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PRODUCTION OF LOW-CALORIE MANDARIN NECTAR SWEETENED WITH STEVIA AND ITS EFFECT ON QUALITATIVE AND SENSORY PROPERTIES

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Abstract:

A standard sample of mandarin nectar was prepared and sucrose was replaced with Stevia (rebaudioside A) sweetener at 25, 50, 75 and 100%. The physical, chemical and sensory properties of all treated samples were studied while they were stored for 60 days. It was noticed from the results that a significant increase occurred at the end of storage in the values of Total Acid% for sample T_4 amounted to 0.689%, Total Soluble Solid% for standard sample T_0 amounted to 13,833%, viscosity of sample T_0 reached cP 45.600 and the browning index in sample T_0 reached 0.425 nm, which means these indicators rose with the progress of the storage period. It was noted from the results that the lowest significant value was at the end of storage for each of the pH of samples T_3 and T_4, which amounted to 3.367 and 3.366, respectively, and vitamin C in the sample T_0 amounted to 39.137 mg/100 ml. The storage period and the treated samples all affected the sensory properties (taste, smell, color and general appearance) of mandarin nectar and the degrees of acceptance of all traits were high at the beginning of storage, but decreased at the end. However, the taste decreased with the increase of the substitution, despite the increase in the color and general appearance in those two samples, due to the bitter taste added by the sweetener.

Keywords: Stevia, Rebaudioside A, Sweeteners, sugar, treatments

INTRODUCTION

Changing human lifestyle to lower levels of physical activities and increasing consumption of high-calorie food products such as fruit juices, nectarines and sucrose-sweetened energy drinks among different segments of society, especially adolescents, has made human health particularly threatening in low- and middle-income countries (Garcia-Noguera et al. 2010, Smith et al., 2017). Excessive consumption of sucrose or products containing it leads to obesity, diabetes, metabolic syndrome, cardiovascular disease and tooth decay (Khan and Sievenpiper, 2016, Imamura et al., 2016 and Bleich and Vercammen, 2018), so artificial sweeteners such as saccharin, cyclamate, aspartame and acesulfame K were used. Sucralose is widely used in the production of low-calorie foods (Ferrer and Thurman, 2010). Due to their adverse health effects, plant-derived sweeteners such as Stevia Rebaudiana had a sweet taste with a slight bitterness, with a relative sweetness of 250-300 times compared to sucrose (Lemus-Mondaca et al., 2012). The stevia plant belongs to the Asteraceae family. Its cultivation spread in Paraguay, then Brazil, Argentina, some Asian countries and other regions in the world (Madan et al., 2010); Therefore, attention has been focused on the production and consumption of different types of products containing this type of natural sweetener that provide more effective sweetness and contain no calories as an alternative to sucrose (Kumari et al., 2018, Kalicka et al., 2019 and Belc et al., 2019).

The aim of the current study is to search for the best proportion of replacement with the sweetener Stevia (rebaudioside A) that can partially or completely replace sucrose in the processed pulp juice (mandarin nectar) so that it has physical, chemical and sensory properties similar to those of nectar containing sucrose, as well as to study the effect of sample type and period Storage in the above-mentioned properties .

RESEARCH MATERIALS AND METHODS

The study used fine white sucrose powder that was purchased from the local market of Mosul/Iraq. And the fine white Stevia (rebaudioside A) powder is one of the 98% purity stevia glycosides which was imported from Jiangxi Congcongle Food Industry Co., Ltd. Citrus reticulate medium-ripe mandarin fruits from the local market of Mosul/Iraq.

PREPARATION OF MANDARIN PULP PUREE

The mandarin pulp was prepared after washing the fruits, removing the outer peel, the inner white Albedo layer and around the lobes, as well as removing the seeds. Crush the pulp using an electric mixer (Blender) type Newal-BLD-426, of Turkish origin

Fixation of sweetener Stevia (rebaudioside A) and preparation of mandarin nectar.

The sweetness of Stevia (rebaudioside A) was fixed to equal the sweetness of sucrose according to the method reported by Sheet (2013) with a weight of 13 g sucrose/100 ml distilled water representing the final Brix grade of nectar. The amount of sweetener was prepared by dividing the final brix score by the sweetness of the sweetener (250). The standard sample was prepared using sucrose according to the specifications of Codex Standards (2005), which determined the percentage of mashed pulp 50% by weight in mandarin nectar and the percentage of dissolved solids 13% by weight, and the acidity was determined according to what was stated in the standard by estimating it by weight in the mash and it was 1.024% by weight. While the percentage included in the equation was determined by adjusting the acidity of the mash depending on the taste, and it was 1.075 by weight at a temperature of 20 ° C, and all quantities were calculated according to Sheet equations (2013).

