PRODUCTION OF ORANGE JUICE POWDER AS AFFECTED BY METHOD OF DRYING, PACKAGING AND STORAGE

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Summary

Orange (valencia) juices were mechanically dehydrated and freeze-dried. The orange juice powder was packed in 1.5 mil polyethylene bags, aluminium foil containers and stored at room temperature for 6 months.

Ascorbic acid, total and reducing sugar, total acidity, total and amino nitrogen and free amino acids were determined.

Dehydrated and freeze dried orange juices had somewhat inferior qualities compared with fresh juice. However, the freeze-drying had less deteriorating effect than dehydration. Aluminium foil containers were more suitable for packaging orange juice powder than polyethylene bags. The keeping qualities of the juice powder did not noticeably change during storage for 6 months.

Introduction

Orange is one of the important citrus fruits grown in Egypt. The fruits are consumed either fresh or as juice. The juice can be preserved by several methods. Fresh or concentrated juices undergo changes in their chemical components during storage. These changes are affected by some factors such as method of extraction, processing, packing and storage (Vendercook et al., 1963; Salem 1968 and Heikal et al. 1972).

Heikal et al. (1972) reported that ascorbic acid was clearly affected by the several steps of processing. Moreover, it was found that up to 30 per cent of the initial content of ascorbic acid in some fruits juices could be lost on dehydration. Nehring (1969) reported that considerable heating caused the greatest decrease in amino acid of fruit juices. Townsley et al. (1953) found

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significant losses in aspartic acid, serine, glutamic acid and alanine in heated juices. Such a loss was 20, 30, 40 and 60 per cents of the above amino acids.

The aim of this work is to study the changes which may take place in some chemical properties of orange juice upon the effect of drying, packaging materials and storage at room temperature for 6 months.

Material and methods

Materials

Valencia oranges obtained from an orchard in Benha were used in this study. The fruits were picked when at a ripe stage as elucidated by Salama et al. (1959) and Heikal et al. (1964). The fruits were thoroughly cleaned using running tape wale. The juice was mechanically extracted from the fruits using a Berthozie fruit juice extractor.

Methods

Preparation of samples

The juices were divided into two parts, one lot was mechanically dehydrated, while the other lot was dried in two ways:

— The juice was spread in one layer on stainless steel trays and placed in a cabinet drier for 19 hours at 60 °C till the moisture content reached 5–10%.

— Juice quaters of the other lot were frozen for 3 hours at −25 °C. The frozen juices were then immediately transferred to the drying trays of the freeze-drier unit. The freeze-drying was carried out at 36 °C under vacuum (0.1 mm Hg) for 12.5 hours till the moisture reached 3.50%.

Packaging and storage

The final products were immediately packed in polyethylene bags (250 gram) and aluminium foil bottles (250 gram). The containers were sealed. The sealed containers were stored at room temperature for six months. Samples were withdrawn monthly for analyses.

Analytical methods

The moisture content, ascorbic acid (by using 2.6 dichlorophenol indophenol method) content and total acidity (as citric acid) of the samples were determined according to the methods described in the A.O.A.C (1970).

Total and reducing sugar of the samples were measured using the Lane-Eynon general volumetric method (A.O.A.C., 1970).

The total nitrogen was measured colorimetrically by a Hilger colorimeter at 430 mμ filter; the samples were digested using sulfuric acid and 30 per cent hydrogen peroxide. Nesslers reagent was prepared as described by Yuen and Pollard (1951).

Amino nitrogen was estimated by the Sorensen formel volumetric titration method as described in the A.O.A.C. (1970). Free amino acids were determined qualitatively and quantitatively using paper partition chromatographic method as mentioned by Heikal (1970).

Results and discussion

Effect of drying methods

Tables (1) and (3) show the moisture content, ascorbic acid, total sugar, reducing sugar, total acidity (as citric acid), total nitrogen, amino nitrogen and amino acid of fresh and dried orange juice (calculated on dry weight basis).

From these tables it was found that the method of drying had a clear effect on the above-mentioned components. The dehydrated and freeze-dried juice moisture content was equal to 5.10 and 3.50%; respectively. The loss in the ascorbic acid content was higher in dehydrated juice (75.42%) than in freeze-dried (49.43%). Foda et al. (1970) found higher retention of ascorbic acid in the case of freeze-dried orange juice powder. This variation in the ascorbic acid was due to the time needed for drying, temperature processing and probably because of oxidation during processing.

Concerning the sugar content, it was found that this component decreased after drying. It was also observed that the sugar content of the dehydrated juice was decreased markedly compared to that of freeze-dried.

Dehydration and freeze-drying reduced the amount of acids present in the juice. The reduction was higher in the dehydrated samples than in the freeze-dried samples.

The per cent loss of the total and amino nitrogen was more during dehydration than during freeze-drying.

From these tables it could be observed that two methods of drying partially destroyed the free amino acids present in the orange juice.

