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MASS SPECTRAL ANALYSIS (GCMS) GAS CHROMATOGRAPHY AND MASS SPECTROMETRY OF VARIOUS VOLATILE BIOACTIVE COMPOUNDS IN SONAKA SEEDLESS RAISINS

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ABSTRACT

Grape (*Vitis sp.*) belonging to Family Vitaceae is a commercially important fruit crop of India. Grapes are eaten as raw or they can be used for making wine, raisins, jam, and jelly, which are very nutritious and rich source of minerals like potassium, phosphorus, calcium, magnesium, other micronutrients and different vitamins. Raisins are dried fruits of certain varieties of grapevines with a high content of sugar and solid flash (Khair and Shah, 2005). Analysis of organic compounds by FT Raman spectrum of raisin. The Raman spectra of the films were recorded in the spectral range of 35–4000 cm−1 using a Raman spectrometer (Bruker Multi RAM, Germany Make). The Raman shift corresponds to the frequency of the fundamental IR absorbance band of the bond (Thygesen *et al.,* 2003). It is known that specific chemical bonds (C-H, N-H, and C=O) generate specific peaks (Huang *et al.,* 2010). Hence this technique proves to be a powerful technique which facilitates to determine molecular structure of spectral pattern of fingerprinting of sample.

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INTRODUCTION

Grape (*Vitis sp.*) belonging to Family Vitaceae is a commercially important fruit crop of India. Grapes are eaten as raw or they can be used for making wine, raisins, jam, and jelly, which are very nutritious and rich source of minerals like potassium, phosphorus, calcium, magnesium, other micronutrients and different vitamins. The dried grapes, commonly known as raisins, have a great importance in economy of the country and considered as one of the nutritious most popular dry fruits in the world. Raisins are dried fruits of certain varieties of grapevines with a high content of sugar and solid flash (Khair and Shah, 2005). The important raisin grape varieties are Thompson seedless and their selections like Tas-A-Ganesh, Sonaka and Manikchaman. The increased production of table grapes has a great potential to produce raisins with minimum losses of fresh fruits (Telis *et al*., 2004).Thapar (1960) indicated that grape was introduced in India in 1300AD by the Persian invaders in North and South India (Daulatabad in Aurangabad districts of Maharashtra) during the historic event of changing the capital from Delhi to Daulatabad by King Mohammed-bin-Tughlak and in South India districts Salem and Madurai by the Christian missionaries around 1832 A. D. From Daulatabad grape cultivation was spread to Hyderabad in Deccan during the Nizam's period. Nizam of Hyderabad has also introduced some grape varieties into Hyderabad from Persia in the early 20th century (Chadha and Shikhamany, 1999). There are two subgenera viz *Euvitis* and *Muscadania*. All commercially important varieties of grape belong to sub genus *Euvitis*, referred as true grape. More than 90% of cultivated grape varieties belong to this species which is referred as 'old world grape' the 'European grape' or 'California grape' (Shymal and Patel, 1953 and Shetty, 1959). India is a small producer of grapes, with a world share of less than 2 percent (Barrientos and Kritzinger, 2004). The total average cultivation of grape is near about 80,000 hectares in India and 28,000 hectares in Maharashtra. The total yield in India is about 15 to 18 lakh tons and in Maharashtra, it is about 7 to 9 lakh tons. Out of this annual production, 76% is used as table grapes, 0.3% in wine industry, 3. 70% exported to Middle East and European countries as table fruit and 20% used for preparation of raisin. Recently, grape cultivation is increased more in Maharashtra and the major growing districts are Nasik, Sangli, Sholapur, Ahmednagar, Pune and Osmanabad. Near about 80 % of grape production comes from Maharashtra followed by that from Karnataka and Tamil-Nadu. The commercial production of grapes started in India only after seedless varieties were introduced in Maharashtra during the 1960s. Maharashtra accounts for 70 percent of India's total grape acreage and 63 percent of production. Varieties grown include Thompson, Sonaka, Sharad and Tas-A-Ganesh Seedless. Within Maharashtra, the grape crop comprises 12 percent of the total fruit acreage, with 42,500 acres. Sangli, Sholapur, Pune and Ahmednagar are the other locations, with more than 2,500 acres each under grape cultivation. Due to the higher water content, these fruits drastically disintegrate and are spoiled. Hence dehydration of such fruits is urgent need to avoid the spoilage. Grape is an important source of carbohydrates, minerals and vitamins but due to its low shelf life it is very difficult to fulfill the needs of the society. The preparation of raisin was started long back, and known as "Manuka" (simply drying the grapes in open sunlight). Then after introduction of mutant Thomson seedless variety many grape growers turned to prepare yellowish Golden raisin and from last fifteen years many of grape growers from Sangli district are diverted towards the preparation of green raisin at Junoni [Sholapur] and nearby areas which has a good market potential in Delhi, Kanpur and other cosmopolitan cities. Nasik, Sangli and Sholapur are the leading grape producing districts of Maharashtra. The most of these regions are drought prone. So the area under grape cultivation is increasing day by day, which will create a problem of marketing of table grape. During last 19 to 20 years due to increase in yield, expanding area under cultivation and fluctuation in the market price the farmers are slowly turning towards raisin production. Hence, an attempt has been made to study some aspects of post - harvest physiology in relation to production of raisin in two verities of grape, Thompson and Sonaka seedless growing in Sangli district.

