Identification and determination of aroma components of some juice and its blends

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ABSTRACT

In this study, the chromatographic analysis method was used to determine the components responsible for the flavor in some types of juices and beverages in Egypt. The components of the flavor were also estimated in mango juice, orange juice, apricot juice, carrot juice and kaki juice after the addition of pectinase and cellulose enzymes with a concentration of 0.1% to determine the effect of these enzymes on the flavor components of this juice. And also prepared 4 mixtures including mango juice with orange juice, mango juice with carrot juice, mango juice with apricot juice and mango juice with kaki juice mixing rate 80:20% respectively. Flavor components were estimated in 11 samples. The results showed that the product of mango juice contained propane, 2-methoxy-content of 21.86 and apricot juice on 9-Octadecenoic acid (Z)with 14.59 and orange juice on compound ethane, 1,1'-oxybis-with 79.36 and kaki juice on ethane, 1,1'-oxybis compound with 84.39 and carrot juice on 9-octadecenoic acid (Z)-compound by 40.31. The addition of pectinase and celluloseal enzymes to mango juice increased 9-Octadecenoic Acid (Z)- by 86.88 and 96.29 respectively. And contain mango juice mixed with orange juice on 9-Octadecenoic acid (Z) compound with 54.91 and mango juice mixture juice carrots on the ethane, 1,1'-oxybis compound 70.35 and mango juice mixed with kaki juice ethane, 1,1'-oxybis on the compound 89.07 and mango juice mixed with apricot juice ethane, 1,1'-oxybis- on the compound 89.07.

Key words: Aroma chemical composition; aroma components, Mango juice, Orange juice, Apricot juice, Carrots juice, Juice blends.

Introduction

Fruits produce a wide range of volatile organic compounds that impart their characteristically distinct aromas and contribute to unique flavor characteristics. Fruit aroma and flavor characteristics are of key importance in determining consumer acceptance in commercial fruit markets based on individual preference. Fruit producers, suppliers and retailers traditionally utilize and rely on human testers or panels to evaluate fruit quality and aroma characters for assessing fruit salability in fresh markets, **Baietto and Wilson (2015).**

Flavor study in different foods has been of increasing interest due to its relationship with the quality of product. In the case of fruits, aroma is one of the most appreciated characteristics. Fruit flavor is particularly sensitive to compositional alteration. The volatile compounds that form the fruit flavor are produced through metabolic pathways during ripening, harvest, post – harvest and storage and depend on many factors related to the species, varity and type of technological treatment **(Rizzolo *et al.*, 2002)**

Aroma profiles of fruit juices usually comprise a mixture of a large number of volatile organic compounds. The individual aroma components differ according to their molecular structure, which in turn defines the solubility, boiling point, and the volatility of each type of compound, **Ramteke *et al.*, (1990) .**

Fruit aromas consist of a complex mixture of VOCs whose composition is specific to plant species and fruit variety. Although different fruits often share many aromatic characteristics, each fruit has a distinctive aroma that depends upon the combination of volatiles, the concentration and the perception threshold of individual volatile compounds. The most important aroma compounds include amino acid-derived compounds, lipid-derived compounds, phenolic derivatives, and mono- and sesquiterpenes. Although fruit aromas are generally complex mixtures of a wide range of compounds, **Tucker (1993).**

Fruits produce and release a wide variety of Volatile Organic Compounds (VOCs) that make up their characteristic aromas with esters, terpenoids, lactones and derivatives of amino acids, fatty-acids and phenolic compounds being the dominant classes of organic volatiles represented in fruit aromas, **Schwab *et al.*, (2008).**

Mango (*Mangifera indica L.*) popularly known as 'The King of Fruits' and currently ranks fifth in total production among major fruit crops worldwide and is grown commercially in more than 87 countries, **Tharanathan,** (**2006**).

Mango (*Mangifera Indica Cv. Chokanan*) is one of the most important and popular commercial tropical fruits in the World. In the processing of mango products like mango pulp and amchur (dried, powdered unripe mango), mango peel is a major byproduct (**Ajila *et al.*, 2007)** of mango juice industry.

Orange juice is one of themajor traded commodities throughout the world, and themostwidely consumed fruit juice. It comprises 46% of the worldwide fruit juice consumption, amounting to 18,449 million L in 2013 (**Markstrat, 2013**).

Carrots (*Daucus carota L.*) are one of the most widely consumed vegetables because of their characteristic flavor and health benefits. Carrots are the major vegetable source of provitamin A, and they play a central role in the increased interest in healthy food as well as the demand for more vegetables containing various health-related compounds (**Theodosiou and others 2010**).

Apricot fruit (*Prunus armeniaca*) is native from China and is widely adapted to Mediterranean conditions. It is consumed around the world due to its pleasant and delightful aroma, which has been previously studied, **Azodanlou *et al.*, (2003).**

Persimmon (*Diospyros kaki* L.) is an important fruit crop and approximately 4.6 million tons of persimmon fruit were produced globally in 2013 (**FAO., 2013**).

The ability of acidic (AcW) and alkaline electrolyzed waters (AlW) to improve the flavour of persimmon (*Diospyros kaki L.*) wine was evaluated. Wines made with AcW (WAcW) were significantly better than wines made with AlW or pure water (PW) in aroma, taste, and colour.(**Zhu., 2016**)

Khakimov *et al.*, (2016) studies that, tropical fruits contribute significantly to the total fruit intake worldwide. However, their metabolomes have not yet been investigated comprehensively, as most previous studies revealed only volatile and bulk compositions.

Qiao *et al.*, (2008) reported that, gas chromatography-mass spectrometry (GC-MS) and gas chromatographyolfactometry (GC-O) were used to determine the aromatic composition and aroma active compounds of fruit juice and peel oil of Jinchen sweet orange fruit. The aromatic compositions of fruit juice were more complex than that of peel oil. Ethyl butanoate, β-myrcene, octanal, linalool, α-pinene, and decanal were found to be responsible for the aromatic notes in fruit juice and peel oil. Nineteen components have been perceived only in the juice and ten compounds were described as aromatic components of only the peel oil by the panelists. These differences lead to the different overall aroma between fruit juice and peel oil.

Musharraf *et al.*, (2016) studies that, a quantitative method was developed based on gas chromatography triple quadrupole mass spectrometry (GC–QQQ-MS) for the analysis of aroma component of mango sap (latex) in nine Pakistani varieties that are Anmol, Began pali, Badami, Caroba, Chaunsa, Lal patra, Neelum, Sohnara and Tota pari.

Singh *et al.,*(2014) determine the influence of postharvest vapour heat treatment (VHT) on qualitative and quantitative measurement of aroma volatiles during fruit ripening in mango (cv. Chausa) using gas chromatography–mass spectrometry (GC–MS) .

Mastello *et al* ., (2015) Odour-active compounds present in pasteurised orange juice were identified by gas chromatography– olfactometry (GC–O) employing heart-cut multidimensional GC techniques with olfactometry (O) and mass spectrometry (H/C MDGC–O/MS) and comprehensive two-dimensional gas chromatography–accurate mass time-offlight MS (GC × GC–accTOFMS). Headspace solid phase microextraction sampling proved to be qualitatively adequate for the analysis of pasteurised orange juice .

Aroujalian *et al.*, (2007) showed that pervaporative recovery of volatile aroma compounds from orange juice was studied to determine the influence of various operating parameters such as feed flow rate which is correspondent with Reynolds numbers of 500, 1000, 1500, 2000, and 2500, feed temperature (25, 40, and 50 ◦C) and permeate pressure (1, 10, 20, 30, and 40 mmHg) on flux and selectivity.

Selli *et al.*, (2004) studies that, the volatile flavour components of orange juice obtained from the cv. Kozan oranges were investigated. Flavour components were extracted by using Amberlite XAD-2 polymeric resin and eluted by pentane/ dichloromethane solvent and then analysed by gas chromatography-flame ionization detection (GCFID) and gas chromatography-mass spectrometry (GC-MS). Thirty-four components, including seven esters, two aldehydes, five alcohols, five terpenes, twelve terpenols, and three ketones were identified and quantified. The major flavour components were linalool, limonene, β-phellandrene, terpinene-4-ol and ethyl 3-hydroxy hexanoate.

