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EFFECT OF CONCENTRATION PROCESS AND STORAGE PERIOD ON QUALITY PROPERTIES OF SOME FRUIT AND VEGETABLE CONCENTRATES

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ABSTRACT

This study was carried out to follow up quality changes occurred in some fruit and vegetable concentrates during processing and storage. Orange, apple and tomato concentrates were evaluated for some quality attributes such as TSS%, acidity, vitamin C, carotene, pH and specific gravity. The obtained results indicated that vitamin C content of orange concentrate was decreased as a result of both the concentration process and storage period. While, it was increased from 0.38 mg/100 ml. in fresh apple to 1.33 in apple concentrate. As for tomato concentrate, reducing sugar content increased from 1.277% in fresh to 6.55% after three months of storage. Finally, it could be stated that concentration process and storage period highly affected the chemical and physical quality properties of the studied concentrates.
Keywords: Concentration process, chemical, physical and microbiological properties, fruits and vegetables.

INTRODUCTION

Evaporation technology is a process of separating substances by means of thermal energy. The concentrated liquid, usually is the final desired product. Evaporation might also aims to recovering the volatile constituents as in case of solvents and aroma. In beverage industry, a frequently used process is the under vacuum evaporation. Freshly pressed fruit juice from stone, pomaceous and soft fruit as well as juice from citrus and tropical fruit is concentrated and preserved in this way. Before or during the evaporation process, the extracted volatile flavors are from the clear, are recovered and are re-added to the fruit juice later for intensifying the typical fruit taste *(GEA, 2009)*. The same author stated that the advantages of juice evaporation and the storage of concentrate are obvious that: Six to seven times the quantity can be stored in the same storage tank under simplified storage conditions, concentrates can be preserved without being cooled due to its high sugar content, fluctuations in quantity and quality of different vintage can be balanced and adapted to the market situation, concentrate as commodity is easier to market and finally the transport of concentrate is simpler and cheaper. Concentration process has also solved the problem of seasonal nature of crops and allowed economic utilization of perishable agricultural products (Rao, 1989).

Tomato (*Lycopersicum esculentum)* is one of the most consumed fruit in the world, either as a raw fruit or as a processed product. In fact, in the entire world, tomato follows potatoes in the economic importance and consumption and are used in food industries as raw material for the production of several products such as juice, sauce, purees, pastes, and canned tomatoes. In recent decades the consumption of tomatoes has been associated with the prevention of several diseases (Wilcox *et al.,* 2003 and Sharoni and Levi 2006) mainly due to the content of antioxidants, including carotenes (lycopene as well as β-carotene), ascorbic acid, tocopherol, and phenolic compounds. Lycopene is a hydrocarbon carotenoid, $C_{40}H_{56}$, with molecular weight 537 (Periago *et al.,* 2009).

Ascorbic acid is recognized as antioxidant vitamins and a heat-labile compound, lycopene and phenolic compounds are more resistant to thermal processing, being the main antioxidants in processed products (George *et al.,* 2004).

Citrus fruits are considered to be the major produced fruit in Egypt. Balady orange and mandarin fruit represent the main local citrus crops. The increasing rate of citrus products demands the application of better techniques to improve the manufacture of their products. The production of orange concentrates is limited and has been produced in very restricted quantities, inspite of high quality of fruits and the need of their concentrates for further uses. Concentration normally takes place by means of vacuum evaporation in one or more stages. During this operation many of volatile aroma compounds of the juice (the various oxygenated volatile components including alcohols, esters and aldehydes, which give the characteristics flavor to fresh orange juice) are lost in the vapour resulting in reduced product quality. Loss of these compounds causes a significant deterioration in quality and overall aroma and flavor of the concentrated juice (EL-Hamzy *et al.,* 1998).

The degradation products can cause off-flavors in orange concentrated juices. The advantages in concentrating fruit juices using a low cost, energy efficient process combined minimum heat damage to the color, aroma and viscosity characteristics of the juice were first noted in work on orange and apple juice (Hedges and Pepper 1986).

