 min) guava nectar samples resulted in saponins content of 0.76 at zero time and slightly decreased to 0.72 mg/100 ml after 10 months of storage. In comparison, almost twice of saponins content was found in guava nectar when dried juniper leaves was added by 100 mg/L, where it reached to 1.43 and 1.39 mg/100 ml at zero time and after 10 months of storage, respectively. The addition of dried juniper leaves by 50 and 100 mg/L to the guava nectar increased tannins level to 10.50 and 12.49 mg/100 ml at zero time respectively. It decreases gradually with storage to 10.41 and 12.40 mg/100 ml after 10 months. The addition of juniper berries to the heated (70ºC/20 min) guava nectar samples increased saponins content by about 1.5 folds of those found when the treatment with dried juniper leaves was applied. The saponins level was 1.16 and 2.30 mg/100 ml at zero time and 1.09 and 2.23 mg/100 ml after 10 months of storage following the addition of juniper berries by 50 and 100 mg/L, respectively. The tannins level in the guava nectar treated with juniper berries was however slightly less than that obtained for the samples treated with dried juniper leaves. It was 9.66 and 10.87 mg/100 ml at zero time and 9.60 and 10.77 mg/100 ml after 10 months of storage in the heated (70ºC/20 min) guava nectar samples and treated with juniper berries by 50 and 100 mg/L, respectively. Results may be due to hydrolysable tannins are commonly found in foods such as guava and grapes. Both condensed and hydrolysable tannins have been shown to have antioxidant, enzyme inhibiting, and antimicrobial properties (De Bruyne *et al.,* 1999).

Table (1): Antioxidants contents in guava pulp and dried juniper leaves and berries at zero time

Items	Guava pulp (mg/100ml)	Juniper leaves (mg/g)	Juniper berries (mg/g)
Total polyphenols	50.43±2.43*	63.73± 3.25	43.22±2.55
Total flavonoids	49.79±1.97	14.55±0.82	20.32±1.02
Total carotenoids	82.49±7.34	0.19±0.002	0.22± 0.002
Vitamin C	78.03±5.43	32.54±1.23	65.90± 2.43
Saponins	ND	15.22±0.96	23.12±1.04
Tannins	8.51±0.56	41.32±3.42	24.55±1.87
Volatile oil (v/w)	0.14± 0.003	1.12±0.002	1.92±0.005
Antioxidant activity DPPH*	84.50±4.62	38.20±3.25	66.80±4.52

*Means ± SD

Table (2): Total polyphenols and flavonoids changes in guava nectar treatments during ten months storage (mg/100ml)

Items	Total polyphenols						Total flavonoids					
	0	**2**	**4**	**6**	**8**	**10**	**0**	**2**	**4**	**6**	**8**	**10**
Guava nectar 85°C/30 min	40.25	39.02	37.22	36.53	33.40	31.92	40.00	38.21	38.00	35.63	34.88	32.92
Guava nectar 70°C/20 min	46.40	44.97	42.43	40.13	38.00	38.62	44.52	42.90	41.84	39.82	38.64	36.80
Nectar (70°C/20 min) + Juniper leaves												
50 mg/L	79.00	77.23	76.46	73.22	70.46	68.66	53.50	52.98	50.56	49.80	48.66	46.45
100 mg/L	131.42	128.53	125.60	121.46	118.44	109.47	63.42	61.88	60.22	58.62	57.60	56.34
Nectar (70°C/20 min) + Juniper berries												
50 mg/L	74.02	72.22	70.35	68.42	65.43	63.44	57.63	56.42	54.67	51.56	49.45	48.22
100 mg/L	99.64	96.06	92.64	90.66	85.96	82.68	71.20	69.86	68.28	65.84	64.04	61.08

Table (3): Carotenoids and vitamin C (mg/100ml) changes in guava nectar treatments during ten months storage

Treatment	Carotenoids (mg/100 ml)						Vitamin C (mg/100ml)					
	0	2	4	6	8	10	0	2	4	6	8	10
Guava nectar 85°C/30min	82.49	81.98	81.30	81.22	81.03	79.99	76.21	76.13	76.07	76.05	75.11	75.00
Guava nectar 70°C/20min	85.22	85.18	84.91	84.63	84.11	83.99	82.94	82.32	81.54	80.97	80.88	80.34
Nectar (70°C/20min)+ Juniper leaves 50 mg/L	88.52	88.23	88.02	87.98	87.77	87.53	84.23	84.20	84.06	84.02	83.90	83.43
100mg/L	88.80	88.55	88.23	88.01	87.88	87.62	87.76	87.75	87.54	87.32	87.02	86.82
Nectar (70°C/20min) + Juniper berries 50mg/L	89.02	88.97	88.78	88.35	88.12	88.08	92.21	92.00	91.86	91.54	91.51	91.50
100mg/L	89.24	89.12	89.00	88.92	88.86	88.63	95.53	95.46	95.29	95.12	95.07	95.02