Solı´s *et al.*, (2007) studies tha, the volatile fraction of eight varieties of apricot were analyzed using simultaneous distillation extraction (SDE), solid phase extraction (SPE) with reverse phase (C18), liquid–liquid extraction (LLE) and headspace-solid phase microextraction (HS-SPME). The free aroma compounds were identified by GC–MS, finding common compounds such as linalool, α-terpineol, β-ionone and ϒ -decalactone and specific compounds due to the extraction method used. On the other hand, **Solis *et al.*, (2007)** obtained from eight varieties of apricots (*Prunus armeniaca*) were compounds in SPME (hexanol, limonene, 2-hexenal, 6- metil-5-hepten-2-one, linalool, 3,7-dimetil-1,6-octadiene, β-ionone, ϒ-decalactone), and with five aroma compounds in LLE (limonene, linalool, 1,3-dimethylcyclohexanol, cyclohexylisotiocianate, β-ionone). These aroma compounds served to recognize and classify all the analyzed varieties.

Riu-Aumatell *et al.*, (2004) described that, a rapid evaluation of volatile profiles of several commercial fruit juices (pear, apricot and peach) by headspace-solid phase microextraction and gas chromatography/mass spectrometry (HS-SPME and GC/MS). In addition, this is the first study to report the detection of several norisoprenoids (mainly naphthalenes) that characterised apricot and peach juices. Moreover, by means of volatile compounds it could be possible to distinguish between juices of organic and conventional production and juices with flavourings additioned.

Kjeldsen *et al.* , (**2001**) showed that, dynamic headspace sampling was used to collect aroma compounds from raw samples of four carrot (Daucus carota L.) cultivars (Brasilia, Duke, Fancy, and Cortez). The collected volatiles were analyzed by capillary GC-FID and GC-MS using large-volume cool on-column injection (LVI-COC). Of the 36 compounds identified, 6 had not been previously detected in carrots. Significant differences between the carrot cultivars were found for 31 of the identified volatiles as well as for total monoterpenes, sesquiterpenes, on the other hand, the loss among major monoterpenes in the concentrated samples varied from 16% for p-cymene to >40% for R-pinene as compared to nonconcentrated samples. The loss among high-boiling sesquiterpenes varied from not detectable (β-caryophyllene, α-humulene, and caryophyllene oxide) to approximately 7% for (E)- and (Z)-γ-bisabolene.

Wang e*t al.* , (**2011**) showed that, An aroma extract of persimmon fruit (Diospyros kaki L., var. Triumph) was obtained by hydrodistillation under vacuum followed by solid phase extraction. Gas chromatography–mass spectometry (GC-MS) analysis of the extract led to the positive identification of 50 compounds, among which aldehydes emerged as the most important class of volatile compounds. Thirty-two compounds were determined to have aroma-impact, by gas chromatography–olfactometry analysis of the aroma extract. The six most intense aroma-impact compounds were methional, (E)-2-hexenal, phenylacetaldehyde, (E,Z)-2,6-nonadienal, hexanal and Furaneol.

Wang e*t al.* , (**2011**) investigation that, persimmon flavour, we applied recent improvements in volatiles isolation, gas chromatography–mass spectrometry (GC-MS) and gas chromatography–olfactometry (GC-O) analyses to characterize the volatiles and aroma-impact compounds of persimmon fruit available in a US local food market.

Kjeldsen *et al.* , (2001) reported that, gas chromatogram of a carrot headspace sample is shown a total of 44 volatile compounds were repeatedly detected and quantified in the different carrot cultivars. Thirty-six of these were identified by comparison of their mass spectral data with those from authentic compounds and/or mass spectra suggested by the NIST database (33) and GC retention indices.

Aroma of apricots (*Prunus armeniaca*) were compounds commonly found in all the analyzed varieties was established: hexilacetate, limonene, 6-methyl-5-hepten-2-one, mentone and trans-2-hexenal as the most common and furthermore, linalool, _-ionone and 3,7-dimethyl-1,6-octadiene **Guillot *et al.*, (2006).**

Pectins are complex high-molecular-mass glycosidic macromolecules that contribute to complex physiological processes such as cell differentiation or cell growth, being largely responsible for the structural integrity and cohesion of plant tissues (**Sharma *et al.*, 2006; Nigam and Pandey, 2009**).

Cellulose is a structural carbohydrate and one of the cell-wall constituents of plants. It is considered a complex sugar, used for protection and structure of the plant, where the cellulose fibers are embedded in a matrix of other structural biopolymers, primarily hemicellulose and lignin (**Sharma *et al.*, 2014**).

Materials And Methods

Materials:

The raw materials used throughout this study for production juice nectar and nectar blends were:

1. Mango and apricot pulp were obtained from Kaha Company, Kaha, Qalyabia governorate, Egypt.
2. Carrot , kaki and orange were obtained from local market, Benha, Qalyabia governorate, Egypt.
3. Cellulase and bectinase enzymes were obtained from Novo Nordisk, Switzerland.

Technological treatments:

Preparation of nectar blends:

The mango juice and fresh juices were blended together as follows:

Blend (1):80 gm mango juice and/or (20 gm orange, 20 gm apricot, 20 gm kaky, and 20 gm carrot juices). Nectar was prepared as recommended methods described by **Sharoba (2007)** from 25% (mango, orange, apricot, kaky and carrot) juices + 75% (Sugar Solution) to get total soluble solids (16 –18%), pH 3.5. The pH was adjusted to 3.5 by adding citric acid as 50% (W/V) solutions according to **AOAC (2016)**.

Methods:

Determination of volatile components:

Extraction of volatile compounds:

Three hundred grams of pulp were homogenized and mixture with (1 L of water) then distilled by a simultaneous steam distillation. The volatile aroma compounds were extracted using (dichloromethane solvent, 200 ml.). The aroma extract was dried over anhydrous sodium sulfate and concentrated using by rotary evaporator, the obtained concentrates were analyzed using gas chromatography-mass spectrometry, **Abd el- hafez(2009).**

Combined gas chromatography-mass spectrometry:

GC-MS analysis was performed with an Aglient 6890 gas chromatograph (Made in England) equipped with an Aglient mass spectrometric detector, with a direct capillary interface and fused silica capillary column HP-5MS (30 m X 320 µm X 0.25 µm film thickness). Samples were injected under the following conditions:

Helium was used as carrier gas at approximately 1.0 ml/min., pulsed splitless mode. The solvent delay was 3 min. and the injection size was 1.0 µl. The GC temperature program was started at 40°C (3 min) then

elevated to 260°C at rate of 8°C/min. the detector and injector temperature were set at 280 and 250°C, respectively. Wiley mass spectral data base was used in the identification of the separated peaks.

Results And Discussion

Data presented in **Table (1)** showed that determination of mango juice by GC/ MS chromatography analysis compounds, which could be classified mainly as aldehyde ketones, alcohols, fatty acids and hydrocarbons. Aldehydes and alcohols were the most representative chemical fractions and contents were: the highest propane, 2-methoxy-(21.86), 1,2-ethanediol,monoacetate(10.86), ethane, 1,1'-oxybis-(9.82), docosane,(5.33),2,2-dimethoxy-5,5-dimethyl-1,3,4-.deta.(3) oxadiazoline (3.80),ethyl2-(1'-hydroxy-1'-methylethyl)-5,6, trimethyl-3,4-hep tadienoate, (3.75), acetic acid, methoxy-, methyl ester,(3.74), ethane, 1,2-diethoxy-(3.57) and 2-butanol (3.30). on the other hand, propane, 2-methoxy-(0.01), 2-butanol (0.22) , acetic acid, methyl ester (0.28), formic acid, ethyl ester, (0.33), propanoic acid,2-hydroxy-2-methyl-,methyl ester, (0.35) , ethane, 1,1'-oxybis- (0.43) and heptadecane, 9-hexyl- (0.65) were the lowest contents compounds.

Results on **(Table 1)** were in agreement with those reported by **Zhu, *et al* (2014)** the volatile profile of the persimmon wines and juices was determined by GC–MS with the aid of SBSE, leading to the identification of 50 and 60 compounds, respectively. Among these compounds, only 26 detected compounds showed the OAV above 1 in all persimmon wines. **Abu el- maaty (2012)** found that, mango juice found high concentration Myrcene 38.58% - limonene 11.68% - Ocimene 10.56% and less concentration1-Butanol 0.01% and Ethyl isobutyrate 02%.

The main pattern of aroma released and formed from the yeast employed in the vinification of persimmon must was clear: the strain was able to produce fermentative ethyl esters which were responsible for fresh fruit attributes. In our study, persimmon wines produced by strains IFFI 1363 and D254 were characterised by persimmon, aroma harmony, fruity, fusel and taste balanced, fullness and hedonic scale. Therefore, the two yeast strains could be used as starter culture for persimmon wine production. In addition, based on the characteristics of the produced persimmon wine, persimmon fruits showed great application potential in the production of fermented beverages.

