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SOME FUNDAMENTAL ASPECTS AFFECTING THE PROCESSING OF POMEGRANATE JUICE

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Abstract

This study was performed to asses the suitability of introducing pomegranate juice in glass bottles as well as to investigate the factors affecting its preservation. Mature Manfalooty pomegranate fruits were used in this study. the results revealed that addition of sucrose to the juice until the concentration of 20% total soluble solids and adjusting the pH value to 3.0 by citric acid were the most suitable procedures to prevent undesirable changes in anthocyanin content and browing reactions. Moreover, no pronounced changes in the pH values were noticed during storage of the procesed juice for up to ten weeks either at room temperature (25^{o}C) or at 4^{o}C. Finally, it could be recommended that storage of processed pomegrante juice at 4^{o}C was more suitable for preserving the juice qualities and when glass bottles were used as packaging materials.

INTRODUCTION

The pomegranate (Punica granatum) is a tropical and/or subtropical tree. It is also grown in recently reclaimed areas as it needs minimum requirements of care. The total annual production of pomegranate in Egypt was about 32478 tons produced from about 4582 feddaans (Anonymous, 1996). The extension of pomegranate plantation in Egypt is taking place especially in the southern part of Egypt. Mahgoub *et al* (1991) and Jagtiani *et al* (1992) reported that fruit juices were easily clarified by heating in a flash pasteurizer at 175^{o} - 180^{o}F followed by sudden colling, then settling for 24 hours.

Omran (1991) stated that pomegranate juice was found to contain 5.46% glucose, 6.14% fructose and no sucrose. On the other hand, total reducing sugars have been found to be 16.9% as mentioned by Tressler and Joslyn (1971). Addition of sugars to pomegranate juice is very necessary to get palatable and popular beverages since pomegranate juice is to tart to be used alone. Tressler and Joslyn (1971) demonstrated that pomegranate juice contained 1.6% organic acids as citric. Beveridge (1994) stated that it was advised to use gelating solution to precipitate tannin in pomegranate juice. Anthocyanins were found to be the main natural pigments of pomegranate juice (Shrede *et al*, 1992). The same author also added that anthocyanins were easily oxidized or reduced by heat, metals and enzymes. Furthermore, minimum heat caused a change in the red anthocyanins of many products. These changes could be attributed to the decrease in anthocyanins content which is mainly accompanied by an increase in brown color (Pedro and Moriss, 1990). They also added that certain metalic cation, enzymes, oxygen, ascorbic acid, high temperature and long storage period usually accelerate the loss of natural red anthocyanins and hence lowered the absorption at wavelength 520 n.m. Meanwhile the brown color formed due to anthocyanin oxidation, increased the absorption at 400-460 n.m. Nada (1975) came to a similar conclusion and added that storage at 4^{o}C lowered the loss in anthocyanins content in red juices compared to storage at 20^{o}C.

This study aims to produce popular delicious, and palatable pomegranate juice as well as to investigate the factors affecting its preservation.

MATERIALS AND METHODS

Materials:

Mature fresh pomegranate fruits (Manfalooty variety) used in this study were obtained from a private farm in Giza Governorate during November (1996). The fruits were cleaned, sorted, cut into halves and the seeds were eliminated to determine the percentages of seeds and peels in the fruits. The seeds were pressed and the juice was strained through the muslin cloth then collected to determine the juice percent in seeds. The extracted juice was subjected to different treatments as follows:

1. Addition of sucrose to three portions of the juice to raise the total soluble solids to 16, 18 and 20% respectively.

2. The pH values of three portions of the original juice were adjusted to 2, 2.7 and 3 respectively by adding citric acid.

3. The pH value of the original juice was adjusted to 3.7, 4.1 and 4.7 respectively by adding sodium carbonate.

4. The last portion of the juice was left for comparison as a control.

All the previous juuice treatments were treated with 1000 ppm sodium benzoate as a preservative then packed in 50 ml glass bottles. Samples were withdrawn for spectrophotometric analysis to study the effect of added sucrose on the color as well as the effect of pH adjustment on the degree of browning of the juice.