1. Pulp + x + y + z = Amount of orange nectar (kg).

2. Pulp(Brix) + x (Brix) + y (Brix) + z (Brix) = Amount of orange nectar (kg) (Brix).

3. Pulp(Acid%) + x (Acid%) + y (Acid%) + z(Acid%) = Amount of orange nectar (kg) (Acid%).

x = sugar, y = water, z = acid

Samples containing the sweeteners sucrose and Stevia (rebaudioside A) were prepared in the same way with a TSS of 13%. The amount of sucrose was calculated in the equations and amounted to 72 g, and the amount of stevia sweetener was calculated as 0.29 g, as well as the amount of water that was added to the two sweeteners to prepare solutions from them, with the rest of the calculated components remaining constant. , Sucrose was replaced in proportions of 25, 50, 75 and 100% with the substitute sweetener as shown in Table (1).

The estimated pH and TA% based on citric acid and TSS% were measured for the sucrose-containing sample to ensure compliance with the standard as well as the replacement samples. The nectar was filled in 250ml glass bottles with vertical space left (10 cm3), tightly closed and pasteurized in a water bath for 15 minutes after gradually raising the temperature to 75°C. The bottles were lifted and inverted for the purpose of sterilizing the caps. It was gradually cooled with cold water, and stored at a temperature of 4°C in the refrigerator for 60 days. Physical, chemical, and sensory tests were performed every 15 days for the sensory properties of taste, odor, color and general appearance at the beginning and end of the storage period .

Table(1):Components of different mandarin nectar samples

Treatments *	Ingredients of mandarin nectar gm/1000gm				
	sweeteners solutions		other ingredients		
	Standard (sucrose) 14.551٪	stevia Stevia (rebaudioside) ((A 0.059٪	pulp	Citric acid	Vitamin C
T_0	494.810	-	500	4.87	0.32
T_1	371.108	123.702	500	4.87	0.32
T_2	247.405	247.405	500	4.87	0.32
T_3	123.702	371.108	500	4.87	0.32
T_4	-	494.81	500	4.87	0.32

***T_0=Standard(sucrose),T_1=25%RebaudiosideA+75% Sucrose,T_2= 50% Stevia (rebaudioside A)+50% sucrose, T_3= 75% Stevia(rebaudioside A)+25% Sucrose, T_4= 100% Stevia (rebaudioside A)**

Physical, chemical and sensory analyses

The pH was estimated using a manual pH2- Singapore Eco Tester, No. 374, % TA as citric acid and %TSS using a Digital-L.002-R.2-Germaney Refractometer, Manual at 20°C according to AOAC (2012). Viscosity was estimated using a Brookfield Digital Viscometer DV-E, Germany. Vitamin C was estimated by the estimation method according to the method reported by Satpathy et al. (2021). The browning index was estimated according to the method mentioned by Klim and Nagy (1988), and samples were sensually evaluated using 9 degrees of acceptance (taste, smell, color and general appearance) according to the method mentioned by Meilgaard et al. (1999). Finally, statistical analysis of the data was conducted according to the factorial system using the Completely Randomized Design C.R.D. Significantly different coefficients were marked with different alphabets using Duncan's Multiple Range Test under 5% probability level (Antar,2010).

RESULTS AND DISCUSSION

Effect of treatments type and storage period on the pH of mandarin nectar

The results of Table (2) indicate that there are significant differences ($p \leq 0.05$) in the pH value between the standard sample T_0 and the rest of the treated samples, in zero days (beginning of storage), as it was observed that the value increased significantly ($p<0.05$) in the standard sample T_0. It reached 3.867 compared to the treated samples T_1, T_2, T_3 and T_4 which amounted to 3.800, 3.733, 3.667 and 3.666, respectively, which may be due to the lower pH value in glycoside stevia sweetener solutions and powders than that of sucrose close to neutral (Abu-Arab et al., 2010). It was mentioned that the pH value of stevioside sweetener powder was 5.72, while sucrose was close to neutral.

