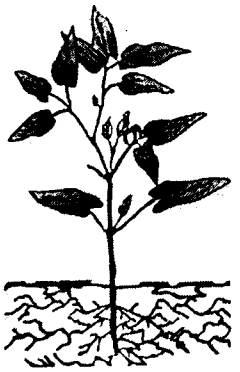

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ROLE OF L-CYSTEINE AND GREEN TEA EXTRACTS FOR MINIMIZING THE NON-ENZYMATIC BROWNING IN GUAVA NECTAR

[9]

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ABSTRACT

The non-enzymatic browning is considered as one of the main problems in guava nectar glass packaged. So, this work was aimed to minimizing the non-enzymatic browning by using green tea extract and L-cysteine. Physico-chemical analysis of guava juice indicated that the juice yield and total soluble solids were 75.8% and 9.7% respectively while it contained 95.5 mg/100g ascorbic acid. The results illustrated that the changes in color was very low during storage at room temperature for 6months by using these inhibitors. The statistical analysis of sensory evaluation of guava nectar bottled in glass treated with green tea extract and L-cystiene then stored at room temperature, were extremely analogous to that of cooled samples without the addition of antibrowning inhibitors in their constituents. On the other hand the results revealed that the use of 400 ppm of L-cysteine or 400 ppm of green tea extract minimized non-enzymatic browning without any undesirable effect on the sensory properties. Sodium metabisulfite, 50 ppm in addition to 200 ppm of green tea extract, gave high quality and acceptable guava nectar. Therefore, the addition of 400 ppm of L-cysteine or 400 ppm of green tea extracts caused to reduce non-enzymatic browning in glass bottled guava nectar.

INTRODUCTION

Guava (*Psidium guajava L.*), belonging to the Myrtaceae family, is a native of tropical fruits produced throughout the tropical and sub-tropical areas **(Chopda and Barrett, 2001)**.

Guava is consumed fresh and/or made into processed products such as juice, nectar, puree, jam and jelly, to extend the shelf-life and make the fruits available throughout the year. **(Kashyap *et al* 2001)**. The total quantity of guava fruits produced in Egypt was 243434 tons obtained from 27892 feddans **(Ministry of Agric and Land Reclamation**, 2004).

The processed guava products have a lower ascorbic acid content compared to the fresh fruits as losses during processing are inevitable because ascorbic acid is highly heat labile and water soluble in addition to the effect of storage period, oxygen and light **(Jagtiani *et al* 1988)**.

Since quality is a supreme target in foods and food products, deterioration must be controlled during processing storage. In processed guava nectar, one of the main causes of deterioration is the non-enzymatic browning, since enzymatic browning is eliminated by heat treatment during processing **(Brasil *et al* 1995)**. The greater numbers of browning pigments were found in bottles than in cans and fewer but more intense browning pigments were found in cans. Some brown pigments were unstable and diminished or disappeared with extended storage time, whereas others increased with increasing time **(Marshall *et al* 1986)**.

The browning reactions involve caramelization, ascorbic acid degradation and Maillard reaction **(Clegg**, 1964).

Brown pigments formation occurs during the storage period and is dependent upon many factors such as soluble solids, ascorbic acid, pH

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value, oxygen level, metal ion, and packaging container type and temperature **(Karel and Nickerson, 1964; Saguy *et al* 1978; Kacem *et al* 1987 and Lee and Nagy, 1988).** Beside the brown color, the loss of nutrients and the formation of undesirable compounds like furfural and 5-hydroxy methyl furfural (HMF), caused to unfavorable quality of the products **(Buedo *et al* 2001 and Koca *et al* 2003)**

The most wide spread agents used for control of browning are sulphiting agents. Due to adverse health effects, several studies have been developed to use non-sulfite antibrowning agents such as reducing agents (ascorbic acid, glutathione, L-cysteine), chelating agents (phosphate, EDTA, enzymes and polyphenolic compounds such as flavonoids which acts as free radical scavengers **(Sapers and Hicks, 1989; Chu and Juneja, 1997; Balentine, *et al* 1997 and Peterson and Tottani, 2005).** Some thiol compounds are natural components of human diets which can play significant physiological roles in vivo as nueleophiles and scavengers of free radicals **(Friedman, 1991).** The extent of non-enzymatic browning in serum was estimated by measuring juice absorbance at 420 nm. The specific brown pigments formed were not as much concerned as the rate of which they were formed **(Sawamura *et al* 1991).**

