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STUDIES ON AROMA COMPOUNDS OF APRICOT – CARROT NECTAR

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Abstract

Apricot (*Prunus armeniaca*) is one of the most important, popular and delicious fruits grown in Egypt . It is well known that its season is very short . This study was carried out to produce a new and untraditional product namely, apricot-carrot nectar possessing high quality attributes. The effect of storage period on physio-chemical properties and volatile components on the best selected nectar sample was also investigated. The results obtained reveal that ascorbic acid was higher in apricot pulp than that of carrot juice while the latter was characterized by having high content of total carotenoids. Carrot juice contained higher total sugars (6.13%) compared to that of apricot pulp (5.39%) . Fructose was the predominant sugar in apricot pulp while sucrose was the main sugar in carrot juice .

Aromatic volatile components of apricot pulp and carrot juice were separated and identified using the GC technique. Esters were the first major groups identified in the aroma compounds of apricot pulp and carrot juice which represented 43.39 % and 98.26 % , respectively . Alcohols, aldehydes, hydrocarbons and lactones were also detected.

Hydrocarbons were the first major groups isolated and identified in the aroma of apricot-carrot nectar which decreased from 70.31% to 13.63% after the storage period. Alcohols, aldehydes and lactones were highly increased at the end of storage of the nectar while hydrocarbons and ester groups followed a significant decrease.

The addition of carrot juice in the ratio of 40% to apricot pulp produced nectar possessing the best organoleptic qualities .

INTRODUCTION

Apricot (*Prunus armeniaca*) is considered as one of the most popular fruits grown in Egypt and which are usually consumed either in the fresh form or as processed products. Yellow carrot roots also (*Daucus carota* L.) are among the oldest vegetable crops grown in Egypt. It is well known that large quantities of yellow carrots are widely processed into canned, frozen, dehydrated and/or pickled products. The best varieties of yellow carrots are usually characterized by having high content of carotenoids, sugars and minerals. Besides, its total acidity is low while apricot fruits usually contain high total acidity with low sugar content compared to carrot. Both yellow carrot roots and apricot fruits are good sources of carotenoids especially β– carotein

which is considered as a precursor of vitamin A which is very essential in human nutrition (Hamed, *et al.* 1999 and Sheashea, *et al.* 2002). Aroma is a criterion of fruit quality, quality tests involving a certain number of measurements of sensory evaluation .. In contrast to apricot, few studies were accomplished about the aroma and flavor of carrots. Major volatile compounds known to contribute to carrot aroma, are terpenes and sesquiterpenes including sabinene, terpinenes, caryophyllene and β– bisabolene. Although, fresh carrot flavor has been attributed to high sugar levels , predominant terpenoid volatiles such as terpinolene and caryophyllene provided an important impact.

In Egypt, four major varieties of apricots, namely, El-Amar, Fayoumy, Hamawy and Kaneno (new variety) were planted in 18564 feddans producing about 71191 tons of fruits. As for yellow carrot, Chantenay is the best variety, which planted in 9397 feddans and producing about 111179 tons (Anonymous ,2001). Since the apricot season in Egypt is very short, it is our task to prolong the apricot consumption period in the local market through processing and preservation technology and the possibility of producing some new untraditional and delicious nectar products prepared from different mixtures of apricot pulp and carrot juice .

MATERIALS AND METHODS

Materials

Apricot Fruits (*Prunus armeniaca*) Balady variety and yellow carrot roots (*Daucus carota* L.) were obtained from an orchard near Kaluobia governorate, Egypt .

Methods

1- Preparation of nectars

Apricot fruits were sorted, washed and pitted meanwhile, yellow carrot roots were sorted, washed, scrapped and cut into small spieces. Both apricot fruits and yellow carrots in small spieces were blanched for five and fifteen minutes, respectively . Carrot juice was extracted by Brown juicer then mixed with ratios namely (10, 20, 30, 40, 50 and 60%) to blanched apricot pulp to prepare apricot -carrot nectar. Sugar was added to adjust the total soluble solids of processed nectar to 18%. Nectar samples were stored under cold temperature (at 4^{o}C for 6 months) until using for analysis.

2- Analytical Methods.

Moisture content, total soluble solids, total titratable acidity, ash, crude fiber,

protein, fat, ascorbic acid contents and total caroteniods as β -carotene, were determined according to the methods described in the A.O.A.C (1990).

- The pH value was measured at 25°C using Fisher Accument pH meter, Model (825MP).

- Minerals (Potassium, Calcium, Magnesium and Iron) were determined after ashing using atomic absorption PYe Unican Spectrophotometery Sp, England (Kasai, *et al.* 1997).

- Sugars were determined according to the method described by Macherey (1992) by using HPLC (Hewlett Packard 1050) whereas extracted sugars were injected using RI detector (Shodex RI-71) at the Central Laboratory of Horticultural Res. Institute. The standard sugars (Sigma Comp.) were prepared and used to calibrate the HPLC. HPLC chromatogram of standard sugars is shown in Fig. (1).