MATERIAL AND METHODS

Analysis of Bioactive Compounds (GCMS): The methods described by Anwar *et al*. (2006) and Sultana *et al*. (2008) with slight modifications were employed for the preparation of methanolic extracts. 0.5 grams of oven dried powdered raisins subjected to different chemical treatments in Sonaka seedless were taken in a 250 ml flask and mixed thoroughly with 10 ml of 100 % methanol (HPLC grade). Methanolic extracts were obtained in an electric shaker (Remi Rotary Shaker, Mumbai, India) for 48 hours in ambient conditions (shaking intensity 120 rpm). The extracts were then filtered using Whatman No. 1 filter paper. The residues obtained after the filtration were subjected to re-extraction twice with the fresh methanol and these extracts were added to previous extracts. The crude extracts so obtained were concentrated to dryness on water bath in pre weighed evaporating dishes at 45˚C. After complete drying of the extracts evaporating dishes were again weighed for determination of the yield and stored in a refrigerator (-4˚C), until used for further analysis. From the dried powder, known quantity was dissolved in methanol to prepare stock solution for further use in GCMS analysis. These methanolic extracts were subjected to Gas Chromatography and Mass Spectrometry for the determination volatile metabolites.

GC-MS analysis of the samples was carried out using Shimadzu Make QP- 2010 with non polar 60 M RTX 5MS Column. Helium was used as the carrier gas and the temperature programming was set with initial oven temperature at 40°C and held for 3 min and the final temperature of the oven was 480°C with rate at 10°C. 2 μL sample was injected with split less mode. Mass spectra were recorded over 35-650 amu range with electron impact ionization energy 70 eV. The total running time for a sample was 45 min. The chemical components from the methanolic extracts of raisins were identified by comparing the retention times of chromatographic peaks using Quadra pole detector with NIST Library to relative retention indices. Quantitative determinations were made by relating respective peak areas to TIC areas from the GC-MS.

RESULT AND DISSCUSSION

Analysis of Bioactive Compounds (GCMS: The mass spectral analysis of bioactive volatile compounds of untreated sonaka seedless raisins is shown in the Table 5 and mass fragments in the Plate 16 to 20. It is observed from the table that raisins of variety are rich in various bioactive volatile compounds. Among these compounds some represents to class of Acids, Aldehydes, Alcohols, Ketone, Alkane and Alkene. The major compound reported from the seedless untreated raisins are 2-Furancarboxaldehyde, Octacosane, Decosane, 4H-Fyran-4-one, 2, 3 dihydro-3,5 dihydoxy- 6 methyl, 1,2- Benzene dicarboxylic acid, Octane, n- Hexadecanoic acid, Heptadecane and Dibutyl phthalate. The raisins treated with K_2CO_3 and Sulphur fumigated shows the presences of 4 H-Pyran-4-one,2,3 dihydroxy -3, 5 dyhydroxy-6-methyl, Dibutyl phthalate, 1,2,3- Propanetriol, mono acetate, 2- Hexanone, 3-methyl-4-methylene, n-Hexdecanoic acid and Octadecanoic acid. The mass spectral analysis of bioactive volatile compounds of untreated sonaka seedless raisins is shown in the Table 5 and mass fragments in the Plate 16 to20. it is noticed from the table and figure that the untreated Sonaka raisins shows six volatile bioactive compounds such as 1 2 -Furancarboxaldehyde, 5 (hydroxymethyl), Dibutyl phthalate, 4H- Pyran-4-one, 2, 3- dihydro-3,5 dihydroxy -6-methyl, n-Hexadecanoic acid, Octadecanoic acid and d-Glycero-d-ido-deptose. Whereas the raisins treated with K_2CO_3 and sulphur fumigated results in the development of fourteen various bioactive volatile compound are 9,12-Octadecadienoic acid (Z,Z) -, methyl ester, 4-Hepten-3-one, 4-methyl, n-Hexdecanoic acid, Hexadecanoic acid, methyl ester Propanoic acid, 2-methyl-, methyl ester, 4H- Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-, 9- Octadecenoic acid, methyl ester, Limonene, Oleic acid, Octadecenoic acid, methyl ester, Octadecanoic acid, 2-(2-hydroxyethoxy) ethyl ester, 2,6,6-Trimethyl bicycle (3.1.1)hept-Zene, Dibutyl phthalate and Petanoic acid, 4-oxo-While Zein protein coated raisins displays ten bioactive compounds are 9,12-Octadecadienoic acid, methyl ester, Propanoic acid, 3-(acetylthio)-2-methyl-, 1,2,3-Propanetriol, diacetate, Propanol, 2,3-dihydroxy, Xanthosine, Dibutyl phthalate, Hexadecanoic acid, methyl ester, Octadecenoic acid, methyl ester, 9-Octadecenoic acid, methyl ester(E) and n-Hexdecanoic acid. While the zein protein coated with mango essence exhibits eight volatile compounds are 1,2-Benzenediacarboxylic,acid, butyl 2-ethylhexyl ester, Xanthosine, Dibutyl phthalate, Squalene, Docosane, Hexadecane, 1,2-Benzenediacarboxylic, bis(2-metylpropyl) ester, Limonene and orange essence coated raisins shows ten different volatile bioactive compounds are Xanthosine, 2-Furancarboxaldehyde, 5-(hydroxymethyl)-, 4H-Pyran-4-one,2,3-dihydroxy-3,5-hidroxy-6-methyl, Dibutyl phthalate, 1,2-Benzenedia carboxylic acid, butyl 2- ethylhexyl ester, n-Hexdecanoic acid, Octadecanoic acid, 2-(2-hydroxyethoxy) ethyl ester, 9-Octadece namide,(2)-, 9,12-Octadecadienoic and 1,2-Benzenediacarboxylic acid, bis(2-methylpropyl) ester.

