Oils From Perennial Gourds*

WALDO C. AULT and MARGARET L. SWAIN
Eastern Regional Research Laboratory,[1] Philadelphia 18, Pennsylvania
and
LAWRENCE C. CURTIS
University of Connecticut, Storrs, Connecticut

Introduction

RECENTLY, one of the authors (Curtis) discussed (1) the possibilities of using certain species of perennial gourds, or cucurbits, as a source of vegetable fats and protein. In the Southwestern States, particularly in arid regions, are a number of wild species, among which are *C. foetidissima,* H.B.K., *C. palmata,* S. Watson, and *C. digitata,* A. Gray. The seeds are stated to have been used as food by the American Indian.

The oil from only one of these, *C. foetidissima* (Buffalo gourd), has been examined previously (2). The report of this examination states that in general the characteristics of the oil from the seeds are similar to those of pumpkin seed oil as reported by Riebsomer and Nesty (3).

The fatty acid composition of pumpkin seed oil has been reported by Power and Salway (4) and more recently by Kaufmann and Fiedler (5). These investigators reported that the mixed fatty acids consist of the following constituents in approximately the percentages shown: oleic (25-28), linoleic (45-55), palmitic (10-12), and stearic (5-8).

On the other hand, oil from two genera of the family Cucurbitaceae, *Telfairia occidentalis* (Krobanko oil) and *Trichosanthes cucumeroides,* have been reported to contain trienoic conjugated acids. Farmer and Paice (6) established the presence of α-eleostearic acid in *Telfairia occidentalis* by isolation of the pure acid, m.p. 48° C. The oil from this nut has more recently been examined by Hilditch and Riley (7), who concluded from results obtained by low-temperature crystallization methods that it contains about 20% eleostearic acid and no linolenic acid.

Toyama and Tsuchiya (8) have reported the presence of a new stereoisomeric form of eleostearic acid in *Trichosanthes cucumeroides.* Kaufmann, Baltes, and Büter (9) have confirmed the presence of such a conjugated acid in the oil by use of the diene number.

In this paper we report the results obtained by examination of the seeds as well as the oil from the seeds of *C. palmata* and *C. digitata.*

Experimental

Both species were from the 1946 crop, the *C. palmata* being gathered from Imperial County, Cal., and the *C. digitata* from near Litchfield Park, Arizona. The seeds were prepared for analysis by grinding in a Wiley mill. The oil was obtained from the resulting meal by repeated extraction at room temperature with commercial *n*-hexane. Most of the solvent was removed from the oil on the steam bath, but the last traces were removed by bubbling nitrogen through it while heating it on the bath under a good vacuum.

One whole air-dried fruit of *C. palmata,* 61.9 grams, was broken, and the seeds were separated from the shell manually. They weighed 43.3 grams.

Results and Discussion

Table I shows the analytical data pertaining to the whole seeds. Table II shows the properties of these oils while the fatty acid composition is shown in Table III. These oils differ from those of the commonly reported squash, pumpkin, and gourd seed oils chiefly in that they contain 10-17% of a trienoic conjugated acid.

TABLE I.

Analysis of Cucurbit Seeds.

	C. palmata	*C. digitata*
	%[1]	%[1]
Moisture	6.3	8.6
Crude fat	30.8	28.1
Crude protein (N×6.25)	31.81	37.44
Ash	3.48	5.23
Crude fiber	33.9	33.6

[1] By weight. All results except moisture data are expressed on moisture-free basis.

TABLE II.

Properties of Cucurbit Seed Oils.

	C. palmata	*C. digitata*	*C. digitata*[1]
Specific gravity 30/4	0.9175	0.9154	.....
n_D^{20}	.....	.....	1.4851
n_D^{30}	1.4790	1.4762	.....
n_D^{35}	1.4771	1.4743	.....
Iodine number (Wijs 1 hr.)	131.0	122.7	.....
Saponification value	190.8	191.3	.....
Acid number	0.9	6.7	.....
Hydroxyl Hydroxyl (OH)	0.35	0.32	.....

[1] Small sample of seed from fruit of a single plant found near Deming, New Mexico.

TABLE III.

Composition of Cucurbit Seed Oils.

