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CITRUS BLEND JUICES TO IMPROVE THE FLAVOR THROUGH MINIMIZING BITTER COMPOUNDS

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ABSTRACT

The bitterness of grapefruit juice was overcomed by blending with other citrus juices such as balady Valencia suckary and sweet sour orange . Through blending TSS, ascorbic acid total pectic substance were unchanged, whereas total acidity, naringin and limonin were decreased. Meanwhile , total sugar, total carotenoids increased. Acordingly the sensory properties of the new blends were satisfactory. Organleptic scores were highest for blend No.4 and No.5 due to decreasing the contents of both naringin and Limonin to a level, which could be accepted by the local consumers and in the same time residues would be acted as a potent antioxidants.

INTRODUCTION

Naringin the main flavonoid constituents of grapefruit and sour orange is responsible for bitter flavor in processed citrus juices. Also, limonin and naringin components cause bitterness and acidity, however both gradually decrease with maturities. Reducing bitterness and increasing both ascorbic and carotene contents thought the blending process of different citrus juices was thought to be effective in increasing the consumer's acceptance. Noomhorm and Kasemsuksakul (1992) stated that Limonin and naringin components causing bitterness and acidity. Higher limonin contents were observed in tangerine fruits harvested early in the season, whereas naringin contents gradually decreased upon reaching maturity . Tsen and Yu (1991) found that naringin and limonin are two bitter components of citrus products such as grapefruit (*Citrus Paradisi Macf*) juice.

To improve juice taste, naringin can be removed by hydrolysis with immobilized naringinase (from *Penicillium sp.*) and limonin by adsorption capacity to cellulose mono acetate gel beads. Cellulose triacetate fibers show a similar limonin adsorption capacity as cellulose mono acetate gel beads.

When naringinase was entrapped in such fibers, an enzyme colomn was made, which could remove both bitter components simultaneously. Fellers (1989) studied the effect of limonin in grapefruit juice on sensory flavor quality.

Using different methods to debitter grapefruit juices may affect the sugars acids and vitamins components of the treated juices. Beside naringin showed antioxidant activity (Miyake and Shibamoto, 1997), accordingly, would be beneficial to remain a low percent of naringin rather than to remove it totally. Therefore, it was thought to blend different citrus juices (i.e. orange, sweet sour orange and grapefruit juices) in order to improve the nutritional value of the new blends and to decrease the bitterness of the juice to be highly accepted by local consumers.

MATERIALS AND METHODS

Two varieties of grapefruit [Marsh seedless (White) and Foster (Pink)], Sukary orange, Balady orange and Valencia orange were brought from private orchard in Kaliobiah governorate in 2003 and 2004, respectively at their optimum matureties, wheras sweet sour oranges (sweet variety) were picked at top maturity from the experimental orchard of the Horticultural Research Institute at Giza in the same above mentioned years . Off sized, decayed and mechanically injured fruits were sorted out. The juices were extracted by a hand reamer pasteurized at 90°C for one minute cooled at 4° c and blended as recorded in table 1:

Table (1) Percentages of citrus juices blends

Citrus juices	1	2	3	4	5
Grapefruit (March Seedless)	25	25	25	25	-
Grapefruit (Foster)	25	25	25	-	25
Balady orange	25	-	-	-	-
Valancia orange	-	25	-	-	-
Sukary orange	-	-	25	50	50
Sweet sour orange	25	25	25	25	25

All citrus juice blends were evaluated for flavor on a 10 point hedonic scale by an experienced taste panel according to , Snedecor and Cochran (1973). Total soluble solids, total acidity (as anhydrous citric acid), ascorbic acid using (2.6 dichlorophenol indophenol method), reducing and total sugars and total pectic substances and carotenoids were determined according to AOAC (1990).

Limonin content was measured according to methods of Scot and Veldhuis (1966).

Naringin was determind according to the Davis method modified by IToo and Kuwabata (1988).

RESULT AND DISCUSSION

Grapefruit plantation increased in the last decade due to expansion in both local consumption and exportation. However, because of their higher acidity and bitterness grapefruit juices are not acceptable by local consumers. The bitterness of citrus juices was related to both limonin and naringin . Sweet orange including balady, valincia and suckary oranges are almost free from naringin, but still have a moderate percent of limonin. Many trials have been carried out to remove or even to decrease both limonin and naringin (Noomhorm and Kasemsuksakul, 1992; Tsen and Yu, 1991 and IToo and Kuwabata 1988). However, a low level of both naringin and/or limonin would be beneficial, since they have potent antioxidants, which could retard the effect of free radicals and decrease their lethal compact to health (Miyake and Shibamoto, 1997) .

The main components of different citrus fruits are represented in Table (2). These results indicate that both naringin and limonin were found in both grapefruits and sour orange in relatively high percentages. However, naringin could not be detected in balady, Valencia, and suckary juices these results are in agreement with results of Russell *et al.* (1987).

Meanwhile , limonin was found in the aforementioned juices at low level, since its contents ranged between 2.7 to 4.5 gm / 100 ml juices. These results are in line with results obtained by El Hamzy (1988).

Moreover, total acidity was relatively low in sweet orange juices, since it ranged from 0.32 % in suckary to 0.78 % in Valencia. In the same time , high percent of acidity was observed in both grapefruit varieties . These results are in agreement with results obtained by Rizk *et al.* (1978). Ascorbic acid contents, in citrus juices were relatively high especially in sweet sour orange since it reached 68.9 mg/100 ml juice. These results are in partial agreement with results obtained by Nagy (1980) and Habashy (2002).