Data presented in **Table (2)** showed that determination of apricot juice by GC/ MS chromatography analysis compounds, which could be classified mainly as aldehyde ketones, alcohols, fatty acids and hydrocarbons. Aldehydes and alcohols were the most representative chemical fractions and contents were the highest 9-octadecenoic acid (z)(14.59), ethane, 1,1'-oxybis-(13.16), 9-octadecenoic acid (z)-,methyl ester (11.31), 10-undecenoic acid,methyl ester (10.56), [1,1'-bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester (10.15), 1-hexadecanol, 2-methyl- (9.75), 9-Hexadecenoic acid (6.25), d-glycero-d-galacto-heptose (6.12) and 6-nonenoic acid, methyl ester (5.28) . on the other hand, 1-deoxy-d-mannitol (2.24), 2-ethoxyethanol (2.60), 6-nonenoic acid, methyl ester (3.09) and z-(13,14-epoxy)tetradec-11-en-1-ol acetate (3.28). were the lowest contents compounds. .

Results on **(Table 2)** were in agreement with those reported by **Solís-Solís,*et al* (2007)** The aroma of a food is not related to the total concentration of volatile compounds, but to the aromatic compounds characteristics of the fruit impact compound that are in that volatile fraction. Results on **(Table 2)** were in agreement with those reported by **Evrendilek,(2016)** given the mean values of the 73 aroma active compounds across the treatment times, the initial mean values of the 10 compounds on average increased significantly for apricot (six) and peach (four) nectars, while the 33 compounds decreased significantly for peach (24) and apricot (eight) nectars, and sour cherry juice (one). **Abu el- maaty (2012)** found that, apricot juice observed the highest concentration 1- Butanol 13.28% ester compound was less concentration Ethyl dodecanoate 0.07%.

Data presented in **Table (3)** showed that determination of orange juice by GC/ MS chromatography analysis compounds, which could be classified mainly as aldehyde ketones, alcohols, fatty acids and hydrocarbons. Aldehydes and alcohols were the most representative chemical fractions and contents were the highest ethane, 1,1'-oxybis-(79.36), 9-octadecenoic acid (z)(16.94), oleic acid(12.01), [1,1'-bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester(7.31) and 9,10,11-octadecenoic acid (z)-, methyl ester (5.63). on the other hand, ethane, 1,1,2-trimethoxy-(0.01), 13-tetradecynoic acid, methyl ester(0.19), 9-octadecenoic acid, (2-phenyl-1,3-dioxolan-4-yl)methyl ester, cis(0.22), 7-nonenoic-7,8-d2 acid, methyl ester(0.42) and 10-undecenoic acid, methyl ester(0.50) were the lowest contents compounds. .

Results on **(Table 3)** were in agreement with those reported by **Mastello,*et al* (2015)** demonstrated an efficient analytical approach using multidimensional techniques of MDGC and GC × GC coupled with olfactometry and MS to assess pasteurised orange juice aroma. The GC–O DF technique allowed successful screening of the most significant odour impact zones (according to DF ≥ 3) for volatile composition in pasteurised orange juice. Four aldehydes (hexanal, heptanal, octanal, citral), 2 esters (ethyl butanoate, methyl hexanoate), and 4 monoterpenes (α-pinene, D-limonene, linalool, α-terpineol) were confirmed in accordance with olfactometry assessment in the processed juice. **Abu el- maaty (2012)** found that, orange juice found compound D-limonene 45.57%, ethanol 12.67%. The composite Alaladheady found Neral 12% the compound Alkithoni Carvone 0.35%.

Table 1. Identification and determination of mango juice by GC/ MS chromatography analysis:

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	2.03	DIMETHOXYPROPANE	1.40	104	$C_5H_{12}O_2$
2	2.30	ETHANE, 1,1'-OXYBIS-	9.82	74	$C^4H_{10}O$
3	2.54	1,2-ETHANEDIOL,MONOACETATE	10.86	104	$C_4H_8O_3$
4	2.68	PROPANE, 2-METHOXY-	21.86	74	$C_4H_{10}O$
5	2.96	2-OXIRANYLMETHYL 2 METHYLACRYLATE #	1.44	142	$C_7H_{10}O_3$
6	3.21	Ethane, 1,2-diethoxy-	3.57	118	$C_6H_{14}O_2$
7	3.54	Hexadecanoic acid,1,5-pentanediyl ester	1.27	580	$C_{37}H_{72}O_4$
8	3.65	ACETAMIDE	1.13	59	C_2H_5NO
9	3.74	DOCOSANE	5.33	310	$C_{22}H_{46}$
10	3.81	Acetic acid, methoxy-, methyl ester	3.74	104	$C_4H_8O_3$
11	3.97	BUTANOIC ACID,2-HYDROXY-, METHYL ESTER	0.38	118	$C_5H_{10}O_3$
12	4.09	ETHYL2-(1'-HYDROXY-1'-METHYLET HYL)-5,6,6-TRIMETHYL-3,4-HEP TADIENOATE	3.75	254	$C_{15}H_{26}O_3$
13	4.14	2,2-DIMETHOXY-5,5-DIMETHY L-1,3,4-.DETA.(3)-OXADIAZOLINE	3.80	160	$C_6H_{12}N_2O_3$
14	4.36	BUTANOIC ACID,2,3-DIMETHYL-	2.28	116	$C_6H_{12}O_2$
15	4.45	METHYL-(3R)-(-)-3-ETHYL-5-O XOPENTANOATE	2.23	158	$C_8H_{14}O_3$
16	4.52	FORMIC ACID, ETHYL ESTER	0.33	74	$C_3H_6O_2$
17	4.62	PROPANE, 2-METHOXY-	0.01	74	$C_4H_{10}O$
18	5.46	Heptadecane, 9-hexyl-	0.65	324	$C_{23}H_{48}$
19	5.60	Acetic acid, methyl ester	0.28	74	$C_3H_6O_2$
20	5.80	2-Butanol	0.22	74	$C_4H_{10}O$
21	6.58	PROPANOIC ACID,2-HYDROXY-2-METHYL-,METHYL ESTER	0.35	118	$C_5H_{10}O_3$
22	7.43	ETHANE, 1,1'-OXYBIS-	0.43	74	$C_4H_{10}O$
23	7.76	BUTYL ESTER OFHYDROXYACETIC ACID	2.12	132	$C_6H_{12}O_3$
24	7.85	PENTOSE	1.26	150	$C_5H_{10}O_5$
25	9.49	CIS-INOSITOL	2.50	180	$C_6H_{12}O_6$
26	10.71	BUTANE, 2-METHOXY-	1.20	88	$C_5H_{12}O$
27	13.43	NONANAL	2.15	142	$C_9H_{18}O$
28	13.90	Gibberellic acid	1.15	346	$C_{19}H_{22}O_6$
29	16.41	2-BUTANOL	3.30	74	$C_4H_{10}O$
30	19.49	2-DECENAL, (E)-	2.46	154	$C_{10}H_{18}O$
31	21.76	2,4-DODECADIENAL, (E,E)-	2.85	180	$C_{12}H_{20}O$
32	26.89	11,14-Octadecadiynoic acid,methyl ester	1.50	290	$C_{19}H_{30}O_2$
33	30.39	1-TRIDECANOL	1.18	200	$C_{13}H_{28}O$
34	31.81	9-OCTADECENOIC ACID (Z)-	1.50	282	$C_{18}H_{34}O_2$
35	33.39	Oleic Acid	1.12	282	$C_{18}H_{34}O_2$

*R.t, retention time (min).
(values expressed as relative area percentage to total identified compounds).

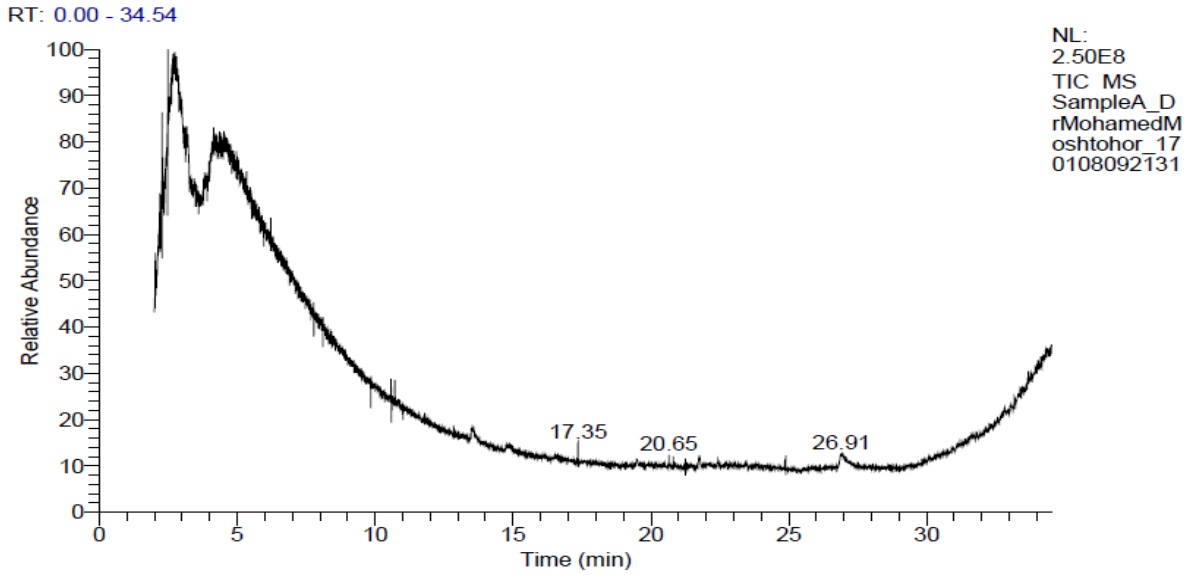


Fig (1) Identification and determination of mango juice by GC/ MS chromatography analysis