Green tea has been considered by the traditional Chinese medicine as healthful beverage. Recent studies suggested that green tea may contribute to a reduction in the risk of cardiovascular diseases and some forms of cancer, as well as to the promotion of oral health and other physiological functions such as anti-hypertensive effect, body weight control, anti-bacterial and antiviral activity **(Cabrera *et al* 2006).**

Peterson and Tottani (2005) reported that green tea may be using as a natural anti-browning component and green tea extracts were able to inhibit Maillard browning aroma compounds in model food systems. In addition, green tea compounds have been widely studied for health benefits, but little was known about the functionality in food system. The use of green tea extract as a food additive to control Maillard browning would be useful to the food industry **(Roedig-Penman and Gordon, 1997).**

Schamberager and Labuza (2007) found that the addition of green tea extracts reduced Maillard browning associated with fluorescence and color changes during UHT milk processing.

The objective of this work was to reduce non-enzymatic browning in guava nectar especially packed in clear bottled glass by using L-cysteine and green tea extracts as well as to minimize the using of sodium metabisulfite.

MATERIALS AND METHODS

Materials

- Baladi white Guava fruits (Psidium guajva L.), were obtained from the local market, Giza Governorate, Egypt. The fruits were at the full ripe stage.
- Carboxy Methyl Cellulose (CMC), Sodium metabisulfite,
  L-cysteine and potassium sorbate (food grade) were obtained from Aldrich Chemical Co.Ltd, Gilingham, Dorset-England.
- Green tea and sugar (white sucrose) were also purchased from the local market.

Methods

Extraction of guava juice

Guava fruits were sorted, washed, cut into small pieces and mashed in a mincing machine. The obtained mash was sieved through a fine screen to separate the seeds and other fibrous matter then the obtained juice was pasteurized at 90°C for 5 min to inactivate the existing native enzymes as reported by **Brasil *et al* (1995).**

Preparation of green tea extract

Green tea extracts were done as described by **Peterson and Tottani (2005)** as follows: 10grams of dried green tea were weighed and extracted overnight in sufficient quantity of absolute ethyl alcohol. The extract was filtered and evaporated using rotary evaporator at 40°C. Evaporation was completely performed until dryness, and then kept at freezing temperature until used.

Preparation of guava nectar

Guava nectar was prepared, as reported in the Egyptian Standard No. 1602/2003 Part 2, from guava juice diluted by water to1:4(guava juice: water). The sugar was added and mixed until the total soluble solids of the nectar reached to 12° Brix. 200, 400 and 600ppm of L-cysteine, green tea extract and sodium metabisulfite were added to the formula individually and also as a combination of sodium metabisulfite with green tea extract at various concentrations. 0.3% citric acid, 150ppm of

sodium benzoate (as preservative agent) and 0.5g/L of carboxy methyl cellulose (to maintain the cloudiness) were also added to the formula, then homogenized well using homogenizer at full speed for 3 min.After that nectars were bottled in 200 ml of sterilized glass bottles, tightly closed then subjected to pasteurization process at 90°C for 1 min. The bottles were cooled immediately with tap water and divided into two parts, the first are stored at room temperature 25±5°C while the second was refrigerated at 5°C± 2°C for 6 months.

Analytical methods

- Total soluble solids, pH value, ascorbic acid and titratable acidity as (citric acid) were determined according to the methods of **A.O.A.C (1995)**.
- Alcohol insoluble solids (AIS %) were determined as described by **Ting (1970)**.
- Tannins content were estimated as mentioned by **Martin and Larry (1977)**.
- Hydroxyl methyl furfural (HMF) was measured according to **Wong *et al* (2006)**.
- Viscosity was measured using Brookfield viscometer at rotation speed of 60 rpm, using spindle No.4 (**Asker and Treptow, 1993**).
- The color changes were estimated by the method of **Hunter (1958)** with Hunter colorimeter type (DP-9000) for the estimation of L, measure the lightness on a scale ranging from 0 (black) to 100 (white), a denoting greenness when negative and redness when positive; b denoting blueness when negative and yellowness when positive.
- Browning index was determined according to the method of **Meydev *et al* (1977)**. The juice was centrifuged at2000rpm for 5min.The supernatant was decanted and diluted with an equal volume of 95%ethanol and centrifuged again. The obtained supernatant was filtered through Whatman No. 1 paper and color measured at 420nm by Jenway 640 5UV/VIS spectrophotometer against 60% aqueous ethanol as blank.