Table (4): Saponins and tannins (mg/100ml) changes in guava nectar treatments during ten months storage

Treatment	Saponins						Tannins					
	0	2	4	6	8	10	0	2	4	6	8	10
Guava nectar 85°C/30min	ND						8.12	8.11	8.11	8.09	8.08	8.03
Guava nectar 70°C/20min	ND						8.43	8.41	8.38	8.37	8.36	8.31
Nectar(70°C/20min) + Juniper leaves 50 mg/L	0.76	0.76	0.75	0.73	0.73	0.72	10.50	10.48	10.45	10.43	10.42	10.41
100mg/L	1.43	1.43	1.41	1.40	1.40	1.39	12.49	12.47	12.45	12.44	12.42	12.40
Nectar(70°C/20min) + Juniper berries 50mg/L	1.16	1.15	1.12	1.10	1.10	1.09	9.66	9.66	9.64	9.63	9.60	9.60
100mg/L	2.30	2.30	2.26	2.25	2.23	2.23	10.87	10.84	10.83	10.81	10.78	10.77

The DPPH – radical scavenging activity in guava nectar was also influenced by different treatments (Table 5). It was 0.84 mg/ml at zero time for the samples heated at 85ºC for 30 min, and steadily declined with storage for 10 months to 0.77 mg/100 ml, whereas it was 1.29 mg/100 ml at zero time for the samples heated at 70°C for 20 min and also declined to 1.18 mg/100 ml after 10 months of storage. Difference in temperature and heat period extract made differences in antioxidative activity due to the susceptibility of valuable compounds.

The DPPH – radical scavenging activity was 39.25 and 48.35 mg/100 ml in 50 and 100 mg/L of dried juniper leaves and was 60.37 and 76.54 mg/100 ml in 50 and 100 mg/L of juniper berries. These results reveal that the antioxidant activity of juniper berries was much higher than of dried juniper leaves. With the addition of dried juniper leaves by 50 and 100 mg/L to the heated (70ºC/20 min) guava nectar samples, the antioxidant activity was 51.25 and 58.22 mg/100 ml at zero time and decreased slightly with storage to reach 51.14 and 58.03 mg/100 ml after 10 months, respectively. Similarly, the heated (70ºC/20 min) guava nectar samples treated with juniper berries by 50 and 100 mg/L showed antioxidant activity of 63.22 and 87.40 mg/100 ml at zero time and 63.10 and 87.26 mg/100ml after 10 months of storage, respectively. It's valuable to say that supplemented guava nectar with juniper leaves or berries increased radical scavenging activity dramatically comparing to guava.

Table (5): Antioxidant activity in Guava nectar fortified with Juniper extracts by DPPH method during ten months storage

Treatment	Antioxidant activity DPPH (mg/ml)					
	0	2	4	6	8	10
Guava nectar 85°C/30 min	0.84	0.82	0.82	0.79	0.78	0.77
Guava nectar 70°C/20 min	1.29	1.27	1.23	1.21	1.20	1.18
Juniper leaves						
50 mg/L	39.25					
100mg/L	48.35					
Guava nectar 70°C/ 20 min+ Juniper leaves						
50 mg/L	51.25	51.23	51.22	51.18	51.17	51.14
100mg/L	58.22	58.21	58.17	58.12	58.09	58.03
Juniper berries						
50 mg/L	60.37					
100mg/L	76.54					
Guava nectar 70°C/20 min + Juniper berries						
50mg/L	63.22	63.22	63.17	63.13	63.10	63.10
100mg/L	87.40	87.38	87.35	87.32	87.29	87.26

The levels of total soluble solids (TSS) and pH in guava nectar under different treatments are shown in Table (6). The levels of TSS in different treatments were somewhat not much varied by different treatments. The TSS in the samples heated at 85ºC for 30 min was 19.6% at zero time, and there was no big difference when the storage for 10 months and valued to 19.8%. Similarly, the samples heated at 70ºC for 20 min showed TSS of 19.8% at zero time and declined to 19.2% after 10 months of storage.