- Volatile components, were extracted and separated using gas chromatographic – mass spectrometric (GC. MS) analysis as described by Guichard and Souty (1988). The isolated volatiles were subjected to GC-MS analysis using a Varian 3400 GC equipped with DB-5 capillary column (60M x 0.25 mm i.d.) and coupled with a Finnigen –Mat 55 Q 7000. Helium was used as the carrier gas, flow rate 1.1 ml/min. , the column temperature was maintained initially at 50°C for 6 min., then programmed from 50 to 250°C at a rate of 4°C /min. The injection voltage applied was 70 eV., mass range m/z 39-400. Isolated peaks were identified by matching with data from the library of mass spectra (MST) and compared to those of standard compounds and published data (Adams, 1995). The quantitative determination was carried out depending upon peak area integration.

3-Organoleptic evaluation.

Color, taste, flavor and overall palatability of apricot-carrot nectar were evaluated by ten panelists directly after preparing in the Food Technology Res. Institute. Values given by panelists were statistically analyzed according to Roscoe (1969).

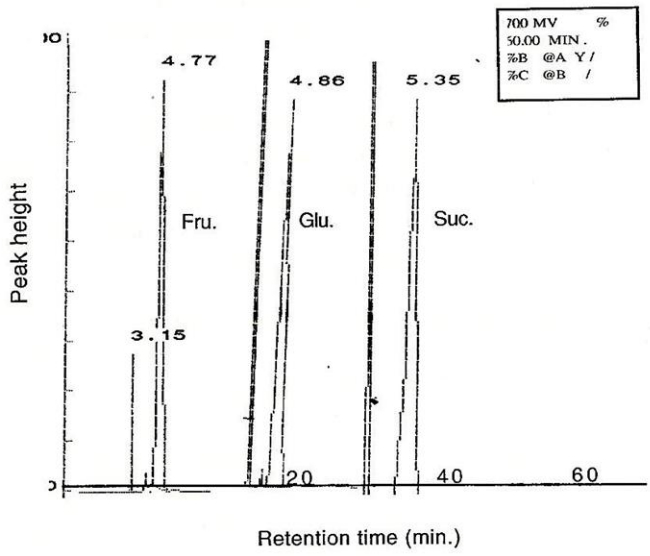


Fig (1) : HPLC Chromatogram of standard sugars.

1- Chemical compositions of fresh apricot pulp and carrot juice.

From the data shown in Table (1), it could be observed that moisture content of carrot juice was higher than that of apricot pulp (87.30% and 85.33%, respectively). On the other hand, total soluble solids content of apricot pulp was higher than that of carrot juice (11.88% and 10.90%, respectively) . From the same table, it could be concluded that total titratable acidity in apricot pulp was about eight folds of that in carrot juice (1.75 and 0.22g/100 gm, respectively). These results are in agreement with those reported by Hamed , *et al.* (1999) and El-Sayed, (2000) who demonstrated that apricot fruits were more acidic than carrot juice. The pH value was higher in carrot juice than that of apricot pulp but there is no great difference in the ash content of apricot pulp and carrot juice (0.67% and 0.71% , respectively).

From the data presented in the same table , apricot pulp and carrot juice have low contents of both crude fiber and fat contents . The crude fiber content was 1.1 and 0.88% whereas the fat content was 0.25 and 0.33% for apricot pulp and carrot juice , respectively . The protein content was higher in carrot juice 1.18% than the apricot pulp 0.75% . Also, ascorbic acid content was higher in the apricot pulp compared carrot juice Table(1). Total carotenoids were also determined in both samples . Carrot juice showed higher contents of total carotenoids than those of apricot pulp . Minerals (K,Na, Ca , Mg and Fe) were determined in both samples which were considered as moderate sources of minerals . However, both have high contents of K (281 and 341 mg/100 gm for apricot pulp and carrot juice , respectively) .

Table (1): Chemical composition of fresh apricot pulp and carrot juice

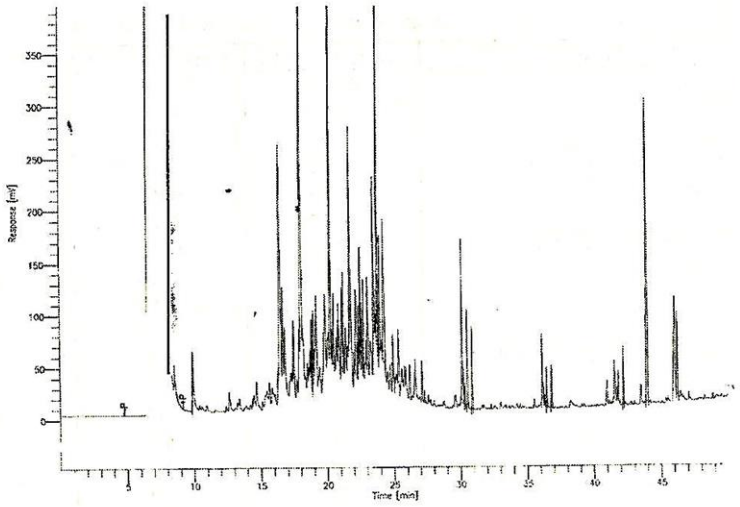
*Constituents%	Apricot pulp	Carrot juice
Moisture	85.33	87.3
T.S	14.67	12.7
T.SS	11.88	10.9
Total acidity (g/100gm)	1.75	0.22
pH value	3.86	6.46
Ash	0.67	0.71
Ascorbic acid (mg/100 gm)	17.45	8.15
Crude fiber	1.1	0.88
Protein	0.75	1.18
Fat	0.25	0.33
Total carotenoids (mg/100 gm)	5.43	8.8
Minerals (mg /100 g)		
K	281	341
Na	1	47
Ca	30	39
Mg	12	23
Fe	1.1	0.8

* On wet weight basis

2-Volatile components of fresh apricot pulp and carrot juice.