To study the effect of storage conditions on the juice quality another amount of seeds were pressed where the juice was extracted as mentioned before, the juice was adjuted to pH value 3.0 and to 20% total soluble soluble solids by adding citric acid and sucrose respectively. A solution of 1% gelatin was added (10 ml/kg juice) to precipitate tannins. Sodium benzoate (1000 p.p.m.) was also used as a preservative. All samples were clarified by heating in flash pasteurizer to 175-180°F, suddenly, cooled left to precipitate for 24 hours and filtered. The juice was bottled and pasteurized in hot water bath for 30 minutes at 175-180°F. Glass bottles were sealed, cooled and divided into two groups, the first was stored at 4°C while the second was stored at room temperature (25°C).

Methods

Reducing and total sugars were determined according to the A.O.A.C. (1990). The pH value was measured at 25°C using (Fisher Accument pH meter, Model 825 M.P.)

Color measurement

An ultraviolet spectrophotometer "Unicam SP. 1800" was used for the measurement of color intensity where absorbance was measured at 525 nm (optimum wavelength which gives maximum absorption of anthocyanin pigments (Sallam *et al*, 1996) after extraction of anthocyanin was applied by Fuleki and Francis (1968). Higher absorbance indicated better quality of juice. Browning was measured according to Hendel *et al* (1955) at 420 nm. using the same spectrophotometer, higher absorbance indicated lower quality of the juice.

Tannins were determined according to Winton and Winton (1958). Total soluble solids (T.S.S.) were determined using Carl Zeiss refractometer.

Organoleptic tests

The color and flavor of pomegranate juice treatments were evaluated by 10 panelists directly after processing and after storage for ten weeks at both room temperature (25°C) and 4°C.

Statistical analysis

For presentation of palatability of color and flavor of every treatment the following scale was applied to all samples for color and flavor:

Excellent : (10) Very good : (8-9)

Palatable : (6-7) Un palatable : (0-5)

These proportions were scored on a scale from 1 to 10 according to Larmond (1970).

RESULTS AND DISCUSSION

Pomegranate seeds represented about 65% of the fruits used in this study. Juice represented about 75% of pomegranate seeds and 51% of the pomegranate fruit these results agree with those repored by Wang and Francis (1975).

1. Effect of total soluble solids on juice color

From data in Table 1, it can be observed that the higher the total soluble solids in the juice the higher the absorbance at 525 nm [optimum wavelength giving maximum anthocyanin absorption (Sallam et al, 1996). As a result of adding sucrose to raise the soluble solids in pomegranate juice and simultaneous increase of osmotic pressure, the anthocyanin pigments were leached out with the cell sap. Accordingly, better and more regular dispersion of color through pomegranate juice will be achieved, possibly followed by increasing color intensity (Labib, 1992).

Table 1. Effect of total soluble solids (adjsted with) (sucrose) on pomegranate juice color abssorbance at 525 nm.

Treatment No*	T.S.S. %	Absorbance at 523 nm
Control	14	0.320
1	16	0.375
2	18	0.420
3	20	0.470

* 1 : Pomegrantate juice with total soluble solids 16%.
2 : Pomegranate juice with total soluble solids 18%.
3 : Pomegranate juice with total soluble solids 20%.

2. Effect of pH value on juice browning

From Table 2, it can be seen that the pH values had an effect on juice browning, as absorbance at 420 nm. increased with the increase in pH value. From the same results, it could also be noticed that the minimum browning occurred at pH 3.0 Reynolds (1985) and Abd El-Salam (1991) reported that the nonenzymatic browning which took place as a result of the reacion between organic acids and reducing sugars in fruit juices caused pronounced losses in total acidity of these juices, hence lowering the pH value of the juice by the addition of citric acid will decrease the browning rate. Meanwhile increasing pH value of the initial juice by addition of the sodium bicarbonate will be accompanied by a reverse effect to what mentioned before.

