Table I. Effect of Temperature on the Lead Contents of Canned Single-Strength Orange Juice Stored for 12 Weeks

	lead contents, ppm (mg/kg of juice)											
	21 °C		27 °C		32 °C		38 °C		43 °C		49 °C	
processor	R^a	$\overline{X}^{a,d}$	R	$\overline{X}$	R	$\overline{X}$	R	$\overline{X}$	R	$\overline{X}$	R	$\overline{X}$
A[b]	0.05–0.30	0.17	0.08–0.15	0.11	0.04–0.17	0.10	0.05–0.14	0.08	0.02–0.28	0.10	0.03–0.26	0.11
B[b]	0.09–0.32	0.14	0.05–0.08	0.07	0.04–0.17	0.11	0.04–0.29	0.13	0.04–0.19	0.13	0.05–0.14	0.09
C[b]	0.07–0.29	0.16	0.04–0.23	0.11	0.04–0.29	0.14	0.04–0.25	0.08	0.06–0.32	0.16	0.03–0.19	0.08
D[c]	0.07–0.20	0.11	0.07–0.13	0.09	0.10–0.14	0.12	0.12–0.31	0.21	0.06–0.10	0.08	0.04–0.13	0.07

[a] R = range; $\overline{X}$ = mean. [b] Eight samples were analyzed at each storage temperature; 48 samples per processor; total of 144 samples. [c] Four samples were analyzed at each storage temperature; 24 samples for processor D. [d] Analysis of variance (1% level of significance) of lead means at various temperatures (treatments) showed no statistical relationship by the F test.

cluded that the large can to can lead variations were primarily due to the different amounts of the solder surface exposed to the juice.

Our experiment was intended to show the effects of temperature on the lead contents of canned SSOJ. If a relationship did exist, we did not find this because of the lead variation of the commercially canned product. A careful screening of cans, prior to canning, to group those that showed minimal solder splashings and seepage would have yielded a theoretical analytical conclusion; however, a practical conclusion from analysis of randomly selected commercial samples would not have been ascertained.

The FAO/WHO (Codex Alimentarius Commission, 1971) has established a lead tolerance limit of 0.3 ppm for canned juice consumed by infants, whereas the United Kingdom (Ockerman, 1978) has established a limit of 0.5 ppm for canned orange, grapefruit, and mandarin juices and 2.0 ppm for lemon and lime juices. The United States does not have an official tolerance limit for lead in canned foodstuffs (Department of Health and Human Services, 1979). However, FDA (Food and Drug Administration, 1968) has established a tolerance of 1 ppm for combined lead in or on fresh citrus fruits. Our results (Table I) show that of the 168 samples analyzed, only 4 samples exceeded the stringent tolerance level of 0.3 ppm established by the FAO/WHO for canned citrus baby juices. Storage temperature of a canned citrus product is not as important as the can used in packaging. Reduction of lead could result from a better can-manufacturing practice, whereby the interior solder surface area of the can is reduced.

LITERATURE CITED

American Can Company "The Sanitary Can"; American Can Co.: Barrington, IL, 1973.
Codex Alimentarius Commission "Recommended International Standards for Orange, Grapefruit and Lemon Juice Preserved Exclusively by Physical Means"; FAO/WHO: Rome, 1971; *CAC/RS*, **1971**, *45*, 3.
Department of Health and Human Services *Fed. Regist.* **1979**, *44*, 51 233.
Food and Drug Administration *Fed. Regist.* **1968**, *33*, 18578.
McHard, J.; Foulk, S. J.; Jorgensen, J. E.; Bayer, S.; Winefordner, J. D. *ACS Symp. Ser.* **1980**, *No. 143*, Chapter 16.
Nagy, S.; Rouseff, R.; Ting, S. V. *J. Agric. Food Chem.* **1980**, *28*, 1166.
Ockerman, H. W. "Source Book for Food Scientists"; Avi Publishing Co.: Westport, CT, 1978; p 676.
Roberts, J. A.; Gaddum, L. W. *Ind. Eng. Chem.* **1937**, *29*, 574.
Rouseff, R. L.; Ting, S. V. *J. Food Sci.* **1980**, *45*, 965.
Stoewsand, G. S. In "Safety of Foods", 2nd ed.; Graham, H., Ed.; Avi Publishing Co.: Westport, CT, 1980; Chapter 12.
Thomas, B.; Edmunds, J. W.; Curry, S. J. *J. Sci. Food Agric.* **1975**, *26*, 1.

