J. Agric. Sci. Mansoura Univ., 28 (9): 6807 - 6819, 2003

MANUFACTURING OF HEALTHY TRADITIONAL AND LOW CALORIE CITRUS JUICES BLENDS AND THEIR KINETIC STABILITY

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ABSTARCT

In spite of the healthy benefits of grapefruit, it is still seldom utilized in Egypt due to the bitter taste. Therefore, various attempts were carried out to overcome the bitter taste through blending the grapefruit juice with some more favorite and delicious juices. In the current study, grapefruit, balady, sukkary orange, and mandarin juices were used to prepare healthy, delicious, highly palatable and preferable blends. Other low calorie blends were also prepared to be used by the obese and diabetes by replacing the stevia compounds instead of sugar addition. Both of the traditional and low calorie blends were periodically studied during cold storage in a refrigerator.

The sensory evaluation showed that the balady orange juice addition overcame the bitterness taste of grapefruit juice. Most of the tested blends seemed to be stable over six months of cold storage. A specified amount of stevia compounds was selected by the panelists to prepare the low calorie juice blend. Their kinetic stabilities were studied in details. It was found that most of the stevia compounds seemed to be stable in both of sukkary-balady and grapefruit-balady blends.
Key words: Citrus juices, traditional and low calorie, kinetic, stability, cold storage.

INTRODUCTION

It is well established that citrus fruits are characterized for their high contents of different important vitamins and minerals which play a great role in human nutrition. Orange juice has been the favorite fruit juice consumed in both worldwide and the United States (Shaw, 1994), primarily because of the high palatability of orange flavor. In Egypt the annual production and cultivation area reached up to 2401054 tons and 342674 feddans, respectively (Anonymous, 2001).

In recent years, consumer awareness about the health promoting ability of bitter flavonoids such as naringin has generated keen interest in processing of indigenously available fruits such as grapefruit, not only for local consumption but also for the export market. Naringenin has also been shown to have a partial suppressive effect on adhesive glucan formation by *streptococcus muttans* on human dental plaque. Further, naringin or naringenin could be administered in a pharmaceutical composition, a food composition or as a beverage. Some bitterness in grapefruit products is acceptable to consumers, but excessive bitterness is one of the major consumer objections to such products (Prakash *et al.,* 2002).

El-Saidawy (1997) stated that all the citrus species differ in their organoleptic properties of course, this difference is due to their different chemical and physical characteristics. Therefore, juice blending is a favorable technique which is almost adopted to improve both flavor and nutritional aspects.

Sugar substitution is an important factor in low-calorie foods manufacturing. Studies with adults, as well as infants, have demonstrated that a preference for sweetness in foods is “an unlearned preference present from birth”. Consumers select low-calorie foods sweetened with sugar substitutes for different reasons, primarily to decrease or control calorie intake and consequently body weight and to aid control of certain health/medical status such as diabetes and hyperoglycemia. An additional benefit of the available sugar substitutes in low-calorie foods is their noncariogenicity or cariostatic properties. On the other hand, the high sugar consumption continues to be a risk factor for the development of caries and may reduce the nutrient density of the diet as well as increase the risk of vitamins and minerals deficiency, especially in low energy consumers.

Stevia rebaudiana contains six diterpene glycosides with an intense sweet taste, the most abundant and important being stevioside, with a sweetening power 150- 300 times that of sucrose, the second most abundant is rebaudioside A, which is 400 times sweeter than sucrose. The rest components of minor concern are rebaudioside C and dulcoside A, and at trace levels, rebaudioside E and D (Kolb *et al*., 2001). The stability of stevioside to heat and low pH makes it a suitable noncaloric sweetener for cooked and baked foods and for beverages. It may also be used in dietetic food and by diabetes patients (Ikan, 1992). Stevioside is used in Japan in soft drinks, candy, and chewing gum. It has, also, been used in many sugar-free or diabetic foods either alone or in combination with other non nutritive sweeteners. Stevia has been widely used in dietetic and therapeutic foods, and currently consumption of Stevia based foods amounts reached to > 100000 tons/year. Stevia leaves are said to be 300 times sweeter than sucrose, with this sweetness being derived from the presence of diterpene glycosides in the leaves (Lisitsin and Kovalev, 2000). Steviosid and other diterpene glycosides (rebudiside A, Dulcosides A and B), were isolated from the leaves of *stevia rebaudiana bertoni* by Ishima *et al*., (1978) and were sensory evaluated. These compounds equal 240 times sweeter than sucrose solution (2%), rebaudioside A had a higher general acceptability than stevioside and was sweeter than sucrose by about 200-300%. Dulcosides A and B were similar to reboudioside A in taste quality and were 50-60% sweeter than 1% sucrose solution (Kamal, 2002).

