Fatty Acid Compositions of Seed Oils of Seven *Hibiscus* Species of Malvaceae

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ABSTRACT

The seeds of seven *Hibiscus* (Malvaceae) species, viz., *H. surattensis, H. vitifolius, H. hirtus, H. punctatus, H. zeylanicus, H. micranthus* and *H. solandra*, contained 13-17% oil. Linoleic acid predominated (43.9-67.6%) in the component fatty acids of all the oils, followed by palmitic (15.1-30.1%) and oleic acids (5.9-24.8%), while malvalic, sterculic, dihydrosterculic and epoxy acids were present in small concentrations (1.7-8.4, 0.6-3.9, trace-2.1, trace-0.5%, respectively).

INTRODUCTION

During our search for new oilseeds to augment oil resources, we have studied 7 *Hibiscus* species of the Malvaceae family, viz., *H. surattensis* Linn., *H. vitifolius* Linn., *H. hirtus* Linn., *H. punctatus* Dalzell, *H. zeylanicus* Linn. (syn. *Pavonia zeylanica* Cav.), *H. micranthus* Linn. (syn. *H. ovalifolius* Vahl.) and *H. solandra* L'Her. (syn. *H. lobatus* O'Kuntz). Some of these plants are used in indigenous medicine, while others are cultivated as ornamentals (1-3). The fatty acid compositions of the seed oils are reported here for the first time.

EXPERIMENTAL METHODS

The contents of oil in the seeds and of unsaponifiable matter in the oils were determined according to the Official and Tentative Methods of the American Oil Chemists' Society (4). The oils were qualitatively examined for the presence of hydroxy, epoxy and cyclopropene fatty acids (CFA) by the sulfuric acid turbidity (5), picric acid (6) and Halphen (4) tests, as well as by ultraviolet (UV), infrared (IR) and proton nuclear magnetic resonance (NMR) spectroscopy. The methyl esters, obtained by treatment with methanolic sodium methoxide at room temperature (7), were separated by thin layer chromatography (TLC) into epoxy and nonepoxy esters. The epoxy esters were estimated by gas liquid chromatography (GLC) after conversion to hydroxy-methoxy esters and then to trimethylsilyl ethers (8). The nonepoxy methyl esters were treated with methanolic silver nitrate to convert CFA esters into stable ether and keto derivatives (7) and analyzed by GLC. Other experimental procedures were described in detail in an earlier communication (9).

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RESULTS AND DISCUSSION

The seeds are small in size. The oil contents were sufficiently high for economic recovery of oil by solvent extraction (Table I). The amounts of unsaponifiable matter in *H. punctatus, H. micranthus* and *H. solandra* seed oils were slightly higher than in conventional edible oils. The picric acid test showed the presence of epoxy fatty acids. The oils responded positively to the Halphen test, indicating the presence of CFA.

The band at 1008 cm^{-1} in the IR spectra and a signal at δ 0.8 in the NMR spectra confirmed their presence. The sulfuric acid turbidity test and IR spectra did not indicate the presence of hydroxy fatty acids. The UV and IR spectra showed no conjugation or *trans* unsaturation.

The fatty acid compositions are presented in Table I. Linoleic acid was predominant (43.9-67.6%), followed by palmitic (15.1-30.1%) and oleic (5.9-24.8%) acids. Total CFA content ranged from 2.4% to 10.2%. Malvalic acid was present to a greater extent than sterculic except in *H. micranthus* seed oil. Dihydrosterculic acid was found in very small quantities (traces-2.1%). Trace quantities to 0.5% of epoxy acids also were found.

In Malvaceae seed oils linoleic acid generally predominates, followed by palmitic and oleic acids, and CFA are present in significant quantities (10, 11). The dihydroderivatives of CFA and epoxy fatty acids also occur in very small quantities in some species.

The fatty acid compositions of the seed oils of seven *Hibiscus* species of the Malvaceae family studied in this investigation fit into this general pattern and resemble those of other *Hibiscus* species, *H. caesius* (12), *H. grandiflorus*

