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ASCORBIC ACID AND QUALITY RETENTION IN ORANGE SQUASH AS RELATED TO EXPOSURE TO LIGHT AND CONTAINER TYPE

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The effect of flourescent light (20 Ft-C) and packaging material on the physicochemical and organoleptic characteristics of orange squash stored at room temperature (22.5-35^{o}) was studied. More ascorbic acid was retained and better sensory quality characteristics (colour and flavour) were maintained in the samples stored under darkness than those kept under flourescent light. As far as the container type was concerned, amber and green glass bottles proved superior for the retention of both ascorbic acid and organoleptic characteristics of orange squash as compared to uncoloured glass, white polyethylene and poly vinyl chloride bottles.

Key words. Flourescent light; Container type, Ascorbic acid.

INTRODUCTION

The use of proper packaging material to minimize the deleterious effect of light on various food products has been extensively advócated [1-4]. Citrus squashes are popular summer drinks of Pakistan. Citrus fruits are rich in ascorbic acid and the retention of this vitamin in citrus products like squashes during storage is very important from the nutritional point of view. Squashes are stored under flourescent light in retailer shops. Ascorbic acid is reported to be photosensitive vitamin [4-6]. Light induced changes, therefore, might have deleterious effect on ascorbic acid content and other quality indices of squash samples stored under flourescent light. This study was undertaken with the view to investingating the effect of light and container type or the physicochemical and organoleptic characteristics of orange squash during storage at room temperature.

MATERIALS AND METHODS

Good quality oranges (Valencia Late) were procured from the local market and washed under running tap-water. The juice was extracted with a hand-operated juice extractor, strained through single fold muslin cloth and collected in a stainless steel container. Freshly extracted juice had a Brix of 8^{o} and titratable acidity of 0.50 g per 100 ml. The orange squash was prepared by mixing an equal amount of cane sugar with freshly extracted juice and then citric acid was added at a level of 1 %. Freshly prepared squash on analysis gave 54.4^{o} Brix, 1.34 g per 100 ml titratable acidity and 27.90 mg per 100 ml ascrobic acid. The squash was preserved with 0.061 % potassium metabisulphite (350 ppm SO_2). The following five type of containers were used for storing orange squash.

Bottles	Average thickness
(i) Uncoloured glass	2.58 mm
(ii) Green glass	2.53 mm
(iii) Amber glass	2.55 mm
(iv) White polyethlene	0.83 mm
(v) Poly vinyl chloride	0.99 mm

The squash was divided into five equal lots and stored into the above mentioned hermetically sealed sterilized bottles. Half of the squashes of each container type were kept in dark and the other half were kept under flourescent light (20 Ft-C) for subsequent analysis at room temperature (22.5 to 35^{o}).

Ascorbic acid, acidity and total soluble solids (TSS) of different squash samples were determined according to the methods of AOAC (7). TSS and acid ratio was determined by dividing the former by the latter. Organoleptic evaluation of different squash samples was carried out by a panel of ten judges adopting a numerical score method [8]. A scale of 0 to 10 was used where 0 was disliked extremely and 10 liked extremely. All the data was analysed statistically by split-split plot design [9].

RESULTS AND DISCUSSION

(1) *Ascorbic acid.* Results regarding the effect of flourescent light and packaging material on the ascorbic

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acid content of orange squash stored at room temperature (22.5 to 35°) are presented in Table 1. Different types of packaging material had significant ($P < 0.01$) effect on the retention of ascorbic acid. Maximum ascorbic acid was retained in squash samples stored in amber and green colour glass bottles. This was followed by uncoloured glass and poly vinyl chloride bottles and minimum ascorbic acid was retained in squash samples stored in white polyethylene bottles.

Storing of squash samples in flourescent light of intensity of 20 Ft-C resulted in significant decrease ($P < 0.01$) in ascorbic acid content as compared to those kept in darkness. Average loss of ascorbic acid of orange squash packaged in uncoloured, green and amber colour glass bottles, and white polyethylene and poly vinyl chloride bottles during five months' storage in darkness was 33.7, 22.4, 22.9, 41.7 and 37.4 %, respectively. However, comparable samples stored in flourescent light lost 42.4, 29.1, 25.3, 48.0 and 49.6 % ascorbic acid, respectively.

Besides storage temperature, light and the properties of packaging material were the major factors determining the loss of ascorbic acid during the storage of kraut [5], tomato paste [6] and Boysonberry puree [10]. Packaging materials were considerably effective in protecting ascorbic acid against light. No significant decrease of ascorbic acid was observed in pasteurized orange juice packaged in tin cans. However, considerable losses were found in some of the plastic bags [11]. Packaging of single strength orange juice in crown capped glass bottles resulted in better retention of ascorbic acid. Hermetically sealed polyethylene containers were next while losses were greater in polystyrene bottles and waxed cartons [12]. Ahmad *et al.* [4] while studying the effect of different packaging material and light on orange juice reported that losses in light exposed packages were much higher with a reconstituted orange drink than with orange juice. Drinks packaged in plastic bottles face the problem of diffusion of gases and water vapours through the walls of the container [13]. This diffusion of gases (especially oxygen) might be responsible for more loss of ascorbic acid in plastic bottles in present investigation [10]. Other probable reasons could be thin walls as well as the package material.