2.1- Fresh apricot pulp

The volatile components of fresh apricot pulp were separated and identified using the gas chromatography (GC). Fig. (2) shows the GC chromatogram of the volatile components. Meanwhile , the volatile components of fresh apricot pulp and their concentrations are given in Table (2). The identified volatile component groups included alcohols , aldehydes, esters, monoterpenes hydrocarbons and lactones. Four different alcohols were detected, identified and constituted 22.76% of the total separated volatile components .



Retention time (min.)

Fig(2) : GC Chromatogram of volatile components of fresh apricot pulp.

Linalool and butanol were the predominant alcohols and their concentrations were 8.42 and 7.0%, respectively. These results are in agreement with those of Gomez and Ledbetter (1997) who found that linalool, α- terpineol and geraniol were detected with high concentrations in apricot pulp .

Table (2): Volatile components of fresh apricot pulp.

Peak No	Components	Retention Time	Area%
	Alcohols		
1	Butanol	7.8	7.0
11	Linalool	20.31	8.42
19	α - Terpineol	23.54	3.91
23	Geraniol	30.18	3.43
	Total		22.76
	Aldehydes		
4	Benzaldehyde	16.47	9.09
	Total		9.09
	Esters		
2	Butyl propanoate	8.5	3.7
3	Pentyl acetate	9.91	1.53
5	Methyl hexanoate	16.50	1.97
6	Butyl 2-me- propanoate	16.84	0.81
7	Butyl butanoate	17.50	1.37
9	Butyl-2-methyltanoate	18.86	1.26
10	Pentyl butanoate	18.99	1.47
12	Hexyl propanoate	20.53	1.49
13	Methyl octanoate	21.18	2.51
14	Pentyl -2-me-butanoate	21.27	1.73
15	Hexyl-2-me propanoate	21.79	3.39
16	2-Methyl –propyl hexanoate	22.21	2.99
17	2-Methyl butyl pentanoate	22.55	2.16
18	Ethyl octanoate	22.64	1.47
20	Butyl hexanoate	23.84	8.07
21	Hexyl butonoate	23.99	2.44
24	2-Methyl butyl hexanoate	30.56	1.75
25	Pentyl hexanoate	30.92	1.50
26	Hexyl hexanoate	36.17	1.29
28	Ethyl decanoate	42.24	1.00
	Total		43.39
	Hydrocarbons		
8	Limonene	18.00	10.83
27	β -ionene	36.49	1.15
	Total		11.98
	Lactones		
22	γ -Octalactone	25.40	1.30
29	γ -Decalatone	44.40	8.71
30	γ -Dodeclactone	46.29	2.72
	Total		12.73

Aldehyde identified in volatile components of fresh apricot pulp was benzaldehyde which possesses a very strong almond aroma detected with high concentrations (9.09%) . It is a typical constituent of many prunus apricot species (Gomez and Ledbetter, 1997)

Esters were the first major group identified in the aroma of apricot pulp (Table 2). Twenty esters are represented in the table with total concentration of 43.39%. Esters may play a role in the fruity odor (Takeoka, *et al* . 1990). The main ester compound identified was butyl hexanoate (8.07%) followed by butyl propanoate and hexyl-2-me -propanoate (3.7 and 3.39%, respectively). Organic acids may react with alcohols leading to formation of aromatic esters including methyl and ethyl benzoates (Gomez and Ledbetter, 1997) .

Natural terpenes as unsaturated hydrocarbons derived from isoprene units, are widely distributed in nature. The oxygenated derivatives commonly named terpenoids, are important flavor compounds. Several natural terpenes such as α-pinene, β-myrcene and limonene are relatively cheap and produced in bulk quantities (Adams, 1995). Monoterpene hydrocarbons represented about 11.98 % and limonene was the most dominant hydrocarbon to be identified in fresh apricot pulp(10.83%) whereas β-ionene was detected in lesser concentration 1.15% Table (2).

The total identified lactones represented 12.73% in fresh apricot pulp. Three lactones, namely γ-Octalactone, γ-Decalatone and γ-Dodecalatone were identified with concentration (1.30 , 8.71 and 2.72% , respectively). Lactones were known to be responsible for both peach and apricot aroma.

2.2- Fresh carrot juice

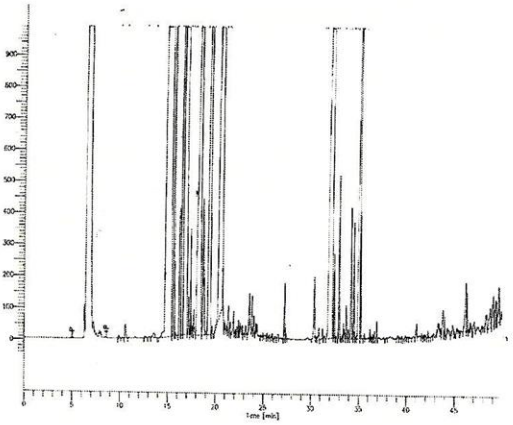
The chromatogram of the aroma concentrate of the fresh carrot juice is given in Fig. (3) and the identified compounds are listed in Table (3) .