Table (2): Effect of the treatments type and storage period on the pH of mandarin nectar

*Treatments	pH				
	storage period/day				
	zero beginning of) (storage	15	30	45	60
T_0	3.867 a	3.733 b c	3.633 c d e	3.567 d-g	3.467 g h i
T_1	3.800 a b	3.669 c d	3.630 c d e	3.533 e-h	3.453 g h i
T_2	3.733 b c	3.633 c d e	3.626 c d e	3.500 f g h	3.433 h I j
T_3	3.667 c d	3.631 c d e	3.600 d e f	3.500 f g h	3.367 I j
T_4	3.666 c d	3.628 c d e	3.567 d- g	3.433 h I j	3.366 I j

***T_0=Standard(sucrose),T_1=25%Rebaudioside A+75%Sucrose,T_2=50% Rebaudioside A+50% sucrose, T_3= 75% Rebaudioside A +25% Sucrose, T_4= 100% Rebaudioside A**
***The coefficients that took the same letter are not significantly different from each other under the 0.05 probability level**

It is noticed from the interaction of the type of treated samples and storage period ($p \leq 0.05$) in the pH value, the highest significant value of the standard sample T_0 was 3.867 in zero days of storage, and the lowest significant value for samples T_3 and T_4 were 3.367 and

3.366 respectively in 60 days. The same value also decreased with the progress of the storage period, and the reason is attributed to the decomposition of reducing sugars in the mandarin puree into carboxylic acids, in addition to the formation of organic acids from the decomposition of pectic and pectinic acids. The same results were reached by Shahid et al. (2015) when storing mandarin and mango puree concentrate for 90 days at room temperature, and Gautam et al. (2021) when storing nectar of a mixture of apple and strawberry pulp with mandarin and lime juice at room temperature for three months.

Effect of treatments type and storage period on Total acidity (TA%) of mandarin nectar

The results of Table (3) showed that there were significant differences ($p \leq 0.05$) in TA% between the standard sample T_0 and the rest of the samples treated with sweetener in zero days of storage. It decreased significantly ($p<0.05$) in the standard sample T_0 and amounted to 0.576% compared to the treated samples T_1, T_2, T_3 and T_4 in which that percentage increased and reached 0.587%, 0.597%, 0.610% and 613.0%, respectively, for the same reason mentioned in the pH. Effect of the interaction of the type of treated samples and storage period ($p \leq 0.05$) on TA%, the highest significant value of sample T_3 and T_4 in 60 days of storage was 0.689% and the lowest significant value of the standard sample T_0 was 0.576% in zero days. It is noted from the table that TA% increased significantly with the progression of the storage period, for the reasons mentioned in the pH.

Table (3): Effect of treatments type and storage period on TA% of mandarin

*Treatments	TA % total acidity				
	storage period/day				
	zero beginning of) (storage	15	30	45	60
T_0	0.576 m	0.587 l m	0.608 l j k	0.665 d	0.678 a b c
T_1	0.587 l m	0.606 j k	0.618 h i	0.670 c d	0.681 a b c
T_2	0.597 k l	0.613 h I j	0.624 g h	0.676 c d	0.687 a b c
T_3	0.610 I j	0.624 g h	0.635 f g	0.687 a b	0.689 a
T_4	0.613 h i j	0.641 f	0.652 e	0.689 a	0.689 a

***T_0=Standard(sucrose),T_1=25%Rebaudioside A+75%Sucrose,T_2=50% Rebaudioside A+50% sucrose, T_3= 75% Rebaudioside A +25% Sucrose, T_4= 100% Rebaudioside A**

***The coefficients that took the same letter are not significantly different from each other under the 0.05 probability level**

Effect of treatments Type and Storage Period on Total Soluble Solids% (TSS%) of mandarin nectar

It is noticed from the results of Table (4) that there are significant differences ($p \leq 0.05$) in Total Soluble Solids% between the sample treated with T_0 sucrose and the rest of the samples.The percentage of TSS% increased significantly in zero days of storage in the standard sample 13.267%, while it decreased significantly in samples T_1, T_2, T_3 and T_4, reaching 10.067%, 8.200%, 7.767% and 5.133%, respectively. The reason is due to the difference in the added amounts of sucrose and stevia (rebaudioside A) sweetener after stabilizing its sweetness according to the Sheet method (2013), as well as the conversion of sucrose by heat and acid treatment to glucose and fructose reducing sugars, which may contribute to an increase in TSS%. Similar results were reached by Shahid et al. (2015). The interaction between the type of treated samples and storage period significantly ($p \leq 0.05$) in TSS%, as the highest significant value of sample T_0 was 13.833% in 60 days of storage and the lowest significant value of sample T_4 reached 5.133% in zero days of storage.