The mass spectral analysis of 5% mango essence in methanol shows ten different bioactive compounds such as 2-Propanol,1,1'-[(1-methyl-1,2-ethanediyl]bis-, Benzyl alcohol, 2-Propanol,1,1'-oxybis, 2-Propanol,1,1'-[(1-methyl-1,2-ethanediyl]bis-, Diphenyl ether, 4H-Pyran-4-one,2-ethyl-3-hydroxy, 2-Butanol,3,3-oxybis, Benzaldehyde,3-hydroxy-4-methoxy, 2(3H) Furanone, 5-hexidihydro and 4H-Pyran-4-one,2-ethyl-3-hydroxy. The 5% orange essence in methanol indicates five different volatile bioactive compounds Benzyl alcohol, 2-Propanol,1,1'-oxybis, 2-Propanol,1,1'-[(1-methyl-1,2-ethanediyl]bis-, 2-Propanol,1,1'-[(1-methyl-1,2-ethanediyl]bis- and Butanol,3,3'-oxybis-. While 4% rapseed oil in methanol exhibits two volatile compounds such as 1,2-Benzenediacarboxylic acid, butyl 2-ethylhexyl ester and 1,2-Benzenediacarboxylic acid, bis(2-methylpropyl)ester. Volatile monoterpenes shows a greater diversity of compounds. Volatiles have diverse structures and arise from the activities of several biochemical pathways. Many plants emit substantial amounts of phytogenic volatile organic compounds (PVOSs). The most common volatiles include C6 volatiles (lipoxygenase/hydroperoxide lyase-dependent pathways), indole and MeSA (the shikimic acid/tryptophane pathway), cyclic and acyclic terpenoids (isoprenoid pathway), and oximes and nitriles (derived from amino acids) (Dicke, 1999). Hanus *et al.,* (2006) reported more than hundreds volatile compounds from the fruits of *Mandragora autumnalis*, which belongs to n-alkanes, branched-chain alkane, cycloxanes, alkenes, , alcohols, aldehydes, six ketones, heterocyclic compounds, thio compounds, benzene hy-drocarbons, phenols, carboxylic acids and esters of carboxylic acids.

According to Ribereau-Gayon (2000), the grape fruit skin volatile compounds terpenes, C13-norisoprenoids, benzene derivatives, and aliphatic alcohols) are the main contributor to the fresh and fruity aroma to grape products Aromatic compounds are one of the most important constituent in governing the quality of grape-derived products. And play a key role affecting the quality of its products. Concentration of these volatile compounds varies according to the grape variety, cultural practices, and climatic or biological factors (Jackson and Lombard, 1993, CSIRO and Australian Bureau of Meteorology; 2012). Sixteen compounds were identified by Sanchez-Palomo *et al.* (2005) in pulp and skins of Muscat grapes including C6-alcohols and aldehydes, terpenes and benzenic compounds. Which (Linalool, geraniol, and nerol) are responsible for the typical floral aroma of Muscat grapes and contribute to the aroma of their wines.

Table 1: GCMS analysis of Sonaka raisins treated with various chemicals.

