EFFECT OF OSMOTIC DEHYDRATION ON PHYSIOCHEMICAL PROPERTIES OF RED CARROTS

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Abstract

This study was carried out to assess the quality parameters of osmo-dried red carrots pretreated with various types of osmotic sucrose syrup i.e. 40%, 50%, 60% and 70%sucrose syrup, compared with those produced by untreatedred carrots(control). The sucrose syrup 70% had the lowest osmosis time for osmosedcarrots followed by 60%, 50%, and 40% sucrose syrup respectively. However, the reduction time of dehydration for both red carrots caused the increase in solid gain (SG) and total solids (T.S) than that obtained bythe control (untreated) drying. Furthermore, the dehydration parameters (WL and WC) were strictly related to the type and concentration of the used osmosis solution. The phsico-chemical properties, microbiological assessment and quality attributes of both osmo-dried and controlred carrotsjust after processing and during storage for 6 months were also undertaken. Results indicate that, osmo-dried red carrotspretreated with sucrose syrup 70% had the highest retention of ascorbic acid followed by 60%, 50% and 40% sucrose syrup, respectively. Reducing sugars content ranged between 51.69 to 56.50% for osmos-dried red carrotswith various pretreatments just after processing. While, the corresponding values of fibers ranged from 9.53 to 9.75% respectively. The control- dried carrots had the highest total microbial counts (9.1x102 cfu/g) followed by osmo-dried pretreated with sucrose syrup 40% (6.3x 102cfu/g), 50% sucrose syrup (5.2 x102cfu/g), 60% sucrose syrup (3.7x102cfu/g) and 70% sucrose syrup (2.6 x102cfu/g), respectively. On the other hand, all tested counts of microorganisms either total counts of bacteria or yeasts and molds showed proportional reduction with extending the storage period and reached to the maximum reduction after 6 months of storage. The osmo-dried red carrotspretreated with sucrose syrup 70% recorded the highest scores of color, texture, taste, flavour and overall acceptability followed by osmo-dried samples pretreated with 60%,50% and 40% sucrose syrup and the un treated (control) just after processing and after 3 and 6 months of storage at ambient temperature. Therefore, pretreatment of carrots with osmotic sugar solution to produce osmo-dried product played an important role for producing high quality dried red carrotsthan those produced by the control drying process.

