

Neutral Volatiles from Blended Endive (*Cichorium endivia*, L.)

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Concentrates of endive volatiles were obtained by standard controlled solvent extraction (pentane-dichloromethane, 2:1) of the blended leaves followed by silica gel LC pre-separation using a pentane-diethyl ether gradient. Analysis by capillary gas chromatography and coupled capillary gas chromatography-mass spectrometry led to identification of 119 volatiles first described as endive constituents. Qualitatively and quantitatively enzyme-catalyzed lipid cleavage products were predominant; C₆ aldehydes comprised about 70% of the total amount of volatiles.

Endive (*Cichorium endivia*, L.) originates from South Asia and is one of the most important European winter salads (Franke, 1976). Our knowledge about its constituents is rather scarce. Studies on a few nonvolatile compounds such as glycosides and dicaffeoyltartaric acid have been carried out (Wöldecker and Herrmann, 1974a,b,c), but the volatiles formed after disruption of the tissue have not been previously investigated.

EXPERIMENTAL SECTION

Endive. Fresh endive (*C. endivia*, L; variety not determined) was obtained from the local market (Oct-Dec 1984).

Sample Preparation. The leaves were washed, and only green parts (1 kg) were blended (2 min) at 25 °C in a laboratory blender with 2.5 L of distilled water. By separation with a hydraulic press (Hafico) 3.4 L of diluted juice was obtained. After addition of internal standards (0.58 mg of *n*-butylbenzene; 0.57 mg of ethyl (*E*)-4-heptenoate; 0.50 mg of 2-methyl-3-heptanol) the liquid was subjected to solvent extraction.

Solvent Extraction. The diluted juice was extracted with pentane-dichloromethane (2:1) over 24 h (Drawert and Rapp, 1968). The extract was dried over anhydrous sodium sulfate and carefully concentrated to 0.5 mL on a Vigreux column (45 °C).

Column Chromatography on Silica Gel. The concentrated extract was fractionated on silica gel 60 (Merck), activity grade II, by using a pentane-diethyl ether gradient (Idstein et al., 1984). Cooled (11-13 °C) glass columns, 5.0 cm i.d. × 45 cm, were used. The elution rate was 60 mL/h; three fractions were separated. Fraction I was eluted with 250 mL of pentane, fraction II was obtained by eluting with 250 mL of diethyl ether-pentane (1:9, v/v), and fraction III was obtained by eluting with 250 mL of diethyl ether. All eluates were dried over anhydrous sodium sulfate and concentrated to 0.2 mL for HRGC and HRGC-MS analysis.

High-Resolution Gas Chromatography (HRGC). A Carlo Erba Fractovap 4160 gas chromatograph with FID equipped with a Macherey & Nagel fused silica CW 20 M CB capillary column (25 m, 0.32 mm i.d., film thickness 0.15 μm) and a 2-m uncoated fused silica capillary precolumn as the retention gap (Grob and Müller, 1982) was used. On-column injection with an air-cooled injection system was employed. The temperature program was 50 °C, 2 min isothermal, and then 50-240 °C at 5 °C/min. The flow rates were 2.5 mL/min He for the carrier gas, 30 mL/min N₂ for the makeup gas, and 30 mL/min H₂ and 300 mL/min air for the detector gases. The detector

Table I. Volatile Compounds Identified in Blended Endive by HRGC and HRGC-MS (Silica Gel Fraction I)