Table 2. Identification and determination of apricot juice by GC/ MS chromatography analysis:

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	2.35	ETHANE, 1,1'-OXYBIS-	13.16	74	$C_4H_{10}O$
2	7.12	6-Nonenoic acid, methyl ester	5.28	170	$C10H_{18}O_2$
3	8.01	10-UNDECENOIC ACID,METHYL ESTER	10.56	198	C12H22O2
4	10.07	6-NONENOIC ACID, METHYL ESTER	3.09	170	C10H18O2
5	1.83	2-ETHOXYETHANOL	2.60	90	C4H10O2
6	15.28	d-Glycero-d-galacto-heptose	6.12	210	C7H14O7
7	19.32	1-Deoxy-d-mannitol	2.24	166	C6H14O5
8	23.70	[1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester	10.15	322	C21H38O2
9	29.06	1-HEXADECANOL, 2-METHYL-	9.75	256	C17H36O
10	29.17	9-OCTADECENOIC ACID (Z)-,METHYL ESTER	11.31	296	C19H36O2
11	30.68	Z-(13,14-Epoxy)tetradec-11-en-1-ol acetate	3.28	268	C16H28O3
12	31.95	9-Hexadecenoic acid	6.25	254	C16H30O2
13	34.40	9-OCTADECENOIC ACID (Z)	14.59	282	C18H34O2

*R.t, retention time (min).
(values expressed as relative area percentage to total identified compounds).

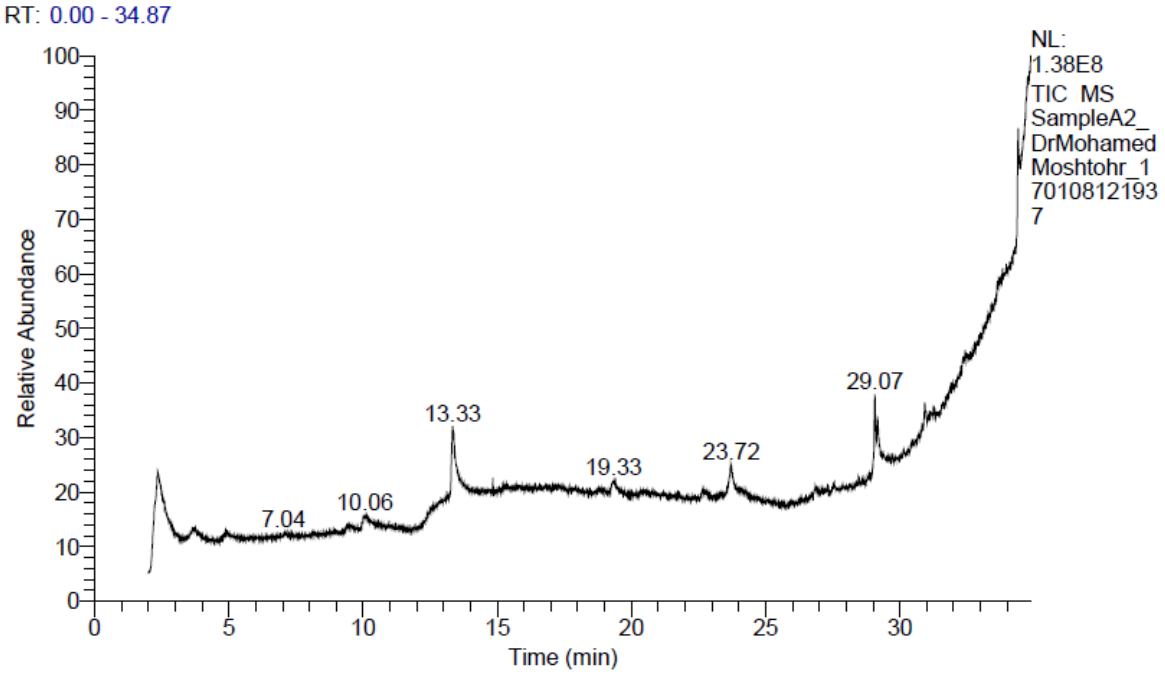


Fig 2. Identification and determination of apricot juice by GC/ MS chromatography analysis

Table 3. Identification and determination of orange juice by GC/ MS chromatography analysis:

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	2.05	Ethane, 1,1,2-trimethoxy-	0.01	120	C5H12O3
2	2.18	ETHANE, 1,1'-OXYBIS-	79.36	74	C4H10O
3	29.07	7-NONENOIC-7,8-D2 ACID, METHYL ESTER	0.42	172	C10H16D2O2
4	29.07	10-UNDECENOIC ACID, METHYL ESTER	0.50	198	C12H22O2
5	29.18	13,16-Octadecadiynoic acid, methyl ester	0.80	290	C19H30O2
6	29.86	13-TETRADECYNOIC ACID, METHYL ESTER	0.19	238	C15H26O2
7	30.83	14-PENTADECYNOIC ACID, METHYL ESTER	0.46	252	C16H28O2
8	34.11	[1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester	7.31	322	C21H38O2
9	34.41	9-OCTADECENOIC ACID (Z)	16.94	282	C18H34O2
10	34.41	HEXADECANOIC ACID, 2,3-DIHYDROXYPROPYL ESTER	3.89	330	C19H38O4
11	35.18	9-Hexadecenoic acid	1.52	254	C16H30O2
12	35.72	9,10,11-OCTADECENOIC ACID (Z)-, METHYL ESTER	5.63	296	C19H36O2
13	36.46	Oleic Acid	12.01	282	C18H34O2
14	36.81	2-HYDROXY-3-[(9E)-9-OCTAD ECENOYLOXY]PROPYL (9E)-9 OCTADECENOATE	1.9	620	C39H72O5
15	38.09	9-Octadecenoic acid, (2-phenyl-1,3-dioxolan-4-yl)methyl ester, cis	0.22	444	C28H44O4

*R.t, retention time (min).
(values expressed as relative area percentage to total identified compounds).

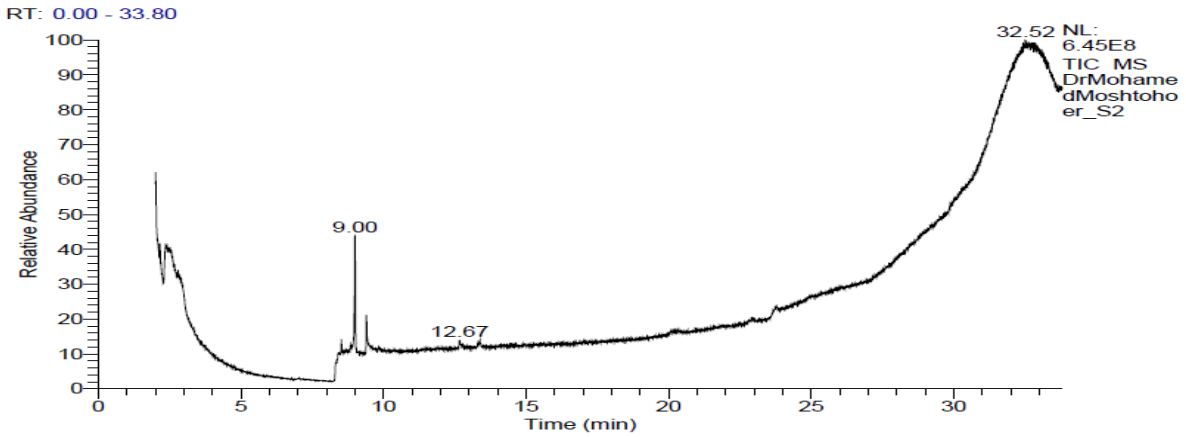


Fig 3. Identification and determination of orange juice by GC/ MS chromatography analysis

Data presented in **Table (4)** showed that determination of kaki juice by GC/ MS chromatography analysis compounds, illustrates that fractions were identified and could be related mainly to ketones, alcohols, fatty acids and hydrocarbons. Ketones and alcohols were the most predominate chemical fractions as ethane, 1,1'-oxybis (84.39), 9-octadecenoic acid (z)-(13.01), oleic acid (6.43), 9-hexadecenoic acid (6.16) and 1-heptatriacotanol(6.06). On the other hand, permethylated and reduced product of degradation product from h3-glycolipid by l-l-fucosidase and by b-galactosidase (0.06) was the lowest contents compounds.