INTRODUCTION

Osmotic dehydration is the process in which water is partially removed from the cellular materials when these are placed in a concentrated solution of soluble solute. Osmotic dehydration, which is effective even at ambient temperature, preserves the color, flavour and texture of food from heat, and is used as a pre-treatment to improve the nutritional, sensorial and functional properties of food. The amount of water remaining in the material after osmotic dehydration, however, does not ensure its stability, as water activity is generally higher than 0.9. When shelf stability is an ultimate process objective, other, complementary methods of water removal, such as convective drying, freeze drying, freezing, etc. are suggested Valiaet,al(2009)Carrots originated from Middle Asia, where it has been known for 3000 years and nowadays, it is cultivated in Europe, Turkey and many countries [Schwarz et,al. (2004).].Red carrotsanthocyanins comprise high amount of acylatedcyanidin derivatives (41.0%) which exhibit remarkable stability to pH value changes and heat treatment Stintzing et.al,(2002)showed that acylatedanthocyanins are protected from the hydrophilic attack of water molecules by the acyl moieties (intramolecular effect). Beside improving the stability, the acylatedanthocyanins display enhanced biological activities, anthocyanins possess strong radical-scavenging,antimutagenic activities and anti-hypertensive effects.Anthocyanins have been reported to exert cancer chemo preventive activity Hou(2003). Contrary to grape skin, red carrots contain low amounts of non-anthocyanin phenolics which causehazing and precipitation in clear fruit juices. Moreover, red carrotsanthocyanins give an excellent bright strawberry red shade at acidic pH values, therefore, red carrotsjuice can be consideredas good choice for coloring fruit juices, nectars, softdrinks, jellies and confectioneries.Alasalvar *et. al.*., (2001) reported that red carrots contain a high amount of nutraceutical components. Furthermore, Netzel *et. al.*. (2007)proved that anthocyanin extracted from red carrotsinhibited proliferation of human cancer cells (colorectal adenocarcinoma and promyelocytic leukemia) in a dose dependent manner..The process of osmotic dehydration can be used for the preparation of shelf-stable products for the purpose of using during off-season. The quality of promisedcarrots is much superior to the product dehydrated with theconventional method of convective dehydration.Red carrots (Daucuscarota L.) is one of the important root vegetable crops and is highly nutritious as it contains appreciable amounts of vitamins B1, B2, B6 and B12 besides being rich in β-carotene. It also contains many important minerals. β-Carotene is a precursor of vitamin A and is reported to prevent cancer . The osmotic dehydration (OD) enables the water removal from the food by immersing the product in a hypertonic solution (of certain solutes). A water transfer takes place from the food product to the solution and a solid transfer from the solution to the food product (Matusek and Méresz, 2002). In this regard, the osmotic treatments, previous to air-drying process (Rastogi *et. al.*., 2004 andRevaskar *et. al.*., 2007) improve the nutritional, sensory and functional characteristicsof dehydrated food products. They may even improve the texture and the stability of pigments during the dehydration and storage of dehydrated products. Osmotic dehydration can be used to remove water from heat-sensitive products with low energy consumption at a low temperature. Since osmotic dehydration cannot remove moisture to a level that will prevent microbial growth, it is good as a preliminary partial dehydration step. While osmotic dehydration is a simultaneous process of water flow out and solid gain from osmotic agents, the gaining of osmotic agent can represent an added value in improving nutritional, sensorial and functional properties of the dried food.Singh *et. al.*., 2006 and Górnicki and Kaleta, 2007).

The objective of this investigation to study the effect of using various osmotic sucrose syrups as pretreatments for producing osmo-dried red carrotson dehydration parameters, physicochemical properties and microbial assessment as well as sensory evaluation was undertaken and during the storage for 6 month at ambient temperature.

MATERIALS AND METHODS

Materials

Redcarrots (Daucuscarota L) were obtained from El- Obour market, El- Obour city, Cairo, Egypt, at season 2011.

Methods

Preparation of red carrots

The red carrots were washed and peeled manually. The green parts of the carrots were removed to retain the uniform quality of the final product. Carrots were cut into slices

. The carrotsslices were washed withfresh water to remove the carrots fines adhering to the surface of the carrots, blanched at 90°C for 3 min., and then cooled with water. After that, eachpart was divided into 5 groups (T1, T2, T3, T4 and T5) carrots

Osmotic Dehydration

T1, T2, T3 and T4 were immersed in solutions of 40, 50, 60 and 70% sucrose syrup in the presence of 1% calcium chloride at 50°C for 12 hr. At the end of immersion the syrups were drained, and can be re-concentrated and re-used as osmotic agent for another osmotic process. While, the samples after draining rinsed quickly in a stream of tap water and blotted with tissue to remove the adhering solution. The obtained samples (T1, T2, T3, T4 and T5 control) were then weighed and dried in an oven at 50°C for about 23-32hr. according to type of osmosis solution used for pretreatment.

Packaging and storage

Samples were packed in poly ethylene bags of about 100g capacity with removing the air. Finally bags were sealed by heat and stored for 6 month at ambient temperature.

Analytical methods

The following variables were determined as described by Lerici *et. al.* (1985) for each sample: % water content (WC), water loss (WL), solid gain (SG) as g/100g fresh product, weight reduction (WR) and total solids% (T.S).