A total of sixteen volatile compounds were identified from fresh carrot juice. The volatile compounds were mainly terpenoids composed of two (terpenes) or three (sesquiterpenes) isoperene units. Monoterpene hydrocarbons of the general formula ($C_{10}H_{16}$), hydrocarbons sesquiterpenes ($C_{15}H_{24}$), both of which serve primarily as carriers for the more important classes of oxygenated compounds. Although oxygenated compounds are present in smaller quantities, they are usually the bearers of the characteristics odor of the oil in question (Berk, 1976).

Data in Table (3) show that, aroma compounds included terpene alcohols ; ter-

pene esters; monoterpenes and sesquiterpenes. Alcohol related terpenes were α– terpineol and terpinene- 4-ol and their concentrations were 0.18 and 0.47%, respectively. Bornyl acetate was a terpene acetate found in fresh carrot juice (1.09%) .

Ten different simple monoterpenes were identified namely, α-pinene ; sabinene; camphene ; β-pinene ; α-phellandrene; myrcene ; α-terpinene ; limonene ; γ-terpinene and terpinolene. α-pinene was detected in the highest concentration (21.1%) followed by terpinolene (12.6%) then myrcene and α- terpinene (11.72 and 11.68%, respectively) [Table 3]. The terpene aldehydes are very widely distributed in essential oils and are greatly evaluated because they possess characteristic odors and flavors (Berk 1976). The sesquiterpenes included caryophyllene, β -bisabolene and γ -bisabolene. The caryophyllene was the predominant sesquiterpenes detected in fresh carrot juice (12.95%) followed by γ -bisabolene (5.14%). The simple terpenes accounted for 79.41% compared to sesquiterpenes that accounted for 18.85% of total terpenoids extracted form fresh carrot juice Table (3). This could be related to the low molecular weight and high volatility of simple terpenes. These results are in agreement with Shamaila, *et al.* (1996) who reported that the major volatile components known to contribute to carrot aroma were terpenes and sesquiterpenes and the predominant terpenoid volatiles such as α - pinene, terpinolene and caryophyllene provide an important impact.



Retention time (min.)

Fig(3) : GC Chromatogram of volatile components of fresh carrot juice.

Peak No	Components	Retention Time	Area%
	Alcohols		
11	α - Terpineol	23.85	0.18
13	Terpineol-4-ol	32.66	0.47
	Total		0.65
	Esters		
14	Bornyl acetate	33.01	1.09
	Total		1.09
	Hydrocarbons		
1	α - pinene	14.80	21.1
2	Sabinene	15.56	3.6
3	Camphene	15.77	0.01
4	β -pinene	16.32	2.2
5	α -phellandrene	16.51	6.3
6	Myrcene	16.51	11.72
7	α -Terpinene	18.27	11.68
8	Limonene	18.72	1.80
9	γ -Terpinene	19.34	8.40
10	Terpinolene	20.40	12.60
12	Caryophyllene	31.97	12.95
15	β -Bisabolene	34.23	0.76
16	γ -Bisabolene	35.07	18.85
	Total		

3-Organoleptic evaluation of apricot- carrot nectar.

Carrot juice was added to apricot pulp with different ratios namely 10 , 20 , 30 , 40 , 50 and 60% for preparing a new and untraditional product namely apricot-carrot nectar. All samples of apricot-carrot nectar were organoleptically evaluated for their color, taste , flavor and overall palatability and the results are given in Tables (4 , 5 , 6 and 7.).

From those aforementioned tables , it could be clearly observed that summation of ranks increased when carrot juice was added in the ratios of 10 , 20 , 30 and 40% to apricot pulp . This indicates that the addition of carrot juice gave more palatable, preferable and desirable nectar till 40%. The addition of carrot juice in the ratio of 40% gave the best color and taste for the produced nectar (Table 4 , 5).

Table (4): Statistical analysis of values given through organoleptic evaluation of color of apricot–carrot nectar .

Panelists	*Control		A		B		C		D		E		F	
	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks
1	2.5	2	2.0	1	3.0	3.5	3.0	3.5	3.5	5	4.0	6	4.5	7
2	2.0	1	2.5	2	3.5	5.0	4.5	7.0	4.0	6.0	3.0	3.5	3.0	3.5
3	2.0	1	3.0	4.5	2.5	2.5	3.5	6.5	3.5	6.5	2.5	2.5	3.0	4.5
4	3.0	1.5	3.0	1.5	3.5	4.5	3.5	4.5	4.5	6.0	3.5	4.5	3.5	4.5
5	3.5	1	4.0	2.5	4.0	2.5	4.25	4.0	4.5	5.5	4.75	6.0	4.5	5.5
6	2.5	1	4.0	2.0	4.5	4.5	5.0	7.0	4.5	4.5	4.5	4.5	4.5	4.5
7	2.0	1	3.0	2.5	3.0	2.5	3.5	4.0	4.0	5.0	4.5	6.5	4.5	6.5
8	3.0	3.5	3.0	3.5	3.0	3.5	3.0	3.5	4.0	7.0	3.0	3.5	3.0	3.5
9	2.5	1	3.5	3.5	4.0	5.5	4.5	7.0	3.5	3.5	4.0	5.5	3.0	2.0
10	2.0	1	3.0	2.0	4.5	6.5	4.0	4.0	4.5	6.5	4.0	4.0	4.5	4.0
Σ		14.0		25.0		40.5		50.5		55.5		46.5		45.5