The percentage also increased significantly with the progression of the storage period The reason may be attributed to the transformation of the insoluble protopectin in the pulp of the fruits into soluble pectin and the continued decomposition of sucrose into the reducing sugars glucose and fructose. These results agreed with Ahmed et al. (2008) when they stored a sweetened mandarin drink with aspartame and acesulfame k for 60 days, and the same results were reached by Ilame and Singh (2018) when they stored mixed fruit nectar and Jabeen et al. (2019) when they stored guava drink sweetened with raw stevia extract for 90 days .

Table (4): Effect of treatments type and storage period on Total Soluble Solids (TSS%) of mandarin nectar

*Treatments	TSS % Total soluble solids%				
	storage period/day				
	zero beginning of) (storage	15	30	45	60
T_0	13.267 c	13.367 c	13.600 b	13.667 b	13.833 a
T_1	10.067 g	10.267 f	10.433 e	10.567 d	10.633 d
T_2	8.200 k	8.333 j	8.467 i	8.533 i	8.667 h
T_3	7.767 m	7.800 m	7.867 m	8.000 l	8.067 l
T_4	5.133 q	5.233 p q	5.267 o p	5.367 n o	5.467 n

***T_0=Standard(sucrose),T_1=25%Rebaudioside A+75%Sucrose,T_2=50% Rebaudioside A+50% sucrose, T_3= 75% Rebaudioside A +25% Sucrose, T_4= 100% Rebaudioside A**
***The coefficients that took the same letter are not significantly different from each other under the 0.05 probability level**

Effect of treatments type and storage period on the viscosity of mandarin nectar

The results of Table (5) show that there are significant differences (p≤0.05)in the value of the viscosity of mandarin nectar in the standard sample T0 from the rest of the replacement samples, as the viscosity increased significantly in the standard sample T0 and reached 38.467 cP, while its value decreased significantly in samples The replacements were all T_1, T_2, T_3, and T_4 in the amount of 37,933 cP, 32,400 cP, 30,200 cP, and 29,800 cP, respectively, in zero days of storage. These results agreed with Alizadeh (2021) when studied on the effect of stevia and inulin on the viscosity of mango nectar. As for the effect of the interaction of the type of treated samples and storage period (p≤0.05) on the viscosity of nectar, it was noted that the highest significant value of the viscosity in sample T_0 was 45,600 cP in 60 days of storage, and the lowest significant value of the viscosity in sample T_4 in zero and 15 days of storage. They are 29,800 cP and 30,133 cP, respectively. It was also noted that the value increased significantly (p≤ 0.05) with the progression of the storage period. The reason may be attributed to the increase in TSS% during storage, due to the high molecular weight of sucrose or glucose and fructose resulting from its decomposition by heat and acid, in addition to the decrease in water activity and thus the increase in viscosity (Manjunatha et al., 2012).

Table (5): Effect of treatments type and storage period on the viscosity of mandarin nectar

*Treatments	viscosity cP				
	storage period/day				
	zero beginning of) (storage	15	30	45	60
T_0	38.467 g	39.533 f	40.933 d	43.333 b	45.600 a
T_1	37.933 h	38.300 g h	40.000 e	41.233 d	42.000 c
T_2	32.400 o	34.133 m	35.467 l	36.667 j	37.467 i
T_3	30.200 q	31.667 p	33.000 n	34.467 m	36.267 k
T_4	29.800 q	30.133 q	31.333 p	33.133 n	34.333 m

***T_0=Standard(sucrose),T_1=25%Rebaudioside A+75%Sucrose,T_2=50% Rebaudioside A+50% sucrose, T_3= 75% Rebaudioside A +25% Sucrose, T_4= 100% Rebaudioside A**

***The coefficients that took the same letter are not significantly different from each other under the 0.05 probability level**

Effect of treatments type and storage period on vitamin cconcentration of mandarin nectar

The results of Table (6) show that there are significant differences (p≤ 0.05) in the concentration of vitamin C between the standard sample T_0 and the rest of the samples. Zero day, while its concentration increased significantly in all replacement samples T_1, T_2, T_3 and T_4 during the same period and reached 42,430, 42,743, 42,810 and 42.853 mg/100 ml, respectively. The reason is due to contain the sweetener Rebaudioside A on flavanones and flavanols that preserve vitamin C. The results are consistent with what Salar et al. (2020) reported that antioxidants in stevia-containing beverages preserved vitamin C, especially in refrigerated conditions.The effect of the treatment and storage period ($p \le 0.05$) was observed in vitamin C concentration, as its highest value in the two t_3 and T_4 was 42.810 and 42.853 mg / 100 ml, respectively in zero days As well as a significant concentration with the progress of the storage period, the reason is due to thermal treatment and Oxidation of ascorbic acid to dehydroascorbic acid in the presence of ascorbic acid oxidase enzyme (ascorbinase), It is caused by the remaining oxygen in the bottles. The same results are followed by Pareek et al. (2011) when stored for the mandarin juice for six months. The results match with Gautam et al. (2021) when stored by a mixture of fruit at room temperature and for three months.