Apple and apple juices contain bioactive secondary plant substances like polyphenols and also different amounts of dietary fibers. These substance classes are characterized by health-promoting effects, but are no nutrients (Frank *et al.,*2008).

In Europe, apple juice is a highly-consumed product, in second place after orange juice (Kay-Shuttleworth 2008). Among the most important constituents of apple juice are polyphenolics that have the ability to increase its antioxidant potential. Polyphenolics also affect lipid metabolism (Akazone, 2004) and the absorption of cholesterol (Aprikian *et al.,* 2001).

Most apple juice is still consumed as clear juice, which is characterized by having a low phenolics content (Markowski and Płocharski 2005) due to the clarification process which leads to dramatic changes in the profile of phenolic compounds compared to whole fruit (Dietrich, 2004 ; Hubert *et al.,* 2007).

Carotenoids, as the main groups of coloring substances in nature, are responsible for many of the red, orange and yellow color of fruit and vegetables (WHO, 2009). Lin and Chen (2005) showed higher losses of carotenoid during processing and/or storage. Also, Rao and Rao (2007) mentioned that, since there are double bonds in the carbon chain of carotenoids are susceptible to some reaction such as oxidation and isomerisation (cis-trans) during food processing and storage, especially due to light, heat, acids, and oxygen; thus causing loss of color.

So, the main target of the study is directed to the documentation of the concentration process. Also, to follow up some chemical and physical changes of orange, apple, tomato during concentration process and storage.

MATERIALS AND METHODS

Materials:

Tomato: Tomato (*Lycopersicum esculentum)* **(**Tri Star Hybrid) was collected from Telema, Samanoud ,El-Gharbia Governorate, season of 2011. Samples comprised the intact ripe fruits and semi finished products after fruit-breaking were used in this study.

Orange: Throughout season of 2011, the Egyptian Balady orange fruit (*Citrus sinensis*) was used in this investigation. Orange was harvested from trees grew in Dakahlia and Kaliobia Governorate, Egypt.

Apple :season of 2011, the Egyptian apple fruit (*Malus domestica*) Anna and Dorestt Golden was used in this study. Apple was harvested from tree grew in Beheira and Kaliobia Governorate, Egypt.

Containers: Glass bottles and gars used in this study were bought from local market in Mansoura city, Dakahlia Governorate, Egypt.

Sugar: Sugar was purchased from Dakahlia sugar company.

Acid: Citric acid was purchased from Arab Commercial Center, Cairo.

Flavors: (orange and apple flavor) were purchased from 6 Oct. Company Tecnotest, Cairo.

Methods:

Concentration process:

Tomato concentration:

The commercial variety Tri Star Hybrid, the pulp was separated from seeds and skin, evaporated (FBR- ELPO company Italia), three plate stage using vacuum pump, under condition 522, 627 and 661 mm/Hg respectively. Vapor pressure 0.9-1.0 bar and condenser water temperature 52.2°C. Finally, pasteurized by aseptic method at 110°C±3 for 40 sec. in a scraped-surface heat exchanger. Then, cooled to 35°C±3 in tubular cool-exchanger, and aseptically packaged in sterile plastic bags about 225 Kg. Products were assessed immediately after processing, and after nine months at ambient storage, for microbial, physical, chemical, and sensory evaluated as final products titled tomato paste.

Orange concentration:

Orange fruit were washed, grated, squeezed and refined to remove the seeds and fibers by discarding the fruit centers. Then, the obtained pure juice passes through the evaporator type: J300-BC, preheated to 90°C, the first effect temperature 83°C, juice were concentrated until 55-60°brix, concentrated juice temperature recorded 27°C, feed juice recorded 5000 L/h, vacuum recorded 723mm/Hg and device arresting about 4:5 minutes. Juice concentrate was cooled and blended. Then, It was stored at -18°C as frozen storage in plastic bags. Concentrated orange samples were chemically and physically analyzed after 1, 3, 6 and 9 months. and sensory evaluated as final product titled orange nectar.