Sensory evaluation

The prepared nectars were evaluated organoleptically according to the method of **Larmond (1982)**. Ten panelists from the staff of Food Technology Research Institute were asked to evaluate color, taste and aroma on a10-pont hedonic scale. The organoleptic data were analyzed statistically using one way ANOVA procedure of the SPSS statistical analysis program **(SPSS, 1990)**.

RESULTS AND DISCUSSION

Properties of guava juice

Some important properties of guava juice are illustrated in **Table (1)**. The yield of juice after removing guava seeds and other insoluble materials was about 75.8% while the T.S.S, titratable acidity, pH value and ascorbic acid content were 9.7%, 0.56%, 3.86 and 95.5 mg / 100g, respectively. These results are similar with the findings of **Samson (1986)** who reported that the guava fruits were characterized by containing high amount of ascorbic acid over100 mg/100g at levels far higher than citrus fruits (orange, lime and grapefruits) 25-50 mg/100g.

Table 1. Some important properties of guava juice

Parameters		Value
Yield	%	75.8
Residual product	%	24.2
TSS	%	9.7
Titratabel acidity (Citric acid %)		0.56
pH value		3.86
Ascorbic acid mg/100g		95.5
Brix/acid ratio		17.32:1
Viscosity (centipoises)		156.9

Quality parameters of guava nectar

Guava nectar produced in glass bottles or cans has attractive flavor and color with uniform consistency **(Jagtiani *et al* 1988)**.

Table (2) shows some quality parameters for prepared guava nectar. Since the TSS were adjusted to 12° Brix.Results indicated that, the pH value and titratable acidity were 4.18 and 0.235% respectively where the pH value for guava nectar was higher than that obtained in guava juice which may act as lowering the losses of ascorbic acid. These results may be explained by the opinion of **Berlinet *et al* (2006)** which showed that increasing the pH value from 3.2 to 4.0 in bottled orange juice significantly reduced the amount of off-flavour (furfural and α-Terpineol) and can protect ascorbic acid level without increasing the non-enzymatic browning. The remained amount of ascorbic acid content (20.54 mg/100g) was found in bottled

guava nectar after pasteurization. Alcohol insoluble solids (AIS%) and tannins were 0.89 and 0.08% respectively and the viscosity reached 200 centipoises due to the addition of carboxy methyl cellulose and rising of concentration for prepared nectar. Results also indicated that the Hunter color parameters, L value (lightness) was 72.75, a value (redness) was 2.6 and b value (yellowness) was 18.29.

Table 2. Quality parameters of prepared guava nectar

Parameter		Value
TSS (Brix)		12
Titratable acidity	%	0.235
pH value		4.18
Ascorbic acid (mg/100g)		20.54
AIS *	%	0.89
Tannins	%	0.08
Viscosity (centipoises)		200
Browning index at (420 nm)		0.092
HMF(mg/L)**		3.067
Hunter values***	L	72.75
	a	2.6
	b	18.29

*AIS = Alcohol insoluble solids
**HMF=Hydroxy methyl furfural
***L=degree of lightness
a= (+) redness to (-) greenness
b= (+) yellowness to (-) blueness

Reduction of non-enzymatic browning during storage

In processed guava nectar, some factors are responsible for occurring the non-enzymatic browning such as Maillard reaction and ascorbic acid degradation (**Jagtiani *et al* 1988**). Color, degradation of ascorbic acid and hydroxymethyl furfural are considered the main changes caused in non-enzymatic browning (**Raynolds, 1965 and Koca *et al* 2003**). Some trials were carried out by using L-cysteine and green tea extract at various concentrations to reduce the non-enzymatic browning compared to sodium metabisulfite added trough preparing of guava nectars. As known about the bottled products that usually stored at room temperature under normal condition, but in this investigation the storage at 5°C±2°C in darkness was carried out to indicate the efficiency of the inhibitors used.

