Fatty Acids of Pimiento Pepper Seed Oil[1]

J. E. MARION and A. H. DEMPSEY, Georgia Experiment Station, Experiment, Georgia

Abstract

Pimiento pepper (*Capsicum annum L.*) seed oil was shown to contain 66–71% linoleic acid with smaller quantities of 16 and 18 carbon saturated and monounsaturated fatty acids. Neither geographical location nor location within pimiento processing plants influenced the level or composition of the seed oil. Two varieties of bell-type peppers were shown to have essentially the same seed oil composition as that of pimientos. Oil extracted from the fruit wall and placenta of pimientos was red and contained high levels of linolenic and small quantities of very long chain polyunsaturated fatty acids.

Introduction

FRUIT OF THE pimiento pepper, a cultural variety of *Capsicum annum L. (C. frutescens)*, contains approx 4.14% seed on a fresh wt basis (1). Pimiento seeds are separated, along with the placenta and stem, from the fruit wall and discarded as waste in commercial processing (Fig. 1). Ebert and Bailey (2) reported that pimiento seeds contain 18% oil. The crude oil was described as red in color with the following chemical properties: sp g at 20C, 0.9228; N_D^{20}, 1.4750; sap. v., 171.4; I.V., 134.4; titer, 21.2C; sat. acids, 12.6%; unsat. acids, 82.9%. The oil appeared to be suitable for edible purposes after refining. This report is concerned with results obtained by gas-liquid chromatography (GLC) analysis of pimiento seed oil, and with factors that influence the composition of this oil.

Experimental

Seeds were obtained from red ripe fruits for this study. All seed samples analyzed were brought to the laboratory, air-dried for 3–7 days, ground in a Wiley Mill (20 mesh screen) and extracted for 16 hr with light petroleum ether (30–60C bp) in a continuous extractor. The oil was recovered by evaporating the petroleum ether under a nitrogen stream. The fatty acid content of each sample was measured by GLC as reported previously (3). Sample moisture was determined at the time of oil extraction by heating aliquots *in vacuo* at 70C for 24 hr.

Results and Conclusions

A typical level of oil and fatty acid composition of a pimiento seed sample shows in Table I. Since seed samples contained particles of fruit wall, placenta and stem, samples of these tissues were also analyzed for total oil and fatty acids. The oil of pimiento seeds was predominantly linoleic acid with smaller quantities of 16 and 18 carbon saturated and monounsaturated acids. The oil from the fruit wall and placenta differed from oil of the seed by containing a high level of linolenic acid and small quantities of very long chain polyunsaturated fatty acids. In contrast to the report of Ebert and Bailey, oil of pimiento seed had a golden yellow color and a faint pimiento odor, while the oil from the fruit wall and placenta had a very dark red color and a pronounced pimiento odor. These results indicate that it would be desirable to eliminate all waste from the seeds in order to obtain an edible oil with a desirable color and fatty acid composition.

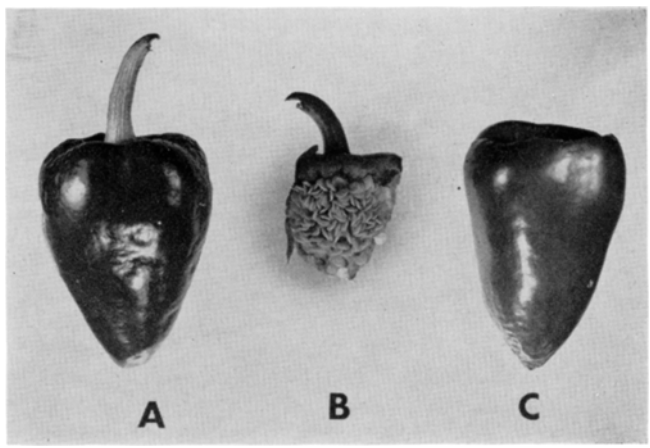

FIG. 1 A. Red ripe pimiento fruit.
B. Stem, placenta and seeds (waste).
C. Fruit wall used for processing.