Table (6): Effect of treatments type and storage period on vitamin C concentration of mandarin nectar

*Treatments	vitamin C mg/100ml				
	Storage period/day				
	zero beginning of) (storage	15	30	45	60
T_0	42.270 g h	42.190 i	41.353 n	40.857 p q	39.137 s
T_1	42.430 و	42.320 g	41.477 m	41.217 o	40.800 q
T_2	42.743 b	42.467 e f	42.227 h i	41.680 l	40.340 r
T_3	42.810 a	42.563 c d	42.427 f	41.767 k	40.883 p
T_4	42.853 a	42.613 c	42.520 d e	42.303 g	41.907 j

***T_0=Standard(sucrose),T_1=25%Rebaudioside A+75%Sucrose,T_2=50% Rebaudioside A+50% sucrose, T_3= 75% Rebaudioside A +25% Sucrose, T_4= 100% Rebaudioside A**

***The coefficients that took the same letter are not significantly different from each other under the 0.05 probability level**

Effect of treatments type and storage period in the Browning Index (BI) of mandarin nectar

The results of Table (7) show that there are significant differences($p \le 0.05$) in the Browning Index (BI) between the standard sample T_0 and the rest of the treated samples, as the highest significant value of absorption was 0.392 nm reached by the sample T_0, and the lowest significant value of absorption was for the treatments T_1, T_2, T_3 and T_4, which amounted to 0.390 nm, 0.388 nm, 0.383 nm, and 0.380 nm respectively in zero day.

The reason for the high BI may be due to the high water activity of nectar, as well as the samples containing sucrose, especially the standard sample, which led to slow interactions of non-enzymatic brown coloration (Judy, 2011), as well as the oxidation of ascorbic acid to dehydroascorbic acid by heat treatment or oxygen remaining in bottle or exposure to light (Pareek et al., 2011). Similar results were reached by Pham et al. (2021) when studying the effect of non-enzymatic brown coloration on the shelf life of stored orange juice and Skrypec et al. (2021) when studying the effect of oxygen in peach puree during storage. Its value is reduced in exchange transactions. As the addition of Stevia (rebaudioside A) reduced oxidative reactions and thus maintained high levels of antioxidants, Bender (2015) reached the same results when studying the effect of raw stevia extracts in stored fruit drinks. As for the effect of the interaction of the type of treated samples and storage period in BI, it was noted that the highest significant value of absorption was for treatment T_0, which amounted to 0.425 nm in 60 days of storage, and the lowest absorption value of sample T_4 reached 0.380 nm in zero days. It was also noted that the value of absorption increased significantly with the progression of the period storage for the aforementioned reasons.

Table (7): Effect of treatments type and storage period in the Browning Index (BI) of mandarin nectar

*Treatments	BI nm				
	Storage period/day				
	zero beginning of) (storage	15	30	45	60
T_0	0.392 o	0.397 m	0.409 g	0.418 c	0.425 a
T_1	0.390 q	0.394 n	0.407 i	0.414 e	0.420 b
T_2	0.388 s	0.391 p	0.401 k	0.408 H	0.417 d
T_3	0.383 u	0.389 r	0.400 l	0.404 j	0.411 f
T_4	0.380 v	0.385 t	0.392 o	0.402 k	0.408 h

***T_0=Standard(sucrose),T_1=25%Rebaudioside A+75%Sucrose,T_2=50% Rebaudioside A+50% sucrose, T_3= 75% Rebaudioside A +25% Sucrose, T_4= 100% Rebaudioside A**
***The coefficients that took the same letter are not significantly different from each other under the 0.05 probability level**

Effect of treatments type and storage period in the characteristics of the sensory evaluation (taste, odor, color and appearance)