Results on **(Table 4)** were in agreement with those reported by **Zhu, *et al* (2016)** found that AcW strongly affected the sensory qualities and the volatile compounds of persimmon wine. Compared with PW, AcW significantly improved the flavour of persimmon wine, which was attributed to the fact that AcW was capable of extracting more amino acids from the persimmon fruit than PW or AlW. In addition, these amino acids were converted into volatiles, mainly alcohols and esters, that affected the flavour of the resulting persimmon wine .

Table 4. Identification and determination of kaki juice by GC/ MS chromatography analysis:

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	2.46	ETHANE, 1,1'-OXYBIS	84.39	74	C4H10O
2	3.43	[1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester	0.11	322	C21H38O2
3	3.43	PERMETHYLATED AND REDUCED PRODUCT OF DEGRADATION PRODUCT FROM H3-GLYCOLIPID BY L-L-FUCOSIDASE AND BY B-GALACTOSIDASE	0.06	1780	C94H180N4O26
4	3.43	9,10-SECOCHOLA-5,7,10(19)-T RIENE-3,24-DIOL, (3á,5Z,7E)	0.14	358	C24H38O2
5	13.07	Dodecanoic acid, 3-hydroxy	0.30	216	C12H24O3
6	26.97	11,14,13,16-Octadecadiynoic acid, methyl ester	0.42	290	C19H30O2
7	34.03	ALANINE, 3-(BENZYLOXY)-, L-	2.56	195	C10H13NO3
8	34.03	9-OCTADECENOIC ACID (Z)-	13.01	282	C18H34O2
9	34.03	Oleic Acid	6.43	282	C18H34O2
10	34.03	2-HYDROXY-3-[(9E)-9-OCTAD ECENOYLOXY]PROPYL	4.19	620	C39H72O5
11	34.60	1-Heptatriacotanol	6.06	536	C37H76O
12	36.55	Ethyl iso-allocholate	1.83	436	C26H44O5
13	36.74	9-Hexadecenoic acid	6.16	254	C16H30O2

*R.t, retention time (min).
(values expressed as relative area percentage to total identified compounds).

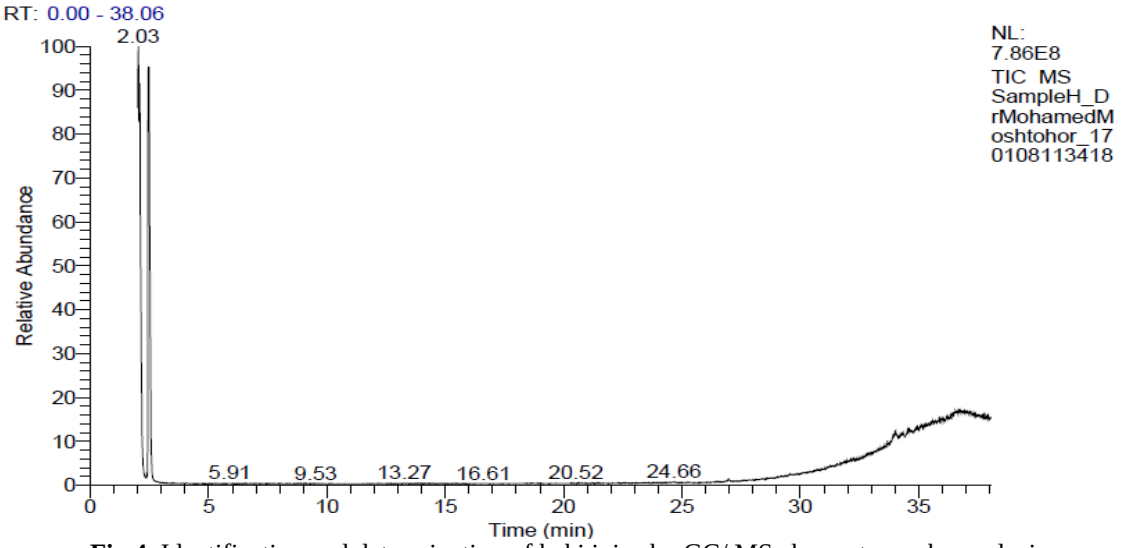


Fig 4. Identification and determination of kaki juice by GC/ MS chromatography analysis

Data presented in **Table (5)** showed that determination of carrot juice by GC/ MS chromatography analysis compounds, which could be classified mainly as aldehyde ketones, alcohols, fatty acids and hydrocarbons. Aldehydes and alcohols were the most representative chemical fractions and contents were the highest 9-octadecenoic acid (z)- (40.31) , oleic acid (20.55) and 9-octadecenoic acid (z)-,methyl ester (10.74). on the other hand, ethane, 1,1'-oxybis-(2.94), 1-ethoxyethane (3.04) and isochiapin b (5.12) were the lowest contents compounds.

Results on **(Table 5)** were in agreement with those reported by **Fukuda,*et al* (2016)** found that the aroma attribute intensity and volatile contents of the Kuroda type was lower than those of other carrot types. Therefore, using the Kuroda types to breed new carrot varieties will reduce the content of certain chemical components, and thus, the F1 hybrid carrots will have less harshness and bitterness**. Abu el- maaty (2012)** found that, carrot juice 1- Penten-3-one 15.21% - 1- Penten-3- ol 14.06%- Methyl butanoate 13.42% was less concentration Methannol 0.02%.

Table 5. Identification and determination of carrot juice by GC/ MS chromatography analysis:

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	2.04	1-ETHOXYETHANE	3.04	74	C4H10O
2	4.18	ETHANE, 1,1'-OXYBIS-	2.94	74	C4H10O
3	12.90	Dodecanoic acid, 3-hydroxy-	8.22	216	C12H24O3
4	25.37	9-Hexadecenoic acid	7.97	254	C16H30O2
5	34.43	Oleic Acid	20.55	282	C18H34O2
6	35.71	9-OCTADECENOIC ACID (Z)-,METHYL ESTER	10.74	296	C19H36O2
7	36.50	9-OCTADECENOIC ACID (Z)-	40.31	282	C18H34O2
8	38.59	ISOCHIAPIN B	5.12	346	C19H22O6
9	2.04	1-ETHOXYETHANE	3.04	74	C4H10O

*R.t, retention time (min).
(values expressed as relative area percentage to total identified compounds).

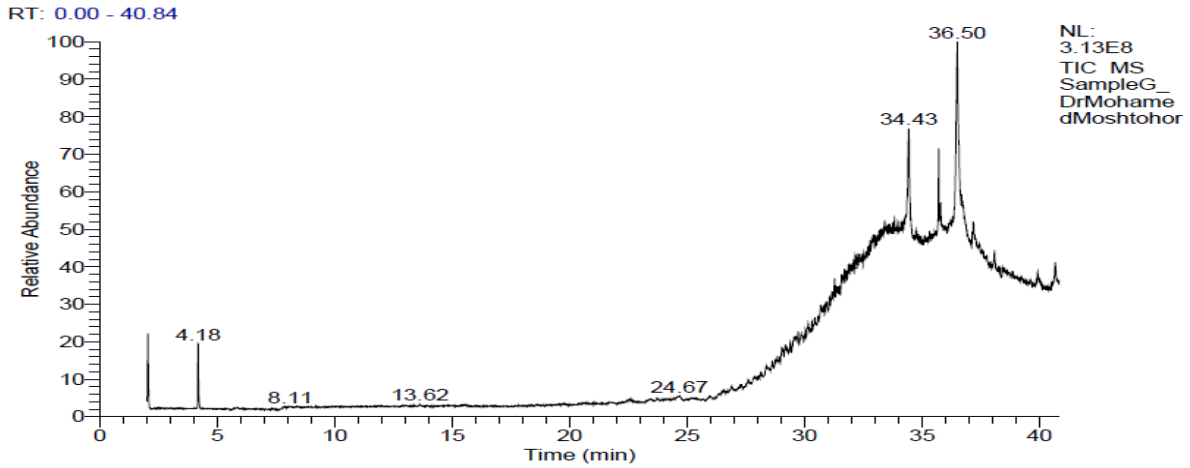


Fig 5. Identification and determination of carrot juice by GC/ MS chromatography analysis