Since the possibility of salvaging seed oil from related types of peppers exist, bell-type peppers of the California Wonder and Yolo Wonder varieties were sampled from experimental plots where they had been grown with the Truhart Perfection variety of pimiento peppers. The appearance and fatty acid composition of the seed oil of both bell-type peppers and pimiento peppers did not differ appreciably from that noted for pimiento seeds in Table I. However, seeds of hot chile peppers (also *C. annum L.*) were shown by Bush (4) to have red veins in the edge of the seed coat which imparted a red color and a burning taste to the seed oil. The examination of oil from hot chile pepper seeds in our laboratory confirmed the observations of Bush although the level and fatty acid composition of oil in the seeds were very similar to that found for pimiento seeds.

Samples of seeds were obtained from various points along a processing line in a commercial plant in Georgia. Also, samples were obtained from at least 3 different geographical locations in Georgia and 2 locations in Alabama. Neither the in-plant nor geographical location influenced the oil content or fatty acid distribution of the seed oils.

TABLE I

Composition of Pimiento Seeds, Fruit Wall and Placenta

Material	Seeds	Fruit wall	Placenta[a]
Dry matter—%	53.2	12.4	11.4
oil—% of D.M.	20.6	0.17	0.18
Fatty acid[b]	%[c]	%	%
12:0	.....	1.4	1.0
12:1	.....	0.1	0.2
14:0	0.2	3.9	2.7
14:1	.....	0.2	0.3
16:0	11.3	13.8	15.6
16:1	0.5	1.4	1.3
16:2	0.2	0.2	0.2
17:0	0.1	0.2	0.4
18:0	4.4	4.7	6.9
18:1	14.8	5.2	9.6
18:2	67.4	45.5	40.4
18:3	0.2	21.9	18.7
20:0	0.5	trace	trace
20:4	.....	0.6	0.9
20:5	.....	0.2	0.3
22:0	0.2	0.3	0.2
22:?	.....	0.3	1.1
22:?	.....	0.1	0.1

[a] Included attached stem.
[b] Carbon chain length: number of double bonds.
[c] Each fatty acid expressed as a percentage of total fatty acids.

[1] Journal Series Paper No. 462, Georgia Experiment Station, Experiment, Ga.

In 1961 a total of 35,174 tons of red ripe pimiento fruits were processed in the southeastern U.S. These fruits contained approx 1,456 tons of seeds (fresh wt). From the data in the present report and others (2,4), meal from the dried seeds would be expected to contain approx 20% oil while the remaining dry matter would contain approx 29% protein, 29% fiber, 36% NFE and 6% ash.

ACKNOWLEDGMENTS

Assistance in obtaining seed samples from Ray Malcolm, Griffin, Ga., and Jack Chapell, Cullman, Ala.

REFERENCES

1. Cochran, H. L., Proc. Am. Soc. Hort. Sci. *83*, 613 (1963).
2. Ebert, H. C., and H. S. Bailey, Cotton Oil Press *7*, 35 (1924).
3. Marion, J. E., and J. G. Woodroof, Poultry Sci. *42*, 1202 (1963).
4. Bush, W. A., J. Am. Chem. Soc. *58*, 1821 (1936).

[Received November 13, 1963—Accepted May 5, 1964]

Degradation of Monocarbonyls from Autoxidizing Lipids[1]