The TSS in the heated (70ºC/20 min) samples and treated with 50 and 100 mg/L of dried juniper leaves was 20.1 and 19.8% at zero time and declined to 19.8 and 19.4% after 10 months of storage. Also, the heated (70ºC/20 min) samples and treated with 50 and 100 mg/L of juniper berries showed TSS of 19.9% and 19.2% at zero time and 19.6% and 18.7% after 10 months of storage. The pH values under different treatments were considerably varied, as it was obviously higher in the samples heated at 70ºC for 20 min, and in the samples treated with 100 mg/L of either dried juniper leaves or juniper berries. It was 3.48 at zero time in the guava nectar samples heated at 85ºC for 30 min and steadily decreased with storage for 10 months to 3.44.

The same trend for pH values, but with higher extent, was found for the samples heated at 70ºC for 20 min, where it was 3.57 and 3.54 at zero time and after 10 months of storage. In the heated (70ºC/20 min) samples and treated with dried juniper leaves by 50 and 100 mg/L, pH value was 3.58 and 3.69 at zero time and slightly declined to 3.54 and 3.64 after 10 months of storage, respectively. Also, the heated (70ºC/20 min) samples and treated with juniper berries by 50 and 100 mg/L showed pH of 3.75 and 3.88 at zero time and 3.71 and 3.82 after 10 months of storage, respectively.

Table (6): The levels of total soluble solids (TSS) and pH in guava nectar under different treatments

Treatment	TSS						pH					
	0	2	4	6	8	10	0	2	4	6	8	10
Guava nectar 85°C /30min	19.6	20.4	20.4	20.1	19.8	19.8	3.48	3.47	3.45	3.45	3.44	3.44
Guava nectar 70°C /20 min	19.8	19.8	19.7	19.5	19.4	19.2	3.57	3.56	3.55	3.54	3.54	3.54
Guava nectar +Juniper leaves 50mg/L	20.1	20.0	20.0	19.9	19.8	19.8	3.58	3.58	3.57	3.56	3.54	3.54
100mg/L	19.8	19.7	19.6	19.5	19.5	19.4	3.71	3.69	3.68	3.65	3.65	3.64
Guava nectar + Juniper berries 50mg/L	19.9	19.9	19.7	19.7	19.7	19.6	3.75	3.74	3.74	3.74	3.71	3.71
100mg/L	19.2	19.1	18.8	18.8	18.7	18.7	3. 88	3.86	3.85	3.84	3.82	3.82

Sensory evaluation:

The colour and flavour scores of guava nectar under different treatments and stored for up to 10 months are presented in Table (7). The colour of samples heated at 85ºC for 30 minutes scored 9.17 for the fresh samples (zero time), then gradually faded upon storage and scored 6.08 after 10 months of storage. In comparison, the colour of samples heated at 70ºC for 20 minutes scored 8.75 at zero time. Also, gradually faded with storage to reach a score of 5.75 after 10 months. The addition of dried juniper leaves by 50 or 100 mg/L resulted in similar preservation of colour score, especially during storage. The colour score of the samples supplemented with dried juniper leaves by 50 mg/L was 9.00 at zero time and somewhat gradually declined upon storage and reached to 6.92 after 10 months, however, the colour score of the samples with dried juniper leaves (100 mg/L) was 9.00 at zero time and declined to 6.42 after 10 months of storage. The addition of juniper berries by 50 mg/L resulted in colour score of 9.50 at zero time and 7.75 after 10 months of storage, whereas the addition of juniper berries by 100 mg/L resulted in color score of 9.58 at zero time and 8.08 after storage for 10 months. Also, the fade in colour due to storage in the samples treated with juniper leaves or juniper berries was less than that found in the heated samples. Treating guava nectar with juniper berries resulted in highest color scores during the storage periods and thus adding juniper berries was better than adding dried juniper leaves in maintaining the color score. According to nectar 70ºC/20 min, berries extract (100 mg/L) increased all the sensory factors even after 10 months storage and that due to excessive antioxidative activity (Table 5).

