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**CHEMICAL AND TECHNOLOGICAL STUDIES ON PRODUCTION OF  
CONCENTRATES FROM SWEET ORANGE JUICE  
BY**

**Zeid, M.H.M.**

Horticultural Crop Processing Res. Dept., Food Technology Research Institute,  
Agriculture Research Center, Giza, Egypt.

**ABSTRACT**

This work aimed to study the effect of concentration and storage on chemical components and sensory attributes of sweet orange juice. Two concentration methods were adopted. The first method is the traditional method by heating under vacuum. The second method is serum- pulp method. The obtained concentrates used to prepare nectars at different total soluble solids of 14,16 and 18%.The concentrates and the nectars were analysed – chemically, organoleptically adopted on nectars prepared from these concentrates. Results indicated that, the concentration and processing and storage of nectars caused a decrease in ascorbic acid, carotenoids and total sugars of sweet orange juice while the color index increased slightly. Serum –pulp method is recommended to concentrate sweet orange juice compare to the traditional method by heating under vacuum. Sweet orange nectar with 14% (T.S.S) prepared from concentrates and prepared by serum-pulp method of concentration was preferable compared to the other treatments

**INTRODUCTION**

The area cultivated with sweet oranges in Egypt were 10667 Feddans producing 9413 tons according to the statistical report of the Ministry of Agriculture in Egypt, 2005.

An important need exists for the production of fruit concentrates characterized by high quality and very attractive for the consumers.

High quality concentrates seem to be an important alternative to fruit juices in terms of reducing the costs of production, storage and transportation. Furthermore shipment of concentrates to other markets is much more economic where they can be applied in many ways in a large variety of products depending on the local consumer taste (Asker, 1981).

With respect to the concentration methods, Abd El – Fadeel (1978) reported that concentration of balady orange juice by freeze concentration or by heating under vacuum caused a decrease in ascorbic acid content and a slight decrease in the total sugars content beside a decrease in the free amino nitrogen content.

Abd El-Fadeel (1981) used serum – pulp method for the concentration of Balady, Pairy and Zibda mango juices. He found that ascorbic acid and carotenoids content decreased by concentration of all mango juices.

Serum- pulp method was used also by Abd El-Hady (2001) for the concentration of Balady mango juice. With respect to sweet orange juice processing. Karim and Rahman (1973) studied the total acidity of canned sweet orange juice, grape fruit /orange juice blends and orange juice fortified with 25 mg or 50mg ascorbic acid /100ml. During storage at room temperature for 300 days, the total acidity increased slightly and ascorbic acid decreased.

There was no discernable pattern in over all acceptability of the juices of thick and skinned sweet oranges (Onayemi,1977).

Giacomo, *et al.* (1979) studied the limits of variability of free amino acids composition of sweet orange juice produced industrially. About 90% of amino acid content consist of aspartic acid, serine, asparagine, glutamic acid, proline, alpha amino butyric acid and argenine; 3-6% of alanine and glutamine, all the others are present at low concentration.

There is a considerable variations in the vitamin C content of different citrus fruits. Oranges generally contain from 40 to 70mg /100mg (Robertson and Nisperos, 1983). The juice of mature Balady oranges contained total sugars ranged from 8.97 to 12.4% (El-Hamzy, 1988 and Aly,1999). Regarding to free amino nitrogen content of Balady orange juice it contained 24.2 and 26.5mg /100 g in fruits picked in December and February (El- Ashwah,1970). Aly (1999) found that Balady orange juice contained 30.08 (mg/100ml) free amino nitrogen and total soluble solids 12.4%.

Mabesa (1982) indicated that the addition of sugar significantly contributed to the enhancement of the fruit flavor of individual fruit juices. The ratio between added sugar and acid affected the flavor intensity only up to a certain extent, in as much as excessive addition of either or both did not increase the flavor intensity.

This work aimed to study the effect of concentration by the traditional method by heating under vacuum and serum-pulp method on quality of sweet orange juices concentrates and the nectars prepared from these concentrates. Besides study effect of storage at ambient temperature for 2 months on the quality of these nectars.

## MATERIALS AND METHODS

### I- Materials

Sweet orange (*Citrus sinensis*). Oranges washed, cut into halves and the juice extracted mechanically. The obtained juice contained 12% (T.S.S.) and concentrated as follows:-

**1- The concentration by heating under vacuum (The traditional method):-**

The juice concentrated by means of an all glass apparatus using a vacuum pump at a temperature not exceeding 54° C under vacuum 28 mm Hg to 25% T.S.S.

**2- The concentration by serum-pulp method:-**

Sweet orange juice was separated into serum and pulp by centrifugation at 3000 r.p.m for 15 minutes in the Beckman centrifuge (Made in U.S.A.). After centrifugation, the obtained serum was concentrated in the aforementioned apparatus as in (1) to 35.12% T.S.S. The concentrated serum was mixed with the pulp to obtain sweet orange concentrate with 25% T.S.S.