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Variation of Myristicin Content in Cultivated Parsnip Roots (*Pastinaca sativa* ssp. *sativa* var. *hortensis*)

The roots of 24 varieties of cultivated parsnip were investigated to determine the myristicin content of the essential oil. The results show that the high myristicin content is not an effect of cultivation. Different chemical types of plants were not found. The aspects of the selection of the variety in regard to the insecticidal, psychotropic, and possibly toxic effect of myristicin are discussed.

Myristicin as a substituted allylbenzene must be classified as a hazardous environmental agent. Nevertheless myristicin is present in many foodstuffs encountered in everyday life. Lichtenstein and Casida (1963) isolated myristicin from the edible parts (roots) of *Pastinaca sativa* parsnip and reported on its insecticidal and synergistic properties.

In our previous work we confirmed myristicin as a main component of the essential oil content of the above and underground parts of *P. sativa* (Kubeczka and Stahl, 1975, 1977). Further investigations (Stahl and Kubeczka, 1979) proved that the myristicin content of the above-ground parts could be used to define two different groups of plants, a high-content type (17.4–44%) and a low-content type

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Table I.[a] Myristicin and Terpinolene Content of Several Varieties of Cultivated Parsnip Roots

no.	variety	country	myr., %	ter., %	res. MT., %	residue, %
1	Harris' Model	USA	18.3	66.6	13.3	1.8
2	unknown	D	19.7	67.3	10.0	3.0
3	Offenham	E	27.5	55.4	14.4	2.7
4	Lisbonnais	E	29.7	57.0	9.7	3.6
5	Cobham Improved Marrow	E	29.9	58.7	9.0	2.4
6	Evesham	E	32.3	57.0	9.3	1.4
7	Harris' Model	USA	34.5	49.4	14.8	1.3
8	Evesham Special	E	34.6	54.0	9.1	2.3
9	White Gem	E	34.9	51.6	11.3	2.2
10	Melbourne White Skin	E	34.9	51.0	10.8	3.3
11	Harris' Early Model	USA	35.8	51.4	9.7	3.1
12	Leda	E	36.1	49.6	11.3	3.0
13	Tender and True	E	37.6	49.6	9.5	3.3
14	Hollow Crown Improved	USA	38.8	52.1	7.7	1.4
15	unknown	D	40.1	44.5	10.1	5.3
16	Asmer Improved Marrow	E	40.2	49.8	7.4	2.6
17	Improved Hollow Crown	USA	40.8	47.8	9.1	2.3
18	Sperling Studio	D	43.6	37.1	17.5	1.8
19	Offenham Reselected	E	44.4	45.0	8.0	2.6
20	Long Smooth Hollow Crown	USA	44.6	44.1	8.9	2.4
21	Hollow Crown	E	45.5	43.9	7.5	3.1
22	Sperling Halblange	D	49.8	37.4	11.0	1.8
23	All American	USA	53.4	36.7	8.2	1.7
24	Suttons Student	DK	66.2	25.3	6.5	2.0
			x: 38.5	50.3		
			s: 6.9			
			s %: 17.3			

[a] myr. = myristicin; ter. = terpinolene; res. MT. = residual monoterpenehydrocarbons; D = West Germany; E = Great Britain; DK = Denmark.

(0.3–6.0%). These results were shown to be valid for both wild and cultivated forms.

This work presents the results of investigations into the myristicin content of the essential oil of cultivated parsnip roots.

EXPERIMENTAL SECTION

Seeds from several cultivated varieties of parsnip were sown in spring. In the following autumn the plants were harvested and fresh root material was subjected to a steam distillation. For quantitative analyses of the various components of the essential oil, a gas chromatograph, Perkin-Elmer F22, equipped with a flame ionization detector and an integrator, Spectra Physics System I, were used. The 4 m × 2 mm stainless steel column, containing 10% Carbowax 20M coated on 80–100-mesh Kieselghur silica, Merck, was programmed from 80 to 200 °C. The quantitative results were calculated as peak area percents without a correction factor.

RESULTS

The composition of the essential oil of cultivated parsnip roots was the same as previously found in wild plants (Kubeczka and Stahl, 1975). In addition to myristicin, we found various monoterpenehydrocarbons, mainly terpinolene. The results of the quantitative measurements are listed in Table I.