Physico- chemical analyses

Moisture content, total solids, ascorbic acid, total titratable acidity, total sugars, (reducing and non-reducing sugars), ash and crude fibers contents were determined according to the**A.O.A.C. (1995).**

Microbial analysis

Samples were serially diluted and plated on total count agar for total bacteria counts and on acidified (10% tartaric acid) potato dextrose agar for mold and yeast counts. Plates were incubated for 48 hr at 30ºC for total bacteria, and for 5 days for molds and yeasts **(APHA 1992)**.

Sensory evaluation

The method of sensory evaluationwas carried out by using five sensory characteristics (color, texture, taste, flavor and overall acceptability) of the osmotic dehydration and control dried carrots were performed by 10 trained panelists, assigned a score of each sensory characteristic according to 10 point category scales.

Statistical analysis

Statistical analysis was done by using the SAS statistical program (SAS, Statistical analysis system 1996)

For sensory evaluation was expressed as the mean values. To ascertain the significance among means of the treatments Duncan's multiple range was tested at significant level of $P < 0.05$.

RESULTS AND DISCUSSION

Chemical constituents of redcarrots are presented in table (1). It could be noticed that fresh redcarrots contain 86.40 % moisture content, 0.65 %protein ,0.15 % fat,6.80 %reducing sugar ,8.62 %total sugars ,1.2 5ash and 2.53 % crude fiber. On the other hand ,the total acidity in redcarrots was 0.25 while ,the ascorbic acid,total anthocyanin,calcium,phosphorus and iron were 60.25 ,170,35,30 and 0.80mg /100g fresh carrots

Table 1. Chemical constituents of fresh red carrots

Constituents	Value
Moisture %	86.40
Total solids %	13.60
Protein %	0.65
Fat %	0.15
Total carbohydrates %	9.07
Total sugar %	8.62
Reducing sugar %	6.80
Fiber %	2.53
Ash %	1.20
Ascorbic acid mg/100g	60.25
Total acidity	0.25
Total anthocyaninmg/100g	170
Calcium mg/100g	35
Phosphorus mg/100g	30
Iron mg/100g	0.80

Dehydration parameters of osmotic dried red carrots are shown in Table (2). The Brix concentration of T1,T2,T3and T4 solutions used for osmosis were 40,50,60 and 70 Brix just before processing of red carrotsat temperature 50°C. However, the concentration of osmoses solutions used for osmotic processing were lowered at the end of osmosis to become 35, 45, 52 and 60 Brix forT1,T2,T3and T4 solutions, respectively. This phenomenon presumably owing to the reduction of water diffusion coefficient in the product- solution interface as explained by (Lerici, *et. al.,* 1985). The osmosis timechanges the driving force of the drying process as the alteration of the type of osmosis solution.Meanwhile,thesolution of T4 had the lowest osmosis time for osmosis carrots followed by T3, T2, T1and T5, respectively.Its worth to know that, the sugars in the fruits were considered as a distinctively characteristics of the fruit varieties. As the equilibration time increase, the ratios between the various components showed considerable changes (Giangiacomo *et. al.,* 1987 and Salem and Hegazi 1973).

Consequently, the higher weight reduction of osmosis- dehydrated redcarrots was obtained with T4, followed by T3 (69.5%) T2 (69.7%) and T4 (67.3%), respectively compared with 74.8% for T5 control carrots product.However, dehydration parameters WL and WC were strictly related to the type and concentration of the osmotic solution used. The weight loss of osmosis carrots with T4 recorded the lowest one followed by T3, T2 and T1, respectively but a reversible trend was observed between the values of WC and osmotic solutions used for processing of osmosis dried carrots. It is interesting to observe that under the investigated conditions of osmotic conditions, the reduction time for dehydration can give a higher percent of T.S in the final products of osmosed dried carrots depending upon the type of osmotic solutions used. Results also indicated that, the pretreated osmosis dried carrots with osmosis syrups before drying increased the obtained solid gain than that for the untreated samples (control). Furthermore, the osmosis dried carrots pretreated with T4 had the highest solid gain followed by T3, T2, T1 and T5 respectively. These results may be explained by Taiwo et. al., (2001) and Tedjo et. al., (2002) who mentioned that, solid uptake during osmotic dehydration (OD) may not necessarily be a function of permeabilized cells alone but may also depend on the type of chemical and structural changes caused by the pretreatments. Also, the osmosis process reduced the time of dehydration of grapes compared with grapes dried with sun drying may be due to the choice of osmosis solution and the addition of NaCl to osmotic solutions which increased the driving force of the drying process. These results are correlated well with (Lerici *et. al.* 1985).