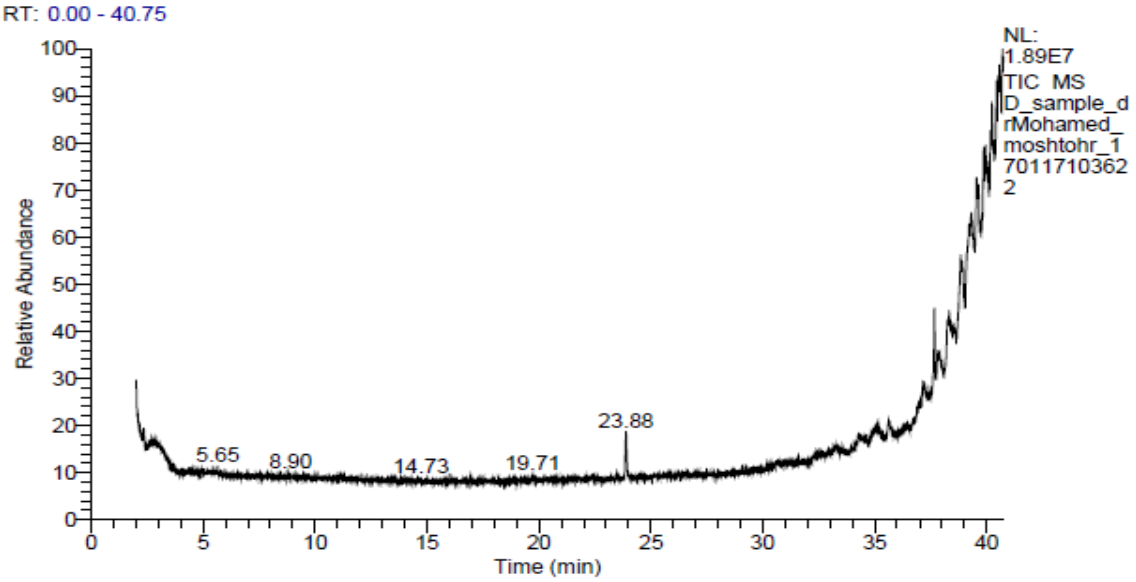
Data presented in **Table (6)** illustrated GC/MS analysis of fresh mango juice treated with addition bectinase enzyme. Ten compounds mainly the identified fractions were related to: ketones, alcohols, fatty acids and hydrocarbons, where ketones and alcohols were the most representative chemical fraction as 9-octadecenoic acid (z)-(86.88), 9-hexadecenoic acid(76.41) and oleic acid (76.27) has been found as highest fractions. In addition to the lowest contents compounds volatiles fractions in **(Table 6**) was Dodecanoic acid, 3-hydroxy-(2.73) .

Results on **(Table 6)** were enzymatic pretreatment of chopped fruit materials may hydrolyze galacturonic acid and polysaccharides to check titrable acidity (TA) and total soluble solids (TSS), **(Sharma *et al.*, 2017)** and **Chauhan, *et.al* (2001).**

Table 6. Volatile compounds identified in headspace of fresh mango juice treated with addition bectinase enzyme by GC/ MS chromatography analysis.

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	2.71	[1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester	6.64	322	C21H38O2
2	2.71	PERMETHYLATED AND REDUCED PRODUCT OF DEGRADATION PRODUCT FROM H3-GLYCOLIPID BY L-L-FUCOSIDASE AND BY B GALACTOSIDASE	5.97	1780	C94H180N4O26
3	2.85	13,16-Octadecadiynoic acid, methyl ester	9.32	290	C19H30O2
4	23.88	1,5,5-Trimethyl-6-methylene-cyclo hexane	3.43	136	C10H16
5	33.23	Dodecanoic acid, 3-hydroxy-	2.73	216	C12H24O3
6	33.23	2-AMINOETHANETHIOL HYDROGEN SULFATE (ESTER)	4.34	157	C2H7NO3S2
7	34.27	ALANINE, 3-(BENZYLOXY)-, L-	3.17	195	C10H13NO3
8	38.84	9-OCTADECENOIC ACID (Z)-	86.88	282	C18H34O2
9	39.21	9-Hexadecenoic acid	76.41	254	C16H30O2
10	39.21	Oleic Acid	76.27	282	C18H34O2

*R.t, retention time (min).
(values expressed as relative area percentage to total identified compounds).



Fig(6): Volatile compounds identified in headspace of fresh mango juice treated with addition bectinase enzyme by GC/ MS chromatography analysis

Data presented in **Table (7)** showed the results of the GC-MS analysis of the volatiles isolated from fresh mango juice treated with addition cellulase enzyme. **Table (7)** illustrates that fractions were identified and could be related mainly to ketones, alcohols, fatty acids and hydrocarbons. Ketones and alcohols were the most predominate chemical fractions as 9-octadecenoic acid (z) (96.29) , oleic acid (79.73) and hexadecanoic acid (14.01) has been found as highest contents compounds volatiles fractions. in addition to the lowest contents compounds volatiles fractions in **(Table 7**) was 9-octadecenoic acid, (2-phenyl-1,3-dioxolan-4-yl)methyl ester, cis- (2.35) . Results on **(Table 7)** were color changed with oxidation, not with enzyme-assisted treatment and storage time, **Mihalev *et al.* (2004).**

Table 7. Volatile compounds identified in headspace of fresh mango juice treated with addition cellulase enzyme by GC/ MS chromatography analysis:

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	29.46	HEXADECANOIC ACID	14.01	256	C16H32O2
2	30.72	9,10-Octadecenoic acid, methyl ester	4.5	296	C19H36O2
3	31.41	9-OCTADECENOIC ACID (Z)	96.29	282	C18H34O2
4	31.41	Oleic Acid	79.73	282	C18H34O2
5	32.67	1-Heptatriacotanol	3.99	536	C37H76O
6	34.68	9-Octadecenoic acid, (2-phenyl-1,3-dioxolan-4-yl)methyl ester, cis-	2.35	444	C28H44O4

*R.t, retention time (min).
(values expressed as relative area percentage to total identified compounds).

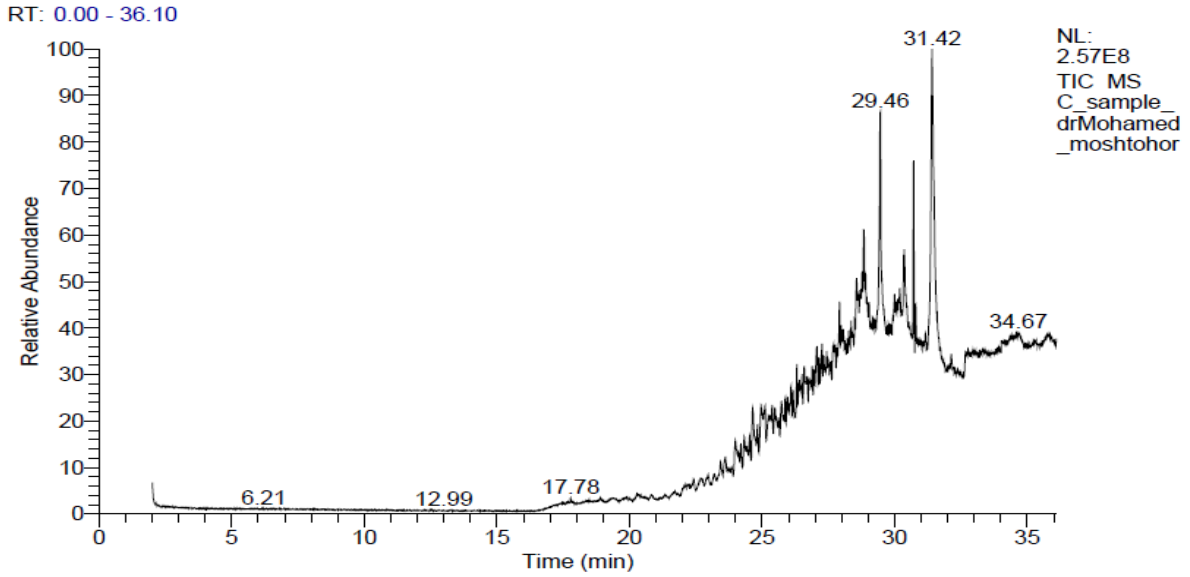


Fig 7. Volatile compounds identified in headspace of fresh mango juice treated with addition cellulase enzyme by GC/ MS chromatography analysis

Data presented in **Table (8)** showed that determination of fresh mango blending with orange juice by GC/ MS chromatography analysis compounds, which could be classified mainly as aldehyde ketones, alcohols, fatty acids and hydrocarbons. Aldehydes and alcohols were the most representative chemical fractions and contents were the highest 9-octadecenoic acid (z) (54.91), 10-octadecenoic acid, methyl ester (38.27), oleic acid (35.48) , ethane, 1,1'-oxybis- (32.7) and [1,1'-bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester (32.33) . on the other hand, 2-hydroxy-3-[(9e)-9-octad ecenoyloxy]propyl (8.90) and hexadecanoic acid, 2,3-dihydroxypropyl ester (11.69) were the lowest contents compounds.