Sr. No	MolWt.	Name of compound	O	B	C	D	E	F	G	H
1.	176	1,2,3-Propanetriol, diacetate	-	-	21.49	-	-	-	-	-
2.	278	1,2-Benzenediacarboxylic acid, bis(2-methylpropyl) ester	-	-	--	-	0.53	-	-	17.25
3.	334	1,2-Benzenediacarboxylic acid, butyl 2-ethylhexyl ester	-	-	-	10.0	5.59	-	--	82.75
4.	278	1,2-Benzenediacarboxylic, bis(2-metylpropyl) ester	-	-	-	1.86	-	-	-	-
5.	170	2(3H) Furanone, 5-hexidihydro	-	-	-	-	-	2.86	-	-
6.	162	2-Butanol,3,3-oxybis	-	-	-	-	-	6.33	-	-
7.	126	2-Furancarboxaldehyde, 5-(hydroxymethyl)-	-	-	54.45	-	-	-	-	-
8.	192	2-Propanol,1,1'-[(1-methyl-1,2-ethanediyl]bis-	-	-	-	-	-	58.00	12.06	-
9.	144	4H- Pyran-4-one, 2, 3- dihydro-3,5 dihydroxy - 6-methyl	26.61	10.80	-	-	24.56	-	-	-
10.	126	4-Hepten-3-one, 4-methyl	-	46.10	-	-	-	-	-	-
11.	140	4H-Pyran-4-one,2-ethyl-3-hydroxy	-	-	-	-	-	7.85	-	-
12.	296	9- Octadecenoic acid, methyl ester	-	5.12	9.29	-	-	-	-	-
13.	294	9,12-Octadecadienoic acid, methyl ester	-	77.71	45.79	-	1.18	-	-	-
14.	281	9-Octadecenamide,(2)-	-	-	-	-	1.22	-	-	-
15.	122	Benzaldehyde,3-hydroxy-4-methoxy	-	-	-	-	-	5.81	-	
16.	108	Benzyl alcohol	-	--	-	-	-	39.10	39.10	
17.	134	Butanol,3,3'-oxybis-	-	-	-	-	-	-	2.30	
18.	210	d-Glycero-d-ido-deptose	13.70	-	-	-	-	-	-	
19.	278	Dibutyl phthalate	40.64	1.18	12.66	13.10	7.88	-	-	
20.	170	Diphenyl ether	-	-	-	-	-	18.12	-	
21.	310	Docosane	-	-	-	3.98	-	-	-	
22.	226	Hexadecane	-	-	-	2.95	-	-	-	
23.	270	Hexadecanoic acid, methyl ester	-	12.38	12.48	-	-	-	-	
24.	136	Limonene	-	4.24	-	1.64	-	-	-	
25.	256	n-Hexadecanoic acid	18.48	17.12	7.76	-	5.18	-	-	
26.	284	Octadecanoic acid	16.17	-	-	-	-	-	-	
27.	372	Octadecanoic acid, 2-(2-hydroxyethoxy) ethyl ester	-	2.07	-	-	4.14	-	-	
28.	298	Octadecenoic acid, methyl ester	-	3.61	12.01	-	-	-	-	
29.	282	Oleic acid	-	3.72	-	--	-	-	-	
30.	116	Petanoic acid, 4-oxo-	-	0.83	-	-	-	-	-	
31.	102	Propanoic acid, 2-methyl-, methyl ester	-	11.27	-	-	-	-	-	
32.	162	Propanoic acid, 3-(acetylthio)-2-methyl-	-	-	29.62	-	-	-	-	
33.	90	Propanol, 2,3-dihydroxy	-	-	18.34	-	-	-	-	
34.	410	Squalene	-	-	-	8.09	-	-	-	
35.	284	Xanthosine	-	-	16.42	60.90	94.41	-	-	
36.	126	1 2 -Furancarboxaldehyde, 5 (hydroxymethyl)	52.58	-	-	-	-	-	-	
37.	134	2-Propanol,1,1'-oxybis	-	-	-	-	-	25.97	25.97	
38.	136	2,6,6-Trimethyl bicycle (3.1.1)hept-Zene	-	1.33	-	-	-	-	-	

O=Untreated, **A=**K_2CO_3+Sulphur fumigated; **B**=K_2CO_3+ Sulphur fumigated and Zein protein coating; **C**=K_2CO_3+Sulphur fumigated and Zein protein coating with mango essence; **D**=K_2CO_3+Sulphur fumigated and Zein protein coating with orange essence; **E**=5% mango essence in methanol; **F**=5% orange essence in methanol and **G**=4% Rapseed oil in methanol.