*Control 100% Apricot
A 10 gm carrot juice + 90 gm Apricot pulp
B 20 gm carrot juice + 80 gm Apricot pulp
C 30 gm carrot juice + 70 gm Apricot pulp
D 40 gm carrot juice + 60 gm Apricot pulp
E 50 gm carrot juice + 50 gm Apricot pulp
F 60 gm carrot juice + 40 gm Apricot pulp
Σ : Summation of ranks

Also, typical flavor and highly overall palatability scores (49.5 and 62.0, respectively) were obtained when carrot juice was added at the same aforementioned level (40%) compared to those given to control sample (40 and 33, respectively). Meanwhile , it was clearly noticed that the summation of ranks decreased when 50 and 60% of carrot juice were added to apricot pulp .

Table (5): Statistical analysis of values given through organoleptic evaluation of taste of apricot- carrot nectar.

Panelists	*Control		A		B		C		D		E		F	
	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks
1	2.5	1.0	3.5	4.0	3.5	4.0	4.0	6.5	4.0	6.5	3.0	2	3.5	4.0
2	3.0	5.5	2.5	2.5	2.5	2.5	2.5	2.5	4.0	7.0	3.0	5.5	2.5	2.5
3	2.5	2.0	2.5	2.0	3.0	4.5	3.0	4.5	4.0	7.0	2.5	2.0	3.5	6.0
4	2.5	1.0	3.5	3.0	3.5	3.0	4.0	5.5	4.5	7.0	3.5	3.0	4.0	5.5
5	3.0	1.0	4.0	4.0	4.25	6.5	4.0	4.0	4.25	6.5	4.0	4.0	3.75	2.0
6	3.0	1.0	3.0	2.0	4.0	3.0	4.5	5.0	5.0	7.0	4.5	5.0	4.5	5.0
7	2.5	1.0	3.5	3.5	3.5	3.5	4.0	6.5	4.0	6.5	3.5	3.5	3.5	3.5
8	3.0	2.0	3.0	2.0	3.5	4.5	4.0	6.5	4.0	6.5	3.5	4.5	3.0	2.0
9	2.5	1.0	3.5	3.0	4.0	5.5	4.5	7.0	4.0	5.5	3.5	3.0	3.5	3.0
10	3.0	2.0	4.0	7.0	3.5	5.0	3.0	2.0	3.0	2.0	3.5	5.0	3.5	5.0
Σ		17.5		33.0		41.5		50.0		61.5		37.5		38.5

* For explanation see Table (4)

Table (6): Statistical analysis of values given through organoleptic evaluation of flavor of apricot-carrot nectar.

Panelists	*Control		A		B		C		D		E		F	
	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks
1	4.5	6.5	4.0	4.0	4.0	4.0	4.5	6.5	4.0	4.0	3.0	1.5	3.0	1.5
2	3.5	2.0	4.0	4.25	4.0	4.25	4.0	4.25	4.0	4.25	3.5	2.0	3.5	2.0
3	4.0	3.0	4.5	4.25	4.5	4.25	4.5	4.25	4.5	4.25	3.5	1.5	3.5	1.5
4	4.0	4.5	4.0	4.5	4.0	4.5	4.0	4.5	4.0	4.5	4.0	4.5	3.5	1.0
5	3.5	2.5	4.0	4.5	4.0	4.5	4.0	4.5	4.0	4.5	3.5	2.5	3.0	1.0
6	4.0	4.5	4.0	4.5	4.0	4.5	4.0	4.5	4.5	7.0	3.5	2.0	3.0	1.0
7	4.0	4.5	4.0	4.5	4.0	4.5	4.0	4.5	4.5	7.0	3.5	2.0	3.0	1.0
8	3.5	2.0	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5	3.5	2.0	3.5	2.0
9	4.0	3.5	4.5	6.5	4.5	6.5	4.0	3.5	4.0	3.5	4.0	3.5	3.5	1.0
10	4.5	7.0	4.0	4.5	4.0	4.5	4.0	4.5	4.0	4.5	3.5	2.0	3.0	1.0
		40.0		47.0		47.0		46.5		49.5		24.0		13

* For explanation see Table (4)

Table (7): Statistical analysis of values given through organoleptic evaluation of overall palatability of apricot- carrot nectar .