Finally, this study was performed to overcome the grapefruit bitter taste through blending grapefruit with other citrus juices namely, balady, sukkary oranges and mandarin. Besides, producing new untraditional blends with high balanced nutritive value and high palatability among different consumers. The aim is also extended to prepare low calorie blends by substituting the added sugar with stevioside compounds.

MATERIALS AND METHODS

Materials :

Citrus fruits (grapefruit, balady as well as sukkary orange and mandarin), which had been picked at the proper stage of maturity, were obtained from Fayoum governorate, the experimental orchard of the Horticultural Research Institute at Giza in the season of 2000. Stevioside compounds were obtained as gifts from International Stevia Co. for Agricultural and Industrial Projects, Cairo, Egypt.

Methods:

1- preparation of blends.

Citrus juices were extracted by a hand cone-pressure reamer. Mixtures were prepared from every two or three sorts of juices by blending them together for 2 minutes as the proposed mixing ratios. The total soluble solids (TSS) of every suggested juice blend were raised to 16% by adding sucrose, filled into glass bottles, pasteurized at 90°C for one minute and finally cooled at 4°C (Rizk *et al.,* 1978) and stored at a refrigerator (5±1°C) for periodically studying their kinetic stability along 6 months. For covering all these blends, 14 groups of Juice(G refer to grapefruit, B for balady orange, S for sukkary orange and M for mandarin) mixtures were prepared as indicated in Table (2). The low calorie blends were prepared by substituting the traditional sweetener (sucrose) by different amounts of stevioside compounds (from 0.025 up to 0.125 g and 1g/100g blend). The substitution was carried out in two selected blends to estimate the effect of stevioside compounds on the lowest and the most favorable blends. All such blends were sensory evaluated with respect to their taste and color attributes. Such evaluation was carried out on the individual two blends group and on both together.

2- Analytical methods:

Total acidity, ascorbic acid, total soluble solids (TSS), total, reducing and non reducing sugars (according to Somogi method), and pH value were determined according to AOAC (1995). Total carotenoids were determined as described by Ranganna (1977). Sugars profile (glucose, fructose and sucrose) was fractionated and determined according to the method of Oefner and Chromatog (1985) by using a High-performance liquid chromatography (HPLC, HP 1050) instrument, connected to Aminex HPX-87H column, 300x 7.8 mm column, H_2O fluent with a flow rate of 0.6 ml/min, at 85°C column temperature and the detector was RI (16X). The stevioside compounds were separated, identificated and determinated by HPLC within six weeks of cold storage (5°±1°C) according to the method described by Kolb *et al*., (2001). [HPLC, (HEWLETT PACKARD 1100), Lichrosoly RP-18 (20 µm) column , with methanol-5 mM NaOH (13:7) as mobile phase. Degasser (G 1322A), Quateknary pump (G1331A), Auto sampler (G1311A) and detection by variable wavelength detector (G1316A) at 210 nm] was used for the determination of glycosidic sweeteners in stevia compounds.

3- Sensory evaluation:

The sensory attributes (taste and color) evaluation was carried out by 20 panelists from the Food Technology Research Institute according to the method of Lindley *et al*. (1993).

4- Statistical Analysis :

The results were analyzed by the analysis of variance (ANOVA) using the General Linear Model (GLM) procedure by statistical analysis system program (SAS) according to Steel and Torrie(1980). Specific differences between types and mixing proportions of juice were determined by least significant differences (LSD) for each individual attribute at P<0.05. The resulted data were statistically [correlation coefficient (R) and the other kinetic parameters, Intercept (A) and change/period (B)] analyzed by (SAS) program according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

Fruits and vegetables are essential parts of the Mediterranean diet, and these products are important for their contribution to the prevention of chronic and acute diseases. Among fruit products orange juice must be highlighted, as this product is a major source of flavonoid intake in the diet of developed countries (Angel *et al*., 2001). Therefore it is of importance to incorporate such juice in our drinking habit. Data presented in Table (1) show that the tested raw materials possessed detectable amounts of TSS, sugars and ascorbic acid (Vit C). Such results are agreed with those found by El-Sayed (1999). Meanable pH values, acidity and moisture contents seemed to be the same in the tested juices.

Table (1): Chemical compositions of the raw materials.

Raw material	Moisture %	TSS %	Reducing sugars %	Non reducing sugars%	Total sugars%	pH value	Total acidity*	Ascorbic acid (mg/100g)
Mandarin	88.47	11.25	4.49	4.05	8.54	3.98	0.88	37.12
Balady orange	88.90	12.13	4.78	4.40	9.18	3.68	1.29	56.30
Soukkary orange	87.58	13.97	6.01	4.47	10.48	4.01	1.00	54.88
Grapefruit	89.02	11.20	3.86	2.60	6.46	3.12	1.09	39.01

***As citric acid %.**

The sensory evaluation of food products is of primary importance, since it reflects the consumer preference for a respective food product. Therefore, it is necessary to conduct such a test for the sensory aspects of the resulted food before marketing to avoid any possible consumer undesirable properties that could be happened in the market. The color and taste estimation of consumers to a respective food material, will give a combined criteria for the organoleptic parameters.