peak no. ^a	compd	mass spectral data, ^b m/e
Hydrocarbons		
2	benzene	78, 52, 51, 50
4	decane	43, 41, 57, 71
6	toluene	91, 92, 65, 51
9	undecane	43, 41, 57, 71
12	ethylbenzene	91, 106, 51, 65
13	<i>p</i> -xylene	91, 106, 105, 77
14	<i>m</i> -xylene	91, 106, 105, 77
16	β -pinene	93, 41, 69, 91
19	<i>o</i> -xylene	91, 106, 105, 77
20	limonene	68, 87, 93, 41
21	propylbenzene	91, 120, 65, 51
22	dodecane	57, 43, 71, 41
23	1,3,5-trimethylbenzene	105, 120, 77, 119
30	2-ethyltoluene	105, 120, 77, 91
31	<i>p</i> -cymene	119, 91, 134, 117
33	1,2,3-trimethylbenzene	105, 120, 77, 79
36	butylbenzene (int std)	
40	1,4-diethylbenzene	119, 105, 134, 91
42	1,2,4,5-tetramethylbenzene	119, 134, 91, 77
43	2,5-dimethylstyrene	117, 132, 115, 91
44	tetradecane	57, 43, 71, 85
45	indene	116, 115, 63, 89
51	hexadecane	57, 43, 71, 85
54	heptadecane	57, 43, 71, 85
56	naphthalene	128, 127, 51, 64
59	octadecane	57, 43, 71, 85
60	2-methylnaphthalene	142, 141, 115, 139
61	1-methylnaphthalene	142, 141, 115, 139
65	[diphenyl]	154, 153, 76, 51
68	eicosane	57, 43, 71, 85
72	heneicosane	57, 71, 85, 43
82	phenanthrene	178, 71, 76, 89
Miscellaneous		
25	2-pentylfuran	81, 53, 82, 41

^aThe peak numbers correspond to the numbers in Figure 1.

^bThe four most intense peaks are represented (M⁺ in italics). [Contaminant].

temperature was kept at 220 °C. Volumes of 0.3 μL were injected.

Results of qualitative analyses were verified by comparison of HRGC retention and mass spectral data with those of authentic reference compounds taken from our own collection. Quantitative HRGC determinations were carried out by standard controlled calculations using a Hewlett-Packard 3388 A laboratory data system without consideration of extraction yields (calibration factors for all compounds, *F* = 1.00).

Capillary Gas Chromatography-Mass Spectrometry. A Varian Aerograph 1440 gas chromatograph equipped with a Carlo Erba water-cooled on-column injector was coupled by an open-split interface to a Finnigan

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Table II. Volatile Compounds Identified in Blended Endive by HRGC and HRGC-MS (Silica Gel Fraction II)

peak no. ^a	compd	mass spectral data, ^b <i>m/e</i>
Carbonyls		
2	pentanal	44, 41, 58, 43
4	1-penten-3-one	55, 84, 56, 57
6	hexanal	44, 41, 43, 56
9	(<i>Z</i>)-3-hexanal	41, 69, 55, 42
10	(<i>E</i>)-2-hexenal	41, 55, 69, 42
12	cyclohexanone	55, 42, 41, 69
22	6-methyl-5-hepten-2-one	43, 41, 55, 69
26	nonanal	41, 43, 44, 57
29	(<i>E</i>)-2-octenal	44, 41, 55, 42
33	furfural	95, 96, 67, 51
34	(<i>E,Z</i>)-2,4-heptadienal	81, 41, 53, 110
38	(<i>E,E</i>)-2,4-heptadienal	81, 41, 53, 110
39	(<i>E,Z</i>)-2,4-octadienal	81, 41, 67, 124
40	2-decanone	43, 58, 59, 41
41	benzaldehyde	77, 105, 106, 51
42	decanal	41, 43, 57, 44
44	(<i>E</i>)-2-nonenal	44, 41, 43, 55
47	(<i>E,Z</i>)-2,6-nonadienal	41, 70, 69, 67
49	2-methylbenzaldehyde	91, 119, 120, 65
50	3-methylbenzaldehyde	91, 119, 120, 65
55	4-methylbenzaldehyde	91, 119, 120, 65
56	acetophenone	77, 105, 51, 120
58	phenylacetaldehyde	91, 65, 92, 120
83	(<i>E,Z</i>)-2,4-nonadienal	81, 41, 67, 138
87	(<i>E,E</i>)-2,4-nonadienal	81, 41, 67, 138
93	carvone	82, 54, 108, 93
99	butyrophenone	105, 77, 51, 148
109	(<i>E,Z,Z</i>)-2,4,6-nonatrienal	79, 77, 41, 136
111	(<i>E,E,Z</i>)-2,4,6-nonatrienal	79, 77, 136, 41
112	geranylacetone	43, 41, 69, 125
113	(<i>E,E,E</i>)-2,4,6-nonatrienal	79, 77, 41, 136
119	β -ionone	43, 177, 41, 55
129	5,6-epoxy- β -ionone	43, 123, 41, 55
Esters		
16	methyl heptanonate	74, 43, 87, 59
25	ethyl (<i>E</i>)-4-heptenoate (int std)	
139	[dimethyl phthalate]	163, 77, 50, 92
164	benzyl benzoate	105, 91, 77, 51
169	[dibutyl phthalate]	149, 41, 56, 57
Alcohols		
88	α -terpineol	59, 93, 43, 68
102	myrtenol	79, 91, 41, 43
Miscellaneous		
31	2-heptylfurane	81, 82, 53, 95
45	1-phenoxybutane	84, 150, 41, 77
94	1,2-dimethoxybenzene	138, 77, 95, 123
150	benzyl isothiocyanate	91, 90, 65, 149
152	2-(methylthio)benzothiazole	181, 148, 135, 108