**Preparation of nectars from the concentrates:-**

Nectars with 14,16 and 18% (T.S.S). was prepared from the reconstituted juices prepared from the concentrates, by using sucrose solution 50%, citric acid 0.3%, 0.2% Carboxy methyl cellulose and 0.1% Sodium benzoate. All nectars were filled in white glass bottles, closed tightly, pasteurized at 70°C for 20 minutes. Then cooled to ambient temperature (20± 2°C) and stored for 2 months and analyzed periodically at Intervals.

**2- Methods**

Moisture content, total soluble solids (T.S.S.), total titratable acidity, free amino nitrogen, and total sugars determined according to methods described in the A.O.A.C method (1990). Carotenoids were determined according to Wettstein (1957). Total sugars were determined colorimetrically according to the method described by Ranganna (1979). Sensory evaluation were performed according to the method of Larmond (1970). Ten panelists asked for their decision concerning color, aroma & taste and overall acceptability. The results were obtained as mean of triplicates. The scale from 1 to 10 used, however the value of 6 was considered as the limit of acceptability.

**RESULTS AND DISCUSSION**

The data given in Table (1) show effect of concentration processing on the chemical constituents of sweet orange juice. It could be clearly noticed that, the concentration by both of the traditional evaporation method and serum- pulp method caused a decrease in ascorbic acid content and carotenoids of sweet orange juice. The sweet orange juice concentrated by the traditional evaporation method contained less values of ascorbic acid and carotenoids compared to that concentrated by serum-pulp method. While the color index increased slightly in all concentrated sweet orange juice treatments. Total sugars decreased slightly by concentration by both of these methods.

Sweet orange juice contained 54.52 mg/100gm ascorbic which decreased to 32.13 and 38.07 mg/100 gm by using the traditional evaporation method and serum – pulp method respectively. The color index increased from 0.954 to 1.185 and 1.043 (optical Density at 420 n.m.) in treated juices by the traditional evaporation method and the serum-pulp method respectively. The increase in the

color index values after concentration may be due to Maillard reaction between reducing sugars and free amino nitrogen in all treatments. These results are in agreement with those reported by Abd-El Fadeel, (1981), Abd El-Hady (2002) and Mekkey *et al.* (2004).

**Table (1): Effect of concentration on the chemical components of reconstituted sweet orange juice.**

Chemical components	Concentration method	Fresh juice	Traditional method	Serum - pulp method
Total titratable acidity (%)		0.0 95	0.0 51	0.0 7 9
Ascorbic acid (mg / 100gm)		54.52	32.13	38.07
Carotenoids (mg /100 gm)		4.370	3.551	3.716
Total sugars (%)		10.48	10.12	10.19
Free amino nitrogen (mg /100 gm)		35.12	33.85	34.36
Color index (O.D. at 420 nm)		0.954	1.185	1.043

Data presented in Table (2) illustrate the effect of processing of nectars from the reconstituted sweet orange juices on the chemical constituents of these nectars. It could be observed that, nectars prepared from juices concentrated by serum-pulp method contained higher contents of ascorbic acid and carotenoids compared to that prepared from the traditional evaporation method. Besides ascorbic acid content decreased by preparation and pasteurization of sweet orange nectars. The decrease in ascorbic acid may be due to the oxidative degradation. The decrease in carotenoids caused by the pasteurization process may be due to non oxidative changes (Cis-trans isomerization or thermal degradation. These results are in agreement with those reported by Aczel (1973), El- Ashwah *et al.* (1974) Abd El - Latif (1995), and Ibrahim (2006).

**Table (2): Effect of processing on the chemical components of sweet orange nectars.**

Chemical components	Treatments Recons- tituted Juice	Traditional method (Nectars)			Serum pulp method (Nectars)			
		14 %	16 %	18 %	Juice	14 %	16 %	18 %
Total titratable acidity (%)	0.051	0.601	0.582	0.564	0.079	0.632	0.613	0.605
Ascorbic acid (mg / 100 gm)	32.13	27.36	23.67	20.15	38.07	33.53	30.75	27.59
Carotenoids (mg / 100 gm)	3.551	3.23	3.11	2.89	3.716	3.351	3.27	3.06
Total sugars (%)	10.12	13.58	15.59	17.45	10.19	13.63	15.62	17.47
Free amines nitrogen (mg / 100 gm)	33.85	31.82	29.16	28.65	34.36	32.43	30.25	29.81
Color index (O.D.at 420 n.m.)	1.285	1.250	1.282	1.340	1.043	1.063	1.080	1.113

From Table (3), it could be seen storage of nectars at ambient temperature for 2 months didn't cause sharp changes in the total titratable acidity while ascorbic acid content decreased slightly by storage. The color index increased slightly by storage of all nectars. These findings are in agreement with those observed by Nezam El-Din (19789), El-Atawy, (1982), Wong & Stanton, (1989) and Sapers (1993).

The same table revealed that carotenoids decreased slightly by storage of all nectars at ambient temperature for 2 months of all nectars.