Panelists	*Control		A		B		C		D		E		F	
	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks	value	ranks
1	3.5	3.5	3.5	3.5	3.0	1.5	4.0	5.5	4.0	5.5	4.5	7.0	3.0	1.5
2	3.5	5.0	2.5	2.0	2.5	2.0	3.0	4.0	4.0	6.5	4.0	6.5	2.5	2.0
3	3.0	1.0	4.0	5.5	3.5	2.5	4.0	5.5	4.0	5.5	3.5	2.5	4.0	5.5
4	3.5	4.5	3.0	2.0	3.5	4.5	3.0	2.0	4.0	6.5	3.0	2.0	4.0	6.5
5	3.0	1.0	4.0	5.5	3.75	3.0	3.75	3.0	4.5	7.0	4.0	5.5	3.75	3.0
6	3.5	1.0	4.0	2.0	4.5	4.0	5.0	6.5	5.0	6.5	4.5	4.0	4.5	4.0
7	4.0	5.5	3.5	4.0	4.0	5.5	3.0	2.5	4.5	6.0	2.5	1.0	3.0	2.5
8	3.5	4.5	3.5	4.5	3.5	4.5	3.5	4.5	4.0	7.0	3.0	1.5	3.0	1.5
9	3.5	4.5	3.5	4.5	4.0	7.0	3.5	4.5	3.5	4.5	3.0	1.5	3.0	1.5
10	3.0	2.5	3.5	4.0	4.0	5.5	4.0	5.5	4.5	7.0	3.0	2.5	2.5	1.0
		33.0		37.75		40.0		43.0		62.0		34.0		29.0

* For explanation see Table (4)

Finally , it could be concluded that the carrot juice in the ratio of 40% could be added to apricot pulp to improve the organoleptic qualities of the produced nectar .

4- Total sugars composition of fresh apricot pulp, carrot juice and their nectars mixture.

The total sugars content of fresh apricot pulp, carrot juice and the best blend of apricot-carrot nectar (60 : 40 w/w, respectively) were determined using HPLC procedure. The obtained results are presented in Table (8). From that table, it could be clearly observed that , carrot juice possessed higher content of total sugars (on the wet weight basis) (6.13%) compared to that of apricot pulp (5.39%). From the same aforementioned table , it could be concluded that, fructose was the predominant sugar in apricot pulp which represented about 60.48% of the total sugar content Fig. (4). This means that, reducing sugars were the major sugars in apricot pulp. On the other hand , non reducing sugars (sucrose) were found in a higher concentration 4.35% of carrot juice . These results are similar to those reported by Ahmed (1998) and El-Sayed, (2000) .The best blend of apricot-carrot nectar had high content of total sugars (12.79%) Table(8).

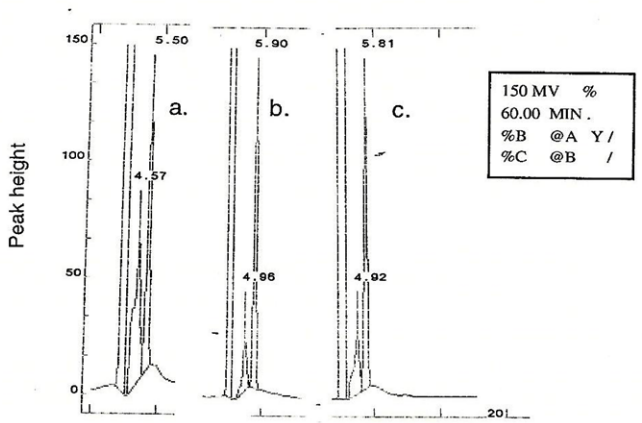


Fig (4): HPLC Chromatogram of neutral sugar compositions of fresh apricot pulp, carrot juice and their nectar .
a- Fresh apricot pulp b- Carrot juice c- Nectar

Sucrose was the predominant sugar in nectar which represented about 65.67% of the total sugars . No fructose could be detected in the nectar. Also, glucose content increased than that of apricot pulp and carrot juice (4.69%). This may due to the interference of fructose with glucose in apricot-carrot nectar. These results supportd the sensory data obtained for the more sweetness when more levels of carrot juice were added to obtain the best blend of apricot-carrot nectar.

Table (8):Total sugars composition of fresh apricot pulp, carrot juice and their nectars mixture .

Samples / Sugars %	Apricot pulp	Carrot juice	Nectar
Fructose	3.26	-	-
Glucose	-	1.78	4.69
Sucrose	2.13	4.35	8.97
% Total sugars	5.39	6.13	13.66

5- Chemical composition of fresh apricot – carrot nectar.

Data presented in Table (9) show that the best blend of apricot – carrot nectar (40% carrot juice) had 84.51% moisture content, 13.90% total soluble solids and pH value 4.38. Total acidity content of nectar sample was lower (1.15 g/100 gm)than that of fresh apricot pulp (1.75 g/100 gm). This means that the addition of 40% carrot juice had a great effect on the produced nectar. Ascorbic acid content (16.80 mg/100 gm) slightly decreased than that of the apricot pulp (17.45 mg/100 gm) Table (1). On the other hand, total carotenoids increased to (7.08 mg/100 gm) when carrot juice was added.

Finally , it could be concluded that total acidity and total carotenoids of the nectar were the most components affected by the addition of carrot juice to apricot pulp .

Table (9) : Chemical composition of fresh apricot- carrot nectar.