The results of **Table (3)** reveal that the loss in ascorbic acid content increased by increasing the storage period. The loss rate of ascorbic acid was higher in the nectar stored at room temperature (86.4%) compared to 20.03% in nectar stored at5°C after 6months of storage.

The aforementioned results indicated that, decomposition of ascorbic acid was reported to be a major deteriorative reaction occurring during the storage of orange juice similar with (**Solomon *et al* 1995**). **Marcy *et al* (1989)** observed that the loss % of ascorbic acid in aseptically packaged orange drink after 6 months of storage at 15°C was 40 % and became 75% at 30°C. Furthermore, **Satter *et al* (1989)** found that the loss of ascorbic acid in orange drink packaged in clear glass exposed to incandescent light for 32 days reached 66% compared to 42% in that unexposed to incandescent light.

The current study indicated that, the HMF is an intermediate product of the Maillard reaction, formed before non-enzymatic browning. HMF combines with amino compounds to give rise of browning color. The content of HMF more than 5 mg/L in juices indicates loss of quality (**Asker and Treptow, 1993**). Depending upon this fact, the bottled packaged guava nectar stored at room temperature (control) became dark brown which could be considered as the important parameter of guava nectar quality after 4 months of storage while, little changes occurred in guava nectar color after 6 months of storage 5°C±2°C.On the other hand, gradual incremental of browning index was observed by increasing the storage time in the control bottled guava nectar, which was increased by 109% after 6 months of storage at room temperature compared to 15%increamental after 6 months of storage at 5°C±2°C and with avoiding the light. These results are in accordance with those obtained by **Harvey *et al* (1986)** they mentioned that the storage of aseptic guava puree at low temperature reduced the color changes and ascorbic destruction.

Also, same findings were observed for guava nectar packaged in glass bottles stored at 5°C±2°C up to 6month of storage by Hunter color measurement.

Table 3. Effect of storage conditions on the browning rate of the untreated bottled guava nectar during storage

Storage condition	Storage period (month)	**Loss of ascorbic acid%	HMF (mg/l) ***	Browning index	Hunter parameter****		
					L	a	b
At room Temperature (25°C±2°C)	Zero time time	0.0	3.067	0.092	72.75	2.6	18.92
	2	34.8	4.014	0.314	58.56	4.16	17.42
	4	58.3	5.132	0.582	54.68	4.98	16.85
	6	86.4	6.446	0.897	42.47	5.72	16.84
*Cold storage (at 5±2°C)	2	8.4	3.129	0.102	68.82	2.86	18.27
	4	14.7	3.363	0.158	64.63	2.95	18.17
	6	20.3	3.560	0.206	56.17	3.21	17.87

* avoid from light
** Initial ascorbic acid content was20.54mg/100g
*** HMF=Hydroxy methyl furfural
****L = Lightness a = (+) redness, (-) greenness b= (+) yellowness, (-) blueness

Therefore, the brown color in glass packaged guava nectar can be reduced by storing at low temperature in addition to avoid the dirct light.

Effect of L-cysteine on reduction of non-enzymatic browning

Results in **Table (4)** and **Fig (1)** represent the effect of adding 200, 400 and 600 ppm of L-cysteine on reduction of the browning in glass bottled guava nectar stored up to 6months where, the increasing loss of ascorbic acid was noticed by increasing the storage period, but the rate of incremental was decreased by increasing the amount of adding L-cysteine. The degradation rates of ascorbic acid after 6months of storage at room temperature were reduced from 86.4% in the control to 29.85%, 18.95% and 17.75 % by adding 200, 400 and 600 ppm of L-cysteine respectively.
L-cysteine prevents brown pigment formation by reaction with quinine intermediates to form stable, colorless compounds **(Sapers and Hicks, 1989)**. L-cysteine has been used as an ingredient in commercial browning inhibition in citrus products, pear concentrates and milk **(Handwerk and Coleman, 1988; Bolin and Steele, 1987 and Montgomery, 2006)**.