The flavor score was 9.17 for the samples heated at 85ºC for 30 minutes at zero time and gradually declined with storage to 6.08 after 10 months. In comparison, the flavor score for guava nectar heated at 70ºC for 20 minutes was higher at all storage periods and was 9.42 at zero time and 6.42 after 10 months of storage. In general, the dried juniper leaves (50 or 100 mg/L) did not improve the flavor score. The addition of dried juniper leaves with 50 mg/L resulted in flavor scores comparable to those obtained in both heated treatments. The addition of dried juniper leaves with 100 mg/L resulted in even less flavor scores. The flavor score was 9.50 at zero time and decreased to 7.67 after ten months of storage by adding juniper berries (100 mg/L), and was 9.08 at zero time and 6.75 after ten months by adding juniper berries (50 mg/L). The results indicate that the addition of juniper berries by 50 or 100 mg/L improved the flavor score of guava nectar at zero time and during all storage periods, although 50 mg/L showed slightly less magnitude.

Concerning taste evaluation, the scores for the samples heated at 70ºC for 20 min. were higher than those obtained for the samples heated at 85ºC for 30 min. at any of the storage periods (Table 7). The samples heated at 85ºC/30 min and 70ºC for 10 minutes showed taste scores of 9.17 and 9.00 at zero time and 6.75 and 6.58 after 10 months of storage, respectively. In the guava nectar supplemented with dried juniper leaves by 50 and 100 mg/L, the taste scores were 8.92 and 8.67 at zero time, 6.17 and 6.92 after storage for 10 months, respectively. The supplementation of guava nectar with juniper berries by 50 mg/L resulted in highest taste scores of 9.12 and 7.33 at zero time and after 10 months, respectively. The addition of juniper berries by 100 mg/L showed also high taste scores, but less than those obtained by 50 mg/L. It is revealed that the addition of dried juniper leaves by 50 or 100 mg/L did not improve the taste score of guava nectar, and showed even less scores than both heated treatments, whereas the supplementation of guava nectar with juniper berries by 50 mg/L resulted in highest taste score at any of the storage periods.

Table (7): Sensorial Evaluation (mean ± SD) for the guava nectar under different treatments and storage periods (10 months)