(ii) *Total soluble solids and acid contents.* Different types of packaging material had no significant effect on TSS, total acid content and their ratio in orange squash during storage. Total acid contents were significantly ($P < 0.01$) higher in samples kept in darkness whereas TSS/acid ratio was significantly ($P < 0.01$) lower in these samples than those kept under flourescent light (Table 2). Increase in TSS/acid ratio during storage of squash was understandable as there was significant decrease ($P < 0.01$) in total acid contents, and significant increase ($P < 0.01$)

Table 1. Effect of flourescent light (20 Ft-C) and packaging material on percent retention of ascorbic acid content of orange squash stored at room temperatue (22.5 to 35°)

Storage period (months)	Packaging material: Uncoloured		Green glass		Amber glass		White poly-ethylene		Poly vinyl chloride		Mean		Mean (storage period)
	D	L	D	L	D	L	D	L	D	L	D	L	
1.	85.0	80.0	90.0	76.7	86.9	83.3	80.0	73.3	83.3	62.8	85.0	72.2	80.1 a
2.	82.8	75.6	86.8	82.9	75.6	82.8	82.9	64.8	57.6	61.2	78.4	70.6	74.5 b
3.	59.6	52.5	73.4	69.9	76.9	75.2	55.9	48.9	59.4	48.9	65.0	59.1	62.05 c
4.	55.9	42.0	42.3	65.8	72.7	69.3	48.9	41.9	52.4	41.9	59.8	52.2	56.0 d
5.	48.2	38.0	68.9	66.3	66.4	62.9	41.9	38.5	41.9	37.2	53.5	48.6	51.1 d
Mean	66.3	57.6	77.6	70.9	77.1	74.7	58.3	52.0	62.6	50.4	68.34 A	61.14 B	
Mean (Packaging material)	61.95 b		74.25 a		75.90 a		55.20 c		56.50 c				

D = Darkness L = Light Figures followed by different letters are significantly different at 1 % level.

Table 2. Mean values showing the effects of flourescent light (20 Ft-C) and storage period (22.5 – 35o) on the physicohemica characteristics of orange squash.

Physicochemical characteristics	Storage period (months) 0	1	2	3	4	5	Mean
Total Soluble							
Solids TSS (%)	54.40	54.08	54.88	55.30	55.40	55.84	55.08 a
Light	54.40	54.04	55.08	55.26	55.50	55.84	55.19 A
Mean	54.40	54.06	54.96	55.29	55.45	55.84	
	a	b	b	c	c	c	d
Acidity (g citric acid/100 ml)							
Darkness	1.34	1.29	1.26	1.20	1.21	1.16	1.24 A
Light	1.34	1.24	1.21	1.17	1.16	1.09	1.21 B
Mean	1.34	1.26	1.24	1.18	1.18	1.12	
TSS/Acid (ratio)							
Darkness	40.60	42.14	43.30	45.52	45.64	48.36	44.26 A
Light	40.40	44.52	45.12	45.94	47.64	51.58	45.90 B
Mean	40.50	43.33	44.21	45.73	46.64	49.97	
	a	b	c	d	e	f	

Storage temperature (22.5 – 35°); Figures followed by different letters are significantly different at 1 % level.

Table 3. Mean scores (0-10)* showing the effect of flourescent light (20 Ft-C) and packaging material on the organoleptic characteristics of orange squash stored at room temperature (22.5 to 35.0°).

Organoleptic characteristics	Packaging Material: Uncolour-glass	Green glass	Amber glass	White polyethylene	Poly (vinyl) chloride	Mean
Colour						
Darkness	7.20	7.13	7.53	6.16	6.43	6.89 A
Light	6.43	7.16	7.13	6.20	6.26	6.64 B
Mean	6.81	7.15	7.33	6.18	6.35	
	ab	a	a	b	b	
Flavour (Odour + taste)						
Darkness	6.73	6.20	7.20	6.26	5.86	6.56 A
Light	6.36	6.39	7.00	5.40	5.56	6.23 B
Mean	6.55	6.58	7.10	5.83	5.66	
	ab	a	a	b	b	

* Average of organoleptic scores taken after 0, 2 and 5 months storage of squash.

0 = Disliked extremely. 10 = Liked extremely

Figures followed by different letters are significantly different at 1 % level.

in TSS.

(iii). *Organoleptic characteristics.* Packaging material as well as flourescent light had significant effect ($P < 0.01$) on colour and flavour (odour and taste) of orange squash stored at room temperature (Table 3). Squash samples packaged in amber and green colour glass bottles were given higher colour and flavour scores than those stored in uncoloured glass, white polyethylene and plyvinyl chloride bottles. Samples stored in the dark also secured more sensory scores than those kept under flourescent light. Sedky *et al* [1] observed that flourescent light seemed to have a browning effect in the discolouration of Kraut [5]. Flavour changes due to light in orange juice occurred quickly in glass and plastic packaged orange juice than in paperboard juices [4]. Intensification of colour of red wine and beer by prolonged exposure to light have been reported by Sato *et al.* [14].

Squash samples packaged in green and amber colour glass bottles retained maximum ascorbic acid content and got higher colour and flavour scores. This confirms the view that colour and flavour changes occurring in fruit and vegetable products during storage run parallel with the progressive decrease in the amount of ascorbic acid [15]. Darkening of citrus juice during storage has been shown to occur after ascorbic acid has been irreversibly oxidized [16]. The fact that the browning of citrus juice can be caused by the degradation of ascorbic acid was shown by Moore [17] who observed that additional quantitities of ascorbic acid in citrus juices increased the formation of brown pigments even more. Specific range of wavelength of visible light is responsible for quality deterioration in foods [18,19,20]. Maintenance of good colour and flavour and higher retention of ascorbic acid in coloured glass bottles packaged squash samples might be due to the fact that they behaved as a shield and removed the deleterious region of the wavelength.

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