Table 2. Initial concentration of osmotic solution (°Brix) as well as conditions applied for drying and characteristics of osmotic redcarrots

Processing conditions	°Brix for treatment		Characteristics of osmosis red carrots						
	Before	After	Immersion time (hrs) of osmosis	WL (%)	WR (%)	WC (%)	SG	Dehydration time (hrs)	WL+SG (%)
T1(40% sucrose)	40	35	12	38.9	67.3	10.3	24.3	30	63.2
T2 (50% sucrose)	50	45	12	40.6	69.0	10.1	25.1	27	65.7
T3(60% sucrose)	60	52	12	41.3	69.5	10.0	25.5	28	66.8
T4(70% sucrose)	70	60	12	50.3	70.0	9.90	26.4	24	76.7
T5 control		-	-	-	74.8	9.93	18.7	37	-

- WL: water loss, WR: weight reduction, WC: water content, SG: solid gain.

** Values are the mean of three independent determinations.

Effect of storage period on physico- chemical properties of osmosis dried red carrotsfor 6 month at ambient temperature

Effect of storage period up to 6 months at ambient temperature on physicochemical properties of both osmo-dried and untreated red carrots are shown in Table (3). Results indicate that, the moisture content was 86.40 for fresh carrots. While the average ratios of moisture contents of osmo-dried red carrots pretreated with different osmosis solution just after processing were 15.11 to 15.75% but it was 15.88 for the control carrots. Also, a little increment in moisture contents were recorded with progress of storage period for all tested samples and reached to the maximum at the end of storage after 6 months of storage at ambient temperature, but still being little than that T5 control carrots after 6 months.

Total solids of fresh red carrots were 13.6 %. While, the total solids ranged from 84.89 to 84.25 % for osmo dehydrated red carrots just after processing, respectively.. Subsequently, a little increment in total solids for osmo-dried red carrotswas found as affectedby the progressive period of storage up to 6 months and its impacts by the type of osmotic solution used for retreating of both carrotssamples before drying.

The stabilization of ascorbic acid during processing is important not only from the nutritional point of view but also because ascorbic acid degradation accelerates non enzymatic browning reaction, which not only cause changes in color but can affect flavour adversely (Paakkomen and Mattiala 1991). According to El-Gharably et.al., (2009),, the main mechanisms of vitamin C losses appear to be due to water solubility and mass transfer, heat sensitivity, and enzymatic oxidation.

The content of ascorbic acid was 60.25 mg/100g on fresh weight basis for red carrotsas shown in (Table3). Meanwhile, the ascorbic acid contents ranged from 89.20 to 94.32 mg/100g on dry basis for osmo-dried red carrots immediately after processing, respectively. However red carrots pretreated with T4 had the highest ascorbic acid content immediately after processing followed by T3, T2and T1, respectively. But T5 control carrots had the highest ascorbic acid content compared to that in osmo dehydrated red after processing. The ascorbic acid content decreased gradually with increasing the time of storage for both osmo dehydrated and control samples by extending the storage periods up to 6 months but the greatest reduction was observed for control samples. The reduction of ascorbic acid for osmo-dried red carrots may be due to the native content of, ascorbic acid in carrots, the type of osmosis solutions used, the immersing time in osmosis solution, the temperature of dehydration process and extending shelf life at ambient temperature. These results coincide with Shastry and Hartel (1996) and El-Gharably et. al., (2009) who mentioned that, during the first four months of osmo dehydrated cherries there was a decrease in ascorbic acid, while in the last two months, a further decrements were found.