Apple concentration:

Apples were washed, sorted, crushed and squeezed. After washing and sorting, the apples were ground and pressed. The enzymatic treatment (Pectinas and arbanas DA6L, 0.08 g/L) was performed for 1 h following the heating, pump through a tubular heat-exchanger to reach the desired initial temperature (52°C) and then stored in a 2000 L container. Later, the recycle was used to distribute enzymes. After one hour, it could be tested for the clarified juice and then pass to evaporator (the same evaporator which used in orange concentrate). finally pasteurization by aseptic method at 110°C±3 for 40 sec. in a scraped-surface heat exchanger. Then, cooled to 35°C±3 in tubular cool-exchanger, and aseptically packaged in sterile plastic bags about 200 Kg. Concentrated apple samples were chemically and physically analyzed after 1, 3, 6 and 9 months. and sensory evaluated as final products titled apple nectar.

Orange and Apple nectar preparation:

100 ml of prepared orange and apple nectar from 7.51% and 4.4% concentrate, 0.18% and 0.33% citric acid and 0.014% and 0.016% flavor respectively, and adjusted to a total soluble solids of 15% and 12%, respectively by using the sucrose and water. Nectar was filled in clear glass bottles, tightly closed, pasteurized at 96°C for one min. as done in Egyptian canning company in water bath, cooled, and later, stored at room temperature (25±2°C) for determining sensory evaluation.

Analytical methods:

Total soluble solids (TSS), acidity % as citric acid or as malic acid, total sugar, reducing sugar, specific gravity, density and ascorbic acid (using the 2,6 dichlorophenol indophenols titration method) were measured as described by the AOAC (1990).

The pH of different prepared concentrate or nectars were measured by using pH meter (Model JENWAY 3505).

Viscosity:

The consist meter Bostwick is a sheet metal scale, along which a row of 24 Cm with a graduated every 0.5 Cm allows the flow of material maintained by a guillotine. The measurement is taken place by release of tomato paste in the flow channel and measured the distance traveled after 30 sec. The concentrate used must first be diluted to 12.5% Brix at an ambient temperature of 20°C±0.3. Values are expressed in Cm Bostwick. The measurement follows a standard method (CODEX, 1981).

Total carotenoids:

Total carotenoids were determined using the modified method described by Koca *et al.* (2007). Extraction were carried out using 100 ml of hexane : acetone (7:3) and 5 g of sample using conditions described for antioxidant extraction. The residue was re-extracted until it become colorless. The filtrates were combined in a separating funnel and washed with 50 ml distilled water. The water phase was discarded and Na_2SO_4 (10g) was added as desiccant. The solvent phase was transferred to a 50 ml volumetric flask and brought to volume with hexane. The absorbance of this solution was then determined at 450 nm using a Hatachi U-1900 spectrophotometer (Kyoto, Japan). External calibration with authenticated β-carotene standards solutions (0.5µg/ml-10µg/ml) was used to quantify carotenoids. Carotenoid content was expressed as β-carotene equivalents in mg/100g of sample.

Microbiological assessment :

Fifty grams of concentrate samples were placed into sterilized flasks, Then 450 ml of sterile phosphate buffer solution was added. The mixtures were homogenized by mechanical shaker for 30 min. at steady speed. Serial dilution was prepared in sterile saline for the following tests.

Total viable count:

Duplicate plates were inoculated with 1 ml for each dilution and thoroughly mixed with 10 to 15 portion of nutrient agar (Difco Manual, 1985) ; the plates were incubated at 37°C for 48 h. The plates of the suitable dilution were recorded after incubation. The counts/g concentrate samples were calculated.

Yeasts and molds count:

Duplicate plate were inoculated with 1 ml for each dilution and thoroughly mixed with 10 to 15 portion of dextrose agar pH 5-6. The solidified plates were incubated at 30° C for 48h. The plate total counts/g concentrate samples were calculated (Nottingham1971).

Sensory evaluation:

Sensory evaluation was carried out by fifteen panelists for orange and apple nectar samples prepared from fresh juice and the nectar prepared from nine months storage concentrates according the method described by Chant and Cavaletto (1982). The samples were judged through the members (fifteen panelists) of the stuff at Egyptian canning company, Egypt. The panelists were requested to evaluate taste, color, aroma, appearance and overall acceptability.