Table (2): The suggested blending ratios and their sensory evaluation.

Type and blending ratio	Taste	Color
S+B 1:1	5.68^{de}	6.60^{abc}

S+B 1:2	5.26^{de}	6.45^{bc}
S+B 1:3	7.66^{a}	7.16^{abc}
G+B 1:1	6.30^{bcd}	7.03^{abc}
G+B 2:1	7.40^{ab}	7.53^{ab}
G+B 3:1	6.98^{abc}	6.83^{abc}
S+M 1:1	4.90^{e}	6.25^{c}
S+M 1:2	4.92^{e}	6.34^{c}
S+M 1:3	7.25^{ab}	7.58^{ab}
G+M 2:1	5.83^{cde}	6.83^{abc}
G+M 3:1	5.90^{cde}	6.93^{abc}
G+M 1:4	7.05^{abc}	7.63^{a}
B+S+M 1:1:1	5.32^{de}	6.32^{c}
B+S+M 2:1:1	4.63^{e}	6.29^{c}

Each value, within the same column, followed with the same letter is not significant different at 0.05 level.

Data presented in Table (2) show the taste and color attributes evaluation of the tested blends, since it is the critical attributes for the consumer acceptability for such products. With respect to the taste attribute, it could be observed that sukkary orange juice was scored the highest value when mixed with balady orange or mandarin juice (in a ratio 1:3 w/w for both blends). These results may be due to the popular and palatable taste of mandarin. It was also found that the same mixing ratio, in case of sukkary and balady juices, was the best. Consequently, the best favorable blends were sukkary and orange balady juices (S+B) in a ratio of 1:3, sukkary and mandarin (S+M) juices in a ratio of 1:3, grapefruit and balady (G+B) orange juices in a ratio of 1:2, grapefruit and mandarin (G+M) juices in a ratio of 1:4. These results are in agreement with those report by El-Saidawy (1997).

Statistical differentiation between the estimated color value of the studied blends could be observed in Table (2). It could be noticed that, addition of mandarin juice to grapefruit and sukkary juices in the ratio of 4 to 1 and 3 to 1 (w/w), respectively, improved the estimated color of these products than the individual juice, especially in case of grapefruit juices(Rizk *et al*., 1985).

As a result of the significant differences among these four blends and all the other blends, these four blends were selected as the most favorite blends and were stored at (5 ± 1^0C) up to 6 months.

Francis (1995) , stated that carotenoids play a very important role as antioxidants for protection of health against different diseases such as cancer, cardiovascular and eye diseases. Data presented in Table (3) revealed that all the four blends significantly differed in carotenoids contents in the fresh samples than their corresponding ones. It may be due to the effect of pasteurization process which led to a detectable decomposition (Hamed *et al.*, 2000). The same trend could be noticed as a result of the cold storage period. Hamed, *et al*. (2000), stated that the decomposition of carotenoids at high temperatures may be due to the free radical attack on the long chain of the unsaturated carotenoids molecule, followed by splitting the carotenoid molecule forming different aldhydes which import no color and hence, their coloring value is lost.

On the other hand, there was a highly correlation coefficient (R) between the storage period (0 to 6 months) and the carotenoids content. This suggested that carotenoids content could be considered a good indicator to predict the storage period by applying the equation parameters (intercept A, and slope or change, b, per time unit). The highest degradation could be noticed in the S+B blend than all the other blends (the decrement change slope was $1.31x10^{-2}$ mg carotenoids/month).

Table (3) showed also that there was no significant difference between the fresh samples of all the tested blends and those after pasteurization process with respect to their acidity and pH values. It could be also noticed the reverse relation between the acidity and pH value of any specified blend. (Hamed, 2000). This finding is obvious by checking the sign prior the R parameter (it was negative in case of acidity and positive in case of pH). The significant difference was noticed only between the values of specified test at the start point of storage and the corresponding value of the same test at the end of the storage period.

Total soluble solids of fruits comprises primarily soluble sugars, acids and other water soluble compounds. It could be found that there was a significantly increment in TSS of the tested blends as a result of the pasteurizing process. The same trend was noticed during the storage period. The highest increment in TSS was found in case of S+M and G+B blends. Each value, within the same column, followed with the same letter is not significant different at 0.05 level.

