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SHORT COMMUNICATION

CHARACTERIZATION OF SOME VOLATILE COMPONENTS OF MUSKMELON FRUIT

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Abstract—Muskmelon fruit oil obtained by vacuum steam distillation at 60–70° was shown to contain *n*-octanol, *n*-nonanol, 2-nonenal, 2-nonenol, *n*-octyl acetate, *n*-octyl butyrate, β-ionone, methyl palmitate, methyl palmitoleate, methyl oleate, methyl linoleate, methyl linolenate, ethyl palmitate, ethyl palmitoleate, ethyl oleate, ethyl linoleate, ethyl linolenate. The identities of compounds were confirmed by direct comparison of their mass spectra and GLC retention data with those of authentic samples. Other compounds tentatively identified on the basis of mass spectral data were nonadienol, nonenol, octyl hexanoate and butyl palmitoleate. The nonadienol was associated with the muskmelon-like aroma.

INTRODUCTION

It has been pointed out[1] that at present there is a very limited knowledge of the organic chemical composition of many common foodstuffs. Knowledge is needed in this area to

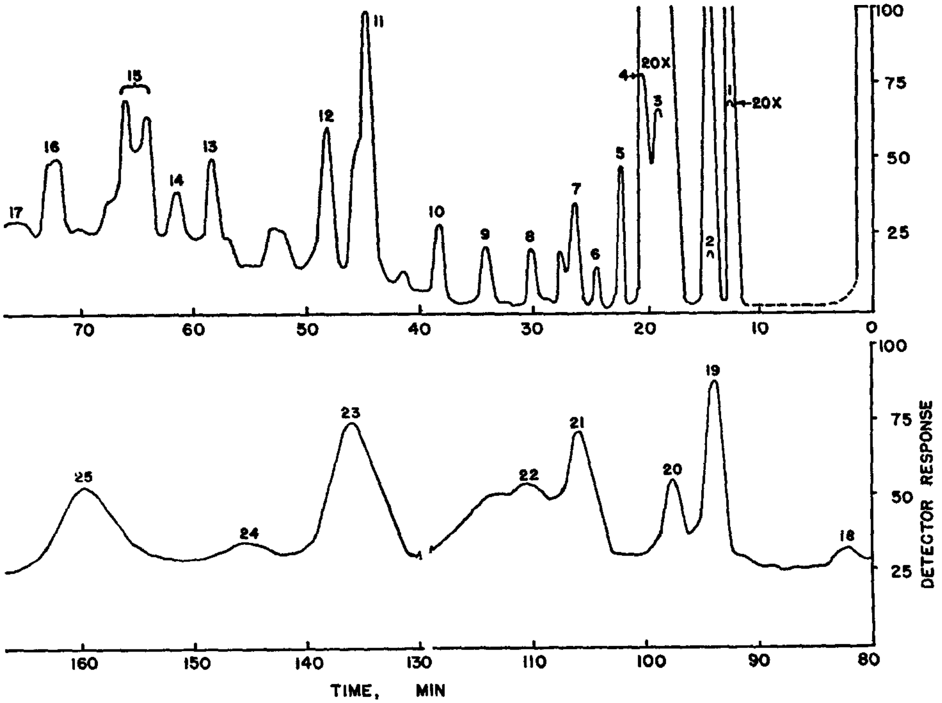

Fig. 1. Temperature programmed GLC analysis of muskmelon volatiles (see Table 1 for identification of components).

The program started at 100° and the temperature was raised at 1°/min to 180° and held there until the time shown.

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[1] D. G. Crosby, *J. Food Sci.* **28**, 347 (1963).

provide a basis for understanding, for example, the nature of flavor. Muskmelon (*Cucumis melo* L.), which is an important fresh food crop in the United States, has received very little attention regarding its chemical composition, especially the volatile constituents responsible for its characteristic odor and flavor. This paper deals with the isolation and identification of some higher boiling volatile constituents of muskmelon as part of a study of muskmelon flavor.

RESULTS AND DISCUSSION

Figure 1 shows a temperature programmed gas chromatogram of muskmelon volatiles obtained by vacuum steam distillation in a water recycling apparatus. During distillation the fruit was kept at a temperature of 60–70°. The present work is concerned with higher boiling components since these were readily collected in amounts sufficient for spectral analyses (all components except *n*-octanol boil above 200°).

In Table 1 are listed all those components which were identified by direct comparison of mass spectra and gas chromatographic retention data with those of authentic compounds. The identification of compounds marked 'tentative' is based on mass spectral data alone.

TABLE 1. IDENTITIES AND MASS SPECTRAL DATA OF MUSKMELON FRUIT VOLATILES

Peak No. (see Fig. 1)	Identity or mass spectral data
1	*n*-Octanol
2	Unknown: peaks at *m/e* 57, 41, 70, 85, 98
3	2-Nonenal
	Nonenol
	Nonadienol
4	*n*-Nonanol
	2-Nonenol
5	*n*-Octyl acetate
6	Unknown: *m/e* 43, 57, 103, 85
7	Nonenoxy deriv.
8	Nonenoxy deriv.
9	Unknown: *m/e* 43, 57, 71, 89, 148
10	*n*-Octyl butyrate
11	Unknown: *m/e* 43, 69, 107, 150, 194(P)
12	β-Ionone
13	*n*-Octyl hexanoate (tentative)
14	Unknown: *m/e* 57, 43, 71, 85, 97, 131
15	Two sequiterpene alcs. MW 222
16	Similar to peak 14
17	Aliphatic hydrocarbon (unsatd.)
18	Aliphatic hydrocarbon
19	Methyl palmitoleate
	C_{18} ketone MW 262
20	Methyl palmitate
21	Ethyl palmitoleate
22	Ethyl palmitate
23	Methyl oleate
	Methyl linoleate
	Methyl linolenate
24	Butyl palmitoleate (tentative)
25	Ethyl oleate
	Ethyl linoleate
	Ethyl linolenate

Table 1 also lists components which were classified, as well as spectral data for those which remained unidentified.