Sensory evaluation was carried out by a panel of seven judges for tomato paste. Samples were presented in succession and panelists were asked to rate evaluation variables according to 9 point Hedonic scale as described by (Larmoned, 1977).

Statistical analysis:

The data of sensory evaluation were statistically analyzed using program SPSS 17 version using T test (SPSS, 2008).

RESULTS AND DISSCUSSION

Effect of concentration process and storage period on some chemical, physical and microbial attributes of orange juice:

The data obtained in Table (1) show the effect of concentration process and storage period on some chemical, physical and microbial attributes of orange juice. As for concentration process, it could be seen that all chemical and physical parameter values were increased as a result of concentration process except vitamin C, carotene content and pH value. Total soluble solid was increased from 12% in fresh orange juice to 55.5% in orange concentrate, acidity % as citric acid increased also from 1.10% to 5.80% before and after concentration process, respectively. These results disagree with Ibrahim (1985), who found a slight persistent decreasing trend in total acidity for orange and lime juice during vacuum concentration. Specific gravity increased from 1.045 in fresh juice to 1.170 in orange concentrate.

Vitamin C content decreased as a result of concentration process from 49.47 mg/100ml in fresh juice to 35.69 in concentrate. Such finding are similar to those obtained by El-Hamzy (1988). Carotenes content and pH value decreased from 4.376 mg/100ml to 3.981 and from 3.63 to 3.59 before and after concentration process, respectively.

The reduction in ascorbic acid may be due to either Maillard reaction or degradation of ascorbic acid to dehydroascorbic acid, which may change to furfural and hydroxyl methyl furfural (Nagy, 1980).

Table (1): Effect of concentration process and storage period on some chemical, physical and microbial attributes of orange juice:

Attributes	Fresh orange juice	Storage time of orange concentrate (month)				
		zero	1	3	6	9
TSS (°Brix)%	12	55.5	55.5	56.0	56.0	56.0
Acidity % (Citric acid)	1.10	5.80	3.69	4.08	3.90	4.32
Vitamin C (mg/100ml)	49.47	35.690	34.79	32.95	28.40	24.00
Carotene (mg/100ml)	4.376	3.981	N.D	N.D	N.D	2.932
pH	3.63	3.59	3.83	3.89	3.66	3.80
Specific gravity (25°C)	1.045	1.170	1.161	1.207	1.267	1.275
Viscosity (Sec.)	N.D	11.0	14.0	21.7	22.0	23.0
Total bacterial count (CFU/ml)	2×10^3	Nil	Nil	Nil	Nil	Nil
Mold and yeast	6×10^2	Nil	Nil	Nil	Nil	Nil

N.D : Not determined

Ambient storage period affected on chemical and physical attributes of orange concentrate, where vitamin C gradually decreased from zero time until reached the minimum value of 24mg/100ml after 9 months of storage. These results are in agreement with other studies of Lee and Coates (1999).

Also, carotene content was decreased from 3.981 to 2.932 mg/100ml at zero time and after 9 months of storage, respectively. The loss of carotenoids may be due to their conjugated double bond systems which make them labile to oxidative decomposition. Lin and Chen (2005) showed higher losses of carotenoid during processing and / or storage. Also, Rao and Rao (2007) mentioned that, since there are double bonds in the carbon chain of carotenoids are susceptible to some reaction such as oxidation and isomerisation (cis-trans) during food processing and storage, especially due to light, heat, acids, and oxygen; thus causing loss of color. There were irregular increases in pH value during storage, it reached the maximum value of 3.89 after 3 months of storage. The same trend was observed in both of specific gravity and viscosity. Specific gravity and viscosity values increased in parallel until reached the maximum value of 1.275 and 23.0 sec., respectively at the end of storage period. There were no clear effects of storage period on both TSS and acidity %, where TSS values recorded 56% and acidity % ranged from 3.69% to 5.80% as citric acid. But acidity % seemed to be lost during storage period.

There was no any bacterial, mold or yeast growth during both of concentration process or storage period.