Storage periods (months)	Treatments					
	Nectar 85ºC/30 min	Nectar 70ºC/20 min	Nectar (70ºC/20 min) + Leaves extract		Nectar (70ºC/20 min) + Berries extract	
			(50 mg/L)	(100 mg/L)	(50 mg/L)	(100 mg/L)
Color						
Zero time	9.17±0.24^{a}	8.75±0.48^{b}	9.00±0.50^{a}	9.00±0.65^{a}	9.50±0.50^{a}	9.58±0.45^{a}
2	8.50±0.41^{b}	8.17±0.47^{b}	8.75±0.38^{b}	8.50±0.41^{b}	8.83±0.47^{ab}	8.83±0.47^{ab}
4	7.75±0.48^{c}	7.75±0.38^{c}	7.92±0.34^{bc}	8.00±0.50^{bc}	8.50±0.41^{b}	8.33±0.47^{b}
6	7.33±0.37^{c}	7.75±0.48^{c}	7.83±0.37^{c}	7.75±0.48^{c}	7.67±0.37^{c}	8.58±0.34^{b}
8	6.33±0.37^{d}	6.92±0.61^{d}	7.58±0.34^{c}	7.08±0.34^{c}	7.75±0.56^{c}	8.50±0.41^{b}
10	6.08±0.53^{d}	5.75±0.63^{e}	6.92±0.34^{cd}	6.42±0.45^{d}	7.75±0.48^{c}	8.08±0.34^{b}
Flavor						
Zero time	9.17±0.47^{a}	9.42±0.53^{a}	9.42±0.45^{a}	9.33±0.37^{a}	9.08±0.19^{a}	9.50±0.41^{a}
2	8.50±0.41^{b}	8.83±0.47^{b}	8.50±0.39^{b}	8.00±0.29^{bc}	8.67±0.37^{b}	9.17±0.23^{a}
4	8.33±0.37^{b}	8.67±0.37^{b}	8.00±0.50^{bc}	8.00±0.41^{bc}	7.92±0.45^{bc}	8.50±0.41^{b}
6	6.67±0.47^{d}	7.75±0.48^{cd}	7.67±0.55^{c}	7.67±0.56^{c}	7.75±0.63^{c}	8.17±0.24^{b}
8	6.58±0.53^{d}	7.66±0.47^{c}	7.67±0.55^{c}	7.50±0.41^{c}	7.75±0.58^{c}	8.00±0.41^{bc}
10	6.08±0.61^{d}	6.42±0.67^{d}	6.17±0.24^{d}	6.25±0.48^{d}	6.75±0.48^{cd}	7.67±0.37^{c}
Taste						
Zero time	9.17±0.47^{a}	9.00±0.29^{a}	8.92±0.34^{ab}	8.67±0.98^{b}	9.12±0.24^{a}	9.25±0.25^{a}
2	8.50±0.57^{b}	8.58±0.34^{b}	8.50±0.41^{b}	8.50±0.41^{b}	9.00±0.41^{a}	8.83±0.24^{ab}
4	8.25±0.38^{b}	7.92±0.34^{bc}	7.33±0.37^{c}	8.33±0.37^{b}	8.50±0.41^{b}	8.33±0.37^{b}
6	7.83±0.47^{c}	7.67±0.47^{c}	7.25±0.48^{c}	7.67±0.37^{c}	8.21±0.52^{b}	7.67±0.24^{c}
8	7.08±0.53^{c}	6.92±0.53^{cd}	6.83±0.47^{cd}	7.67±0.41^{c}	7.67±0.37^{c}	7.58±0.34^{c}
10	6.75±0.48^{cd}	6.58±0.45^{d}	6.17±0.24^{d}	6.92±0.34^{cd}	7.33±0.37^{c}	7.33±0.37^{c}
Appearance						
Zero time	9.22±0.23^{a}	9.14±0.40^{a}	9.11±0.32^{a}	9.20±0.22^{a}	9.23±0.30^{a}	9.28±0.24^{a}
2	9.10±0.25^{a}	9.00±0.00^{a}	9.08±0.28^{a}	9.11±0.23^{a}	9.13±0.34^{a}	9.20±0.30^{a}
4	8.98±0.23^{ab}	8.64±0.31^{b}	8.90±0.29^{ab}	9.04±0.26^{a}	8.99±0.37^{ab}	9.15±0.22^{a}
6	8.88±0.42^{b}	7.54±0.31^{c}	8.89±0.36^{ab}	8.95±0.32^{ab}	8.98±0.26^{ab}	9.02±0.42^{a}
8	8.02±0.33^{bc}	7.22±0.29^{c}	8.76±0.25^{b}	8.87±0.18^{b}	8.90±0.19^{ab}	9.00±0.34^{a}
10	7.53±0.27^{bc}	6.89±0.39^{cd}	8.55±0.26^{b}	8.68±0.29^{b}	8.88±0.30^{b}	8.97±0.23^{ab}
Overall Acceptability						
Zero time	9.41±0.45^{a}	9.41±0.24^{a}	8.92±0.34^{ab}	8.75±0.48^{b}	9.42±0.45^{a}	9.50±0.41^{a}
2	9.08±0.19^{a}	8.58±0.34^{b}	8.67±0.37^{b}	8.50±0.50^{b}	9.33±0.47^{a}	9.25±0.34^{a}
4	8.33±0.37^{b}	8.25±0.38^{b}	8.17±0.47^{b}	8.08±0.61^{b}	8.67±0.37^{b}	8.67±0.37^{b}
6	7.83±0.47^{bc}	7.58±0.45^{c}	7.92±0.67^{bc}	7.67±0.55^{c}	8.17±0.47^{b}	8.25±0.38^{b}
8	7.33±0.38^{c}	7.17±0.24^{c}	7.92±0.34^{bc}	7.25±0.38^{c}	8.00±0.29^{bc}	8.25±0.48^{b}
10	6.67±0.37^{d}	6.42±0.45^{d}	7.08±0.34^{c}	7.08±0.34^{c}	7.92±0.34^{c}	7.58±0.53^{c}

** means + SD: Means with different superscript within the same column are significantly different at $p \leq 0.05$

The general appearance scores for the samples heated at 85ºC for 30 min. was 9.22 at zero time and declined slightly with storage to 8.88 after six months of storage, and then declined sharply to reach 7.53 by 10 months. The appearance score for the samples heated at 70ºC for 20 minutes was 9.14 at zero time and sharply declined with storage to reach 6.89 after 10 months. The addition of dried Juniper leaves by 50 or 100 mg/L showed, in general, appearance scores comparable to those obtained for the samples heated at 85˚C for 30 minutes. The addition of juniper berries to the samples showed in general appearance scores higher than those obtained for the other treatment samples. The differences were slightly low during the early storage periods and considerable during the late storage periods. The guava nectar samples treated with juniper berries by 100 mg/L had higher scores than the samples treated with 50 mg/L (9.28 vs. 9.23 at zero time and 8.97 vs. 8.88 after 10 months of storage).