^aThe peak numbers correspond to the numbers in Figure 2.

^bThe four most intense peaks are represented (*M*⁺ in italics). [Contaminants].

MAT 44 mass spectrometer. A Macherey & Nagel CW 20 M CB fused silica capillary column (25 m, 0.32 mm i.d., film thickness 0.15 μ m) connected to a 2-m uncoated piece of fused silica capillary column as the retention gap (Grob and Müller, 1982) was used. The conditions were as follows: temperature, isothermal for 5 min at 60 °C and then from 60 to 240 °C at 2 °C/min; carrier gas flow rate, 2.5 mL/min He; temperature of ion source and all connection parts, 200 °C; electron energy, 70 eV; cathodic current, 0.8 mV; injection volumes, 0.3 μ L.

RESULTS AND DISCUSSION

The results of HRGC separation of blended endive volatiles obtained by solvent extraction and subsequent silica gel LC prepreparation are outlined in Figures 1-3. The substances identified by HRGC and HRGS-MS in these fractions are represented in Tables I-III. In total,

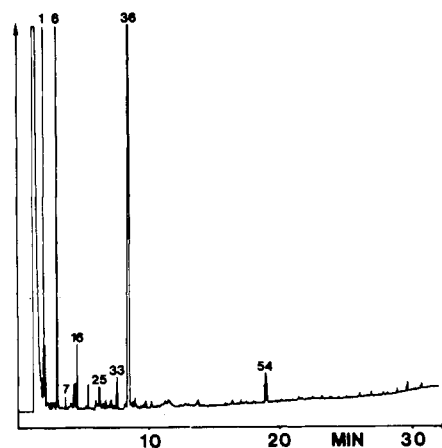


Figure 1. HRGC separation of blended endive volatiles (silica gel fraction I) after on-column injection on a Macherey & Nagel 25 m \times 0.32 mm fused silica WCOT capillary CW 20 M CB, df = 0.15 μ m. The peak numbers correspond to the numbers in Table I.

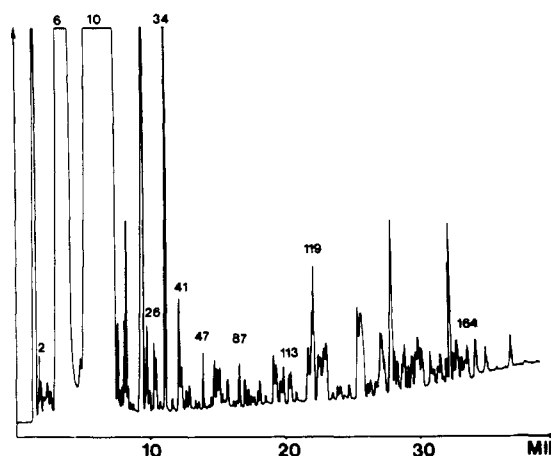


Figure 2. HRGC separation of blended endive volatiles (silica gel fraction II) after on-column injection on a Macherey & Nagel 25 m \times 0.32 mm fused silica WCOT capillary CW 20 M CB, df = 0.15 μ m. The peak numbers correspond to the numbers in Table II.

