Fatty Acid Composition in Seed Oils of Some Onagraceae

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The seeds of *Oenothera picensis, O. indecora, Ludwigia longifolia* and *L. peruviana* (Onagraceae) contained 18.3, 16.4, 13.9 and 10.1% oil, respectively. Chromatographic analyses showed high levels of linoleic acid (>71.5%) in the seed oils.

KEY WORDS: Fatty acids, gas chromatography, *Ludwigia longifolia* (D.C.) H. Hara, *L. peruviana* (L.) H. Hara, *Oenothera picensis* Phil., *O. indecora* Camb., oils, Onagraceae.

Interest in the Onagraceae seed oils arises because some species (*Oenothera lamarkiana* and *O. biennis*) offer the possibility of producing γ-linolenic acid (1-3). Claims have been made that various fatty acids are beneficial in combating certain diseases (4). As a part of our search for new sources of oils, the seeds of *O. picensis, O. indecora, Ludwigia longifolia* and *L. peruviana* (Onagraceae) have been analyzed for physicochemical characteristics and fatty acid composition.

MATERIALS AND METHODS

The seeds from *O. picensis* Phil., *O. indecora* Camb., *L. longifolia* (D.C.) H. Hara and *L. peruviana* (L.) H. Hara were collected near Cordoba, Argentina, and the botanical identification was made at the herbarium of the Museo Botánico de Córdoba (Córdoba, Argentina). The air-dried seeds were powdered and thoroughly extracted with *n*-hexane in a Soxhlet extractor for 12 h. The *n*-hexane extracts were dried over anhydrous sodium sulfate, and the solvent was removed *in vacuo* at 10°C. The analytical characteristics of the oils so obtained were determined according to American Oil Chemists' Society methods (5). The oils were examined qualitatively for the presence of epoxy and cyclopropene fatty acids by picric acid (6) and Halphen (7) thin-layer chromatography tests, as well as by infrared (IR) spectroscopy.

The oils were converted to fatty acid methyl esters (FAME) by transesterification with absolute methanol containing 0.5N sodium methoxide (8) and analyzed by gas-liquid chromatography/mass spectrometry with a fused-silica capillary column AT-WAX (25 m × 0.25 mm, Alltech; Ontario, Canada). The qualitative analysis was performed according to a specific program, from 180 to 240°C at a rate of 4°C/min. The temperature of the injector was 240°C. Nitrogen was used as carrier gas at a flow rate of 2 mL/min. The FAME were also separated on a CBP10 (30 m × 0.25 mm; Shimadzu, Tokyo, Japan). The temperature program was 120 to 260°C, 2°C/min. Injector temperature was 250°C. The flow rate of nitrogen was 1 mL/min. The identification of the compounds was carried out by a built-in NIST Peak Matching Library Search System and by comparison of the retention times with those of reference compounds. Component concentrations were calculated from gas chromatographic peak areas.

IR spectra were taken as liquid films on KBr. The ultraviolet (UV) spectra of the oil and the FAME were run from 330-220 nm in purified hexane with a Bausch & Lomb 21 UV/VIS spectrometer (Bonn, Germany).

Iodine values (IV) were calculated from fatty acid percentages (9) by means of the formula:

$$IV = (\%\ \text{oleic} \times 0.8601) + (\%\ \text{linoleic} \times 1.7321) \quad [1]$$

The nitrogen content was determined by the Kjeldahl method (7).

RESULTS AND DISCUSSION

The seeds of *O. picensis, O. indecora, L. longifolia* and *L. peruviana* yielded from 10.1 to 18.8% of fixed oil on a dry-weight basis. The physicochemical characteristics of the oils are presented in Table 1.

TABLE 1

Characteristics of Seed Oils and Fatty Acid Compositions of *Oenothera picensis* (OP), *O. indecora* (OI), *Ludwigia longifolia* (LL) and *L. peruviana* (LP)

	OP	OI	LL	LP
Weight of 100 seeds (mg)	22.0	23.0	4.0	3.0
Oil content of seed (%)	18.3	16.4	13.9	10.1
Refractive index (n_D^{25})	1.4659	1.4589	1.4668	1.4770
Iodine value	135	140	146	141
Relative density (25°C/water at 25°C)	0.923	0.924	0.923	0.926
Saponification value	188	190	192	191
Unsaponifiable matter (%)	1.0	1.1	1.2	1.4
Halphen test	—[a]	—	—	—
Picric acid test	—	—	—	—
Protein (%)	19.9	20.1	15.4	16.4
Fatty acid composition (%)				
Myristic acid	1.0	trace	trace	trace
Palmitic acid	9.5	10.3	8.0	10.9
Stearic acid	3.5	3.1	2.5	2.4
Oleic acid	13.1	10.2	8.7	9.2
Linoleic acid	71.5	76.0	80.0	77.0
α-Linolenic acid	trace	trace	trace	trace
Arachidic acid	1.0	trace	trace	trace

[a]Indicates negative response to the test.

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Epoxy acids have been isolated from seed oil of Onagraceae (10); however, the oils did not respond to picric acid and Halphen tests, indicating the absence of epoxy and cyclopropenoid fatty acids. Also, IR spectra of the oils and their methyl esters did not show characteristic bands at 825, 1010 and 3450 cm^{-1} for epoxy, cyclopropenoid and hydroxyl functional groups, respectively. The UV data of the oils indicate absence of conjugated fatty acids (11).

The fatty acid compositions of total lipids of *O. picensis*, *O. indecora*, *L. longifolia* and *L. peruviana* are shown in Table 1. Linoleic (>71.5%) was the predominant acid, followed by oleic acid (>8.7%), similar to the seed lipids of other Onagraceae (1,3,10). However, γ-linolenic, cyclopropenoid, epoxy and hydroxy fatty acids are absent in our materials; these species, which are closely botanically related, contain oils that are not closely related by their chemistry.

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