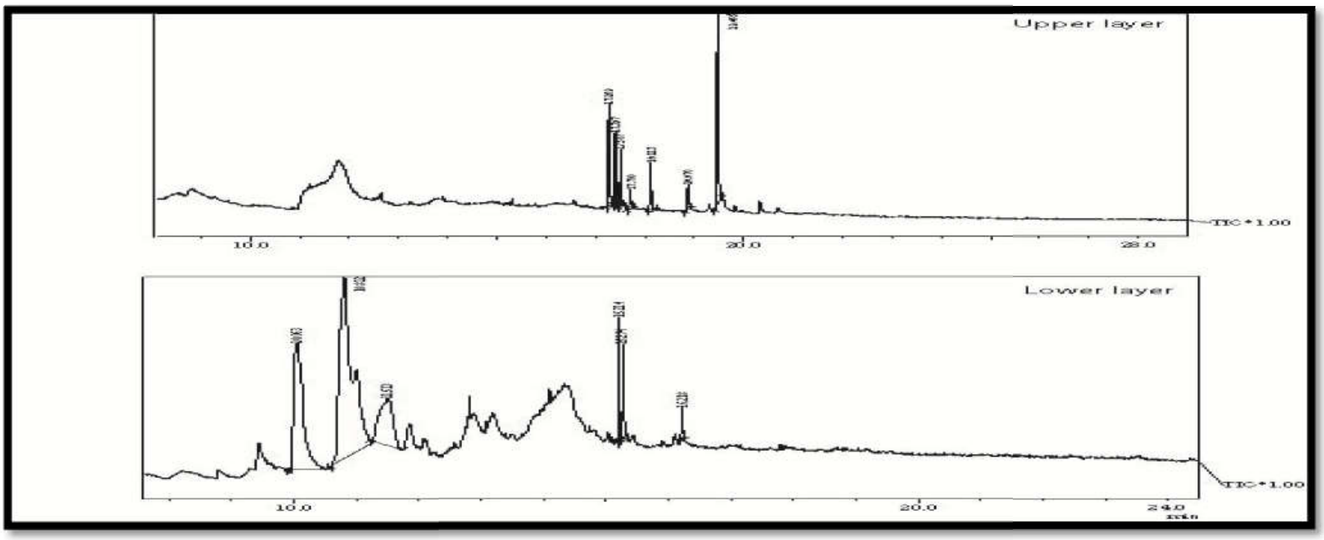

Plate 1: GC MS Spectra of Sonaka Seedless Untreated raisin

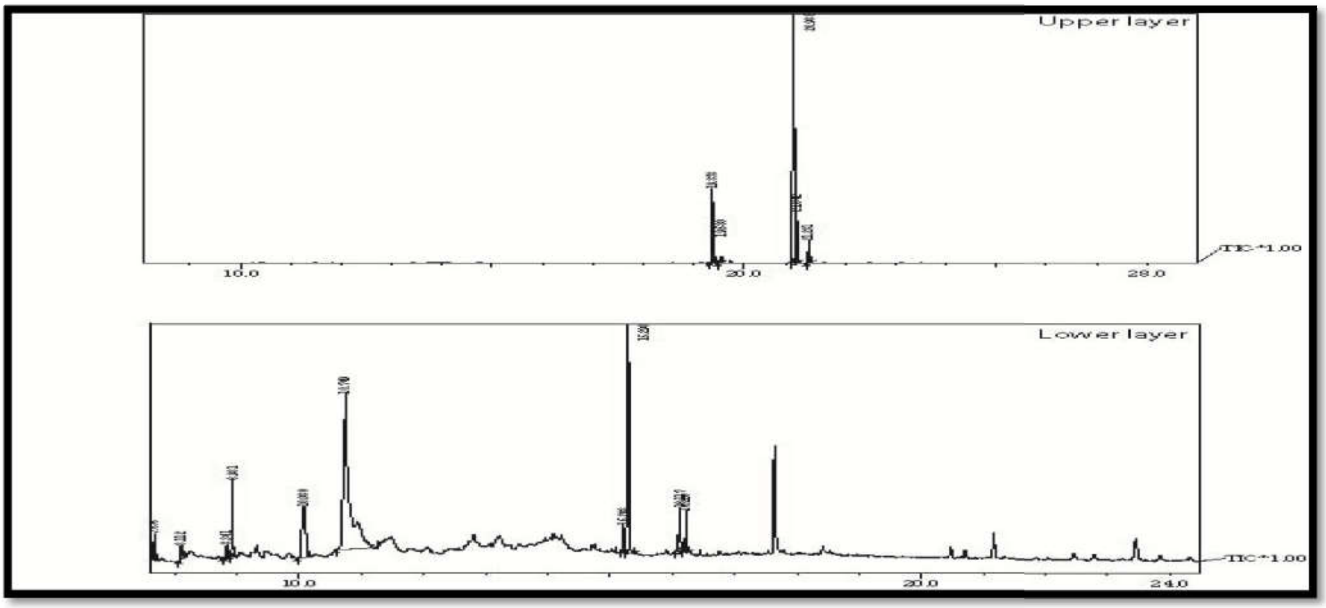

Plate 2: GC MS Spectra of Sonaka seedless raisins treated with sulphur

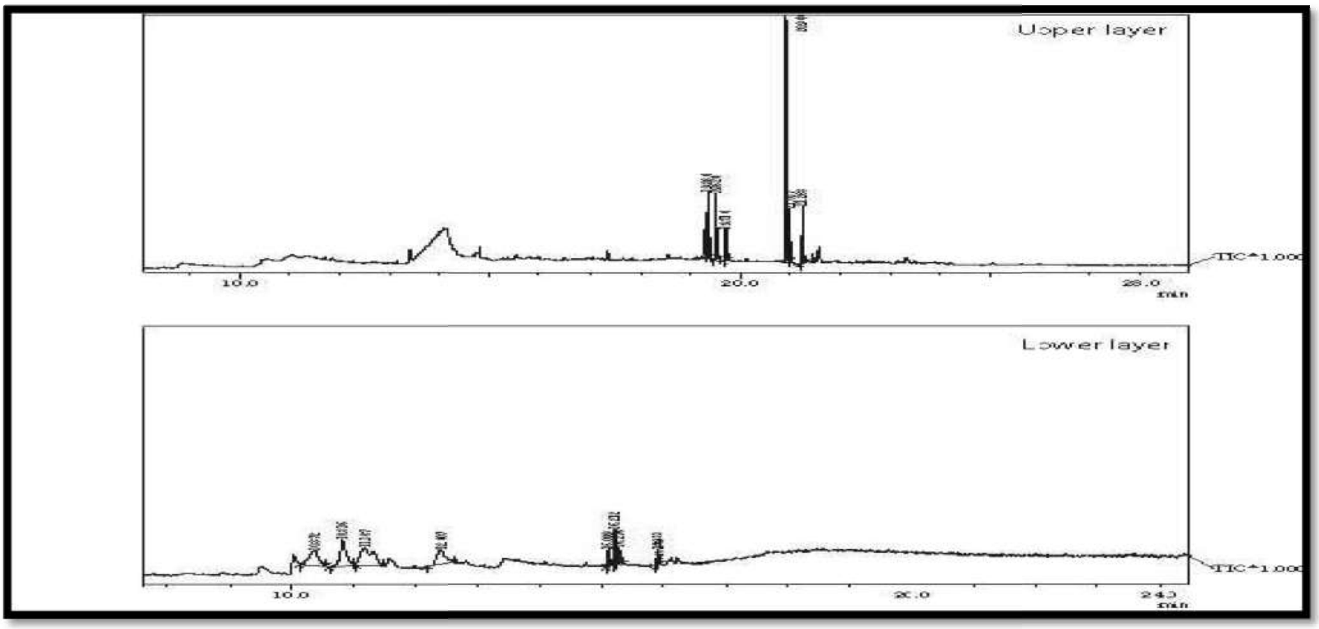