TABLE I

Fatty Acid Composition (Area %) of Seed Oils of *Hibiscus* Species

	H. surattensis	*H. vitifolius*	*H. hirtus*	*H. punctatus*	*H. zeylanicus*	*H. micranthus*	*H. solandra*
100-seed wt (g)	1.60	0.63	0.52	0.71	0.37	0.40	0.20
Oil (%[a])	16.6	13.3	14.6	13.0	13.6	15.2	15.7
Unsaponifiable matter (%)	1.7	1.8	3.2	5.2	2.7	3.9	5.7
Lauric	0.0	0.0	0.8	0.8	0.0	0.0	0.0
Myristic	0.2	0.7	0.3	0.2	0.0	0.5	0.5
Palmitic	20.0	30.1	15.1	17.0	26.2	18.6	17.3
Stearic	3.2	4.3	3.0	1.9	3.3	3.5	3.9
Oleic	24.8	15.2	8.8	14.1	5.9	10.1	8.8
Linoleic	43.9	44.8	67.6	53.3	56.3	59.8	64.4
Linolenic	0.0	0.0	0.0	2.1	0.0	0.0	0.0
Arachidic	0.7	0.7	0.7	0.0	0.3	1.0	0.8
Malvalic[b]	3.7	3.0	2.0	8.4	4.0	1.7	1.7
Sterculic[b]	0.9	0.6	1.1	1.8	3.9	3.1	0.7
Dihydrosterculic	2.1	0.5	0.5	0.3	Trace	1.0	1.3
Epoxy[c]	0.5	0.1	Trace	Trace	Trace	0.5	0.5

[a]Dry basis.

[b]Ether plus keto derivatives.

[c]Trimethylsilyl ethers of hydroxy-methoxy derivatives.

(13), *H. syriacus* (13), *H. panduriformis* (14), *H. trionum* (15), *H. diversifolius* (15), *H. sabdariffa* (16), *H. cannabinus* (17), *H. moscheutos* (17) and *H. syriacus* (17).

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♣Effect of Frost Damage on the Quality of Canola *(B. napus)*

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ABSTRACT

Samples of frost-damaged rapeseed from the 1982 Western Canadian Crop were tested for oil content, protein content, fat acidity, chlorophyll content, fatty acid composition, glucosinolate content, conductivity and germination. These quality factors were related to two frost-related damage factors, green seeds and external "frost-damage," used in the Canadian grain grading system. The green seed factor was positively correlated with chlorophyll, free fatty acids and conductivity, and a negative correlation was found with linolenic acid, iodine value and germination. The frost-damage factor was positively correlated with conductivity, free fatty acids and palmitic acid and negatively correlated with linolenic acid, iodine value, oil content and germination. The effects of frost damage were explained by assuming that the seed maturation process was halted due to freezing.

INTRODUCTION

A severe frost on August 27, 1982 damaged much of the rapeseed and canola[1] growing in the eastern and central Canadian prairies. The extent of the frost damage and the monetary costs involved will be described in a separate report (Clear, K.M., J.K. Daun and J.T. Mills, In Preparation). An estimated 38% of the crop, or about 1,160,000 tons of seed, graded No. 3 Canada or lower as a result of the frost, compared with an average of only 4% of the crop in these grades over the previous five years. Frost damage of this extent is extremely rare in Western Canada, but isolated instances of frost-damaged seeds do occur almost every year. The 1982 crop of rapeseed offered an opportunity to evaluate the quality of a large number of frost-damaged samples under field conditions. The storageability (1) and morphology of frost-damaged seed (2) have been reported elsewhere. This study compared quality parameters (oil content, protein content, fatty acid composition, chlorophyll, free fatty acids, glucosinolates, germination and conductivity) with visual degrading factors associated with frost damage for samples of rapeseed taken after the 1982 frost.

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[1] Canola is a trade mark of the Canola Council of Canada (3) and refers to seeds of *Brassica campestris* L. and *B. napus* L. with low levels of erucic acid in the oil (5%) and low levels of glucosinolates in the oil-free meal (30 μM/g of the four main alkenyl glucosinolates). More than 90% of the Western Canadian rapeseed and canola growing area was planted with canola varieties in 1982. The Canada Grain Act does not recognize canola as separate from rapeseed since, for visual grading purposes, it is impossible to differentiate between canola and rapeseed.

MATERIALS AND METHODS

Sources of Samples

Samples were obtained from 60 bins containing rapeseed harvested from the 1982 crop and located on farms within a 200 km radius of Winnipeg (1). Information on the binned seed including variety name, dates of swathing, combining and binning were obtained from the producer. The bins were sampled in early November, 1982 and two samples (where possible), each of 450 g, were removed by probe (deep bin cup no. 232, Seedburo, Chicago, Illinois) at depths of 2 m and 45 cm either vertically through the top surface or at an angle of about 45° through the side port. The samples were transported in double plastic bags, and stored at −15 C until tested individually.

In order to minimize the effect of species and type in the farm bin study, *B. campestris* varieties (10 samples) and the *B. napus* (non-canola) variety Midas (4 samples) were eliminated from the study. Also eliminated were samples severely infested with wild mustard (11 samples) and samples which showed extensive bin-heating (4 samples). The remaining 50 samples included 40 of *B. napus* cv. Regent and 10 of *B. napus* cv. Altex.

Samples of pooled commercial lots also were obtained from grain firms and crushing plants as a part of the Grain Research Laboratory's annual new crop survey. These samples were graded by Canadian Grain Commission grain