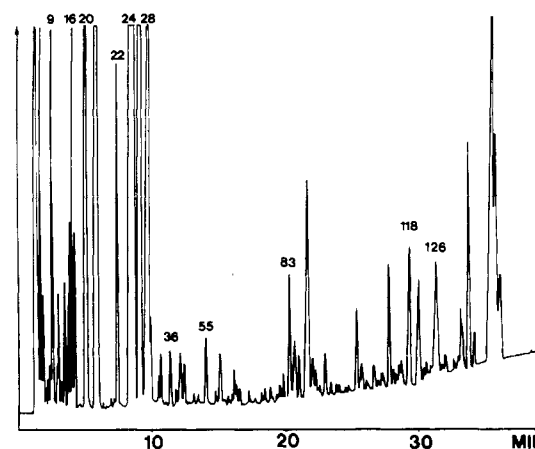


Figure 3. HRGC separation of blended endive volatiles (silica gel fraction III) after on-column injection on a Macherey & Nagel 25 m \times 0.32 mm fused silica WCOT capillary CW 20 M CB, df = 0.15 μ m. The peak numbers correspond to the numbers in Table III.

43 carbonyls, 29 alcohols, 30 hydrocarbons, 4 esters, and 13 components of miscellaneous structures were characterized and described for the first time as endive constituents.

Table III. Volatile Compounds Identified in Blended Endive by HRGC and HRGC-MS (Silica Gel Fraction III)

peak no. ^a	compd	mass spectral data, ^b <i>m/e</i>
Alcohols		
7	2-butanol	45, 59, 41, 44
8	2-methyl-3-buten-2-ol	71, 43, 59, 58
9	1-propanol	42, 59, 41, 60
10	2-methyl-1-propanol	43, 42, 41, 74
11	3-pentanol	59, 41, 57, 58
13	2-pentanol	45, 44, 43, 55
15	1-butanol	56, 41, 43, 42
16	1-penten-3-ol	57, 67, 68, 58
21	2-methyl-3-heptanol (int std)	
22	(<i>Z</i>)-2-pentenol	57, 41, 44, 43
24	1-hexanol	56, 43, 41, 55
25	(<i>Z</i>)-3-hexenol	41, 67, 55, 69
27	(<i>E</i>)-2-hexenol	57, 41, 67, 82
28	(<i>Z</i>)-2-hexenol	57, 41, 67, 82
33	1-octen-3-ol	57, 43, 41, 72
39	2-ethyl-1-hexanol	57, 43, 41, 55
54	1-octanol	56, 41, 55, 43
58	(<i>E</i>)-2-octenol	41, 54, 67, 57
62	6-undecanol	55, 83, 101, 41
63	furfuryl alcohol	41, 42, 98, 53
69	α -terpineol (cf. fr. II)	
77	1-decanol	43, 41, 55, 56
79	1-phenylethanol	79, 43, 107, 77
87	2-phenylethanol	91, 92, 65, 122
101	1-dodecanol	43, 41, 55, 56
109	2-phenoxyethanol	94, 77, 138, 51
114	1-tetradecanol	43, 41, 55, 57
119	1-pentadecanol	43, 41, 55, 57
126	1-hexadecanol	43, 55, 57, 41
Carbonyls		
3	3-pentanone	57, 86, 58, 56
5	2-pentanone	43, 86, 41, 58
13	3-penten-2-one	41, 69, 43, 84
19	(<i>Z</i>)-3-hexenal (cf. fr. II)	
20	(<i>E</i>)-2-hexenal (cf. fr. II)	
23	2-methylcyclopenten-1-one	96, 67, 53, 41
32	(<i>E,Z</i>)-2,4-heptadienal (cf. fr. II)	
36	(<i>E,E</i>)-2,4-heptadienal (cf. fr. II)	
40	benzaldehyde (cf. fr. II)	
41	decanal (cf. fr. II)	
43	(<i>E,Z</i>)-3,5-octadien-2-one	95, 43, 81, 41
51	(<i>E,E</i>)-3,5-octadien-2-one	95, 43, 81, 41
55	2,6,6-trimethyl-2-hydroxy-cyclohexanone	43, 71, 58, 41
59	acetophenone (cf. fr. II)	
64	2-butanoylfuran	95, 110, 65, 134
75	4-methylacetophenone	91, 119, 65, 134
76	carvone (cf. fr. II)	
83	(<i>E,E,Z</i>)-2,4,6-nonatrienal (cf. fr. II)	
85	(<i>E,E,E</i>)-2,4,6-nonatrienal (cf. fr. II)	
98	5,6-epoxy- β -ionone (cf. fr. II)	
107	2-pentadecanone	43, 58, 59, 57
Miscellaneous		
30	(<i>Z</i>)-linalool oxide, furanoid	59, 43, 94, 55
34	(<i>E</i>)-linalool oxide, furanoid	59, 43, 94, 55
89	benzothiazol	135, 108, 69, 63
122	2-(methylthio)benzothiazol (cf. fr. II)	
103	phenol	94, 66, 65, 63
108	2-ethylphenol	107, 122, 77, 79
106	methyl 9-oxononanoate	74, 87, 55, 41
120	piperonyl acetate	135, 43, 51, 134
112	2,3-dimethyl-2-nonen-4-olide	83, 111, 55, 112
114	dihydroactinidiolide	43, 111, 67, 41

