

NEUTRAL LIPIDS FROM SEEDS OF ASTERACEAE PLANTS*

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Lipids from seeds of three plants of the Asteraceae family, Cousinia franchetii, Arctium leiospermum, and Rhaponticum integrifolium, were studied. The principal constituents of lipids from the three plants were shown to be acylglycerides of ordinary fatty acids and oxygenated fatty acids using chemical and chromatographic analyses. The composition of the ordinary unoxidized and epoxy acids was determined by GC.

Key words: Asteraceae, *Cousinia franchetii*, *Arctium leiospermum*, *Rhaponticum integrifolium*, neutral lipids, fatty acids, epoxy- and hydroxyacids.

We investigated lipids from seeds of the Asteraceae plants *Cousinia franchetii* C. Winkl, *Arctium leiospermum* Jur. et Serg., and *Rhaponticum integrifolium* C. Winkl. Plants of the *Cousinia* genus are annual and perennial herbs, some of which bear rubber while others are good food plants [1a]. The species studied by us, *C. franchetii*, is endemic to Samarkand and Surkhandarin oblasts [2a]. Many species of the genus *Arctium* are medicinal plants, the oil from fruits of which finds application for treatment. *A. leiospermum* is distributed through Central Asia and Western and Eastern Siberia [2b]. *Rhaponticum integrifolium* is endemic to Pamiro-Alai and Fergan ridge [1b, 2c].

Total neutral lipids were isolated from previously ground seeds by hexane extraction. The lipid content in seeds of *C. franchetii* was 29.0%; *A. leiospermum*, 15.8%; *R. integrifolium*, 14.8%.

Neutral lipids were separated by column chromatography (CC). Table 1 lists the results. It can be seen that the lipid compositions are characterized by acylglycerides (AG) of both ordinary and oxygenated fatty acids (FA). Polar AG I and II were also oxygenated AG because their hydrolysis products contained epoxy- and hydroxyacids.

The presence of AG of oxygenated FA is typical of lipids from Asteraceae plants [3-13].

Lipids of *A. leiospermum* differ from the other two studied species by a high content of oxygenated AG consisting of almost half of the lipid mass (Table 1). The lowest content of oxygenated AG was found in *C. franchetii*, 6.2%. The principal lipid class was TAG, 90.3%, making up 70.0% of the lipid mass in *R. integrifolium*. Besides TAG, lipids of all three species contained DAG and MAG, the total content of which was greatest in *R. integrifolium* (11.6%) and least in *C. franchetii* (0.9%).

The lipophilic components consisted of hydrocarbons, sterols, triterpenols and their esters with high-molecular-weight FA (Table 1). According to TLC and comparison with authentic compounds, normal paraffins and olefins were identified in all species. Squalene was found in the hydrocarbons from *C. franchetii* and *A. leiospermum*.

The composition of ordinary fatty acids from AG was established by GC (Tables 2-4). The principal unsaturated components of the total acids of all species were 18:1 and 18:2 acids. Linoleic acid dominated almost all lipid classes. The exception was 1(3),2-DAG from *C. franchetii*, where half of the acid mass was 18:1 acid whereas the 1,3-DAG were enriched in 18:2 acid. Therefore, oleic acid is typically distributed primarily in the *sn*-2-position; linoleic, in the *sn*-3-position. The saturated acids were dominated by 16:0 acid, the fraction of which was significantly elevated in the free FA fraction.

Epoxyacids isolated from the hydrolysis products of EADAG by CC were also analyzed by GC (Table 5).

It can be seen that epoxyacids from all three species contained saturated and monoenoic components of the C₁₈ series, with the latter significantly dominating. This has been noted previously in other studied Asteraceae plants [3, 14, 15].

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TABLE 1. Composition and Content of Neutral Lipids from Seeds of *Cousinia franchetii*, *Arctium leiospermum*, and *Rhaponticum integrifolium*, mass %

Lipid class	<i>Cousinia franchetii</i>	<i>Arctium leiospermum</i>	<i>Rhaponticum integrifolium</i>
Hydrocarbons	0.5	0.7	0.5
Fatty acid esters with aliphatic and cyclic alcohols	Tr.	0.1	0.2
Triacylglycerides (TAG)	90.3	48.1	70.0
Epoxyacylglycerides (EADAG)	2.2	11.2	5.7
Free fatty acids (FFA)	1.2	Tr.	2.1
Hydroxyacylglycerides (HADAG)	2.4	18.5	3.4
Triterpenols	Tr.	Tr.	0.3
Epoxyacyl-, hydroxyacylglycerides (EAGAMAG)	0.8	8.6	1.5
Diacylglycerides (DAG)	0.7	1.5	5.0
Sterols	0.5	0.3	0.8
Polar acylglycerides I	0.8	5.1	3.9
Polar acylglycerides II	-	5.4	-
Monoacylglycerides (MAG)	0.2	0.5	6.6
Unidentified components	0.4	-	-
Σ AG with ordinary fatty acids	91.2	50.1	81.6
Σ AG with oxygenated acids	6.2	48.8	14.5
Σ lipophilic components	2.2	1.1	3.9

TABLE 2. Composition of Fatty Acids of Lipids from Seeds of *Cousinia franchetii*, GC, mass %