Ascorbic acid is effective in prevention and treatment of arterosclerosis and its complications. Citrus fruits have a high content of ascorbic acid.All components of grapefruit and oranges that possess antioxidant properties were studied and compared with their total radical-trapping antioxidative potential Gorinstein *et al*. (2001). The obtained results in Table (4) showed that ascorbic acid decreased after pasteurization and during storage for 6 months (at 5 ± 1^0C). The decrease in ascorbic acid could be due to the partial destruction caused by heat of pasteurization treatments. Ascorbic acid is generally considered to act as an antioxidant though, like other antioxidants, it may have prooxidative effects under certain conditions. Most studies in humans have observed a reduction of oxidative damage rather than an increase (Gerster, 1999).

As it is well established that ascorbic acid is very sensitive constituent to high heat temperature, it could represent the quality of the final product. These results are in accordance with the results obtained by Abd El-Fadeel (1978). It could be also found that the highest decrement in Vit. C was recorded in both S+B and G+M blends. On contrary, Vit. C was more resistant in both S+M and G+B blends.

Table (4):Total soluble solids (TSS) and Ascorbic acid (Vit.C) contents of the selected blends and their kinetic stability during storage at (5±1^{0}C) up to six months.

Storage period (month)	TSS(%)				Ascorbic acid (mg/100g)			
	S+B	S+M	G+B	G+M	S+B	S+M	G+B	G+M
Fresh	16.00 ^{e}	16.00 ^{f}	16.00 ^{e}	16.00 ^{e}	66.51 ^{a}	63.12 ^{a}	60.29 ^{a}	62.02 ^{a}
0	16.18 ^{d}	16.10 ^{e}	16.19 ^{d}	16.20e	64.20 ^{b}	60.02 ^{b}	54.11 ^{bc}	60.02 ^{b}
1	16.16 ^{d}	16.15 ^{e}	16.23 ^{cd}	16.26 ^{cd}	64.20 ^{b}	60.02 ^{b}	54.41 ^{b}	60.00 ^{b}
2	16.28 ^{c}	16.35 ^{d}	16.34 ^{c}	06.33 ^{bc}	64.00 ^{b}	60.00 ^{b}	54.07 ^{bc}	60.00 ^{b}
3	16.30 ^{c}	16.47 ^{bc}	16.46 ^{b}	16.38 ^{b}	63.90 ^{b}	60.00 ^{b}	54.06 ^{bc}	59.09 ^{b}
4	16.40 ^{b}	16.44 ^{c}	16.58 ^{a}	16.58 ^{a}	63.90 ^{b}	59.90 ^{b}	54.06 ^{bc}	59.08 ^{b}
5	16.50 ^{a}	16.51 ^{ab}	16.55 ^{ab}	16.50 ^{a}	63.90 ^{b}	59.90 ^{b}	54.06 ^{bc}	59.08 ^{b}
6	16.53 ^{a}	16.55 ^{a}	16.59 ^{a}	16.56 ^{a}	63.70 ^{b}	59.90 ^{b}	54.02 ^{c}	59.06 ^{b}
R	+0.976	+0.942	+0.958	+0.938	-0.943	-0.915	-0.940	-0.935
A	16.13	16.14	16.20	16.21	64.21	60.05	54.10	60.07
B x10 $^{-2}$	+6.67	+7.78	+7.43	+6.46	-7.86	-3.50	-1.11	-6.54

R= Correlation coefficient A = Intercept (as % and mg/100g value for TSS and Vit.C, respectively).
B= Change (as % and mg/100g value for TSS and Vit.C, respectively) /month.

In the next step of the present study, two blends, of the four suggested blends, were selected to represent a highly utilized juice blend (S+B) and a lower utilized juice blend (G+B). This selection was carried out to produce the low calorie blends. Curtis (1988) reported that the sweetness of citrus fruits was due to the presence of glucose, fructose, and sucrose.

Low calorie blends were produced by substituting the added sugar to the two selected blends by different amounts (Table 5) of a non caloric compound (stevia). Quality is the ultimate criterion of the desirability of any food product to the consumer. Overall quality depends on quantity, nutritional and other hidden attributes, and sensory quality (Ranganna, 1977). Therefore, two techniques were applied in sensory evaluation of the two blends. In the first (the individual sensory evaluation), the panelists were asked to individually rank each group (S+B or G+B) with respect to taste and color attributes. In the second technique (the combined sensory evaluation), the panelists were asked to rank both group together with respect to taste and color attributes. In both techniques, the low calorie blends were compared to the traditional ones (sweetened by sucrose).

Table (5): Individual and combined taste and color evaluation of the traditional and low calorie blends.