The results of Table (8) indicate that there are significant differences (p≤0.05) in the degree of taste acceptance between the standard sample T_0 and the rest of the treated samples at the beginning of storage. Manufactured from it for the presence of volatile flavor compounds, as well as the contribution of citric acid to improving the taste (Nirjana, 2012 and Sheet, 2013), while the degree of taste acceptance decreased in samples T_2, T_3 and T_4, reaching 8.577, 8.440 and 8.107, respectively. It is due to the slight bitter taste of Stevia (rebaudioside A) sweetener after the taste of nectar, which increases with increasing of the percentage of replacement, because the sweetener contains some tannins and flavonoids, the same results were reached by Hariharan and Mahendran (2016). This degree decreased significantly in all the replacement samples T_1, T_2, T_3 and T_4 at the end of storage, reached 6.693, 6.567, 6.537 and 6.430, respectively, from the comparison sample T_0, which amounted to 6.707, the reason for the decrease in taste when storing for all treatments is due to the storage period and the loss of volatile flavor compounds during it. Similar results were reached by Sheet (2013) when storing peach nectar for 3 months at room temperature.

As for the degree of odor acceptance, it is noted from the same table that there are significant differences ($p \leq 0.05$) between the standard sample T_0 and the rest of the treated samples at the beginning of storage. That degree increased in the standard sample T_0, reached 8.770, 8.757, 7.780 and 7.781, respectively, the reason may be attributed to the presence of volatile flavor compounds, as well as the contribution of citric acid to improving flavor (taste and smell), that degree decreased significantly ($p \leq 0.05$) in all treated samples at the end of storage, the reason is due to the loss of volatile flavor compounds (Nirjana, 2012).

The results indicate that there are significant differences ($p \leq 0.05$) between the standard sample T_0 and the rest of the treated samples in the degree of color acceptance at the beginning of storage. That degree decreased significantly ($p \leq 0.05$) in the standard sample T_0, reached 8.707, while it increased significantly in T_1, T_2 , T_3 and T_4 , reached 8.710, 8.727, 7.763 and 7.780, respectively, at the beginning of storage, as the addition of Stevia (rebaudioside A) reduced oxidative reactions and thus maintained high levels of antioxidants such as flavonoids that preserved the color. The results agreed with what was mentioned by Salar et al. (2020). It is also noted that this degree decreased significantly in all treated samples at the end of storage than at the beginning, the reason is due to the high acidity during storage, which led to an increase in the loss of flavonoids compounds (Amadeo, 2012).

Table (8): **Effect of treatments type and storage period in the characteristics of the sensory evaluation (taste, odor, color and appearance)**

*Treatments	sensory evaluation attributes							
	The degree of taste acceptance		The degree of odor acceptance		The degree of color acceptance		The degree of general appearance acceptance	
	start of storage	end of storage	start of storage	end of storage	start of storage	end of storage	start of storage	end of storage
T_0	8.633 a	6.707 f	8.783 a	6.697 f	8.707 d	6.857 g	8.767 c	6.873 g

T_1	8.613 b	6.693 f	8.770 b	6.697 f	8.710 d	0.687 g	8.770 c	6.883 g
T_2	8.577 c	6.567 g	8.757 c	6.703 و	8.727 c	6.883 f	8.807 b	6.897 f
T_3	8.440 d	6.537 h	7.780 d	6.707 e f	8,763 b	7.603 e	8.817 b	7.253 e
T_4	8.107 e	6.430 i	7.781 d	6.717 e	8.780 a	7.613 e	8.863 a	7.313 d

***T_0=Standard(sucrose),T_1=25%Rebaudioside A+75%Sucrose,T_2=50% Rebaudioside A+50% sucrose, T_3= 75% Rebaudioside A +25% Sucrose, T_4= 100% Rebaudioside A**
***The coefficients that took the same letter are not significantly different from each other under the 0.05 probability level**

It was noted from the same table that there was a significant increase ($p \leq 0.05$) in the degree of acceptance of appearance in the sample T_4, which amounted to 8.863, and the lowest degree of acceptance in the standard sample was 8.767 compared to the rest of the treatments at the beginning of storage, this trait also decreased significantly in all samples at the end of storage, for the same reason In degree of color acceptance. It can be concluded from the results of all sensory evaluation scores that the standard sample T_0 treated with sucrose obtained the highest acceptance degrees, followed by the sample T_1 and T_2 in which sucrose was replaced by rebaudioside A by 25% and 50%, respectively, but the acceptance scores decreased with the increase in the percentage of substitution, especially the degree of taste acceptance due to Some bitterness is left after drinking nectar.

CONCLUSIONS

Replacing sucrose with the sweetener Stevia (rebaudioside A) resulted in a functional pulp juice that was low in calories and rich in antioxidants, which gave acceptance in terms of sensory properties in samples partially replaced by sucrose with the sweetener and in the replacement ratios of 25 and 50% until the end of storage, and the sweetener reduced vitamin C loss and loss color during storage.