The initial total acidity of fresh red carrots was 0.25% whereas, the same of theosmodehydrated carrots pretreated with different tested osmosis solutions were in the range of 1.11-1.21%, respectively. Just after processing depends on the choice of osmosis solution for pretreatment before drying. However, the control carrots recorded titratable acidity of 1.01 %.

On the other hand, findings in Table (3) show that, the values of sugar contents in fresh red carrotswas 8.62 % in which reducing sugars are the predominant sugars in both cultivars recording 6.80 %. Results also indicated that, both these categories of samples showed little changes in total sugars in spite of using different types of osmosis solution for pretreatment before the drying process. Meanwhile, the amount of reducing sugars just after processing ranged between 51.69 to 56.50% for osmosed dried red carrotssamples where, the corresponding values of non reducing sugars were about 13.51 and 14.40% for all osmo-dried redcarrots. The control carrots had less total sugars than the osmodehydrated samples. Results showed a little change in total, reducing and non reducing sugars during storage at ambient temperature up to 6months of storage. These results are similar to that reported by Taiwo, et. al., (2001).

From Table (3) it could be also observed that, the values of ash and crude fibers incarrots were (1.20 and 2.53%). The ash content forosmosed dried red carrotspretreated with various osmotic solutions just after processing recorded 3.41 – 3.51% in all samples, respectively and greater decrease during storage of all samples up to 6 months was observed. While crude fibers ranged between 9.53– 9.75% for osmo-dried red carrotssamples, respectively, but it was 9.33% for control dried carrots. On the other hand, a little gradual reduction of crude fibers was noticed with extending the shelf-life of both osmo-dried and control-dried carrots up to 6 months of storage at ambient temperature.

Table 3. Effect of storage period up to 6 months at ambient temperature on physico-chemical properties of osmo-dried red carrotstreated with various osmotic solutions

Constituents			Moisture %	Total Solids %	Ascorbic acid (mg/100g)	Total Acidity %	Total sugars %	Reducing sugars%	Non-reducing sugars%	Ash %	Crud fiber %
		Fresh carrots	86.40	13.60	60.25	0.25	8.62	6.80	1.82	1.20	2.53
Storage period (month)	Initial period	T1	15.75	84.25	90.15	1.11	65.20	51.69	13.51	3.41	9.75
		T2	15.42	84.58	89.20	1.16	66.90	53.10	13.80	3.46	9.55
		T3	15.30	84.70	93.62	1.18	68.80	54.70	14.10	3.49	9.50
		T4	15.11	84.89	94.32	1.21	70.90	56.50	14.40	3.51	9.53
		T5	15.88	84.12	96.45	1.01	64.21	49.90	13.31	3.36	9.33
	After 3 month	T1	15.97	84.03	81.72	1.14	64.10	50.89	13.21	3.39	9.50
		T2	15.83	84.17	83.62	1.18	65.21	51.49	13.72	3.44	9.42
		T3	15.80	84.20	85.42	1.20	67.60	53.65	13.95	3.47	9.44
		T4	15.40	84.60	88.23	1.24	69.11	54.85	14.26	3.48	9.47
		T5	16.01	83.99	90.12	1.11	64.70	51.50	13.20	3.33	9.27
	After6 month	T1	16.12	83.89	78.15	1.20	63.17	50.02	13.15	3.34	9.39
		T2	15.91	84.09	79.92	1.22	63.90	50.28	13.62	3.41	9.36
		T3	15.88	84.12	81.32	1.25	66.71	53.01	13.70	3.43	9.39
		T4	15.70	84.30	84.15	1.27	67.45	53.25	14.20	3.44	9.41
		T5	16.30	83.70	86.92	1.16	63.10	50.12	12.98	3.27	9.18