^aThe peak numbers correspond to the numbers in Figure 3.

^bThe four most intensive peaks are represented (*M*⁺ in italics).

The quantitative distribution of the major volatiles is outlined in Table IV. A total amount of 110 mg/kg of blended endive was determined, from which 70% consisted of C₆ aldehydes. Recently, in a screening of plant tissues able to form C₆ volatiles after disruption, endive homo-

Table IV. Quantitative Distribution of Main Constituents of Blended Endive Volatiles

50-250 $\mu\text{g}/\text{kg}^a$	250-1000 $\mu\text{g}/\text{kg}^a$	>1000 $\mu\text{g}/\text{kg}^a$
(<i>E,Z</i>)-2,4-heptadienal		hexanal
(<i>E,Z,Z</i>)-2,4,6-nonatrienal		(<i>E</i>)-2-hexenal
decanal		
β -ionone		
1-propanol	1-hexanol	
1-butanol	(<i>Z</i>)-3-hexenol	
(<i>Z</i>)-2-pentenol	(<i>E</i>)-2-hexenol	
1-penten-3-ol	(<i>Z</i>)-2-hexenol	

^aStandard controlled HRGC determinations without consideration of calibration factors, i.e. $F = 1.00$.

genate has been found to exhibit high activity (Götz-Schmidt et al., 1986). These C₆ volatiles exhibit intensive green aroma notes.

Besides these components, well-known to be formed after disruption of the tissue in the presence of oxygen from unsaturated fatty acids by lipoxygenase L-1/hydroperoxide lyase catalyzed reactions (Galliard, 1978), a series of additional carbonyls were detected, which can be considered as lipid peroxidation products formed by lipoxygenase L-2 (or L-3) enzyme (Grosch, 1982). In model experiments with lipoxygenase L-2 and L-3 isoenzymes from soybean and linolenic acid as substrate, Grosch and Laskawy (1975) observed pronounced formation of (*E,Z*)-2,4-heptadienal, 2,4,6-nonatrienal (two isomers), 3,5-octadien-2-one (two isomers), and (*E,Z*)-2,6-nonadienal, which were all found among the volatiles of blended endive. Both the two first-mentioned components take part of the main constituents (Table IV). While 2,4-alkadienals have been detected in a wide variety of foods, reports on alkatrienals have been much rarer. Previously, isomers of 2,4,6-nonatrienal have been only identified in blended dry beans (Buttery, 1975). Their formation mechanism from linolenic acid has not been elucidated as yet. The occurrence of several carotenoid degradation products such as e.g. β -ionone, 5,6-epoxy- β -ionone, 6-methyl-5-hepten-2-one, 2,6,6-trimethyl-2-hydroxycyclohexanone, geranylacetone, and dihydroactinidiolide further supports the activity of a lipoxygenase L-2 (or L-3) enzyme in endive. The co-oxidation potential of types L-2 and L-3 lipoxygenase enzymes has been demonstrated on several examples (Grosch, 1982).