The formation of HMF was obviously decreased by adding L-cysteine for prepared guava nectar. Results indicated that, browning was reduced by adding L-cysteine to prepared guava nectar where, the adding of L- cysteine caused higher lightness value (L) and yellowness value (b) and lower redness value (a) by measuring the color with Hunter. On the other hand, adding 400 ppm of L-cysteine for prepared nectar considered the potent reduction of browning in bottled guava nectar. These results are in agreement with **Montgomery (2006) and Handwerk and Coleman (1988).**

Effect of green tea extract on reduction of non-enzymatic browning

Tea is the second most consumed beverage around the world, after water, for its attractive aroma and flavor, as well as for its health-related benefits **(Wong *et al* 2006)**. **Table (4)** shows the influence of green tea extract on the browning rate in bottled guava nectar. Green tea was effective for lowering the non –enzymatic browning in guava nectar stored up to 6months at room temperature.

The loss of ascorbic acid decreased from 86.4% in control to 35.2 %, 22.4 % and 22.1%with adding 200, 400 and 600 ppm of green tea extract after 6 months of storage at room temperature respectively. Green tea, a non fermented tea has been extensively studied for antioxidant properties since it contains a large amount of phenolic compounds up to 30% of the dry weight **(Price and Spitzer, 1993)**.

Table 4. Effect of using L-cysteine and green tea extract on the rate of non-enzymatic browning for guava nectar during storage for 6months at room temperature

Treatments		Storage period month	*Loss of ascorbic% acid%	**HMF mg/l	Browning index	Hunter parameters***		
						L	a	b
Control		Zero time	0.00	3.067	0.092	72.75	2.6	18.29
		2	34.8	4.014	0.314	58.56	4.16	17.42
		4	58.3	5.132	0.582	54.68	4.98	16.85
		6	86.4	6.446	0.897	42.47	5.72	16.84
L-cysteine	200 ppm	Zero time	0.00	3.067	0.092	72.75	2.6	18.29
		2	16.45	3.740	0.251	65.78	2.96	19.25
		4	22.70	3.885	0.276	59.96	3.18	19.08
		6	29.85	3.909	0.298	56.84	3.62	18.72
	400 ppm	Zero time	0.00	3.067	0.092	72.75	2.6	18.29
		2	7.81	3.297	0.214	63.71	2.85	20.35
		4	14.05	3.740	0.251	63.14	2.97	19.96
		6	18.95	3.868	0.279	62.87	3.17	19.35
	600 ppm	Zero time	0.00	3.067	0.092	72.75	2.6	18.29
		2	7.24	3.593	0.213	60.81	3.12	23.11
		4	13.85	3.730	0.246	59.76	3.98	22.16
		6	17.75	3.822	0.268	58.85	3.25	21.86
Green tea extract	200 ppm	Zero time	0.00	3.067	0.092	73.15	2.55	18.75
		2	18.6	3.714	0.213	67.81	3.75	17.85
		4	24.6	3.862	0.283	61.72	3.78	16.42
		6	35.2	3.997	0.310	58.76	4.05	16.48
	400 ppm	Zero time	0.00	3.067	0.092	73.78	2.43	18.82
		2	12.1	3.507	0.198	67.14	2.86	18.22
		4	15.7	3.881	0.275	56.72	3.08	17.87
		6	22.4	4.006	0.312	60.80	3.43	17.53
	600 ppm	Zero time	0.00	3.067	0.092	74.28	2.36	19.25
		2	11.8	3.486	0.186	67.92	2.79	18.15
		4	15.2	3.693	0.237	64.81	2.98	17.95
		6	22.1	3.772	0.256	61.52	3.25	17.52