Plate 3: GC MS Spectra of Sonaka seedless treated with K_2CO_3+ sulphure fumigated +coated

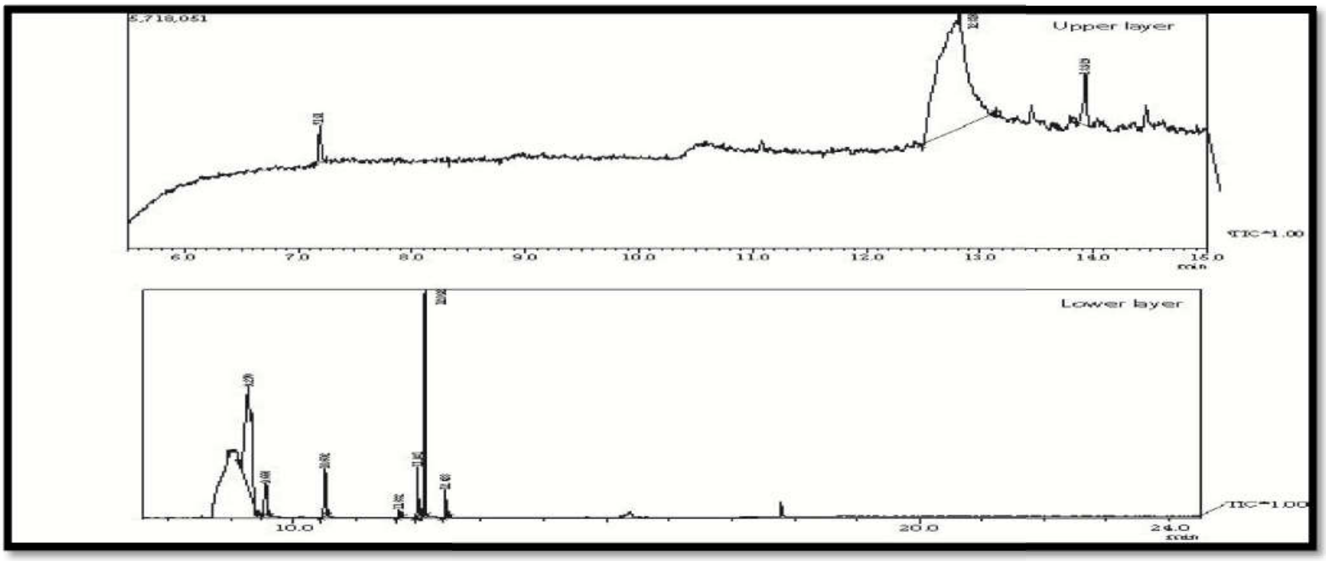

Plate 4: GC MS Spectra of Sonaka seedless treated with K_2CO_3+sulphure fumigated coated with mango essences