The results of overall acceptability scores are presented in the same Table (7). Heating guava nectar at 85ºC for 30 minutes showed scores of 9.41 at zero time which then progressively declined during the storage periods and reached to 6.67 after 10 months. Similar trend was found for the samples heated at 70ºC for 20 minutes, but with somewhat sharp decline during the storage. The samples treated with dried juniper leaves by 50 mg/L had scores little less than those obtained for the samples heated at 85ºC for 30 min at zero time (8.92) and until 6 months of storage (7.92), thereafter the scores were obviously higher and reached to 7.08 after 10 months. Comparable trend was found for the samples treated with dried juniper leaves by 100 mg/L, but with less extent. The addition of juniper berries (fruit) by either 50 or 100 mg/L to guava nectar led to observable increases in the scores compared to all other treatment samples, including the samples heated at 85ºC for 30 minutes. Overall acceptability scores for the samples treated with 50 and 100 mg/L were 9.42 and 9.50 at zero time, and then gradually declined to 7.92 and 7.58 after 10 months of storage, respectively. Though overall acceptability was declined after 10 months for nectar 70ºC/20 min compared to 85ºC/30 min, it was increased by berries extracts even after 10 months of storage period. Nutritive experiments could show high reflection for valuable compounds as polyphenols, flavonoids and vitamins.

CONCLUSION

In conclusion, addition of juniper leaves or berries water extracts increased valuable compounds, DPPH radical scavenging activity and sensory evaluation records. Also, the content of antioxidants at temperature 70ºC at 20 min was stable and it with was better for sensory evaluation as compared to heat treatment at 85ºC at 20 min, also it decreased energy cost which will benefit the food processing widely.

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تحسين خصائص نكتار الجوافة بخفض درجة حرارة التصنيع مع إضافة مستخلصات العرعر

منال عباس الجندي ، إسحق مراد الحديدي*

معهد بحوث تكنولوجيا الأغذية- مركز البحوث الزراعية-الجيزة - مصر

الجوافة تلعب دوراً هاما في العديد من الأمراض بسبب وجود العديد من مضادات الأكسدة العديدة الفينولات ومركبات الفلافونيدات وتلك التي تضار أثناء ما بعد الحصاد والتجهيز وللتغلب على هذه المشكلة يجب الحفاظ علي الخصائص الحسية والتغذوية والوظيفية. تم إعداد نكتارالجوافة عن طريق إستخراج اللب مع إضافة المستخلص المائي لأوراق وثمار العرعر (*Juniperus communis*) (٥٠ و ١٠٠ ملليجم/لتر) التي أعدت وأضيفت في المنتج النهائي ثم البسترة وتخزينها لمدة ١٠ أشهر علي ٤ درجة مئوية. تم تقييم المحتوي من المواد المضادة للأكسدة أثناء التخزين (الفينولات العديدة الكلية والفلافونيدات الكلية والكاروتينات وفيتامين ج والزيت الطيار والصابونين والتانينات) ونشاط مضادات الأكسدة والمواد الصلبه الذائبة والرقم الهيدروجيني لنكتار الجوافة كل شهرين تخزين حتى عشرة أشهر. وقد تم متابعة المنتجات المصنعة وتقييمها حسياً بصفة دورية حتى ١٠ أشهر من التخزين كل شهرين أي بعد ٠ و ٢ و ٤ و ٦ و ٨ و١٠ أشهر. تم تقييم المعاملات حسياً من حيث اللون والنكهة والطعم والقبول العام. وقد أجري التحليل الإحصائي من خلال المقارنة بين العينات باستخدام ANOVA ($P \leq 0.05$). يمكن إستنتاج أن إضافة مستخلص ثمار العرعر أظهر نشاط عالٍ لمضادات الأكسدة مقارنة بنكتار الجوافة دون إضافة المستخلص وأيضا لغيرها من المعاملات بعد ١٠ أشهر. أيضا زيادة إستساغة نكتار الجوافة للمستهلكين. كما لوحظ أن محتوي مضادات الأكسدة عند ٧٠ درجة مئوية لمدة ٢٠ دقيقة كان ثابتاً والأفضل من حيث التقييم الحسي وأيضا من حيث خفض تكلفة الطاقة لتكون تكلفة إقتصادية لتستخدم علي نطاق واسع في التصنيع الغذائي.