Blend type	S+B blend		G+B blend	
	Taste	Color	Taste	Color
Traditional (16%sugar)	8.1[a] (ab)	9.0[a] (a)	7.9[ab] (abcd)	8.0[a] (b)
1 g Stevioside/100g	5.0[c] (e)	9.0[a] (a)	5.0[c] (e)	8.0[a] (b)
0.025 g Stevioside/100g	7.9[ab] (abcd)	9.0[a] (a)	7.8[ab] (abcd)	8.0[a] (b)
0.050 g Stevioside/100g	7.4[b] (d)	9.0[a] (a)	8.1[ab] (abc)	8.0[a] (b)
0.075 g Stevioside/100g	7.9[ab] (abcd)	9.0[a] (a)	8.1[ab] (ab)	8.0[a] (b)
0.1 g Stevioside/100g	8.0[ab] (abcd)	9.0[a] (a)	8.2[a] (a)	8.0[a] (b)
0.125 g Stevioside/100g	7.5[ab] (bcd)	9.0[a] (a)	7.5[b] (cd)	8.0[a] (b)

Each value within the same column directly followed by the same letter is not significant different at the 0.05 level (the individual sensory evaluation rank).

Each value within the same attribute followed by the same letter (in the parentheses) is not significant different at the 0.05 level (the combined sensory evaluation).

The individually estimation of the two tested blend groups data were found in Table (5). It show that there was a significant difference between the traditional blend and the highest stevioside substituted samples one (1g) in S+B blend groups. On the other hand, the partially stevioside substituted samples (0.025-0.125 substitution) was closed to the traditional blend. On contrary, there was no significant difference in the color of all the S+B blend group. The same Table shows also, that the taste of the G+B blend group varied in G+B in unpattern mode for the traditional and low calorie blends. The most palatable blend was noticed in case of blend 0.1 g substitution and the lowest palatability was in case of 1 g stevioside substitution blend with a highly significant difference. The other blends lay in between the two blends and were more close to blend 0.1 substitution than 0.2 stevioside substitution blend. The color of G+B blend group showed the same model of the color of S+B blend group, i.e. there was no significant difference as a result of sucrose substitution.

The combined sensory evaluation of both S+B and G+B blend groups showed the same trend. It means that there was no significant difference in color of each individual group but the S+B blend group color was more preferable than the G+B blend group color. But, the taste of 0.075 and 0.1 substitution samples of G+B blend group and sucrose 100% substitution sample of S+B blend group were the most preferable samples. Therefore, the 0.075 stevia substitution of sucrose in S+B and 0.1 stevia substitution in G+B samples was selected to represent the most favorable low calorie blends of the two groups tested. Consequently, they were stored up to six weeks at cold condition to study the changes occurring in the stevioside compounds and the other components within such period.

Data presented in Table (6) show the changes occurring in the low calorie blends constituents within three weeks of cold storage and their kinetic stability.

Data presented in Table (6) showed that, there was no significant difference in most of the components of the low calorie blends over the storage period under the present storage condition. In some components or properties there was a proportion relation (TSS, pH and reducing sugars), but the others possessed a reversible relation. It could be identified by checking the sign before R parameter. The rate of change and intercept was varied from one parameter to other, one blend to other, etc. Due to the higher R parameter, it is easy to calculate the stored period at any time exceeding the current storage period by applying the specified formula.

Six stevioside compounds could be fractionated and determined in the tested blends. Such components were rebaudioside A, stevioside, rebaudioside C, dulcoside A, rebaudioside E and rebaudioside D. It could be noticed that the higher amount of the fractionated compounds were dulcoside A, stevioside and rebaudioside A which possessed the highest sweetness degree (Table 7). These compounds were higher in S+B blend than in G+B blend. It may be to the higher separation recovery in S+B than in G+B blend. Rbaudioside C was the only compound which was very high in G+B blend than in S+B blend.

On the other hand, changes in and kinetic of compounds as a result of cold storage of the low calorie blends were found in Table (7). It showed that there was a very slightly decrement in the stevioside compounds in both low calorie blends (S+B and S+G). Rebaudioside A, E and D compounds were more stable and resistant in S+B than in G+B.

In conclusion, it is recommended to orient drink and meal habit toward the healthy beneficial intakes and assist such direction through prepare different forms of blends to gain a complementary and healthy drinks and overcome the undesirable attributes.

Table (7): Stevioside compounds (as x10 $^{-2}$ g/100g) of the selected low calorie blends and their kinetic stability during storage (5±1^{0}C) up to six weaks.