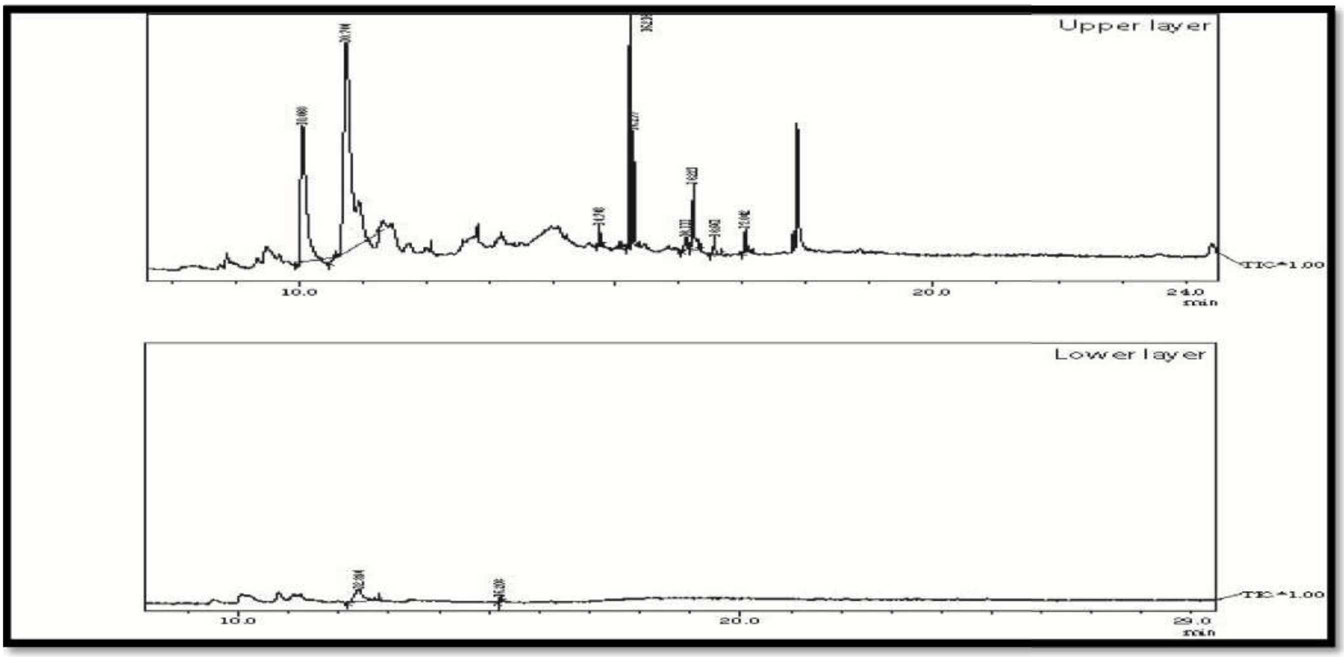

Plate 5: GC-MS Spectra of Sonaka seedless treated with K_2CO_3+sulphure fumigated coated with orange essences

The distribution of volatile compounds can be used for the characterisation of grape varieties and considered as important constituent of grape and wine aroma substance (Ribereau-Gayon, 2000). Genova (2012) observed that the various classes of aromatic compounds contribute to the flavor profile of grapes and grape-based products with alcohols and esters along with carbonyl compounds, terpens, organics acids, and norisoprenoids. They concluded that alcohols and aldehyde were the most represented classes, followed by terpenoids benzoic derivatives and C-13 norisoprenoids. Which are derived from carotenoids and found to be determinant in giving its characteristic flowery aroma.