REFERENCES

Abou-Arab, A. E., Abou-Arab, A. A., & Abu-Salem, M. F. (2010). Physico-chemical assessment of natural sweeteners steviosides produced from Stevia rebaudiana Bertoni plant. African Journal of Food Science, 4(5), 269-281.

Ahmed, M., Ahmad, A., Chatha, Z. A., & Dilshad, S. M. R. (2008). Studies on preparation of ready to serve mandarin (Citrus reticulata) diet drink. *Pak. J. Agri. Sci*, *45*(4), 470-

476.
Alizadeh, A. (2021). Mango nectar as a substrate for L. Plantarum: effect of stevia and inulin on probiotic viability and physico-chemical properties of the synbiotic product. Journal of Food Measurement and Characterization, 1-7.

Antar, Salem Hammadi (2010) Statistical Analysis in Scientific Research and the SAS Program. University of Mosul, Dar Ibn al-Atheer for printing and publishing.

AOAC. (2012) Official methods of analysis Association of Official and Analytical Chemists 17thedn. Washington, D.C.

Belc, N., Smeua, I., Macria, A., Vallauri, D., & Flynn, K. (2019). Reformulating foods to meet current scientific knowledge about salt, sugar and fats. Trends in Food Science & Technology, 84, 25–28.

Bender C, Graziano S, Zimmermann BF (2015) Study of Stevia rebaudiana Bertoni antioxidant activities and cellular properties. Int J Food Sci Nutr 66:553–558.

Bleich, S. N., & Vercammen, K. A. (2018). The negative impact of sugar-sweetened beverages on children's health: An update of the literature. BMC Obesity, 5, 1–27.

Codex Standard (2005) . Codex General Standard for Fruit Juice and Nectars ,Codex Stan 247, p.1-19.

Ferrer I,Thurman EM.(2010) Analysis of sucralose and other sweeteners in water and beverage samples by liquid chromatography/time-offlight mass spectrometry.J Chromatogr. 1217:4127–4134.

Garcia-Noguera J, Weller CL, Oliveira FIP, Rodrigues S, Fernandes FAN (2010) Dual-stage sugar substitution in strawberries with a Stevia—based sweetener. Innov Food Sci Emerg 11:225–230.

Gautam, D., Jain, S. K., Bhatnagar, P., Meena, N., & Chippa, H. (2021). Utilization of custard apple pulp for preparation of blended nectar. Indian Journal of Horticulture, 78(2), 229-235.

Hariharan,G.,& Mahendran,T. (2016). Physico-chemical, sensory and microbial evaluation of ginger-lime ready-to-serve (RTS) functional beverage, sweetened by Palmyra sugar candy. *Imperial Journal of Interdisciplinary Research*, *2*(5), 1545-1552.

Ilame, S. A., & Singh, S. V. (2018). Physico-chemical properties of ultrafiltered kinnow (mandarin) fruit juice. Journal of food science and technology, 55(6), 2189-2196.

Imamura, F., O'Connor, L., Ye, Z., Mursu, J., Hayashino, Y., Bhupathiraju, S. N., & Forouhi, N. G. (2016). Consumption of sugar sweetened beverages, artificially sweetened beverages, and fruit juice and incidence of type 2 diabetes: Systematic review, meta-analysis, and estimation of population attributable fraction. British Journal of Sports Medicine, 50, 496–504.

Jabeen,F., Wahab, S., Hashmi, M.S., Mehmood, Z., Riaz, A., Ayub, M., & Muneeb, M.(2019). Liquid stevia extract as a substitute of sucrose in the preparation of guava drink. Fresenius Environmental Bulletin, 28(1), 233-243.

Judy C. (2011). Chemical and Physical Properties of Food, FNH 200. University of British Columbia, Canadian public research. USA.

Kalicka, D., Znamirowska, A., Pawlos, M., Buniowska, M., & Szajnar, K. (2019). Physical and sensory characteristics and probiotic survival in ice cream sweetened with various polyols. International Journal of Dairy Technology, 72(3), 456–465.

Khan, T. A., & Sievenpiper, J. L. (2016). Controversies about sugars: Results from systematic reviews and meta-analyses on obesity, cardio metabolic disease and diabetes. Journal of Nutrition, 55, S25–S43.

Klim M. and Nagy S.(1988). An improved method to determine nonenzymic browning in citrus juices. J. Agric. Food Chem. 1988, 36, 6, 1271–1274.