Constituent	*C. palmata*	*C. digitata*	*C. digitata*[1]
	% in fatty acids	*% in fatty acids*	*% in fatty acids*
Conjugated trienoic acid[2]	12.0	10.0	17.0
Linoleic acid[2]	43.0	37.0	37.0
Saturated acids (Bertram)	9.8	11.5	.....
Stearic acid[3]	8.3	13.1	.....
Palmitic acid[3]	1.5	1.7	.....
Oleic acid (by difference)	34.0	40.4	.....
Unsaponifiable matter, pct.	1.2	1.1	.....

[1] Small sample of seed from fruit of a single plant found near Deming, New Mexico.

[2] May be in slight error due to use of absorption coefficient for beta-eleostearic acid.

[3] Calculated from neutralization value of the isolated saturated acids.

In accordance with a statement by Hilditch and Riley (7) that plants which elaborate eleostearic glycerides in their seed fats probably do not concurrently produce linolenic acid, we found no definite evidence for the presence of this acid in these fats. We wish to emphasize, however, that in view of the unusual character of the conjugated trienoic acid present small amounts of linolenic acid might remain undetected.

* Presented at the 38th Annual Meeting of the American Oil Chemists' Society, New Orleans, La., May 20-22, 1947.

[1] One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

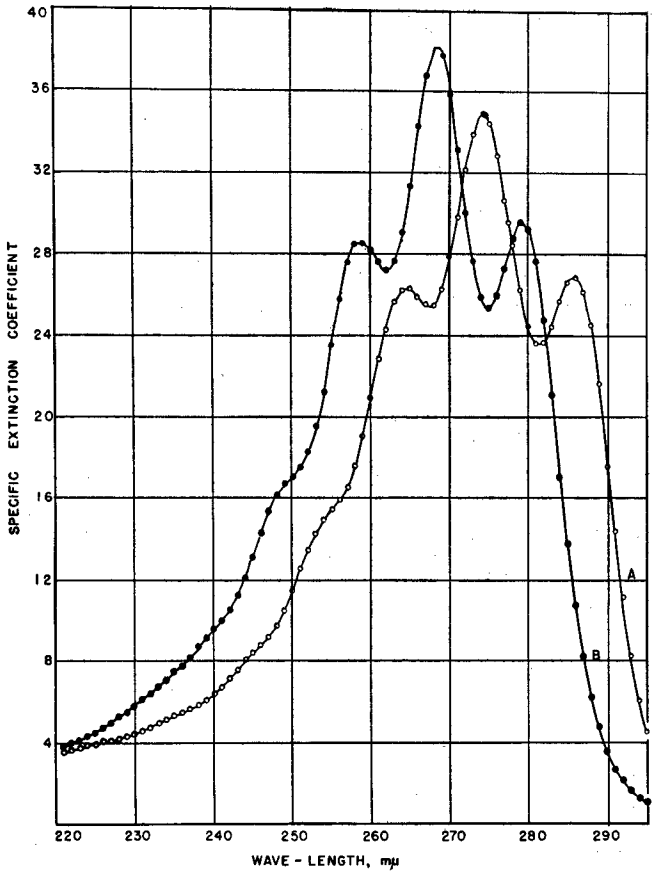

FIG. 1. *Cucurbita digitata* oil in heptane.
A—Untreated.
B—Sulfur-isomerized.