* Initial ascorbic acid content was 20.54mg/100g

**HMF=Hydroxy methyl furfural

***L = Lightness a = (+) redness to (-) greenness b= (+) yellowness to (-) blueness

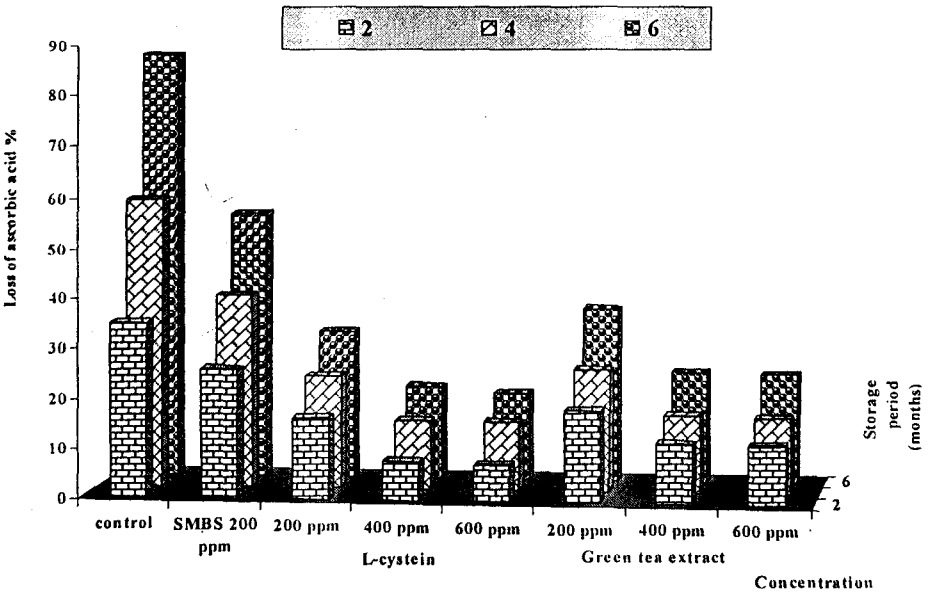

Fig. 1. Effect of various concentrations of L-cystein, green tea extract and Sodium metabisulfite on percent loss of ascorbic acid in bottled guava nectar during storage at room temperature

SMBS : Sodium metabisulfite

Wang and Zhou (2004) reported that tea extract could be used at a level of 150 mg/100g in bread making without problems in acceptability of color.

The browning index was decreased from 0.897 in the control to 0.310, 0.312 and 0.256 by adding 200, 400 and 600 ppm of green tea extract in prepared guava nectar after 6months of storage at room temperature.

The effect of green tea extract on the color of guava nectar measured by Hunter lab instrument led to increase the L value (lightness) than the control. The results are in agreement with **Schamberger and Labuza (2007) and Colhan-Sederstrom and Peterson (2005)** who found that, addition of green tea extracts to raw milk caused a slight increase in L value.

Fore instance, it can be concluded that the tea extracts have a higher effect for reduction of non-enzymatic browning in bottled guava nectar at the concentration of 400 and 600ppm during storage up to 6month.

Effect of sodium metabisulfite on reducing the non-enzymatic browning

Sulfites are highly effective in controlling browning but they are usually subjected to regulatory reaction due to adverse effects on health. Sulfites agents are not teratogenic, mutagenic or carcinogenic, but a fraction of the public are sensitive to sulfites and who are susceptible to a unpredictably sever effect of the agents due to acute allergic reactions **(Rocha and De Morais, 2005).**

Sulfite treatment levels vary widely depending upon the application, **FDA (1988)** proposed the maximum residual levels of 300 and 2000 ppm to be permitted in juices and dried fruits.

Effect of adding 200ppm of sodium metabisulfite alone and/or combined with 50,100 and 150ppm green tea extract to prepared bottled guava nectar on reduction of non- enzymatic browning are illustrated in **Table (5)**.

Data show that sodium metabisulfite had a lower effect for reducing the loss of ascorbic acid compared with using L-cysteine and green tea extract in prepared guava nectar during 6months of storage at room temperature as shown in **Fig. (1)**. However, the efficiency of sodium metabisulfite was promoted with combined by green tea extract. The loss of ascorbic acid after 6 months of storage was decreased from54.28% by using 200 ppm of sodium metabisulfite alone to28.51% by using50 ppm of sodium metabisulfte combined with 200 ppm of green tea extract.