The muskmelon-like aroma was associated with a component obtained upon rechromatography of peak 3. Mass spectral data indicated that this compound was a nonadienol which readily dehydrated to give an ion at *m/e* 122 and other prominent ions at *m/e* 67, 93, 79, 55 and 41. However, it is not *trans–cis*-2,6-nonadienol or *trans–trans*-2,4-nonadienol since its mass spectrum was not the same as those of authentic samples. Forss *et al.*[2] concluded that the pleasant aroma of cucumber (same genus as muskmelon) was principally due to *trans–cis*-2,6-nonadienal, while *trans*-2-nonenal contributed an astringent note.

Two nonenols were isolated from muskmelon volatiles; one was obtained upon subfractionation of peak 3 and was identified as 2-nonenol, while the other, obtained upon rechromatography of peak 4, may be 6-nonenol. Keppler *et al.*,[3] working with the hardening flavor components present in hardened linseed oil and soybean oil, noted that the 6-nonenal which they synthesized had an odor reminiscent of green melons.

The last major peaks in the chromatogram starting with peak 19 consisted mainly of a series of methyl and ethyl esters of palmitic, palmitoleic, oleic, linoleic, and linolenic acids. In each case the amount of methyl ester was somewhat larger than that of the corresponding ethyl ester. The mass spectrum of the principal component of peak 24 indicated it to be the butyl ester of a C_{16} fatty acid with one double bond (MW 310). Because of the similarity of this spectrum to those of other esters (methyl and ethyl) of palmitoleic acid, peak 24 was tentatively identified as butyl palmitoleate.

Rechromatography on DEGS revealed that peak 19 contained a small amount of a C_{18} ketone (MW 262) whose mass spectrum indicated an analog of farnesylacetone, a new flavor component recently isolated from tomato fruit.[4] Peak 15 consisted of two sesquiterpene alcohols (MW 222), one of which yielded a fragmentation pattern similar to that of cadinene.[5]

The major component of peak 7 gave a mass spectrum which suggested a compound which contained a 2-nonenoxy moeity; however, the unknown remained on the SE 30 column for a period of time intermediate between that for 2-nonenyl formate and 2-nonenyl acetate. Hence, it was concluded that this compound was not an ester of 2-nonenol. The material of peak 8 yielded a fragmentation pattern similar to that of 7.

To our knowledge the compounds identified in this work have not been reported previously as components of muskmelon fruit.

EXPERIMENTAL

Muskmelons var. 'Penn Sweet' were harvested August 1969 from the University of Kentucky Experimental Station farm at Lexington and were stored at −23° until used.

Approximately 2·5 kg fruit were thawed, peeled, deseeded and then homogenized in a Waring blender with 2 l. H_2O. The homogenate was placed in the 12 l. flask of a water recycling apparatus[6] adapted for vacuum distillation, and 4 ml redistilled hexane was placed on top of the water layer in the side arm. The pressure in the system was reduced, and distillation was carried out at 60–70° for 3 hr. The hexane layers from five such distillations were pooled and dried over Na_2SO_4, and the solvent was carefully removed under N_2 to give a concentrate with the strong pleasant odor of muskmelons.

The concentrate was first separated on a 1·8 m × 6 mm stainless steel column packed with 20% SE-30 on 60–80 mesh silanized Chromosorb W using a temperature program of 1°/min from 100° to 180°.

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[2] D. A. Forss, E. A. Dunstone, E. H. Ramshaw and W. Stark, *J. Food Sci.* **27**, 90 (1962).

[3] J. G. Keppler, J. A. Schols, W. H. Feenstra and P. W. Meyboom, *J. Am. Oil Chem. Soc.* **42**, 246 (1965).

[4] R. G. Buttery, R. M. Seifert and L. C. Ling, *Chem. & Ind.* **8**, 238 (1969).

[5] J. Andersson, R. Bosvik and E. von Sydow, *J. Sci. Food Agri.* **14**, 834 (1963).

[6] T. R. Kemp, L. P. Stoltz, W. T. Smith, Jr. and C. E. Chaplin, *Proc Am. Soc. Hort. Sci.* **93**, 334 (1968).

Fractions were collected in cooled glass U-tubes and the tubes were immediately sealed. In cases where there was adequate sample, rechromatography was done on a 1·8 m × 6 mm stainless steel column packed with 10% diethylene glycol succinate (DEGS) on 60–80 mesh silanized Chromosorb W. Mass spectra were run on individual components using a Perkin-Elmer Hitachi RMU-6E instrument with ionizing energy of 70 eV and with source and oven temp. at 200°. Authentic samples of chemical compounds identified were obtained from commercial supply houses or synthesized by established methods.

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