Storage period (week)	Rebaudioside A		Stevioside		Rebaudioside C		Dulocoside A		Rebaudioside E		Rebaudioside D	
	S+B	G+M	S+B	G+M	S+B	G+M	S+B	G+M	S+B	G+M	S+B	G+M
0	1.25	1.232	0.275	0.493	5.035	1.074	0.379	0.161	2.277	1.98	0.389	0.35
3	0.956	0.493	0.254	0.1520	1.37	1.057	0.211	0.060	2.192	1.958	0.313	0.332
6	0.261	0.187	0.194	0.116	1.339	0.346	0.153	0.035	1.602	0.976	0.285	0.131
R	-0.9742	-0.9725	-0.9635	-0.7484	-0.8701	-0.8761	-0.9627	-0.9444	-0.918	-0.8767	-0.9663	-0.90236
A x10 $^{-2}$	1.32	1.160	0.282	0.498	4.430	1.190	0.36	0.1483	2.361	2.143	0.381	0.3813
B x10 $^{-2}$	-0.167	-0.1741	-0.0135	-0.0122	-0.616	-0.1213	-0.038	-0.0210	-0.1125	-0.1678	-0.0173	-0.0367

R= Correlation coefficient A = Intercept (as g/100g). B= Change (as g/100g) /weak.

REFERENCES

Abd El-Fadeel, M.G. (1978). Technological and chemical studies on some fruit juice concentrates . M. Sc. Thesis, Fac. Agric., Zagazic Univ., Egypt.

Angel, I.; M. Gil; F. Ferreres and F.Tomas (2001). In-vitro Availability of flavonoids and other phenolics in orange J. Agric. Food Chem., (49): 1035-1041.

Anonymous, (2001). Agricultural Statics. Arab Republic of Egypt, Ministry of Agriculture and Land reclamation, Affairs Sector.

AOAC (1995). Official Methods of Analysis of the Association of Official Analytical Chemists. Published by the Association of Official Analytical Chemists. Washington 25, DC, USA.

Curtis, G. J. (1988). Some experiments with edible coating on long term storage of citrus fruits. Sixth . Int. Citrus Congress Middle East, Tel Aviv, Israel, March 6-11, 1988, Balaban Publishers, Rehovat, Israel, p. 1515.

El-Saidawy, M.H. (1997). Sensory evaluation of some citrus juice mixtures. Egyptian Conference of Home. Economics Minoutfya Univ. (25-26 May 1997).

El-Sayed, A.S. (1999). Studies on some fruit juices. Ph. D. Thesis Food Science and Technol., Faculty of Agriculture, Zagazig Univ.

Francis, F.J. (1995). Carotenoids as colorants. World of Ingredients . Sept. Oct. 34-35, 37-38 (1995).

Gerster, H. (1999). High-dose vitamin C: A risk for persons with high iron stores? Internat. J. Vit. Nutri. Res., 69(2):67-82.

Gorinstein, S.; O. Belloso ; Y. Seo Park; R. Haruenkit; A. Lojek; M. Abraham and I. Simon (2001). Comparison of some biochemical characteristics of different citrus fruits. Food Chem., (74): 309-315.

Hamed, H.S. (2000). Studies on the utilization of natural carotenoids extracted from balady mango wastes.Egypt J. Agric. Res., 78 (3): 1265 - 1277 .

Hamed, H. S.; E.A. Mohamed and M. A. Abou-Zeid (2000). Factors affecting stability of carotenoids from yellow carrot Roots. Proceeding of 1st Mansoura Conf. of Food Sci. and Dairy Technol., 17-19 October, Mansoura Univ. El-Mansoura, Egypt.

Ikan, R. (1992). Sweeteners and flavour ants from plant glycosides. C.F. Abst. Israel,. J. of Botny, 40(1): 256.

Ishima, T.; S. Katayama and Y. Yokoyama (1978). Sensory evaluation of stevioside and newly isolated diterpen glycosides as sweeteners. International Congress, Food Science & Technology-Abstracts, P. 158:(C.F. FSTA 1969-12/195).

Kamal, Wafaa (2002). Natural stevioside sweetener, production, characteristics and utilization in food Ph. D. Thesis, Food Science, and Technol,. Faculty of Agriculture, Cairo Univ.

Kolb, A.; J.L. Herrer and R.F. Ulinana (2001). Analysis of sweet diterpene glycosides from *Stevia rebaudiana*. Improved HPLC method. J. Agric. Food Chem., (49): 4538-4541.

Kolb, N. (1986). Stevioside : un edulcorant natural de bajo conteniod calorico. Mc. Thesis, Institute Quiic du sarria, Barcelona, Spain.

Lindley, M. G.; P. K. Beyts; I. Canales and F. Borrego (1993). Flavor modifying characteristics of the intense sweetener neohesperidin dihydrochalcone. J. Food Sci., 58:592.

Lisitsin, V. and I. Kovalev (2000). Stevia-a source of health and longevity for the nation. Pishchevaya-Promyshlennost Abst., 5: 38-39.

Oefner, P. and J. L. Chromatog (1985). Charles, D.F.(Ed) Int. Sugar J., (1981).C.F. Guide to A minex HPLC columns for biochemical applications.