Lipid class	14:0	16:0	16:1	18:0	18:1	18:2	Total acids	
							sat.	unsat.
Total lipids	0.4	10.0	1.2	1.5	26.8	60.1	11.9	88.1
TAG	0.5	9.9	0.7	1.0	27.5	60.4	11.4	88.6
EADAG	0.7	8.5	0.9	2.3	24.4	63.2	11.5	88.5
FFA	0.9	17.4	1.5	2.2	29.0	49.0	20.5	79.5
GADAG	1.9	13.5	4.2	3.8	35.7	40.9	19.2	80.8
EAGAMAG	0.4	7.8	0.4	Tr.	30.1	61.3	8.2	91.8
1,3-DAG	0.2	8.4	0.4	Tr.	24.4	66.6	8.6	91.4
1(3),2-DAG	0.6	11.7	0.6	Tr.	52.5	34.6	12.3	87.7
Polar AG I	1.4	11.8	2.4	Tr.	22.8	61.6	13.2	86.8
MAG	1.5	12.8	1.5	Tr.	27.7	56.5	14.3	85.7

TABLE 3. Composition of Fatty Acids of Lipids from Seeds of *Arctium leiospermum*, GC, mass %

Lipid class	12:0	14:0	16:0	16:1	18:0	18:1	18:2	18:3	20:0	Total acids	
										sat.	unsat.
Total lipids	0.5	0.4	9.0	0.9	4.6	18.9	57.5	5.7	2.5	17.0	83.0
TAG	-	0.2	8.1	0.4	4.9	21.6	56.9	5.3	2.6	15.8	84.2
EADAG	2.6	0.7	9.2	0.5	1.4	15.6	69.6	0.3	0.2	14.1	85.9
GADAG	Tr	Tr	12.2	0.7	4.4	20.7	55.6	4.5	1.9	18.5	81.5
EAGAMAG	0.2	0.2	9.8	0.5	3.6	16.5	62.4	5.5	1.3	15.1	84.9
DAG	0.2	0.4	12.5	0.9	5.1	22.3	56.2	1.4	1.0	19.2	80.8
Polar AG I	0.9	1.2	15.7	0.9	5.7	18.9	54.6	1.2	0.9	24.4	75.6
Polar AG II	Tr.	1.3	14.3	1.6	5.2	19.8	49.7	4.8	3.3	24.1	75.9
MAG	0.4	0.5	13.2	1.1	6.4	21.2	51.8	3.6	1.8	22.3	77.7

TABLE 4. Composition of Fatty Acids of Lipids from Seeds of *Rhaponticum integrifolium*, GC, mass %

Lipid class	10:0	12:0	14:0	15:0	16:0	16:1	18:0	18:1	18:2	Total acids	
										sat.	unsat.
Total lipids	Tr.	Tr.	Tr.	Tr.	9.4	0.8	1.6	13.7	74.5	11.0	89.0
TAG	-	-	Tr.	-	8.5	0.5	1.0	13.3	76.7	9.5	90.5
EADAG	-	0.2	0.4	-	9.5	Tr.	2.8	15.9	71.2	12.9	87.1
FFA	Tr.	0.1	0.2	0.2	29.5	0.9	4.2	9.7	55.2	34.2	65.8
GADAG	-	0.3	0.3	-	10.0	0.7	3.2	15.7	69.8	13.8	86.2
EAGAMAG	-	0.5	0.5	0.5	14.9	1.2	7.3	21.3	53.8	23.7	76.3
DAG	0.5	0.8	0.8	0.7	14.4	1.6	5.6	21.4	54.2	22.8	77.2
Polar AG I	-	1.9	2.0	-	20.0	3.8	14.6	19.3	38.2	38.5	61.3
MAG	2.4	3.1	3.9	3.5	17.6	4.7	8.6	12.3	43.9	39.1	60.9

TABLE 5. Composition of Epoxyacids of EADAG Lipids from Seeds of *Cousinia franchetii*, *Arctium leiospermum*, and *Rhaponticum integrifolium*, GC, mass %

Acid	<i>Cousinia franchetii</i>	<i>Arctium leiospermum</i>	<i>Rhaponticum integrifolium</i>
Epoxy-18:0	12.3	18.6	20.3
Epoxy-18:1	87.7	81.4	79.7

EXPERIMENTAL

Neutral lipids were separated into individual classes by CC over silica gel with elution of the components as before [7]. The completeness of the elution and the purity of the fractions were monitored by TLC over silica gel using hexane:diethylether (4:1 and 1:1). Fractions containing two and more lipid classes were separated again by preparative TLC using the same solvent systems. Isolated compounds were identified by qualitative reactions [16, 17], chromatographic mobility, and chemical transformations. The content of compounds was estimated gravimetrically. The composition of hydrocarbons was determined by TLC with elution by heptane:benzene (9:1) and comparison with authentic compounds [17]. Hydrolysis of AG and methylation of the isolated FA have been described [3]. GC of fatty acid methyl esters was performed on a Chrom-41 instrument with a flame-ionization detector and a column (2.0 m) packed with Reoplex 400 (15%) on Chromaton N-AW at 194°C. Epoxyacids were separated from other hydrolysis products of EADAG by CC over silica gel using hexane:diethylether (7:3).

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