**Values are the mean of three independent determinations

Microbiological assessment

Table (4) shows the assessment of total microbial bacteria and the yeast and molds during storage ofosmo-driedred carrotspretreated by various osmotic solutions as well as the control-during storage up to 6 months at ambient temperature. The behaviour of the different groups of microorganisms (total microbial bacteria, yeast and molds) immediately after osmo dehydration and the control was quite different depending upon the type of pretreatment used before dehydration. The control carrots just after processing had the highest total microbial bacteria (9.1 x 10^2cfu/g) followed by (3.3 x 10^2 , 5.2 x 10^2, 3.7 x 10^2 and 2.6 x 10^2cfu/g),for osmo-dried red carrotspretreated by immersing with syrups of 40, 50, 60% sucrose syrup and 70%sucrose syrup respectively. Results, also indicated that, yeast and molds in osmo dehydrated red carrotshad markedly lowest counts than the control samples depending upon the type of pretreatment with osmosis solution, where the total counts of yeast and molds micro bacteria ranged from 1.22 x 10^2 to 0.92 x 10^2cfu/g for samples of osmodehydrated redcarrots. Thus, the pretreatment with osmosis solution before dehydration was more efficient for reduction either for total microbial bacteria or total counts of yeasts and molds. However, pretreatment with T4 and T3 for osmo-dried carrots were more effective and caused higher reduction of total counts followed by T2 and T1 respectively, immediately after processing of carrots. Meanwhile, osmodehydrated and the control sample of red carrotscaused gradual increment of reductions or eliminated for total viable counts in relation to the extending period of storage. Also, the viable microbial population gradually decreased during storage of samples tested by extending the time of storage which recorded the lowest total viable counts of total microbial bacteria, yeast and molds at the end of 6 months of storage. Subsequently, both total counts of bacteria and (yeast & molds)bacteria growth decreased and reached the lowest level for all samples tested after 6 months of storage at ambient temperature compared with those values just after processing. In other words, the inactivation and/or the death of all tested counts of microorganisms showed to be proportional with extending the storage time and reached the maximum reduction after 6 months of storage. This trend of decreasing for total microbial counts, yeast and molds was correlated well with the type of osmotic solution used in pretreatment before dehydration, and extended storage period.

Table 4. Population of total microbial bacteria and yeasts & molds for Osmo-driedred carrotspretreated with various osmotic solutions during storage for 6 month at ambient temperature

Parameters			Redcarrots	
			Total count (cfu/g)	Yeast& mold count (cfu/g)
Storage period (month)	Initial period	T1(40% sucrose)	6.3×10^2	1.22×10^2
		T2(50% sucrose)	5.2×10^2	1.10×10^2
		T3(60% sucrose)	3.7×10^2	0.98×10^2
		T4(70% sucrose)	2.6×10^2	0.92×10^2
		T5(control)	9.1×10^2	1.94×10^2
	After 3 month	T1(40% sucrose)	5.2×10^2	1.12×10^2
		T2(50% sucrose)	4.1×10^2	0.94×10^2
		T3(60% sucrose)	2.8×10^2	0.90×10^2
		T4(70% sucrose)	2.0×10^2	0.83×10^2
		T5(control)	7.9×10^2	1.54×10^2
	After6 month	T1(40% sucrose)	3.4×10^2	0.98×10^2
		T2(50% sucrose)	3.2×10^2	0.82×10^2
		T3(60% sucrose)	2.1×10^2	0.73×10^2
		T4(70% sucrose)	1.5×10^2	0.70×10^2
		T5(control)	4.6×10^2	1.00×10^2

Values are the mean of three independent determinations * cfu = colony forming unit

Sensory evaluation of osmo-dried redcarrots:

The analysis of variance for color, texture, taste, flavour and overall acceptability for the processed red carrotsjust after processing and during storage up to 6 month at ambient temperature are shown is Table (5). Analysis of variance indicated that a significant difference in color, texture, taste, flavor and overall acceptability averaged between dehydrated samples tested correlated well with the type of osmotic syrups used for pretreatment of osmo-dried redcarrots. Also, a little significant difference averaged between samples pretreated with syrups of T3 (60% sucrose) and T4 (70%sucrose syrups) just after processing and by extending the shelf life up to 6 months. Osmo-dried carrots pretreated with 70% sucrose syrup recorded the highest values of sensory attributes followed by 60% sucrose, 50% sucrose and 40% sucrose respectively compared with the control dried red carrotswhich recorded the lowest sensory scores. Consequently, there were significant differences between osmo-dried carrots samples stored for 0, 3 and 6 months at ambient temperature depeningupon the type of treatment used and extending the shelf life. On the other hand, the osmo-dehydrated red carrotspretreated by 70% sucrose had the highest scores of all tested sensory parameters followed by that pretreated with 60%, 50%, 40%sucrose syrup and the control respectively. Therefore, it seems that the decline of sensory scores was pronounced for control-dried samples stored for 6 months compared with those for theosmo-dried redcarrots.

Table 5. Sensory evaluation of dried and osmo-dried red carrots during storage for 6 month at ambient temperature

Osmotic solution used before dehydration process			T1 40% sucrose	T2 50% sucrose	T3 60% sucrose	T4 70% sucrose	T5 control
Carrots							
Quality attributes of osmodriedcarrots during storage	Initial period	Color	7.0^{c}	7.4^{c}	8.6^{b}	9.6^{a}	6.1^{d}
		Texture	7.1^{c}	7.4^{c}	8.4^{b}	9.2^{a}	6.2^{d}
		Taste	7.3^{c}	7.5^{c}	8.2^{b}	9.1^{a}	6.0^{d}
		Flavour	7.1^{c}	7.1^{b}	8.2^{b}	8.6^{ab}	6.0^{d}
		Overall acceptability	7.2^{c}	7.3^{c}	8.1^{b}	9.2^{a}	6.1^{d}
	After 3 month	Color	6.7^{c}	7.3^{c}	8.3^{b}	8.6^{b}	5.9^{d}
		Texture	6.8^{c}	7.2^{c}	8.2^{b}	8.7^{b}	5.8^{d}
		Taste	6.6^{c}	7.1^{c}	8.1^{b}	8.8^{b}	5.9^{d}
		Flavor	6.7^{c}	7.1^{c}	7.9^{c}	8.5^{b}	5.8^{d}
		Overall acceptability	6.6^{c}	7.0^{c}	7.6^{c}	8.6^{b}	5.7^{d}
	After6 month	Color	6.6^{c}	6.9^{c}	7.7	8.3^{b}	5.8^{d}
		Texture	6.5^{cd}	6.9^{c}	7.5^{c}	8.4^{b}	5.6^{d}
		Taste	6.3^{c}	6.4^{cd}	7.4^{c}	8.3^{b}	5.7^{d}
		Flavor	6.2^{d}	6.5^{d}	7.6^{c}	8.2^{b}	5.6^{d}
		Overall acceptability	6.5^{c}	6.8^{c}	7.5^{c}	8.2^{b}	5.7^{d}

Mean with different symbols in the horizontal columns significantly different at P≤0.05.