Sensory evaluation of orange nectar processed from stored concentrate and orange nectar processed from fresh juice:

Orange nectar processed from fresh juice and from nine months stored concentrate were sensory evaluated for taste, color, aroma, appearance and overall acceptability,**(** the obtained data was statistically analyzed using T test and results presented in Table (2)**)**. Obtained data indicated that there were no significant differences between the two samples in taste, color and aroma. However, fresh nectar sample had a higher score in these attributes. Appearance of fresh nectar sample was significantly bitter than recombinant nectar (Processed from nine months stored concentrate), which recorded 18.87±0.26 (***p***= 0.01).

Table (2): Sensory evaluation of orange nectar processed from stored concentrate or fresh juice:

Characteristics / Products	Taste (20)	Color (20)	Aroma (20)	Appearance (20)	Overall acceptability (20)
Fresh nectar	**17.93±0.56**	**17.53±0.70**	**17.73±0.69**	**18.87±0.26**	**18.13±0.35**
Recombinant nectar	**16.40±0.65**	**16.80±0.68**	**17.20±0.55**	**17.20±0.47**	**16.20±0.70**
***T* value**	**1.787**	**0.747**	**0.608**	**3.115****	**2.475****

****Means that there were significant differences at p = 0.01.**

Overall acceptability of fresh nectar recorded 18.13±0.35, so there were significant differences between the two studied sample at probability 0.01.

Effect of concentration process and storage period on some chemical, physical and microbial attributes of apple juice:

Illustrated results in Table (3) show some chemical, physical and microbial parameters changes in apple juice as affected by concentration process and storage period.

Table (3): Effect of concentration process and storage period on chemical, physical and microbial attributes of apple juice:

Attributes	Fresh apple juice	Storage time of apple concentrate (month)				
		Zero	1	3	6	9
TSS (°Brix)	11.50	59.50	59.00	60.00	60.00	60.00
Acidity % (Malic acid)	0.52	2.93	3.76	3.76	3.76	3.658
Vitamin C (mg/100ml)	0.38	1.33	1.13	1.00	0.840	0.792
pH	3.55	3.65	3.60	3.56	3.52	3.56
Specific gravity (25°C)	1.036	1.264	1.296	1.285	1.296	1.294
Total bacterial count (CFU/ml)	2×10^2	Nil	Nil	Nil	Nil	Nil
Mold and yeast	0.7×10^2	Nil	Nil	Nil	Nil	Nil

Data in Table (3) indicated that concentration process of apple juice caused increases in all studied chemical and physical parameters. TSS value increased from 11.50% in fresh juice to 59.5% in apple concentrate, acidity % as malic acid recorded 0.52 and 2.93% in fresh juice and apple concentrate, respectively. Vitamin C (mg/100ml) increased as affected by concentration process, and loss water, where it reached 1.33 in apple concentrate. The nutrient changes that occur during concentration will depend on the contents of the mixture and the temperature at which the process takes place. Generally, there is a decreased water content and corresponding increase in other nutrients. (Morris *et al.,* 2004).

pH value also, increased from 3.55 to 3.65 in fresh juice and apple concentrate, respectively. Specific gravity of apple concentrate recorded 1.264. From microbiological view, there was not detected any bacterial, mold or yeast growth during both of concentration process or storage period.

Storage period of apple concentrate causes some clear changes in vitamin C content and acidity %, where acidity % as malic acid increased until reached the maximum value of 3.76% after 6 months of storage, while vitamin C content decreased during storage period and recorded 0.792 mg/100ml at 9 months of storage. TSS value of apple concentrate was constant during storage period, as it was 60%. There were no clear effects in pH values during storage, it was around 3.56. Finally, specific gravity value increased as affected by storage period until reached the maximum value of 1.296 after 6 months of storage.

Increasing storage period of samples may led to the formation of various organic acids in the fruits. Another reason for increasing acidity may be due to trans formation of pectin into pectic acid during prolonged storage (Rizk and Attia, 2010).