Total cartenoids were almost always the same in all citrus juices, expect that of grapefruit juices which showed low level (0.19 mg/ 100 ml juices) in Foster (pink) variety, but it could not be detected in Marsh seedless (white) variety.

Table (2) Chemical constituents of different citrus juices.

Constituents	Orange Juices			Grapefruit		Sweet Sour
	Balady	Valencia	Sukary	White	Red	orange
Juice %	48.70	41.10	42.90	43.10	44.20	33.90
T.S.S	11.50	10.90	11.10	11.20	11.50	12.70
Total acidity [a]	0.67	0.78	0.32	1.20	1.20	0.162
Ascorbic Acid [b]	54.40	48.60	44.0	38.30	40.60	68.90
Reducing Sugar	5.10	5.20	5.50	4.10	4.30	7.70
Non Reducing sugar	5.60	5.20	4.30	3.60	3.40	4.20
Total sugar	10.70	10.40	9.80	7.70	7.70	11.90
Total Carotene [b]	0.26	0.23	0.22	ND	0.19	0.28
Total pectin	48.70	51.20	49.30	51.30	49.80	48.90
Naringin [b]	ND	ND	ND	46.00	41.00	36.00
Limonin [6]	4.50	3.50	2.90	6.20	6.30	4.20

a) % anhydrous citric acid b) mgs / 100 ml juice ND Not detected

Accordingly, it was thought to keep both limonin and naringin at low level through blending the citrus juices rather than to remove them. Chemical constituents of different citrus juice blends are presented in Table (3). Results indicate that blends 1, 2 and 3 still had a relatively higher level of both naringen and lemonin, but total acidity decreased to become in an acceptable range.

Table (3) Chemical constituents of different citrus blends.

Constituents	1	2	3	4	5
T.S.S	11.71	11.60	11.65	11.53	11.60
Total acidity	0.81	0.84	0.72	0.503	0.49
Ascorbic acid	51.91	50.50	49.42	48.81	49.38
Reducing sugar	5.26	5.28	5.31	5.71	5.76
Non-Red sugar	4.21	4.13	3.85	4.29	4.30
Total sugar	9.47	9.41	9.16	10.00	10.06
Total carotene	0.22	0.21	0.22	0.18	0.33
Total pectin	49.61	50.21	49.81	49.53	49.18
Naringin	31.13	30.95	31.09	19.50	18.25
Lemonin	5.41	5.45	5.33	3.90	4.00
Acid / sugar ratio	1:14.6	1:13.9	1:16.2	1:22.9	1:23.6

However, both carotene and ascorbic acid were almost always the same.

Meanwhile , blends 4 and 5 had a distinctive low level of both naringin (18.25 to 19.5mg/100ml juice) and limonin (3.9 to 4.0mg/100 juice) . Total acidity decreased but total sugars increased . Total soluble solids and ascorbic acid remained at the same level within the other blends. However, total carotenoids increased reaching to 0.33 mg / 100 ml juice in blend (5) but decreased reaching to 0.18 mg/100 ml juice in blend (4). It could be concluded that blend (5) was the best blend among all tested blends. Sensory aspects however are of almost importance since they affect directly the consumer acceptance.

Accordingly, an organoliptic panel test was carried out. Results of such panel test were tabulated in Table (4). These results indicate that both blends 4 and 5 had higher organoleptic scores for color taste, aroma and overall acceptability when compared to other blends. Also, significant differences could be observed at level 0.05 between both blends 4 and 5 and the other blends but no significant differences could be detected between both blends Table (4). Conclusively, the best of all blends under study was that of blend No (5) from the nutritional as well as organoleptical point of view.

Table (4) Organoleptic scores for different citrus blends.

Treatments	Color	Taste	Aroma	Overall acceptability
Blend No $_1$	6.389 b	5.944 cd	6.333 cd	6.056 b
Blend No $_2$	5.889 c	5.500 d	5.778 cd	5.944 b
Blend No $_3$	5.389 d	6.222de	5.611 d	5.944 b
Blend No $_4$	7.111a	6.667ab	7.000 a	7.222 a
Blend No $_5$	7.556 a	7.167 a	6.500 ab	7.000 a
L.S.D. (0.05)	0.4710	0.6015	0.3604	0.4710

Values followed by the same letter are not significantly different (p>0.05).

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خلطات لعصائر الموالح لتحسين الطعم واللون ولتقليل المواد المسببة للمرارة

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أمكن التغلب على المرارة المتواجدة في عصائر الجريب فروت عن طريق خلطها مع عصائر لموالح أخرى مثل البرتقال البلدي، الفالنشيا، السكري، والنارنج الحلـو. ولـم يحدث تغير في الجوامد الكلية الذائبة، حمض الأسكوربيك، البكتين الكلي بينما حدث نقص في الحموضة الكلية ، النارينجين، الليمونين وزيادة في السكر الكلي، والكاروتينات الكلية. وكانت نتيجة الإختبارات الحسية لهذه الخلطات الحديثة مرضية.

وقد حصل كلا من المخلوط رقم(٤) والمخلوط رقم(٥) على أعلى الدرجات الحسية نتيجة إنخفاض كل من النارنجين والليمونين إلى المستوى المقبول لدى المستهلكين فى حين أن المتبقى منهما يعملا معا كمضادات للأكسدة .