Constituents %	Moisture	T.S	T.S.S	Total acidity	pH value	Ash	Ascorbic acid mg/100 gm	Total carotenoids mg/100 gm
Nectar	84.51	15.49	13.9	1.15	4.38	0.76	16.8	7.08

* on wet weight basis

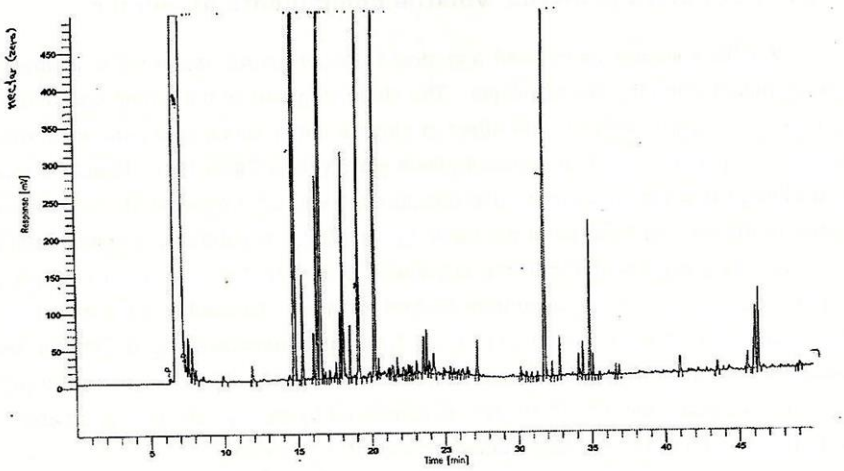
6- Effect of storage on the volatile components of nectar.

Volatile components of fresh and stored apricot- carrot nectar were separated and identified using the GC technique . The chromatograms of the aroma concentrate are given in Figs. (7 and 8). The effect of storage under cooling temperature on the volatile components and their concentrations are given in Table (10) . Results show. that storage had affected the volatile components and their concentrations as compared to the original volatiles of the fresh nectar . Data reveal that the concentration of all volatile groups of stored nectar decreased if compared to their initial values except for alcohols which increased from 13.04% to 14.8% . Linalool was the most alcohol component of fresh nectar (11.16%). This value decreased to 0.44% for the stored nectar. Meanwhile , α -terpineol showed an opposite trend, as it showed pronounced increase from 0.80 to 12.60% as influenced by storage. As mentioned above, α -terpineol is an enzymatic degradation product of γ-terpinene .

Total aldehydes also increased highly from 5.34% to 59.59% in the stored nectar (approx. 11 folds). Hexanal, was the predominant component in the stored nectar 45.37% . This compound is thought to be arised by the enzymatic oxidation of linoleic and linolenic acids (Guichard and Souty 1988). Acetaldehyde was detected (9.09%) in the stored nectar which disappeared in fresh nectar Table (10).

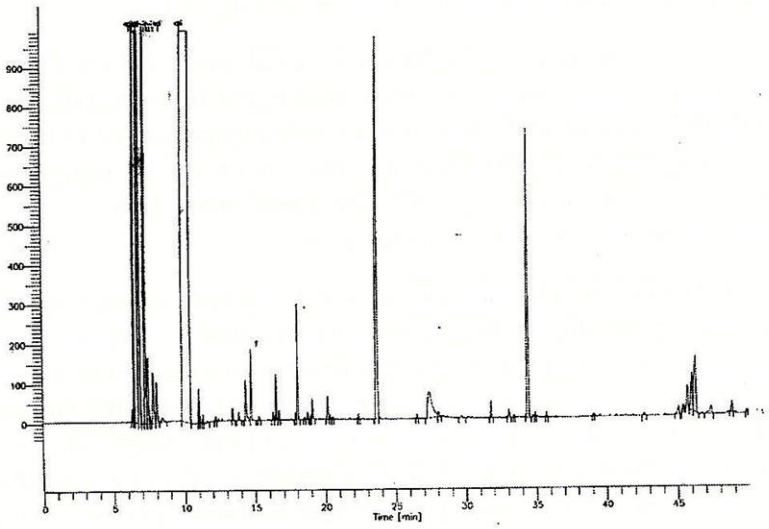
Esters , which play an important role in the fruity aroma and which represent a major class of volatile components of fresh apricot pulp showed remarkable qualitative and quantitative decrease after storage under cooling temperature for six months. Total esters decreased from 6.61% to 2.86% , meanwhile nine esters disappeared after the storage period. On the other hand, ethyl acetate was only the ester which increased above three folds after the storage of nectar .

Data represented in Table (10) show that total hydrocarbons (monoterpenes and sesquiterpenes) had the same behaviour. Nearly all terpene compounds decreased with storage time. A loss of 56.67% in total terpenes were recorded after storage for six months. α - pinene was the highest monoterpene volatile which dropped from 25.26% to 1.0 % after the aforementioned storage period. Meanwhile, β - ionene showed the reversible behaviour which appeared and was detected by (8.80%) after the storage period. This compound may be derived biochemically by indirect enzymatic oxidation reactions of β- carotein (Chariotte , *et al* . 1981).



Retention time (min.)

Fig. (5) : GC Chromatogram of volatile components of fresh nectar .



Retention time (min.)

Fig. (6) : GC Chromatogram of volatile components of stored nectar .

Table (10): Effect of storage on the volatile components of apricot-carrot nectar .