Table 8. Volatile compounds identified in headspace of fresh mango blending with orange juice by GC/ MS chromatography analysis:

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	28.37	ETHANE, 1,1'-OXYBIS-	32.7	74	C4H10O
2	29.26	[1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester	32.33	322	C21H38O2
3	33.86	9-OCTADECENOIC ACID (Z)	54.91	282	C18H34O2
4	33.86	Oleic Acid	35.48	282	C18H34O2
5	33.94	2-HYDROXY-3-[(9E)-9-OCTAD ECENOYLOXY]PROPYL	8.90	620	C39H72O5
6	33.94	HEXADECANOIC ACID, 2,3-DIHYDROXYPROPYL ESTER	11.69	330	C19H38O4
7	36.34	10-Octadecenoic acid, methyl ester	38.27	296	C19H36O2

*R.t, retention time (min).
(values expressed as relative area percentage to total identified compounds).

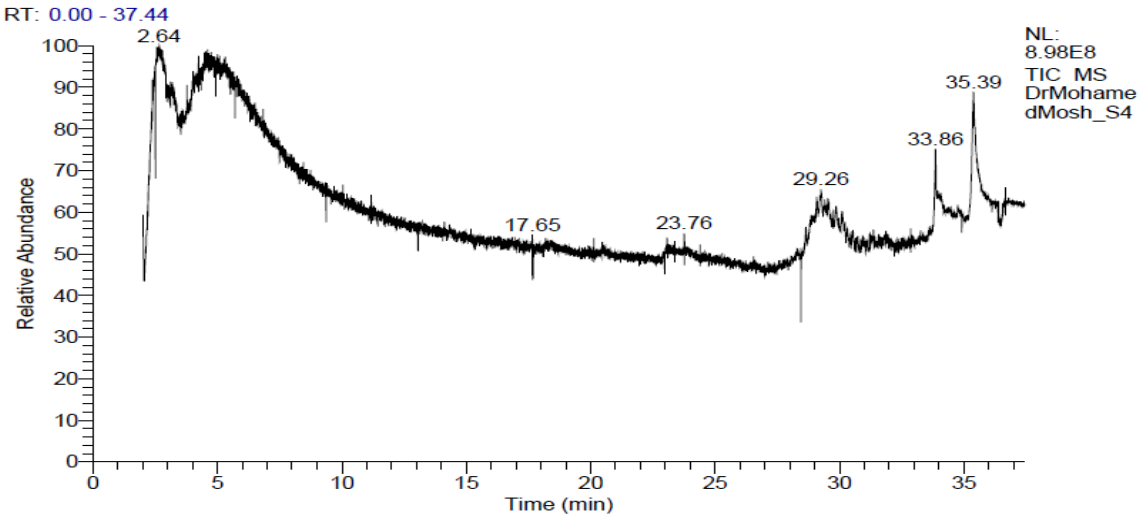


Fig 8. Volatile compounds identified in headspace of fresh mango blending with orange juice by GC/ MS chromatography analysis

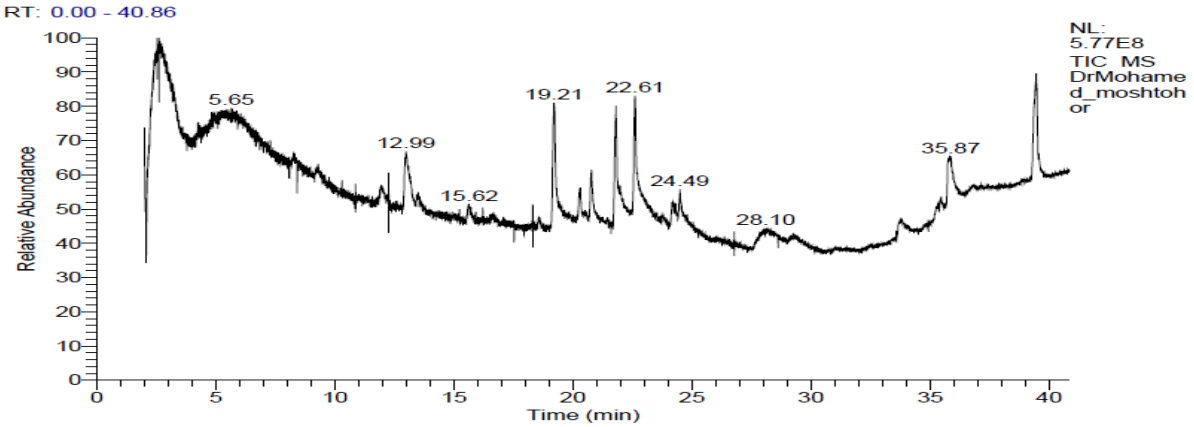
Data presented in **Table (9)** showed that determination of fresh mango blending with carrot juice by GC/ MS chromatography analysis compounds, which could be classified mainly as aldehyde ketones, alcohols, fatty acids and hydrocarbons. Aldehydes and alcohols were the most representative chemical fractions and contents was the highest ethane, 1,1'-oxybis (70.35) . on the other hand, 2,2-dideutero octadecanal (4.06) , 7-nonenoic-7,8-d2 acid,methyl ester (4.59) , 7-nonenoic-7,8-d2 acid,methyl ester (4.59), 8-nonenoic-8,9-d2 acid,methyl ester (4.59), 10-undecenoic acid,methyl ester(4.59)and permethylated and reduced product of degradation product from h3-glycolipid by l-l-fucosidase and by b-galactosidase (4.59) were the lowest contents compounds.

Results on **(Table 9)** were in agreement with those reported by **Abu el- maaty (2012)** found that, the compound Ethyl isobutyrate 20.96% - 11.22% in nectar papaya apricot and papaya carrot. The lowest concentration was compound Ethyl decanoate 0.01% in nectar papaya, apricot and compound limonene 0.06% nectar papaya apricot.

Table 9. Volatile compounds identified in headspace of fresh mango blending with carrot juice by GC/ MS chromatography analysis:

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	9.00	ETHANE, 1,1'-OXYBIS	70.35	74	C4H10O
2	23.77	7-NONENOIC-7,8-D2 ACID,METHYL ESTER	4.59	172	C10H16D2O2
3	23.77	8-NONENOIC-8,9-D2 ACID,METHYL ESTER	4.59	172	C10H16D2O2
4	23.77	10-UNDECENOIC ACID,METHYL ESTER	4.59	198	C12H22O2
5	23.77	PERMETHYLATED AND REDUCED PRODUCT OF DEGRADATION PRODUCT FROM H3-GLYCOLIPID BY L-L-FUCOSIDASE AND BY B-GALACTOSIDASE	4.59	1780	C94H180N4O26
6	32.52	Z-(13,14-Epoxy)tetradec-11-en-1-olacetate	17.83	268	C16H28O3
7	32.52	Z-8-Methyl-9-tetradecenoic acid E-8-Methyl-7-dodecen-1-ol acetate	16.36	240	C15H28O2
8	32.52	6-Acetyl-á-d-mannose	25.06	222	C8H14O7
9	32.97	1-Dodecanol, 3,7,11-trimethyl-	19.31	228	C15H32O
10	33.32	2,2-DIDEUTERO OCTADECANAL	4.06	270	C18H34D2O

*R.t, retention time (min).
(values expressed as relative area percentage to total identified compounds).