Prakash, S.; R.S. Singhal and P.R. Kulkarni (2002). Enzymic debittering of Indian grapefruit (citrus paradisi) juice. J. Sci. Food Agric., 82 : 394-397.

Ranganna, S. (1977). "Determination of Volatile Oil". In Manual of Analysis of Fruit and Vegetable Products, pp. 322, Tata McGrram-Hill, Publishing Co. New Delhi.

Rizk, S.S.; K.A. Awaad; G.A. El-Sherbiny and M.A. El-Shiaty (1978). New blends of citrus juices: 2- Graprefruit juice blends. Agricultural Research Review, 57(3): 65-70.

Rizk, S.S.; G.E. El-Sherbiny; H.K. El-Manawaty and M.A. El-Shiaty (1985). Improving the palatability of grapefruit juice by blending with other citrus juices. Egyptian. J. of Food Sci., 13(2): 157-165.

Shaw, P.E. (1994). Fruit juices. In Kirk-Othmer Encylopedia of Chemical Technology, 4th, Ed., Vol. II, pp.:1082-1097, Weley,, New York.

Steel, R.G. and T.H. Torrie (1980). Principles and procedures of statistics Abiometrical Approach (SAS). McGraw Hill Book Comp., Inc., New York, USA.

تصنيع بعض مخاليط العصائر التقليديه الصحية والمنخفضة فى محتواها من الطاقه وتقدير حركيات الثبات أثناء تخزينها

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على الرغم من الفوائد الصحية لثمار الجريب فروت فإنها مازالت محدودة الإستخدام فى مصر نتيجة طعمها غير المقبول. لذلك فقد بذلت العديد من المحاولات للتغلب على الطعم المر من خلال خلط عصير الجريب فروت مع بعض عصائر الفاكهة الأخرى ذات الطعم المحبب اللذيذ. حيث تم في هذة الدراسة خلط عصائر الجريب فروت ، والبرتقال البلدى والسكري ، واليوسفى من أجل اعداد وتجهيز مخاليط عصائر مقبولة حسيا وذات قيمة غذائية عالية. كذلك تم إنتاج عصائر منخفضة فى محتواها من الطاقة عن طريق إضافة مركبات الإستيفيا لكى تستخدم فى حالات البدانة والسمنة ومرضى السكر. وقد تم متابعة التغيرات الحادثة فى تلك المخاليط التقليدية وكذلك منخفضة المحتوى من الطاقة.

وقد أظهرت نتائج التحليل الإحصائى ان إضافة عصير البرتقال البلدى تؤدى إلى تحسين صفات الطعم لعصير الجريب فروت لكى تماثل الطعم الموجود عند خلط عصير البرتقال البلدي مع السكري. وقد تم تخزين تلك الخلطات علي درجات حرارة الثلاجة ووجد عدم حدوث تغير كبير في صفاتها لمدة ٦ شهور. كذلك تم استخدام كمية من مركبات الاستفيا في إعداد العصائر المنخفضة في الطاقة ودراسة مدي ثبات تلك المركبات تحت ظروف التخزين. ووجد أن معظم مركبات الاستيفيا تكون ثابتة في كلا من نوعي المخاليط التى تم دراستها (البرتقال السكري مع البرتقال البلدي ، الجريب فروت مع البرتقال البلدي). كما أثبتت هذه الدراسة إمكانية الاستفادة من ثمار البرتقال السكري المحدودة الاستخدام في مصر باستخدام عصيرها في خلطات العصائر الأخرى المشار إليها مما يعكس أهمية اقتصادية بالغة للبحث.

Table (3): Total carotenoids, acidity and pH value of the selected blends and their kinetic stability during storage at (5±1^{0}C) up to six months.