Table 2. Effect of pH value adjustment on pomegranate juice browning (absorbance at 420 nm).

Treatment No*	pH value	Browning at 420 nm
4	2.0	0.270
5	2.7	0.265
6	3.0	0.255
Control	3.3	0.285
7	3.7	0.330
8	4.1	0.375
9	4.7	0.415

* 4 : Pomegrantate juice with pH value adjusted to 2.
5 : Pomegranate juice with pH value adjusted to 2.7
6 : Pomegranate juice with pH value adjusted to 3.0
7 : Pomegranate juice with pH value adjusted to 3.7
8 : Pomegranate juice with pH value adjusted to 4.1
5 : Pomegranate juice with pH value adjusted to 4.7

3. Effect of pasteurization, pH value and total soluble solids adjustment on juice quality

Results in Table 3 indicate that pasteurization of pomegranate juice previously adjusted to pH 3.0 and 20% total soluble solids was accompanied by an increment in both reducing sugars and browning. This could be attributed to the inversion of sucrose into reducing sugars. On the other hand, increment of browning may be due to the effect of heat treatment which usually activates browning reactions. From the same table, it seems that the amount of reducing sugars interacting in the browning system was lower than the amount of these sugars produced by inversion. This caused the observed increment in reducing sugars after pasteurization (Haredy, 1992).

Table 3. Effect of pasteurization on pomegranate juice components.

Treatments	Reducing sugars %	Total sugars %	pH value	Color Absorbance at 525 nm	Browning Absorbance at 420 nm	Tannin %
Before Pasteurtzation	13.25	17.90	3.00	0.385	0.355	0.1048
After Pasteurtzation	16.85	17.72	2.95	0.395	0.315	0.1052

4. Effect of storage conditions on pomegranate juice quality

From results in Table 4, it could be observed that reducing sugars seemed to decrease gradually during storage. The rate of decrease was higher in samples stored at room temperature (25°C) than those stored at 4°C. However, this decrease indicate that the amount of inverted sugars would not be enough to substitute all losses in the reducing sugars reacting in the browning system at the end of storage (being in agreement with Hassan, 1995). From the same table, it could be cleary noticed that decrements in reducing sugars in pomegranate juice during storage for ten weeks were accompanied by simultaneous increments in browning reactions during the same period of storage. No pronounced increase in pH values of promegranate juice was detected during storage for ten weeks especially at 4°C. From the same table, it could also be observed that color intensity decreased gradually during storage ascertaining that storage temperature was a definite deteriorative factor on the color where the rate of decrement in color intensity was higher in samples stored at room temperature (25°C) compared to those at 4°C. These results are in agreement with those of (El-Manawaty, 1971).

Concerning the effect of storage conditions of pomegranate juice on browning, data given in Table 4 reveal low absorbance readings at 420 nm. in samples stored at 4°C indicating reductions of browning reactions compared to those stored at room temperature.

Results also indicate that tannins were found to decrease gradually during storage, showing that storage temperature affect, to a great extent, the rate of reduction of this component. This decrease may be due to the oxidation of some phenols in the juice during browning reactions. The rate of this oxidation would be lower during storage at low temperature (4°C) compared to the occurring at room temperature. Same conclosions were reported by (Nezam El-Din, 1988).

Table 4. Effect of storage conditions on pomegranate juice components.