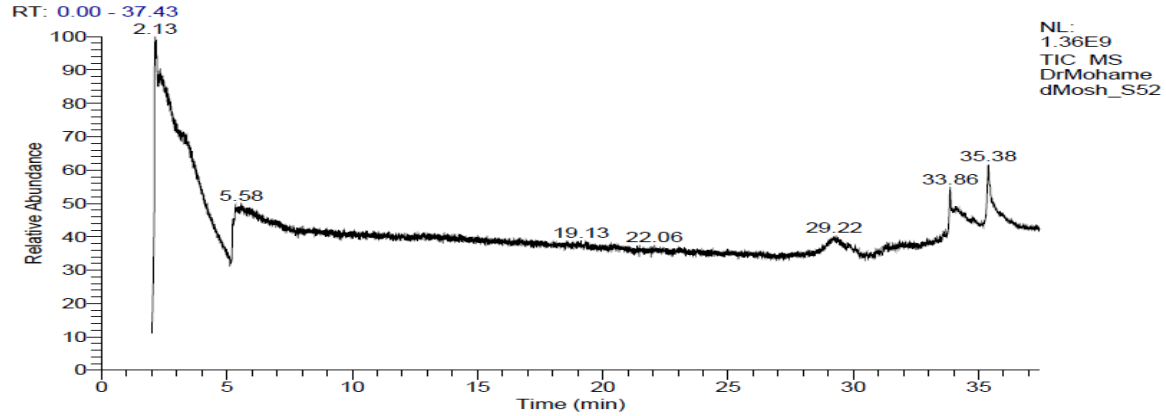
Fig(9): Volatile compounds identified in headspace of fresh mango blending with carrot juice by GC/ MS chromatography analysis

Data presented in **Table (10)** illustrated GC/MS analysis of fresh mango blending with kika juice . Nine compounds mainly the identified fractions were related to: ketones, alcohols, fatty acids and hydrocarbons, where ketones and alcohols were the most representative chemical fraction as ethane, 1,1'-oxybis (89.07), 2-butanol, 1-methoxy (78.85) and ethane, 1,2-diethoxy(78.85) has been found as highest fractions. In addition to the lowest contents compounds volatiles fractions in **(Table 10**) was 13-Tetradecynoic acid, methyl ester (0.76) .

Table 10. Volatile compounds identified in headspace of fresh mango blending with kika juice by GC/ MS chromatography analysis:

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	2.14	ETHANE, 1,1'-OXYBIS	89.07	74	C4H10O
2	2.14	2-Butanol, 1-methoxy	78.85	104	C5H12O2
3	2.14	Ethane, 1,2-diethoxy	78.85	118	C6H14O2
4	30.08	13-Tetradecynoic acid, methyl ester	0.76	238	C15H26O2
5	31.27	[1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester	3.74	322	C21H38O2
6	31.27	9-Octadecenoic acid (Z)-, methyl ester	2.33	296	C19H36O2
7	33.86	Oleic Acid	4.14	282	C18H34O2
8	33.86	HEXADECANOIC ACID, 2,3-DIHYDROXYPROPYL ESTER	3.12	330	C19H38O4
9	35.39	OCTADEC-9-ENOIC ACID	9.91	282	C18H34O2

*R.t, retention time (min).
(values expressed as relative area percentage to total identified compounds).



Fig(10): Volatile compounds identified in headspace of fresh mango blending with kika juice by GC/ MS chromatography analysis

Data presented in **Table (11)** illustrated GC/MS analysis of fresh mango blending with apricot juice . Five compounds mainly the identified fractions were related to: ketones, alcohols, fatty acids and hydrocarbons, where ketones and alcohols were the most representative chemical fraction as 2-butanol, 1-methoxy-(30.18) , oleic acid (29.15) , ethane, 1,1,2-trimethoxy- (19.02) and d-(+)-glyceric acid (15.57) has been found as highest fractions. In addition to the lowest contents compounds volatiles fractions in **(Table 10)** was 11-Octadecenoic acid, methyl ester (6.07).

Results on **(Table 11)** were in agreement with those reported by **Abu el- maaty (2012)** found that, Disappeared compounds α- terpineol, thyhexanoate, cymene and hexen-1-ol in nectar papaya apricot and papaya carrot, respectively immediately after pasteurization.

Table 11. Volatile compounds identified in headspace of fresh mango blending with apricot juice by GC/ MS chromatography analysis:

Peak No.	R.t*	Compound name	Area %	Molecular Weight	Molecular formula
1	2.45	Ethane, 1,1,2-trimethoxy-	19.02	120	C5H12O3
2	2.50	d-(+)-Glyceric acid	15.57	106	C3H6O4
3	2.62	2-Butanol, 1-methoxy-	30.18	104	C5H12O2
4	33.85	Oleic Acid	29.15	282	C18H34O2
5	33.94	11-Octadecenoic acid, methyl ester	6.07	296	C19H36O2

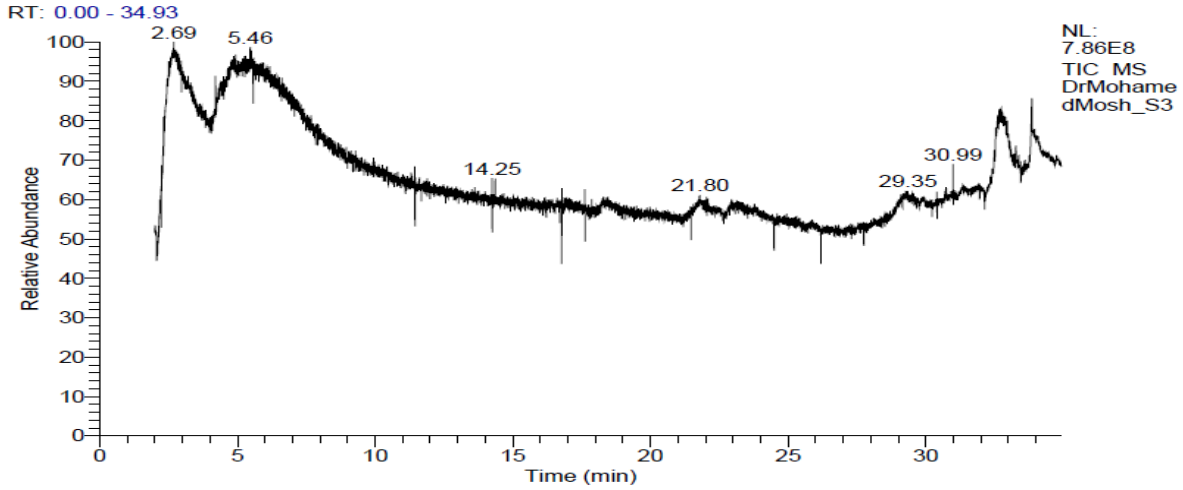


Fig (11): Volatile compounds identified in headspace of fresh mango blending with apricot juice by GC/ MS chromatography analysi.

CONCLUSIONS

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تعريف وتقدير مركبات النكهة فى بعض عصائر الفاكهة ومخاليطها

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في هذه الدراسة تم استخدام طريقة التحليل الكروموتوجرفي لمعرفة المكونات المسئولة عن النكهة في بعض أنواع العصائر والمشروبات المنتشرة في مصر. وتم أيضا تقدير مكونات النكهة في عصير المانجو وعصيرالبرتقال وعصير المشمش وعصير الجزر وعصير الكاكي محل الدراسة بعد إضافة انزيمات البكتينيز والسليلوليز المحسنة للقوام بتركيز (0.1%) لمعرفة مدي تأثير هذه الانزيمات علي مكونات النكهة في هذا العصير محل الدراسة .وأيضا تم تحضيرعدد ٤ مخاليط منها عصير المانجو مع عصيرالبرتقال وعصير المانجو مع عصيرالجزر و عصير المانجو مع عصيرالمشمش وعصير المانجو مع عصير الكاكي بنسبة خلط ٨٠ :٢٠% علي التوالي . وتم تقدير مكونات النكهة في ١١ عينة محل البحث واظهرت النتائج احتواء منتج عصير المانجو علي مركب بروبان–٢–ميزواوكسي بنسبة ٢١.٨٦ وعصير المشمش علي مركب اوكتا دي كونك اسيد بنسبة ١٤.٥٩وعصير البرتقال علي مركب ايثان ١,١اوكسي بيس بنسبة ٧٩.٣٦وعصير الكاكي علي مركب ايثان ١,١اوكسي بيس بنسبة ٨٤.٣٩وعصير الجزر علي مركب ٩–اوكتا دي كونك اسيد (زد)بنسبة ٤٠.٣١ وأظهرت إضافة انزيمات البكتينيز والسليلوليزالي عصير المانجو الي زيادة مركب ٩–اوكتا دي كونك اسيد (زد)بنسبة ٨٦.٨٨ وبنسبة ٩٦.٢٩ علي التوالي .واحتواء عصير المانجو المخلوط بعصير البرتقال علي مركب ٩– اوكتا دي كونك اسيد زد بنسبة ٥٤.٩١ وعصير المانجو المخلوط بعصير الجزر علي مركب ايثان ١,١اوكسي بيس بنسبة ٧٠.٣٥ وعصير المانجو المخلوط بعصير الكاكي علي مركب ايثان ١,١اوكسي بيس بنسبة ٨٩.٠٧ وعصير المانجو المخلوط بعصير المشمش علي مركب ٢–بيتا نول –١– ميزو اوكسي بنسبة ٣٠.١٨ .