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تأثير التجفيف الأسموزي علي الخواص الطبيعية والكيميائية للجزر الأحمر

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أجريت هذه الدراسة بهدف تقييم عينات الجزر المنتج بالتجفيف الأسموزي والمعامل بتركيزات مختلفة من السكروز 40%و 50% و60% 70% سكروز ومقارنتها بالعينة الغير معاملة (كنترول). هذا وقد أوضحت لدراسة أن أقل وقت لإتمام الاسموزية كان باستخدام تركيز 70% من السكروز كمعاملة ابتدائية لتجفيف الجزر تلاه تركيز 60% ثم تركيز 50% ثم تركيز 40% من شراب السكروز علي التوالي. هذا ولقد أدي اختزال وقت التجفيف إلي إمكانية الحصول علي نسبة عالية من المادة المجففة للجزر المجفف وكذلك كمية المادة الصلبة مقارنة بتلك المتحصل عليها بالعينة الكنترول. والأكثر من ذلك فقد لوحظ أن دلالات التجفيف مثل فقد الرطوبة والمحتوي الرطوبي كان ذو ارتباط واضح بتركيز المحاليل الاسموزية المستخدمة للحصول علي المنتجات المجففة اسموزيا بعد المعاملة مباشرة وكذلك أثناء التخزين لمدة 6 شهور علي درجة حرارة الغرفة يضاف إلي ذلك أنه قد أخذ في الاعتبار دراسة الخواص الطبيعية والكيماوية والتقييم الميكروبيولوجي وخصائص الجودة للعينات المجففة مباشرة بعد التصنيع وكذلك أثناء تخزينها علي درجة حرارة الغرفة لمدة 6 شهور.

هذا وقد بينت الدراسة أن الجزر المجفف اسموزيا والمعامل ابتدائيا بتركيز 70% من شراب السكروز كان أكثر احتفاظا بمحتواه من فيتامين ج تلاه ذلك الذي عومل ابتدائيا بتركيز60% ثم تركيز50% ثم تركيز 40% من شراب السكروز علي التوالي. هذا وقد تراوح محتوي الجزر المجفف اسموزيا من السكريات المختزلة من 51.69 – 56.50% مباشرة بعد التجفيف الاسموزي بينما تراوحت تلك النسبة لكلاهما من الألياف علي 9.53–9.75% باستخدام الأنواع المختلفة من المحاليل الاسموزية. هذا وقد كانت نتائج العد الكلي للميكروبات عالية في عينات الجزر الغير معاملة (9.1 X10^2 خلية مكونة لمستعمرة / جم) ثم كانت 6.3 X10^2 للعينات المجففة اسموزيا والمعاملة ابتدائيا بتركيز 40% سكروز ثم 5.2 X10^2خلية مكونة لمستعمرة/ جم للمعاملة ابتدائيا بتركيز 50% سكروز ثم 3.7 X10^2 للعينات المجففة اسموزيا والمعاملة بتركيز 60% سكروز،ثم (2.6 X10^2خلية مكونة لمستعمرة / جم للعينات المجففة اسموزيا بتركيز 70% سكروز. ومن ناحية أخري فلقد لوحظ من الدراسة حدوث انخفاض تدريجي في المحتوي الميكروبي الكلي وكذلك الفطر والخميرة بزيادة فترة التخزين حيث وصلت إلي أقل معدلاتها بعد 6 شهور من التخزين علي درجة حرارة الغرفة.

هذا ولقد سجل التقييم الحسي للجزر المجفف اسموزيا والذي عومل ابتدائيا 70% سكروزأعطي أعلي القيم لخواص اللون، القوام ، والطعم ، النكهة والقبول العام تلاه ذلك الذي عومل ابتدائيا بتركيز 60% ثم تركيز 50% و تركيز 40% من شراب السكروز بعد التصنيع مباشرة وكذلك بعد التخزين لمدة 3 و 6، اشهر علي درجة حرارة الغرفة مقارنة بالعينة الغير معاملة (كنترول) والتى سجلت أقل القيم في خصائص التقييم الحسي.

وعلي ذلك فقد أوضحت الدراسة أن المعاملة الابتدائية بالمحاليل السكرية الاسموزية لإنتاج منتجات مجففة اسموزيا تلعب دورا هاما في الحصول علي منتجات ذات خصائص جودة عالية مقارنة بتلك التى لم تعامل اسموزيا.