Storage in weeks	Storage Temp.	Red. Sugars %	Total Sugars %	pH value	Color at 525 nm	Browning at 420 nm	Tannin %
1		16.70	17.65	2.95	0.360	0.410	0.1040
2		16.50	17.45	2.95	0.350	0.421	0.1016
3		16.42	17.32	2.90	0.340	0.431	0.998
4		16.30	17.21	2.90	0.305	0.481	0.975
5	4°C	15.92	17.08	2.85	0.290	0.498	0.951
6		15.42	16.92	2.80	0.280	0.510	0.914
7		14.88	16.83	2.80	0.250	0.520	0.890
8		14.07	16.75	2.80	0.240	0.535	0.870
9		13.91	16.61	2.80	0.232	0.548	0.850
10		13.28	16.51	2.80	0.210	0.560	0.825
1		0.16.50	16.92	2.95	0.340	0.415	0.1032
2		0.16.42	16.81	2.95	0.325	0.430	0.1024
3		0.15.81	16.75	2.90	0.290	0.470	0.1011
4		0.15.41	16.38	2.85	0.275	0.485	0.984
5	25°C	0.14.71	16.11	2.80	0.245	0.500	0.952
6		0.14.07	15.98	2.75	0.220	0.520	0.994
7		0.13.28	15.29	2.75	0.210	0.525	0.936
8		0.12.21	14.85	2.75	0.190	0.530	0.920
9		0.11.80	14.70	2.75	0.175	0.550	0.890
10		0.10.95	14.21	2.75	0.165	0.560	0.860

Table 5. Statistical analysis of organoleptic evaluation of different pomegranate juice treatments.

Treatment No*	Organoleptic evaluation		
	Color	Odor	Taste
Conrol	7.0	7.0	7.0
1	7.5	8.0	7.0
2	8.0	7.5	7.5
3	9.0	9.0	9.0
4	6.5	7.0	7.5
5	7.5	6.5	6.5
6	9.0	8.5	8
Control	7.0	7.5	7.0
8	6.5	6.5	7.0
9	6.0	6.0	6.5
10	5.5	5.5	6.0

* See Tables (1 and 2).

Statistical analysis of organoleptic evaluation

The data concerning statistical analysis of organoleptic evaluation for color and flavor of all pomegrate juice treatments are shown in Tables (5 and 6). From Table 5, it could be stated that pomegranate juice adjusted to 20% total soluble solids by sucrose with pH value 3.0 had the highest palatability compared to all other pomegranate juice treatments. As for the effect of storage, the data given in Table 6 reveal that pomegranate juice treatments retained their popular quality factors when stored at 4°C as compared to room temperature indicating that the low temperature was more beneficial in preventing discoloration and browning. All these results could be confirmed by the data showing chemical analysis supporting the organoleptic evaluation.

Finally, it could be recommended that producing pomegranate juice with 20% total soluble solids and pH value 3.0 gave a popular, delicious and palatable juice which could be preserved preferably at 4°C against undesirable discoloration and chemical alteration of the juice components during storage for ten weeks. This study led to facilitate the utilization of pomegranate juice in that palatable popular untraditional and easily consumed form.

Table 6. Statistical analysis of organoleptic evaluation of pomegranate juice (20% T.S.S.) and pH value 3 after storage at 4°C and 25°C for ten weeks.

Storage Temperature	Color	Odor	Taste
4°C	8.5	7.5	7
25°C	7	6.5	6

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بعض الضوابط الأساسية التي تؤثر علي تصنيع عصير الرمان

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أجري هذا البحث بهدف إيجاد طريقة مثلي لإنتاج عصير الرمان بالإضافة إلي دراسة العوامل المختلفة المؤثرة علي جودة هذا العصير عند حفظه في زجاجات. وقد أكدت النتائج المتحصل عليها إلي أن إضافة السكروز إلي عصير الرمان حتي تصل نسبة المواد الصلبة الذائبة به إلي ٢٠٪ وكذلك إضافة حمض الستريك لضبط الـ pH علي ٣ قد أفاد في منع تدهور اللون الأحمر الخاص به ومنع زيادة تكون اللون البني. كما لوحظ من النتائج أيضا أن تخزين عصير الرمان السابق ذكره (٢٠٪ مواد صلبة ذائبة، pH ٣) علي درجة حرارة ٥٤ م ساعد في المحافظة علي خصائص الجودة لهذا العصير بصورة أفضل من حفظه علي درجة حرارة الغرفة (٥٢٥ م) لمدة عشر أسابيع.