Peak No	Components	Retention Time	Area% Fresh nectar	Area% Stored nectar
	Alcohols			
3	Butanol	7.84	0.58	1.23
6	Hexanol	11.90	0.38	0.46
20	Linalool	20.28	11.16	.044
28	α - Terpineol	23.59	0.80	12.60
32	Geraniol	30.20	0.12	0.07
	Total		13.04	14.8
	Aldehydes			
1	Acetaldehyde	7.25	-	9.09
5	Hexanal	9.94	0.36	45.37
10	Benzaldehyde	16.33	3.53	0.63
40	Hexa-decanal	46.31	1.45	4.50
	Total		5.34	59.59
	Esters			
2	Ethyl acetate	7.58	0.62	2.14
4	Butyl propanoate	8.07	0.22	0.18
12	Methyl hexanoate	16.73	0.63	-
13	Butyl 2-me- propanoate	16.90	0.11	-
14	Butyl butanoate	17.60	0.30	0.12
17	Butyl-2-me- butanoate	18.57	0.83	0.10
21	Hexyl propanoate	20.53	0.24	0.04
22	Methyl octanoate	21.45	0.34	-
23	Pentyl -2-me-butanoate	21.79	0.25	-
24	Hexyl-2-me propanoate	22-20	0.21	0.07
25	2-me –propyl- hexanoate	22.53	0.21	-
26	2-me- butyl- pentanoate	23.00	0.22	-
27	Ethyl octanoate	23.25	0.23	-
29	Butyl hexanoate	23.81	0.59	-
30	Hexyl butonoate	24.27	0.59	0.05
34	Bornyl acetate	32.86	0.64	0.16
37	Ethyl decanoate	41.03	0.38	-
	Total		6.61	2.86
	Hydrocarbons			
7	α - pinene	14.86	25.26	1.00
8	Sabinene	15.35	1.73	0.06
9	β -pinene	16.12	0.84	0.11
11	Myrcene	16.61	18.86	0.12
15	α - Terpinene	17.90	1.11	2.81
16	Limonene	18.09	3.22	0.10
18	γ -terpinene	19.16	8.14	0.05
19	Terpinolene	19.93	0.86	0.33
33	Caryophyllene	31.87	9.91	0.25
35	γ -Bisabolene	34.91	0.38	-
36	β -Ionene	36.00	-	8.80
	Total		70.31	13.63
	Lactones			
31	γ -Octalactone	25.40	0.15	3.46
38	γ -Decalactone	43.57	0.42	0.24
39	γ -Dodcalactone	46.11	2.13	2.39
	Total		2.70	6.09

Three numbers of lactones had been identified namely, γ-octalactone , γ-decalactone and γ-dodecalactone . The total of lactones increased form 2-70% to 6.09% and γ-octalactone was the most lactone which increased from 0.15% to 3.46% (approx. 23 folds) after six months of storage .

Finally, from the previous results it could be concluded that, large differences in concentrations between stored nectar and initial concentration of all volatile components of fresh nectar were detected. This means that volatile and aroma compounds were greatly affected during storage of nectar under cold temperature for six months.

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دراسات على مركبات النكهة لنكتار المشمش والجزر

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تعتبر ثمار المشمش واحدة من ألذ وأهم ثمار الفاكهة المحبوبة المنزرعة في مصر ولكنها تتميز بقصر مدة عرضها في الأسواق.

ولهذا أجريت هذه الدراسة بغرض إنتاج منتج جديد غير تقليدي هو نكتار المشمش والجزر ودراسة أحسن نسب إضافة للجزر تعطي أفضل صفات حسية بالإضافة إلى دراسة تأثير مدة التخزين على الخواص الطبيعية والكيماوية ومركبات النكهة للخليط الناتج. وأثبتت النتائج ارتفاع محتوى حامض الأسكوربيك في لب المشمش عن عصير الجزر بينما ارتفعت نسبة الكاروتنويدات الكلية في الجزر عن المشمش. كذلك ارتفاع نسبة السكريات الكلية في الجزر ٦,١٣ ٪ عند مقارنتها بنسبتها في لب المشمش ٥,٣٩ ٪. وقد ثبت أن الفركتوز والسكروز كانتا السكريات الأساسية في كل من لب المشمش وعصير الجزر على التوالي.

كما تم تقدير المكونات العطرية الطيارة في كل من المشمش والجزر الطازج وقد وجد أن مجاميع الأستر هي أكثر المجاميع انتشارا حيث كانت نسبتها ٤٣,٣٩ ٪ و ٩٨,٢٦ ٪ على التوالي. بينما كانت أحسن نسبة إضافة من عصير الجزر إلى المشمش هي ٤٠٪ لإنتاج نكتار ذو صفات جودة عالية حيث أعطت أعلى درجات من درجات التقييم الحسى لدى المختبرين. تم تقدير الصفات الكيماوية والطبيعية للنكتار الناتج ووجد أن السكريات الكلية تمثل ١٣,٦٦ ٪ وكان السكروز هو السكر السائد حيث بلغت نسبته ٦٥,٦٧ ٪ من السكريات الكلية للنكتار .

تم تخزين النكتار على درجة حرارة التبريد)٤°م (لمدة ستة أشهر مع دراسة تأثير التخزين على مركبات النكهة ووجد أن المركبات الهيدروكربونية كانت هي المجموعة السائدة في النكتار الطازج بنسبة ٧٠,٣١٪ وانخفضت هذه النسبة إلى ١٣,٦٣ ٪ بعد التخزين لمدة ستة أشهر. بينما زادت نسبة كل من الكحولات و الالدهيدات واللاكتونات في النكتار بعد مدة التخزين إلا أن مجاميع الهيدروكربونات والأستر انخفضت بشكل ملحوظ .