Table 5. Effect of addition of sodium metabisulfite with green tea extract on the parameters of browning in bottled guava nectars during storage at room temperature

Treatment	Storage period month	Loss of *ascorbic acid%	**HMF mg/l	Browning index	Hunter parameters***		
					L	a	b
200 ppm Sodium metabisulfite	Zero time	0.00	3.067	0.092	72.75	2.60	18.29
	2	25.87	3.684	0.235	62.17	3.16	16.35
	4	38.75	4.239	0.386	56.70	3.54	16.87
	6	54.28	4.377	0.401	48.25	3.86	13.28
50 ppm Sodium metabisulfite + 200 ppm green tea extract	Zero time	0.00	3.067	0.092	7.015	2.55	18.75
	2	18.78	3.593	0.213	67.81	2.85	17.25
	4	18.72	3.692	0.237	68.90	2.88	19.07
	6	28.51	3.881	0.282	58.75	3.17	19.25
100 ppm Sodium metabisulfite + 200 ppm green tea extract	Zero time	.0.00	3.067	0.092	73.15	2.55	18.745
	2	15.36	3.405	0.168	69.71	2.76	18.42
	4	20.16	3.350	0.198	68.12	2.86	18.83
	6	28.42	3.651	0.227	65.05	3.01	19.78
150 ppm Sodium metabisulfite + 200 ppm green tea extract	Zero time	0.00	3.067	0.092	73.15	2.55	18.75
	2	14.28	3.422	0.172	70.12	2.78	18.78
	4	23.76	3.547	0.202	69.80	2.86	19.17
	6	30.25	3.699	0.236	65.21	2.98	18.96

* Initial ascorbic acid content was20.54mg/100g ** HMF=Hydroxy methyl furfural
*** L= Lightness a = (+) redness (-) greenness b = (+) yellowness (-) blueness

HMF and browning index decreased from 4.377 mg/L and 0.401 by 200 ppm of sodium metabisulfite to 3.881 mg/L and 0.282 by using 50 ppm of sodium metabisulfite combined with 200 ppm of green tea extracts respectively. Furthermore, the nectar treated with50 ppm sodium metabisulfte combined with 200 ppm green tea extracts gave more lightness (L) and less redness (a) than that of the nectar treated with sodium metabisulfite alone by using Hunter lab. From the previous results in **Table (5)** it could be observed that, the combination between50ppm sodium metabisulfite and200ppm green tea extract caused to higher reduction of non-enzymatic browning than using each one alone in glass bottled guava nectar.

Organoleptic properties

The effect of addition of L-cysteine, green tea extracts and the mixture of green tea extract with sodium metabisulfite at various concentration on the sensory properties of bottled guava nectars after 6 months of storage are shown in **Table (6).**

Concerning color perception, the samples treated with 600 ppm of both L-cysteine and green tea extract indvedually had the highest score, which were 8.48 for each addition followed by 400 ppm of L-cysteine alone which recorded 8.44. However, there were no significant differences of color of nectar treated with 400 and 600ppm L-cysteine, 400 and 600 ppm green tea extracts and guava nectar treated with 200ppm green tea extract combined with 50,100 and 150 ppm sodium metabisulfite. The taste of guava nectar treated with both 200 or 400 ppm green tea extract recorded the highest level for taste.While, the aroma of guava nectar treated with 200 and400 ppm L-cysteine and stored at 5°C recorded the highest level compared with other tested samples.

Table 6. Sensory evaluation of bottled guava nectar treated with various non-enzymatic browning inhibitors after 6 months of storage

Treatment	Color	Taste	Aroma	Overall acceptability
Control	4.36 ^{d}	6.19 ^{f}	6.46 ^{e}	5.77^{d}
Cold storage (at 5°C)	8.23 ^{a}	8.36 ^{ab}	8.65 ^{a}	8.41^{a}
200 ppm L-cysteine	7.85 ^{b}	8.53 ^{ab}	8.55 ^{a}	8.31^{ab}
400 ppm L-cysteine	8.44 ^{a}	8.48 ^{ab}	8.52 ^{a}	8.48^{a}
600 ppm L-cysteine	8.48 ^{a}	7.85 ^{d}	7.90 ^{cd}	8.07^{b}
200 ppm green tea extract	7.77 ^{b}	8.65 ^{a}	8.25 ^{b}	8.22^{b}
400 ppm green tea extract	8.19 ^{a}	8.63 ^{a}	8.37 ^{ab}	8.39^{a}
600 ppm green tea extract	8.48 ^{a}	8.17 ^{c}	8 .00 ^{c}	8.21^{b}
200 ppm sodium metabisulfite	6.28 ^{c}	7.42 ^{e}	7.71 ^{d}	7.13^{c}
50 ppm sodium metabisulfite +200 ppm L-cysteine	8.26 ^{a}	8.29 ^{bc}	8.46 ^{ab}	8.33^{ab}
100 ppm sodium metabisulfite +200 ppm L-cysteine	8.28 ^{a}	8.34 ^{bc}	8.47 ^{ab}	8.36^{ab}
150 ppm sodium metabisulfite +200 ppm L-cysteine	8.35 ^{a}	8.16 ^{c}	8.35 ^{ab}	8.28^{b}