Storage period (month)	Carotenoids				Total acidity				pH values			
	S+B	**S+M**	**G+B**	**G+M**	**S+B**	**S+M**	**G+B**	**G+M**	**S+B**	**S+M**	**G+B**	**G+M**
Fresh	0.701^{a}	0.683^{a}	0.578^{a}	0.398^{a}	1.55^{a}	1.66^{a}	1.71^{a}	1.02^{a}	3.96^{bc}	3.80^{de}	3.50^{c}	3.60^{bcd}
0*	0.663^{b}	0.604^{b}	0.508^{b}	0.361^{b}	1.53^{a}	1.65^{ab}	1.68^{ab}	1.01^{ab}	3.90^{c}	3.70^{e}	3.40^{c}	3.40^{d}
1	0.659^{b}	0.594^{bc}	0.497^{bc}	0.359^{b}	1.52^{a}	1.64^{ab}	1.68^{ab}	1.01^{ab}	3.80^{c}	3.90^{cde}	3.60^{bc}	3.60^{bcd}
2	0.648^{bc}	0.582^{bcd}	0.483^{bcd}	0.350^{bc}	1.52^{a}	1.62^{abc}	1.65^{abc}	1.00^{abc}	4.01^{abc}	3.90^{cde}	3.50^{c}	3.50^{cd}
3	0.640^{bc}	0.579^{bcd}	0.479^{bcd}	0.342^{bcd}	1.49^{a}	1.60^{abc}	1.64^{bc}	1.00^{abc}	4.10^{abc}	4.00^{bcd}	3.80^{ab}	3.80^{abcd}
4	0.629^{bcd}	0.570^{cd}	0.466^{bcd}	0.338^{bcd}	1.48^{a}	1.60^{abc}	1.62^{bc}	0.97^{bcd}	4.30^{ab}	4.20^{ab}	3.80^{ab}	3.90^{abc}
5	0.620^{cd}	0.562^{cd}	0.449^{d}	0.320^{cd}	1.45^{a}	1.58^{bc}	1.60^{c}	0.96^{cd}	4.40^{a}	4.10^{abc}	3.90^{a}	4.00^{ab}
6	0.601^{d}	0.558^{d}	0.457^{cd}	0.311^{d}	1.43^{a}	1.56^{c}	1.59^{c}	0.94^{d}	4.40^{a}	4.30^{a}	4.00^{a}	4.20^{a}
R	-0.867	-0.990	-0.967	-0.978	-0.973	-0.989	-0.988	-0.950	+0.944	+0.974	+0.950	+0.981
A	0.676	0.601	0.505	0.366	1.54	1.65	1.69	1.02	3.83	3.74	3.43	3.51
B x10^{-2}	-1.31	-0.764	-0.950	-0.857	-1.71	-1.46	-1.64	-1.21	+10.0	+9.6	+9.6	+10.0

R= Correlation coefficient A = Intercept (asmg/100g, citric acid% and value for Carotenoids, acidity and pH, respectively).
B= Change (as mg, citric acid % and value for Carotenoid, acidity and pH, respectively)/month.
Each value, within the same column, followed with the same letter is not significant different at 0.05 level.
*** Zero time storage after prcessing.**

Table (6): Specified parameters of the selected low calorie blends and their kinetic stability during cold storage up to six weaks.

Contents	Storage period (week)						Kinetic parameters					
	0		3		6		R		A		$Bx10^{-2}$	
	S+B	G+M	S+B	G+M	S+B	G+M	S+B	G+M	S+B	G+M	S+B	G+M
Tss %	12.0 [a]	11.5 [b]	11.9 [a]	11.75 [ab]	11.8 [a]	11.85 [a]	+1.00	+0.982	11.8	11.52	+3.33	+5.00
Total acidity (mg/100g)	1.71 [a]	1.89 [a]	1.68 [a]	1.83 [a]	1.64 [b]	1.81 [a]	-0.971	-0.990	1.71	1.88	-1.17	-1.33
pH value	3.50 [a]	6.09 [a]	3.95 [a]	6.12 [a]	4.30 [a]	6.13 [a]	+0.866	+0.961	4.23	3.87	+3.33	+6.67
Total sugars%	9.70 [a]	7.60 [a]	9.50 [a]	7.60 [a]	9.60 [a]	7.50 [a]	-0.500	-0.00	9.65	7.57	-1.67	-0.00
Redusing sugar%	5.40 [a]	4.20 [a]	5.50 [a]	4.40 [a]	5.60 [a]	4.50 [a]	+1.00	+0.982	5.40	4.22	+3.33	+5.00
Non redusing sugar%	4.30 [a]	3.40 [a]	4.00 [a]	3.10 [a]	5.00 [a]	3.10 [a]	-0.866	-0.866	4.25	3.35	-5.00	-5.00
Carotenoids%	0.669 [a]	0.520 [a]	0.668 [a]	0.518 [a]	0.664 [a]	0.510 [a]	-0.945	-0.974	0.669	0.521	-0.083	-0.167
Vit.C (mg/100g)	64.5 [a]	54.85 [a]	64.4 [a]	54.70 [a]	64.0 [a]	49.80 [a]	-0.945	-0.982	64.55	54.93	-8.83	-10.00
Sucrose	0.80	0.20	0.00	0.00	0.00	0.00	-0.866	-0.866	0.667	0.167	-13.33	-3.33
Glucose	4.44	2.66	4.44	2.66	2.66	0.80	-0.866	-0.866	4.74	2.97	-29.67	-31.00
Fructose	8.13	8.86	7.00	8.46	6.93	8.33	-0.891	-0.959	7.96	8.82	-20.05	-8.83

Each value, within the same column, followed with the same letter is not significant different at 0.05 level.
*** As the same units previously mentioned**