Sensory evaluation of apple nectar processed from stored concentrate and apple nectar processed from fresh juice:

Apple nectar samples processed from both of fresh juice and nine months stored apple concentrate were sensory evaluated and statically analyzed, tabulated in Table (4). Sensory evaluation scores did not refer to any significant differences between the two evaluated samples in color, aroma, appearance and overall acceptability. However, these attributed scores of recombinant nectar were higher than those of fresh nectar. There were significant differences (***p***=0.01) between the two nectar sample in taste, so it was a necessity to improve the taste of stored concentrate processed nectar.

Table (4): Sensory evaluation of apple nectar processed from stored concentrate or fresh juice:

Characteristics / Products	Taste (20)	Color (20)	Aroma (20)	Appearance (20)	Overall acceptability (20)
Fresh nectar	17.60±0.33	16.26±0.547	17.06±0.462	16.26±0.672	16.46±0.486
Recombinant nectar	17.06±0.50	17.13±0.567	17.26±0.643	17.26±0.589	17.53±0.496
T value	0.883**	-1.09	-0.252	-1.118	-1.53

****Means that there were significant differences at p = 0.01.**

Effect of concentration process and storage period on some chemical, physical and microbial attributes of tomato juice:

Results in Table (5) showed some chemical, physical and microbial changes in tomato juice as affected by concentration process and storage time. As shown in Table (5), concentration process of tomato juice caused increases in all studied chemical and physical parameters and caused a loss in vitamin C content. TSS was increased from 5.5% in fresh juice to 25.20% in tomato concentrate ; acidity % as citric acid and pH value of tomato paste recorded 2.240% and 4.39, respectively.

Total sugar % of tomato juice increased as a result of evaporation process and recorded 21.329% and subsequently, increase of reducing sugar and non reducing sugar were observed. Reducing sugar content increased from 1.277% in fresh tomato juice to 7.708% in tomato paste, while non reducing sugar % recorded 2.149% and 13.621% in fresh tomato juice and tomato paste, respectively. Also, specific gravity was 1.031 in fresh tomato juice, while it was 1.102 in tomato paste.

Table (5): Effect of concentration process and storage period on some chemical, physical and microbial attributes of tomato juice:

Attributes	Fresh tomato juice	Storage time of tomato concentrate (month)				
		Zero	1	3	6	9
TSS (°Brix)	5.50	25.20	25.10	24.80	24.80	25.00
Acidity % (Citric acid)	0.448	2.240	2.400	2.496	2.356	2.280
Vitamin C (mg/100g)	213.76	23.65	15.66	10.01	9.974	9.530
Reducing sugar %	1.277	7.708	7.995	8.550	8.952	9.076
Non-reducing sugar %	2.149	13.621	12.295	11.653	9.083	8.803
Total sugar %	3.427	21.329	20.290	20.203	18.035	17.879
pH	4.30	4.39	4.39	4.39	4.47	4.42
Specific gravity (25°C)	1.031	1.102	1.069	1.092	1.086	1.0788
Viscosity (20°C, 12.5%) (Cm)	N.D	8.80	8.90	8.80	8.85	8.40
Total bacterial count (CFU/ml)	127×10^4	Nil	Nil	Nil	Nil	Nil
Mold and yeast	193×10^4	Nil	Nil	Nil	Nil	Nil

N.D : Not determined

As for vitamin C, it was severally affected by concentration process, vitamin C content decreased from 213.76 mg/100ml in fresh tomato juice to 23.65 mg/100ml in tomato paste. The losses of ascorbic acid is probably attributable to the oxidation of ascorbic acid to dehydroascorbic acid followed by hydrolysis of the latter to 2,3-diketogluconic acid, which then undergoes polymerization to other nutritionally inactive products (Dewanto *et al.,* 2002).

The stability of vitamin C is affected by industrial processes involving heat treatment. The rate of vitamin C as a nutritional parameter unregulated, its decline is interpreted as a loss of product quality (Boumendjel, *et al.,* 2011).

From microbiological view, there was no any bacterial, mold or yeast growth during both of concentration process or storage period.