Effect of packaging and storage

Tables 1, 2, 3, and 4 show the effect of type of packaging materials and storage at room temperature on the chemical properties of dried orange juice.

The ascorbic acid content of the dried product decreased gradually during storage especially in that packed in polyethylene bags. The rate of decrease was more expressed in the initial storage period than in the final stages of storage. This might be due to the loss of ascorbic acid oxidase over a period of time (Draudt and Huang, 1966).

The total sugar present in the dried juice decreased gradually during storage for six months. The reduction was more expressed in the product

Table 1

Effect of storage (at room temperature for 6 months) on some chemical components of dehydrated orange juice packed in polyethylene (1.5 mil.) container*
(Calculated on the basis of dry weight)

Components	Fresh juice	Storage period in months						
		0	1	2	3	4	5	6
Ascorbic acid (mg/100 g)	373.9	91.90	85.70	83.25	80.10	79.20	79.65	79.73
Total sugar (g/100 g)	65.19	54.50	54.00	52.80	52.35	52.00	51.50	51.46
Reducing sugar (g/100 g)	37.22	29.40	29.60	29.95	30.15	30.35	30.50	30.64
Total acidity % (as citric acid)	12.09	8.66	8.72	8.75	8.80	8.85	8.90	8.92
Total nitrogen (mg/100 g)	1127.81	925.29	920.90	918.00	916.70	916.25	915.00	914.19
Amino nitrogen (mg/100 g)	484.46	419.89	419.89	419.89	419.89	419.89	419.89	419.89
Asparagine (mg/100 g)	86.53	68.90	67.50	67.00	66.39	66.40	66.00	65.30
Arginine (mg/100 g)	181.14	140.80	140.5	137.5	137.5	136.90	136.50	136.40
Aspartic acid (mg/100 g)	47.40	40.20	38.50	37.75	37.90	37.60	36.85	36.12
Glutamic acid (mg/100 g)	30.20	18.90	17.50	17.32	17.35	16.25	16.00	15.90
Serine (mg/100 g)	25.90	13.50	13.00	12.60	12.00	12.15	12.00	11.90
Alanine (mg/100 g)	34.50	28.20	28.00	27.90	27.75	27.40	27.25	27.60
Proline (mg/100 g)	198.50	116.00	116.00	115.75	115.50	115.00	115.00	115.50
Cysteine (mg/100 g)	21.50	10.30	10.00	9.50	9.50	9.25	9.00	8.80

* Average results from at least triplicate determinations. Moisture content of the juice before drying was 88.42%. Moisture content of the orange juice powder was 5.10%.

Table 2

Effect of storage (at room temperature for 6 months) on some chemical components of dehydrated orange juice packed in aluminium foil container*
(Calculated on the basis of dry weight)

Components	Fresh juice	Storage period in months						
		0	1	2	3	4	5	6
Ascorbic acid (mg/100 g)	373.9	91.90	90.75	88.90	88.25	87.75	87.45	87.31
Total sugar (g/100 g)	65.19	54.50	54.20	53.98	53.70	53.50	53.50	53.36
Reducing sugar (g/100 g)	37.22	29.40	29.60	29.75	29.90	30.00	30.15	30.15
Total acidity % (as citric acid)	12.09	8.66	8.66	8.72	8.77	8.85	8.85	8.90
Total nitrogen (mg/100 g)	1127.81	925.29	923.95	923.50	921.25	918.95	920.00	918.81
Amino nitrogen (mg/100 g)	484.46	419.89	419.89	419.89	419.89	419.89	419.89	419.89
Asparagine (mg/100 g)	86.53	68.90	68.50	68.50	68.60	68.20	68.70	68.10
Arginine (mg/100 g)	181.14	140.80	140.80	140.80	141.00	141.25	141.10	141.10
Aspartic acid (mg/100 g)	47.40	40.20	40.20	40.25	40.25	40.25	40.25	40.20
Glutamic acid (mg/100 g)	30.20	18.90	18.85	18.50	18.50	18.50	18.50	18.50
Serine (mg/100 g)	25.90	13.50	13.50	13.50	13.75	13.50	13.50	13.60
Alanine (mg/100 g)	34.50	28.20	28.25	28.25	28.40	28.50	28.30	28.30
Proline (mg/100 g)	198.50	116.00	116.00	116.00	116.50	116.20	116.25	116.40
Cysteine (mg/100 g)	21.50	10.30	10.30	10.50	10.50	10.20	10.10	10.00

* Average results from at least triplicate determinations.

packed in polyethylene bags than in aluminium container. The percentage of such decrease ranged between 2.00 and 5.58.

On the other hand, reducing sugar content increased slightly and gradually during storage. These changes were more noticeable in juice placed in polyethylene than in that bottled in aluminium foil.

The increase in reducing sugars during storage is due to the hydrolysis of sucrose in the presence of citric acid (Schoebel et. al. 1969).