Different letter in each column mean significant difference (P<0.05)

Also from the same data in Table (6), it can be summerized that the samples treatrd with 400 ppm of L-cysteine, 400 ppm of tea extract as well as the samples treated with 50 ppm from sodium metabisulfite in addition to 200 ppm of L-cysteine were the best accepted samples .High significant differences were found between the optimal samples and the others dealing with taste and aroma perception.

Generally, from all data given in this work, it can be recomonded that L-cysteine and green tea extract could be used as potential inhibitors with mentaining other quality attributes.

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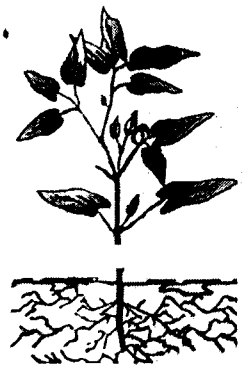

حوليـــات العلـــوم الزراعية
جامعة عين شمس ، القاهرة
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دور الحامض الامينى السيستئين ومستخلص الشاي الأخضر في خفض التلون البني غير الانزيمى في نكتار الجوافة

[٩]

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الموجـــــز

يعتبر التلون البني احد المشكلات الرئيسية التـــي توجد في نكتار الجوافة المعبأ في زجاجـــات. لـــذلك استهدفت هذه الدراسة الإقلال أو الحد مـــن حـــدوث التلون البني غيرالانزيمى في نكتار الجوافة المعبأ في زجاجات باستخدام مواد طبيعيـــة مثـــل مـــستخلص الـــشاي الأخـــضر والحمـــض الامينـــى الكبريتـــي (السيستئين) .هذا وقد أوضحت الدراسة أن عـــصير الجوافة يحتوى على ٩,٧% مواد صلبه ذائبـــة كليـــه ووصل محتواه من حمض الاســـكوربيك إلـــى ٩٥,٥ ملجم/١٠٠جم. وأوضحت نتائج الدراسة أن التغيرات في لون نكتار الجوافة كانت محدودة كنتيجة لإضافة المثبطات بعد مرور فترة ستة اشهر من التخزين على درجة حرارة الغرفة.

ومن ناحية أخرى فلقد أظهرت الاختبارات الحسيه أن إضافة مستخلص الشاي الأخضر والسيستئين إلى نكتار الجوافة المخزن على حرارة الغرفة أدى إلـــى نتيجة مماثله للنكتار المخزن على ٥°م بدون إضـــافة المثبطات ، بل كان هناك تفوقا في الحفاظ على اللون وذلك عندا لتخزين على حرارة الغرفـــة لمـــدة ســـتة اشهر.

وقد بينت الدراسة إن استخدام ٤٠٠ جزء/مليـــون من مستخلص الشاي الأخضر أو ٤٠٠ جزء/مليـــون من حمض السيستئين لم يكن له تأثير غير مرغـــوب على الخواص الحسيه للنكتار من حيث اللون والطعم والرائحة . كما وجد أن إضافة ٥٠ جزء/مليون مـــن كبريتيت الصوديوم و ٢٠٠ جزء/مليون من مستخلص الشاي الأخضر معا ، أدى إلى الحصول على منـــتج ذو مواصفات جيده و طعم مقبول .

وفي النهايـــة يمكـــن التوصـــية باســـتخدام ٤٠٠ جزء/مليون من مستخلص الشاي الأخضر لتثبيط أو الحد من حدوث التلون البني غير الإنزيمـــي لنكتـــار الجوافة المعبأ في زجاجات بفعالية كبيرة.

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