As known from earlier studies with homogenized plant tissues (Galliard, 1978), carbonyls can be quickly reduced to the corresponding alcohols by ADH activity. Thus, it was not surprising to find C₅ and C₆ alcohols such as (*Z*)-2-pentenol, 1-penten-3-ol, 1-hexanol, and the isomer hexenols among the main constituents of blended endive tissue.

Registry No. Benzene, 71-43-2; decane, 124-18-5; toluene, 108-88-3; undecane, 1120-21-4; ethylbenzene, 100-41-4; *p*-xylene, 106-42-3; *m*-xylene, 108-38-3; β -pinene, 127-91-3; *o*-xylene, 95-47-6; limonene, 138-86-3; propylbenzene, 103-65-1; dodecane, 112-40-3; 1,3,5-trimethylbenzene, 108-67-8; 2-ethyltoluene, 611-14-3; *p*-cymene, 99-87-6; 1,2,3-trimethylbenzene, 526-73-8; butylbenzene, 104-51-8; 1,4-diethylbenzene, 105-05-5; 1,2,4,5-tetramethylbenzene, 95-93-2; 2,5-dimethylstyrene, 2039-89-6; tetradecane, 629-59-4; indene, 95-13-6; hexadecane, 544-76-3; heptadecane, 629-78-7; naphthalene, 91-20-3; octadecane, 593-45-3; 2-methylnaphthalene, 91-57-6; 1-methylnaphthalene, 90-12-0; [diphenyl], 92-52-4; eicosane, 112-95-8; heneicosane, 629-94-7; phenanthrene, 85-01-8; 2-pentylfuran, 3777-69-3; pentanal, 110-62-3; 1-penten-3-one, 1629-58-9; hexanal, 66-25-1; (*Z*)-3-hexenal, 6789-80-6; (*E*)-2-hexenal, 6728-26-3; cyclohexanone, 108-94-1; 6-methyl-5-hepten-2-one, 110-93-0; nonanal, 124-19-6; (*E*)-2-octenal, 2548-87-0; furfural, 98-01-1; (*E,Z*)-2,4-heptadienal, 4313-02-4; (*E,E*)-2,4-heptadienal, 4313-03-5; (*E,Z*)-2,4-octadienal, 33819-10-2; 2-decanone, 693-54-9; benzaldehyde, 100-52-7; decanal, 112-31-2; (*E*)-2-nonenal,