In all dried products it was seen that the total acidity (as citric acid) increased slowly during storage. It was also observed that total acidity was not affected by the type of container. Such increase was ranged between 2.70 and 3.00 per cent.

Neither the type of packing material nor the storage time affected the total nitrogen and amino nitrogen content of the dehydrated and freeze-dried orange juice.

From the data indicated in the same formentioned tables, it could be observed that the asparagine, glutamic acid and cysteine content decreased at the end of storage. This reduction was more intensive in dehydrated juice than in freeze-dried juice. Other amino acids increased slowly during six months of storage in all dried products, except in dehydrated juice packed in polyethylene bags by the end of storage.

From the above findings, it could generally be concluded that freeze-dried orange juice was better than dehydrated juice. Aluminium foil containers were preferable packaging material compared with polyethylene bags.

Table 3

Effect of storage (at room temperature for 6 months) on some chemical components of freeze dried orange juice packed in polyethylen (1.5 mil.) container*
(Calculated on the basis of dry weight)

Components	Fresh juice	Storage period in months						
		0	1	2	3	4	5	6
Ascorbic acid (mg/100 g)	373.90	189.08	180.95	172.72	170.00	168.90	166.92	166.39
Total sugar (gL/100 g)	65.19	62.58	61.46	61.16	60.96	60.70	60.58	60.45
Reducing sugar (gL/100 g)	37.22	35.64	36.20	36.65	36.80	36.95	37.02	37.06
Total acidity % (as citric acid)	12.09	9.67	9.70	9.71	9.76	9.82	9.87	9.96
Total nitrogen (mg/100 g)	1127.81	1098.75	1092.70	1088.98	1086.72	1085.50	1085.90	1087.77
Amino nitrogen (mg/100 g)	484.46	463.17	463.17	463.17	463.17	463.17	463.17	463.17
Asparagine (mg/100 g)	86.53	74.85	74.80	74.62	74.21	74.40	73.95	73.70
Arginine	181.14	155.40	155.31	155.01	156.62	156.33	156.12	157.00
Aspartic acid (mg/100 g)	47.40	40.60	40.60	40.60	40.60	40.60	40.60	40.60
Glutamic acid (mg/100 g)	30.20	20.10	19.81	19.62	19.48	19.16	18.82	18.60
Serine (mg/100 g)	25.90	22.20	22.20	22.18	22.36	22.41	22.39	22.40
Alanine (mg/100 g)	34.50	32.80	32.85	32.91	32.95	33.16	33.15	33.10
Proline (mg/100 g)	189.50	196.40	196.51	196.62	197.22	197.80	198.11	198.50
Cysteine (mg/100 g)	21.50	15.30	15.21	15.20	15.18	15.11	15.15	15.00

* Average results from at least triplicate determinations. Moisture content of the juice before freeze-drying was 88.42%. Moisture content of the orange juice powder was 3.50%.

Table 4

Effect of storage (at room temperature for 6 months) on some chemical components of freeze-dried orange juice packed in aluminium-foil container*
(Calculated on the basis of dry weight)

Components	Fresh juice	Storage period in months						
		0	1	2	3	4	5	6
Ascorbic acid (mg/100 g)	373.9	189.08	186.00	183.00	181.20	180.90	180.72	179.63
Total sugar (gL/100 g)	65.19	62.58	62.50	62.07	61.76	61.54	61.26	61.33
Reducing sugar (gL/100 g)	37.22	35.64	35.67	35.90	36.10	36.27	36.41	36.57
Total acidity % (as citric acid)	12.09	9.67	9.72	9.74	9.79	9.85	9.89	9.94
Total nitrogen (mg/100 g)	1127.81	1098.75	1098.75	1097.00	1095.92	1094.96	1094.65	1093.78
Amino nitrogen (mg/100 g)	484.46	463.17	463.17	463.17	463.17	463.17	463.17	463.17
Asparagine (mg/100 g)	86.53	74.85	74.85	74.75	74.35	74.35	74.35	74.30
Arginine (mg/100 g)	181.14	155.40	155.40	155.50	155.50	155.90	155.75	155.90
Aspartic acid (mg/100 g)	47.40	40.60	40.60	40.60	40.50	40.50	40.40	40.60
Glutamic acid (mg/100 g)	30.20	20.10	20.00	20.00	19.75	19.50	19.75	19.10
Serine (mg/100 g)	25.90	22.20	22.20	22.20	22.25	22.20	22.25	22.30
Alanine (mg/100 g)	34.50	32.80	32.80	32.75	32.75	32.80	32.75	32.90
Proline (mg/100 g)	198.50	196.40	196.40	196.35	196.50	196.70	196.50	196.50
Cysteine (mg/100 g)	21.50	15.30	15.25	15.00	14.75	15.00	15.00	14.80

* Average results from at least triplicate determinations.

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