**Table (3): Effect of storage of sweet orange juice nectars at ambient temperature (20+2°C) for 2 months on total titratable acidity, ascorbic acid and carotenoids.**

Treatments storage (Period / month)	Traditional method (Nectars)			Serum pulp method (Nectars)		
	14%	16 %	18 %	14 %	16 %	18 %
	<b>Total titratable acidity(%)</b>					
0	0.601	0.582	0.564	0.632	0.613	0.606
1	0.604	0.585	0.566	0.635	0.639	0.608
2	0.608	0.587	0.569	0.638	0.642	0.610
	<b>Ascorbic acid (mg /100 gm)</b>					
0	27.36	23.67	20.15	33.53	30.5	27.59
1	26.25	22.79	19.13	32.28	29.9	26.06
2	25.11	21.14	18.21	31.44	28.7	25.54
	<b>Carotenoids (mg /100 gm)</b>					
0	3.235	3.113	2.892	3.351	3.270	3.061
1	2.814	2.761	2.453	2.977	2.831	2.536
2	2.389	2.293	2.168	2.467	2.342	2.125

Data presented in Table (4) show the effect of storage of sweet orange nectars at ambient temperature for 2 months on total sugars, free amino nitrogen and color index. Total sugars decreased slightly by storage of all nectars. Sweet orange nectars with 14% total soluble solids contained higher contents of carotenoids compared to that with 16% and 18% total soluble solids.

Free amino nitrogen also decreased while color index increased slightly by storage. This increase may be due to Maillard reaction causing non-enzymatic browning. These results are in agreement with those reported by Sapers (1993) and Ibrahim, (2006).

Organoleptically, Table (5) nectars were prepared from reconstituted sweet orange juices of concentrates prepared by using the traditional method and serum-pulp method. It could be noticed that, nectars having 14% total soluble solids were prepared from reconstituted juices of sweet orange concentrated by

serum- pulp method being preferable and superior compared to that obtained from concentrates by the traditional method. So, it could be recommended that serum-pulp method is preferable for the concentration of sweet orange juice.

**Table (4): Effect of storage of sweet orange nectars, at ambient temperature (20+ 2°C) for 2 months on total sugars, free amino nitrogen and color index**

Treatments Period month	Traditional method (Nectars)			Serum pulp method (Nectars)		
	14	16	18	14	16	18
<b>Total sugars (%)</b>						
0	13.58	15.59	17.45	13.63	15.62	17.47
1	13.51	15.53	17.41	13.56	15.56	17.45
2	13.46	15.48	17.36	13.50	15.49	17.38
<b>Free amino nitrogen (mg /100gm)</b>						
0	31.82	29.016	28.65	32.43	30.25	29.81
1	31.73	28.41	28.53	23.30	30.11	29.73
2	31.58	28.33	28.46	23.18	29.86	29.67
<b>Color index (O.D at 420 n.m)</b>						
0	1.250	1.282	1.340	1.063	1.080	1.113
1	1.284	1.334	1.372	1.080	1.092	1.150
2	1.240	1.382	1.395	1.131	1.151	1.183

**Table (5): Sensory evaluation of sweet orange nectars prepared from reconstituted juices.**

Treatments	Score	Traditional method			Serum pulp method		
		14 %	16 %	18 %	14 %	16 %	18 %
Characteristics		(of total soluble solids)			(of total soluble solids)		
Color	10	9	8.5	7.1	9.5	9.0	7.5
Flavor and Taste	10	8.7	8.2	7.3	9.8	9.2	7.8
Overall acceptability	10	8.9	8.5	7.2	9.7	9.1	7.5

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### دراسات كيميائية و تكنولوجياية على إنتاج المركزات من عصير البرتقال السكرى

مصطفى حسيني مصطفى زيد

قسم بحوث تصنيع الحاصلات البستانية - معهد بحوث تكنولوجيا الأغذية - مركز البحوث الزراعية - ج.م.ع.

تهدف هذه الدراسة العمل إلى إنتاج المركزات من عصير البرتقال السكرى ودراسة تأثير التركيز والتخزين على بعض المكونات الكيميائية والخواص الحسية للعصير. تم استخدام طريقتين للتركيز وهما الطريقة المعتادة للتركيز باستخدام التسخين تحت تفريغ والطريقة الثانية هي طريق (السيرم - اللب). تم استخدام المركزات الناتجة في إنتاج النكتار على تركيزات مختلفة وهي ١٤ و ١٦ و ١٨% مواد صلبة كلية ذائبة. تم تحليل المركزات و النكتار من حيث بعض المكونات الكيميائية وإجراء الاختبارات الحسية والكيميائية على النكتار الناتج. أشارت النتائج إلى أن التركيز والتخزين قد أدوا إلى النقص في المحتوى من حمض الأسكوربيك والكاروتينات والسكريات الكلية وزيادة طفيفة في درجة مؤشر اللون. أوضحت النتائج أن التركيز بواسطة طريقة (سيرم - لب) أفضل من الطريقة المعتادة، كما أن النكتار الناتج من هذه الطريقة أفضل من الناتج بإعداده من المركزات المتحصل عليها بالطريقة المعتادة وأوضحت النتائج أيضا أن النكتار تركيز ١٤% وناتج بطريقة (السيرم - لب) أفضل من عينات النكتار الأخرى.