Obviously, storage period of tomato paste for nine months caused some changes in studied chemical and physical parameters. TSS% was constant during storage period and it was around 25%. Acidity % as citric acid increased during storage period until it reached the maximum value of 2.496% after 3 months of storage. Moreover, vitamin C content gradually decreased during storage period until it reached the minimum value of 9.530 mg/100ml at the end of storage period (9 months).The loss of vitamin C increased with the increase of storage period. Vitamin C is light and heat sensitive, (Heldman and Singh, 1981). However, vitamin is highly oxidized and may be oxidized with the increase of storage period.

As for sugar state, reducing sugar content was gradually increased during storage period, it was 9.076% at the end of storage period. While non reducing sugar content was gradually decreased from 13.621% at zero time to 8.803% after nine months of storage . Subsequently, total sugar % gradually decreased during storage process until it reached the minimum value of 17.879% at the end of storage period. The rate of reducing sugars is a parameter of the product quality. This rate appears to be totally independent to heat treatment. The rate of reducing sugars is a parameter of product quality (EEC, 1986). These changes may be due to conversion of some non reducing sugar to reducing sugar by acid and heat treatment.

pH value was increased during storage period, it recorded 4.47 after 6 months of storage. These results disagree with Mohammed *et al.* (2003), which found both of the total acidity and pH values were constant throughout storage time up to 12 months. Specific gravity of tomato paste was decreased during storage period, while viscosity of tomato paste was constant during storage period, where it was around 8.80 Cm but it was decreased to 8.40 Cm at the end of storage period. This final decrease refers to an increase in viscosity value.

Sensory evaluation of tomato paste processed from stored concentrate and tomato paste processed from fresh juice:

Taste, color, flavor and overall acceptability characteristics of tomato paste processed from stored concentrate and tomato paste processed from fresh juice were organoleptically assessed. The obtained scores were statistically analyzed using SPSS program and the means were tabulated in Table (6).

Obtained results indicated that there were no significant differences between the two studied tomato paste sample in taste, color and flavor and the fresh tomato paste sample scores were higher than recombinant tomato paste scores. Nevertheless, there were significant differences between them in overall acceptability at p= 0.05. Overall acceptability of fresh tomato paste recorded 8.71±0.184.

Table (6): Sensory evaluation of tomato paste processed from stored concentrate or fresh juice:

Characteristics / Products	Taste (9)	Color (9)	Flavor (9)	Overall acceptability (9)
Fresh paste	**8.57±0.202**	**8.57±0.202**	**8.71±0.184**	**8.71±0.184**
Recombinant paste	**8.14±0.261**	**8.28±0.184**	**8.43±0.297**	**8.14±0.142**
***T* value**	**1.299**	**1.044**	**0.816**	**2.449***

***Means that there were significant differences at p = 0.05.**

CONCLUSION

To sum up, it could be concluded from this study that, the concentration process of some fruits and vegetables content rates , has a significantly high effect on the chemical content especially vitamin C and reducing sugars contents. While, sensory quality was not affected especially through the concentration process or storage.

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تأثير عملية التركيز وفترة التخزين علي صفات الجودة لبعض مركزات الخضر والفاكهة

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تم تنفيذ هذه الدراسة لتتبع التغيرات التي تحدث في جودة بعض مركزات الخضر والفاكهة أثناء التصنيع والتخزين. تم تقييم مركزات الطماطم والتفاح والبرتقال لبعض خصائص الجودة مثل المواد الصلبة الذائبة الكلية, الحموضة, فيتامين ج, الكاروتين, رقم الأس الهيدروجيني, الوزن النوعي. و أشارت النتائج إلي أن محتوي فيتامين ج لمركز البرتقال ينخفض كنتيجة لعملية التركيز والتخزين. علي العكس فإن محتوي فيتامين ج يزداد من ٠,٣٨ مجم/١٠٠ مل في التفاح الطازج إلي ١,٣٣ مجم/١٠٠ مل في مركز التفاح. بالنسبة لمركز الطماطم , ازدادت السكريات المختزلة من ١,٢٧٧% في الطماطم الطازجة إلي ٦,٥٥% بعد ثلاث شهور من التخزين. أخيرا من الممكن القول بأن عملية التركيز والتخزين تؤثر علي صفات الجودة الكيميائية والفيزيائية للمركزات تحت الدراسة.

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