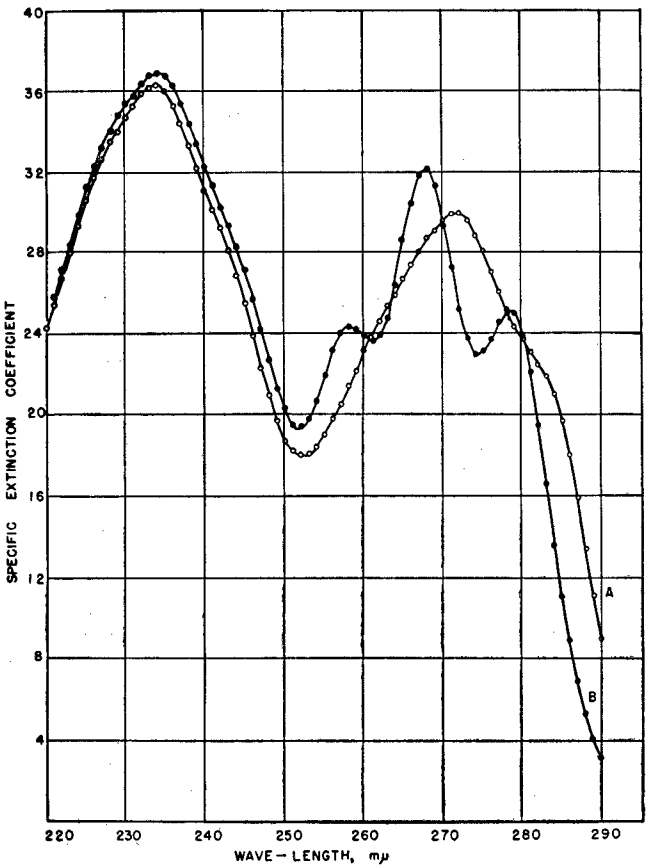

FIG. 2. Alkali-isomerized *Curcurbita digitata* oil.
A—Untreated.
B—Sulfur-isomerized.

Ultraviolet Absorption: The position (274 mμ) of the principal absorption maximum of these oils (Figure 1, Curve A) and the changes produced in their absorption characteristics on alkali isomerization (10) (Figure 2, Curve A) indicate that the conjugated trienoic acid present is not identical with either the usually occurring alpha-eleostearic acid or its beta-isomer. Sulfur isomerization induced by treating with finely divided sulfur for several days, however, produced a hypsochromic shift of the absorption spectrum (Figure 1, Curve B) analogous to and somewhat greater than that produced in oils containing alpha-eleostearic acid (11). On alkali isomerization of sulfur-isomerized cucurbit oils, the fine structure of the triene absorption spectrum survived, as it does in oils containing alpha- or beta-eleostearic acid (Figure 2, Curve B). It would appear, therefore, that these cucurbit oils contain a conjugated trienoic acid whose spectral properties have not previously been described and which on sulfur isomerization may be converted into a form having absorption characteristics closely resembling those of beta-eleostearic acid. It cannot be stated at present whether this acid is identical with the trichosanic acid previously reported as a constituent of *Trichosanthes cucumeroides.*

Acknowledgment

The authors express their thanks to C. O. Willits and Mildred S. Gaspar, who kindly furnished the data shown in Table I, and also to R. W. Riemenschneider for his helpful comments.

Summary

The seeds and the oil from the seeds of two perennial gourds, *Cucurbita palmata* and *Cucurbita digitata,* which grow wild in the Southwestern States, have been examined. Approximately two-thirds, by weight, of the whole dried fruit is seeds. The seeds contain about 28-30% oil and somewhat higher percentages of protein. The oils from both species are chiefly characterized by 10.0 to 17.0% of a conjugated trienoic acid similar to the eleostearic acid of tung oil, but apparently not identical with it.

Analytical data are shown pertaining to the whole seeds as well as the oil extracted from them.

REFERENCES

1. Curtis, The Chemurgic Digest *5,* 221 (July 15, 1946).
2. Wood and Jones, J. Am. Chem. Soc. *65,* 1783 (1943).
3. Riebsomer and Nesty, J. Am. Chem. Soc. *56,* 1784 (1934).
4. Power and Salway, J. Am. Chem. Soc. *32,* 346 (1910).
5. Kaufmann and Fiedler, Fette u. Seifen *46,* 125 (1939).
6. Farmer and Paice, J. Chem. Soc., 1630 (1935).
7. Hilditch and Riley, J. Soc. Chem. Ind. *65,* 74 (1946).
8. Toyama and Tsuchiya, J. Soc. Chem. Ind. (Japan) *38,* 185 B (1935).
9. Kaufmann, Baltes and Büter, Ber. *70B,* 2535 (1937).
10. Brice, Swain, Schaeffer and Ault, Oil and Soap *22,* 219 (1945).
11. O'Connor, Heinzelman, McKinney, and Pack, Oil and Soap, in press.