18829-56-6; (*E,Z*)-2,6-nonadienal, 557-48-2; 2-methylbenzaldehyde, 529-20-4; 3-methylbenzaldehyde, 620-23-5; 4-methylbenzaldehyde, 104-87-0; acetophenone, 98-86-2; phenylacetaldehyde, 122-78-1; (*E,Z*)-2,4-nonadienal, 21661-99-4; (*E,E*)-2,4-nonadienal, 5910-87-2; carvone, 99-49-0; butyrophenone, 495-40-9; (*E,Z,Z*)-2,4,6-nonatrienal, 100113-51-7; (*E,E,Z*)-2,4,6-nonatrienal, 100113-52-8; geranylacetone, 3796-70-1; (*E,E,E*)-2,4,6-nonatrienal, 57018-53-8; β -ionone, 79-77-6; 5,6-epoxy- β -ionone, 23267-57-4; methyl heptanoate, 106-73-0; ethyl (*E*)-4-heptenoate, 54340-70-4; [dimethyl phthalate], 131-11-3; benzyl benzoate, 120-51-4; [dibutyl phthalate], 84-74-2; α -terpineol, 98-55-5; myrtenol, 515-00-4; 2-heptylfuran, 3777-71-7; 1-phenoxybutane, 1126-79-0; 1,2-dimethoxybenzene, 91-16-7; benzyl isothiocyanate, 622-78-6; 2-(methylthio)benzothiazole, 615-22-5; 2-butanol, 78-92-2; 2-methyl-3-buten-2-ol, 115-18-4; 1-propanol, 71-23-8; 2-methyl-1-propanol, 78-83-1; 3-pentanol, 584-02-1; 2-pentanol, 6032-29-7; 1-butanol, 71-36-3; 1-penten-3-ol, 616-25-1; 2-methyl-3-heptanol, 18720-62-2; (*Z*)-2-pentenol, 1576-95-0; 1-hexanol, 111-27-3; (*Z*)-3-hexenol, 928-96-1; (*E*)-2-hexenol, 928-95-0; (*Z*)-2-hexenol, 928-94-9; 1-octen-3-ol, 3391-86-4; 2-ethyl-1-hexanol, 104-76-7; 1-octanol, 111-87-5; (*E*)-2-octenol, 18409-17-1; 6-undecanol, 1653-30-1; furfuryl alcohol, 98-00-0; 1-decanol, 112-30-1; 1-phenylethanol, 98-85-1; 2-phenylethanol, 60-12-8; 1-dodecanol, 112-53-8; 2-phenoxyethanol, 122-99-6; 1-tetradecanol, 112-72-1; 1-pentadecanol, 629-76-5; 1-hexadecanol, 36653-82-4; 3-pentanone, 96-22-0; 2-pentanone, 107-87-9; 3-penten-2-one, 625-33-2; 2-methylcyclopenten-1-one, 97665-06-0; (*E,Z*)-3,5-octadien-2-one, 4173-41-5; (*E,E*)-3,5-octadien-2-one, 30086-02-3; 2,6,6-trimethyl-2-hydroxycyclohexanone, 7500-42-7; 2-butanoylfuran, 100113-53-9; 4-methylacetophenone, 122-00-9; 2-pentadecanone,

2345-28-0; (*Z*)-linalool oxide, furanoid, 5989-33-3; (*E*)-linalool oxide, furanoid, 34995-77-2; benzothiazole, 95-16-9; phenol, 108-95-2; 2-ethylphenol, 90-00-6; methyl 9-oxononanoate, 1931-63-1; piperonyl acetate, 326-61-4; 2,3-dimethyl-2-nonen-4-olide, 10547-84-9; dihydroactinidiolide, 17092-92-1.

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Characterization of a Nitrite Scavenger, 3-Hydroxy-2-pyranone, from Chinese Wild Plum Juice

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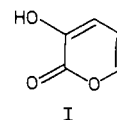
Juice from Chinese wild plum (*Actinidia sinensis*) inhibits nitrosation reactions by efficient scavenging of nitrite. This is due partly to high concentrations of ascorbic acid and partly to a compound not previously reported as a nitrite scavenger, 3-hydroxy-2-pyranone.

Chinese wild plum juice has been traditionally consumed in some districts of China as a preventive for a variety of diseases, including cancer. This fruit is essentially identical with kiwi fruit (both can be designated *Actinidia chinensis* Planch. or *Actinidia sinensis* Planch.), which is known to contain high levels of vitamin C (ascorbic acid) (Selman, 1983). Ascorbic acid is a well-known inhibitor of nitrosation reactions—both in vitro and in vivo (Kamm et al., 1974; Mergens et al., 1980; Mirvish et al., 1972; Mirvish, 1975)—and we have consequently been interested in the inhibitory effects of Chinese wild plum juice on the formation of *N*-nitroso compounds.

In an earlier report (Song et al., 1984), we noted that this juice indeed effectively inhibited the formation of *N*-

nitrosomorpholine from morpholine and nitrite and that this effect was due primarily to scavenging of nitrite by constituents of the juice. These properties, in addition, persisted after enzymatic destruction of ascorbic acid, i.e., the juice contained nitrite-scavenging material other than vitamin C. Subsequent experiments (see the Experimental Section) indicated that this additional activity was due to primarily to a single component.

We have isolated this compound from Chinese wild plum juice and now report its identity as 3-hydroxy-2-pyranone (I).



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EXPERIMENTAL SECTION

Materials. The Chinese fruit juice was brought by S.P. from the People's Republic of China. Fresh California kiwi fruit was obtained from retail markets in Boston. Reagent