The biological activity of volatile compounds is dependent on the synergistic or additive effects of the constituent types present at different concentrations. Volatile compounds from aromatic plants can cause a number of positive or negative interactions (Vokou *et al.,*2003) Like isoprene, some monoterpenes and sesquiterpenes have the potential to combine with various reactive oxygen species (Bonn and Moortgat, 2003), and can protect against internal oxidative damage (Loreto *et al.,*2004). Kubo and Kubo (1995) studied the antimicrobial activity of the constituents (E) 2-Heprenal; (E) 2-octenal; (E) 2-nonenal; (E) 2-decenal; (E) 2-undecenal; (E) (E) 2, 4-decadienal; 3-methyl-2-butenal; hexanoic acid; octanoic acid; hexanal) from the dried flowers of a Brazilian medicinal plant, *Tanaatum balsamita against Bacillus subtilis, Brevibacterium ammoniagenes, Staphylococcus aureus, Staphylococcus mutans, Propionibacterium acnes, Pseudomonas aeruginosa, Enterobactor aerogenes, Escherichia coli, Proteus vulgaris, Pitorosporum ovale; penicillium chrysogenum and Trichophyton mentagrophyte*. Hexanal is viewed as indicator of oxidative state in a number of foodstuffs (Sanches-Silva *et al.,* 2004). Hexanal odour activated hypothalamic nuclei, which control maternal and emotional behavior (Hamaguchi-Hamada *et al.,* 2004). Hence, the presence of some of the important bioactive volatile compounds in the raisins of sonaka seedless varieties will certainly prove the use of dry fruits for the preparation of various antimicrobial products and designing of drug against various microbial pathogenic diseases. In case of raisins of sonaka seedlees variety seventeen new volatile bioactive compounds were reported (1,2,3-Propanetriol, diacetate, 1,2-Benzenediacarboxylic acid, bis(2-methylpropyl) ester, 1,2-Benzenediacarboxylic acid, butyl 2- ethylhexyl ester, 2-Furancarboxaldehyde, 5-(hydroxymethyl)- -3-one, 4-4-Hepten methyl, 9-Octadecenoic acid, methyl ester, 9,12-Octadecadienoic acid, methyl ester, 9-Octadecenamide,(2)-, Docosane, Hexadecane, n-Hexadecanoic acid, Octadecanoic acid, 2-(2-hydroxyethoxy) ethyl ester, Octadecenoic acid, methyl ester, Oleic acid, Petanoic acid, 4-oxo-, Propanoic acid, 2-methyl-, methyl ester, Squalene and Squalene).Other then the untreated raisins .Thus the accumulation of various forms of bioactive compounds which willcertainly improves the flavour, aroma and taste of raisins due to pretreatment as well as zein coating with mango essence. This will improves the market potential and consumer acceptability of the raisins followed by improvement in the shelf-life of raisins during postharvest handling.

SUMMARY AND CONCLUSION

Analysis of Bioactive Compound by GCMS: Raisins of both the varieties are rich in various bioactive volatile compounds. Among these compounds some represents to class of Acids, Aldehydes, Alcohols, Ketone, Alkane and Alkene. The major compound reported from the seedless untreated raisins were 2-Furancarboxaldehyde, Octacosane, Decosane, 4H-Fyran-4-one, 2, 3 dihydro-3,5 dihydoxy- 6 methyl, 1,2-Benzene dicarboxylic acid. The raisins treated with K_2C0_3 and Sulphur fumigated showed the presence of 4 H-Pyran-4-one,2,3 dihydroxy -3, 5 dyhydroxy-6-methyl, Dibutyl phthalate. The untreated Sonaka raisins showed six volatile bioactive compounds such as 1 2 - Furancarboxaldehyde, 5 (hydroxymethyl), Dibutyl phthalate, 4H- Pyran-4-one, 2, 3- dihydro-3,5 dihydroxy -6-methyl. Whereas the raisins treated with K_2C0_3 and sulphur fumigated results in the development of bioactive volatile compound as 9,12-Octadecadienoic acid (Z,Z) -, methyl ester, 4-Hepten-3-one, 4-methyl. While Zein protein coated raisins displayed bioactive compounds are 9,12-Octadecadienoic acid, methyl ester, Propanoic acid, 3-(acetylthio)-2-methyl-. The zein protein coated with mango essence exhibits volatile compounds as 1,2-Benzenediacarboxylic,acid, butyl 2-ethylhexyl ester, Xanthosine, Squalene.

The mass spectral analysis of 5% mango essence in methanol showed major different bioactive compounds such as 2-Propanol,1,1'-[(1-methyl-1,2-ethanediyl]bis-, Benzyl alcohol, 2-Propanol,1,1'-oxybis, 2-Propanol,1,1'-[(1-methyl-1,2-ethanediyl]bis-. The 5% orange essence in methanol showed different volatile bioactive compounds Benzyl alcohol, 2-Propanol, 1, 1'-oxybis, 2-Propanol, 1, 1'-[(1-methyl-1, 2-ethanediyl]bis. In study of Sonaka seedless variety seventeen new volatile bioactive compounds were reported (1,2,3-Propanetriol, diacetate, 1,2-Benzenediacarboxylic acid, bis(2-methylpropyl) ester, 1,2-Benzenediacarboxylic acid, butyl 2- ethylhexyl ester, 2-Furancarboxaldehyde, 5-(hydroxymethyl)- -3-one, 4-4-Hepten methyl, 9-Octadecenoic acid, methyl ester, 9,12-Octadecadienoic acid, methyl ester, 9-Octadecenamide,(2)-, Docosane, Hexadecane, n-Hexadecanoic acid, Octadecanoic acid, 2-(2-hydroxyethoxy) ethyl ester, Octadecenoic acid, methyl ester, Oleic acid, Petanoic acid, 4-oxo-, Propanoic acid, 2-methyl-, methyl ester, Squalene and Squalene).Other then the untreated raisins .Thus the accumulation of various forms of bioactive compounds which will certainly improves the flavour, aroma and taste of raisins due to pretreatment as well as zein coating with mango essence. This will improves the market potential and consumer acceptability of the raisins followed by improvement in the shelf life of raisins during postharvest handling.

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