Table I shows clearly that over 80% of the essential oil consists of myristicin and terpinolene. The mean value of myristicin content of all investigated varieties is 38.5% with the relative standard deviation of 17.3% (excluding no. 1, 2, and 24). The relative standard deviation seems high, but it must be considered that different varieties of parsnip from various countries in Europe and America were compared. A more homogeneous result could not be expected despite the seeds being cultivated and worked up under the same conditions.

In order to illustrate the results more clearly, we transferred the numerical values of myristicin content in the essential oil of cultivated roots into a histogram as shown in Figure 1. The numerical values of myristicin content show a distribution with a mean value indicating a single chemical type.

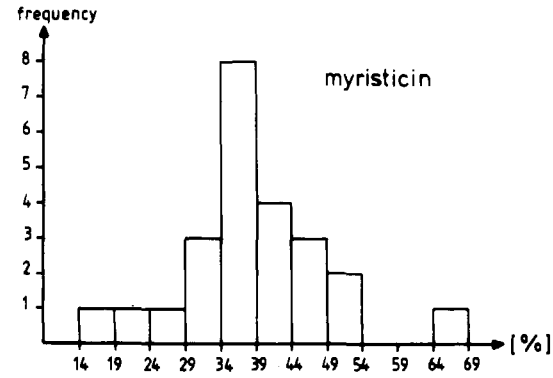

Figure 1. Histogram of the myristicin content of the essential oil of several varieties of cultivated parsnip roots.

CONCLUSION

The composition of the essential oil in cultivated and wild parsnip roots is similar in spite of the fact that the cultivated parsnip root is larger and fleshier than that of the wild variety. This means that neither the accumulation of myristicin nor that of another component of the essential oil can be an effect of cultivation. A correlation between the myristicin content in roots and that in the above-ground parts of parsnip could not be established. Plant breeders while considering the psychotropic and possibly toxic effect of myristicin obviously wish to profit from the insecticidal effect of myristicin. Thus the cultivation of plants with high above-ground myristicin content and low underground content would seem advantageous.

LITERATURE CITED

Kubeczka, K.-H.; Stahl, E. *Planta Med.* **1975**, *27*, 235.

Kubeczka, K.-H.; Stahl, E. *Planta Med.* **1977**, *31*, 173.
Lichtenstein, E. P.; Casida, J. E. *J. Agric. Food Chem.* **1963**, *11*, 410.
Stahl, E.; Kubeczka, K.-H. *Planta Med.* **1979**, *37*, 49.

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CORRESPONDENCE

On the Presence of 1,3-Dioxolanes in Commercial Flavorings

Sir: Several papers on the presence of 1,3-dioxolanes/propylene glycol acetals in commercial flavorings have appeared in this journal over the past several issues. MacLeod et al. (1980) described these compounds in commercial beef flavorings. Welch and Hunter (1980) did not state the type of flavoring used in their analysis but did claim to report the "mass spectra of the acetals of the more common flavoring aldehydes ... for the first time".

In the interest of completeness and information for interested readers, I would like to point out our earlier paper, Heydanek and Min (1976), in which this same problem was described. Our findings are now substantiated by the two papers mentioned above and also contain additional mass spectral data on propylene glycol acetals of common flavoring aldehydes. Since our paper was not referenced in either of the above publications, it should not be overlooked by researchers in this field. All the investigations conclude that this acetal formation does take place in commercial flavoring mixtures and is a potential source for nonuniformity in the flavor of manufactured food products.

Literature Cited

Heydanek, M. G.; Min, D. B. S. *J. Food Sci.* **1976**, *41*, 145.
MacLeod, G.; Segyedain-Ardebili, M.; MacLeod, A. J. *J. Agric. Food Chem.* **1980**, *28*, 441.
Welch, R. C.; Hunter, G. L. K. *J. Agric. Food Chem.* **1980**, *28*, 870.

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CORRECTIONS

SOLUTION-PHASE PHOTODECOMPOSITION OF SEVERAL SUBSTITUTED DIPHENYL ETHER HERBICIDES, by Luis O. Ruzo,* Jae Koo Lee, and Matthew J. Zabik, *J. Agric. Food Chem.* **1980**, *28*, 1289.

On p 1289, the second author's name should be spelled Jae Koo Lee. J.K.L. was supported by the FAO André Mayer Fellowship. His present address is Department of Agricultural Chemistry, College of Agriculture, Chung Buk National University, 310, Cheong Ju, Korea.

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