Kumari, A., Arora, S., Choudhary, S., Singh, A. K., & Tomar, S. K. (2018). Comparative stability of aspartame and neotame in yoghurt. International Journal of Dairy Technology, 71(1), 81–88.

Lateef, M. A. A., Fadhil, N. N., & Mohammed, B. K. (2021, November). Effect of Spraying With Cal-Boron and Potassium Humate and Maturity Stage on Fruit Quantity, Quality Characteristics of Apricot Prunus Armeniaca L. cv." Royal". In *IOP Conference Series: Earth and Environmental Science* (Vol. 910, No. 1, p. 012038). IOP Publishing.

Lateef, M. A., Noori, A. M., Saleh, Y. M., & Al-Taey, D. K. (2021). THE EFFECT OF FOLIAR SPRAYING WITH SALICYLIC ACID AND CALCIUM CHLORIDE ON THE GROWTH, YIELD, AND STORAGE TRAITS OF TWO STRAWBERRY CULTIVARS, FRAGARIA X ANANASSA DUCH. *Int. J. Agricult. Stat. Sci. Vol*, *17*(2), 611-615.

Lemus-Mondaca, R., Vega-Gálvez, A., Zura-Bravo, L., & Ah-Hen, K. (2012). Stevia rebaudiana Bertoni, source of a high-potency natural sweetener: A comprehensive review on the biochemical, nutritional and functional aspects. *Food chemistry*, *132*(3), 1121-1132.

Madan S, Ahmad S, Singh GN, Kohli K, Kumar Y, Singh R, Garg M (2010) Stevia Rebaudiana(Bert.) Bertoni—a review. Ind J Nat Prod Resour 1:267–286.

Manjunatha, S. S., Raju, P. S., & Bawa, A. S. (2012). Modelling the rheological behaviour of enzyme clarified lime (Citrus aurantifolia L.) juice concentrate. Czech Journal of Food Sciences, 30(5), 456-466.

Meilgaard, M. C., Carr, B. T., & Civille, G. V. (1999). *Sensory evaluation techniques*. 3rd Edition, CRC Press, Boca Raton.

Nirjana, H.; L. Brank; B.K.Danijela & K. Sanela (2012). Sensory profile of pulm nectars. Croatian J. of Food Technology, 7:28-33 Dept. Biotechnology and Nutrition, Faculty of Food Technology and Biotechnology, Univ. of Zagreb, Coratia.

Pareek, S., Paliwal, R., & Mukherjee, S. (2011). Effect of juice extraction methods Processing temperature-time on juice quality of Nagpur mandarin (C itrus reticulata Blanco) during storage. Journal of food science and technology, 48(2), 197-203.

Pham, H. T., Pavón-Vargas, D. J., Buvé, C., Sakellariou, D., Hendrickx, M. E., & Van Loey, A. M. (2021). Potential of 1H NMR fingerprinting and a model system approach to study non-enzymatic browning in shelf-stable orange juice during storage. Food Research International, 140, 110062.

Salar, F. J., Agulló, V., García-Viguera, C., & Domínguez-Perles, R. (2020). Stevia vs. sucrose: Influence on the phytochemical content of a citrus–maqui beverage—A shelf life study. *Foods*, *9*(2), 219.

Satpathy L., P. Naganandini, D., B.P. Priyanka and P.P. Siba (2021). Quantitative determination of Vitamin C Concentration of Common Edible Food Sources by redox titration using iodine solution. Platinum open access Journal, Volume 10, Issue 3, 2361 – 2369, 1, India.

Shahid, U., Hussain, S., Nadeem, M., Jabbar, M., Qureshi, T. M., Nasir, M. U., ... & Rashid, F. (2015). Quality assessment of the mango-mandarin (kinnow) squash during storage. Open Access Journal, *3*(2), 115-121.

Sheet, B.S.(2013). Using of some sweeteners in manufacturing of two kinds of low calorie juices and studying their biological effect in rats. Thesis in food sciences, Univ. of Mosul, College of Agri. & Forestry,Iraq.

Skrypec,S., Doh, H., & Whiteside, W.S.(2021). Effect of oxygen scavenging films and modified atmosphere on the color quality of hot-filled freestone peach puree. Journal of Food Process Engineering, 44(5), e136.

Smith,A.D., Fildes, A., Forwood, S., Cooke, L., & Llewellyn,C. (2017). The individual environm-ent, not the family is the most important influence on preferences for common non-alcoholic beverages in adolescence. Scientific Reports, 7, 1–10.

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