D. A. LILLARD[2] and E. A. DAY, Department of Food Science and Technology, Oregon State University, Corvallis

Abstracts

In an attempt to account for carbonyls found in oxidized lipid systems, but not theoretically predicted from the decomposition of lipid hydroperoxides, a member from each of the monocarbonyl classes commonly observed in oxidizing lipids was oxidized at 45C in a Warburg apparatus and the carbonyl products studied. The carbonyl compounds used were *n*-nonanal, *n*-non-2-enal, *n*-hepta-2,4-dienal and *n*-oct-1-en-3-one. Nonanal was relatively stable to oxidation and was oxidized to nonanoic acid. Oct-1-en-3-one did not absorb oxygen during a 52-hr period; however, the unsaturated aldehydes oxidized at faster rates than methyl linoleate or linolenate. Non-2-enal upon absorption of 0.5 mole of oxygen was oxidized almost quantitatively to non-2-enoic acid. Hepta-2,4-dienal was polymerized at 0.5 mole of oxygen uptake. In addition both of the unsaturated aldehydes produced shorter chain mono- and dicarbonyls as oxidative degradation products. The identification of these compounds helps to explain the presence of carbonyls in oxidizing lipids and model systems that are not accountable through the decomposition of theoretically predictable isomeric hydroperoxide esters. The relatively large yield of malonaldehyde from the oxidized dienal suggests that these carbonyls may serve as a major source of malonaldehyde in oxidizing diene esters. Significant quantities of malonaldehyde are not observed in methyl linoleate until late stages of oxidation, and the dienals formed through degradation of primary hydroperoxides may in turn oxidize to give malonaldehyde.

Introduction

THE LIST OF CARBONYL compounds derived from autoxidizing lipids and model systems has become extensive. In attempting to explain their origin, most investigators have repeatedly referred to fatty acid hydroperoxides as immediate precursors (1–5). However, there are a number of carbonyl compounds reported in the literature whose origin from oxidized lipid systems cannot be explained by generally accepted fatty acid hydroperoxide decomposition mechanisms. In attempting to account for these compounds, some of which are found in relatively high concn it seemed feasible to examine other possible substrates that are readily oxidized and that might account for some of the carbonyls observed in autoxidizing lipids. The findings reported herein deal with the monocarbonyls which are themselves initial degradation products of lipid hydroperoxides.

[1] *Technical Paper No. 1804, Oregon Agricultural Experiment Station.*
[2] Submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy.

Experimental

A member from each of the major monocarbonyl classes that are commonly observed in oxidizing lipids was selected for the study. Those compounds selected were *n*-nonanal, *n*-non-2-enal, *n*-hepta-2,4- dienal and *n*-oct-1-ene-3-one. Oxidation rates, peroxide formation, 2-thiobarbituric acid reactants and carbonyl production were studied and compared with methyl esters of linoleic and linolenic acids oxidized under identical conditions.

Materials. Nonanal and non-2-enal were obtained commercially. The purity of nonanal was >98% as determined by gas chromatography. Non-2-enal was purified to 99.5% by preparative scale gas chromatography. Hepta-2,4-dienal was synthesized by the procedure of Pippen and Nonaka (6) and purified by fractional distillation at 4 mm Hg. Purity by gas chromatography was 94%. Oct-1-en-3-one was prepared from oct-1-en-3-ol by the method of Brown and Carg (7). Oct-1-en-3-ol was prepared according to Crabalona (8). The vinyl ketone contained 12% of the alcohol after fractional distillation and was not purified further. Methyl linoleate and methyl linolenate were obtained from the Hormel Foundation and used without further purification.

Ethylene chloride was distilled and stored over potassium carbonate. Celite 545 was dried for 24 hr at 160C. Seasorb 43 was activated for 49 hr at 400C. Nitromethane and chloroform were made carbonyl free according to the method of Schwartz and Parks (9).

Autoxidation of Carbonyls. Duplicate samples of 0.2–0.5 g of the aforementioned carbonyls were weighed into Warburg flasks. After connecting the flasks to manometers, the samples were equilibrated for 15 min at 45C in a nitrogen atmosphere and then oxidized in an oxygen stream. Oxygen uptake was measured at 15-min intervals and the rates of oxygen uptake vs. time were plotted on regular graph paper. Measurement of the areas under the resulting curves enabled calculation of total oxygen uptake. Manometric techniques as described by Umbreit et al. (10) were employed. The peroxide values (11), 2-thiobarbituric acid (TBA) reactants (12), and equivalents of acid were determined when oxygen uptake reached approximately 0.25 and 0.5 mole/mole of carbonyl.

Analysis of Carbonyl Products. Samples of the oxidized carbonyls (0.01–0.02 g) were added to 50 ml 5N HCl saturated with 2,4-dinitrophenylhydrazine (re-