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The Composition of Seed and Seed Oils of Taramira (*Eruca sativa*)

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ABSTRACT

The seeds of *Eruca sativa*, commonly known as taramira, were found to contain 4.1% moisture, 27.8% oil, 27.4% protein and 6.6% ash. Atomic absorption spectrophotometric analysis indicated calcium and potassium levels of 1186 and 1116 mg/100 g of whole seed, respectively. Other mineral contents also are reported. The seed oil had a specific gravity of 0.910, refractive index of 1.4680 (at 40 C), iodine value of 137.0, saponification value of 168.1 and a free fatty acid content of 2.3% (as oleic acid). Gas chromatographic analysis of the oil revealed high levels of linolenic acid (36.2%) and relatively low levels of erucic acid (10.3%).

INTRODUCTION

Taramira (*Eruca sativa*) belongs to the *Cruciferae* family of plants, grown in parts of the Middle East, India and Pakistan as a minor oil crop and for the preparation of some traditional medicines and remedies. It is a useful cash crop in areas where rainfall and soil fertility are too low to cultivate cereals, rape or mustard. Although vulnerable to sawfly attack at the seedling stage, mature plants are highly resistant to insect problems. Morphological studies have revealed that there exist some important differences between field ripe seeds of taramira and most species of *Brassica* (1). Adulteration of *Brassica* seed oils with less expensive taramira oil is now recognized as a major problem, the extent of which is yet to be determined.

A survey of the literature reveals only very sparse information on the chemical composition of taramira seeds and seed oils. Most work has focused on the effects of seed yield and changes in seed oil composition caused by different agricultural practices. Sukhija and Bhatia (2) noted that changes in the fatty acid make-up of taramira seed oil occur during ripening, and further work (3) revealed that the number of irrigations which the plant received also affect oil composition. The purpose of this study was twofold: (i) To determine the chemical composition of the whole taramira seed, and (ii) to investigate the chemical and physical characteristics of the extracted oil of taramira seed.

EXPERIMENTAL

Samples

Samples of freshly imported taramira (*Eruca sativa*) seeds were obtained from the Saudi Arabian Ministry of Agriculture Department, Halat Amar, Saudi Arabia. The origin of the seed was Turkey.

Preparation of the Samples

Samples of the seeds were ground at high speed for 2 min in a Waring blender. The resulting meal was stored in air-tight glass jars prior to analysis. For the analysis of the oil, portions of the meal were extracted in petroleum ether (60-80 ° fraction) using a Soxhlet apparatus. The extract was warm-filtered through a Whatman No. 2 filter paper and the solvent removed under a stream of nitrogen at 60 C.

Methods

E. sativa seed meal was analyzed for moisture, oil, protein and ash according to the procedures of the Official and Tentative Methods of the AOCS, 1972 (4). Major minerals were determined immediately using a Perkin-Elmer 2380 Atomic absorption spectrophotometer, followed by standard addition techniques to check the results.

The extracted, filtered oil samples were checked for specific gravity, refractive index, iodine value, saponification value and percent free fatty acids by methods of the AOAC (5). Methyl esters of the fatty acids were prepared using 14% BF_3 in methanol (AOAC-IUPAC method) and subsequently analyzed by gas chromatography. All gas chromatography was performed on a Varian 6000 gas chromatograph fitted with a 2 m × 3.2 mm o.d. stainless steel column packed with 10% diethylene glycol succinate (DEGS) on Chromosorb W, 80-100 mesh using flame ionization detection. Nitrogen carrier gas was used with a flow rate of 24 ml/min. The injector and detector temperatures were maintained at 220 C and 230 C, respectively. Column temperature was held at 120 C for 2 min, then raised to 190 C at 5 C/min. The upper temperature was held for 25 min. The data obtained was handled by a Varian Vista 401 data station. Fatty acid methyl esters were identified by comparison of retention times with those of standards (obtained from Supelco Inc., Bellefonte, Pennsylvania). Amounts of each fatty acid were calculated by the peak area method, corrected according to detector response.

Unless otherwise stated, all reagents used in the procedures were obtained from BDH Limited, Poole, England, and were of analytical or chromatographic grade.

RESULTS AND DISCUSSION

The characteristics and chemical composition of the seeds and seed oils of *E. sativa* are given in Table I and Table II.

The average oil content of the *Eruca sativa* samples collected for this investigation was 27.8% (or 28.2% on a dry basis). Previous work (2,3) has shown that the lipid content (and composition) varies according to the maturity of the seed and the degree of plant irrigation. It would indicate that the samples used in this study were fully mature, although the lipid content might have been increased by increasing the number of irrigations. The crude protein levels (average 27.4%) suggest that the extracted seed cake would be a useful feed supplement (crude protein ca. 28.5% on a dry weight basis). However, there is evidence of significant levels of isothiocyanates in dry defatted *E. sativa* seed (8) which would restrict its use without pre-treatment.

The acid soluble content (6.6%) is high when compared with many other seeds of the *Cruciferae* family. Particularly high levels of calcium (1186 mg/100 g) and potassium (1116 mg/100 g) were found.

The seed oil of *E. sativa* is dark brown and has a high vis-

TABLE I

Characteristics and Chemical Composition of *Eruca sativa* Seeds and Seed Oil

Seeds	
Dimensions (mm)	1.2 × 0.5
Weight (mg/1000 seeds)	152.0
Moisture (and volatile matter) (%)	4.1
Oil (%)	27.8
Protein (%)[a]	27.4
Ash (%)	6.6
Ca (mg/100 g)	1186
Mg (mg/100 g)	350
K (mg/100 g)	1116
Na (mg/100 g)	233
Zn (mg/100 g)	0.3
Oil	
Specific gravity (25 C)	0.910
Refractive index (40 C)	1.4680
Iodine value	137.0
Saponification value	168.1
Free fatty acids (as oleic acid %)	2.3

[a]N × 6.25.
Average of 5 analyses.

TABLE II

Fatty Acid Composition (wt %) of *Eruca sativa* Seed Oil

	% of Total fatty acids (by weight)[a]		
Fatty acids	Present study	Ref (6)	Ref (7)[b]
C16:0	6.9	9.8	5.5
C16:1	0.2	–	0.2
C18:0	2.3	2.1	1.2
C18:1	11.9	12.3	15.1
C18:2	16.3	10.6	7.6
C18:3	36.2	22.1	12.9
C20:1	13.0	–	11.4
C20:2	1.2	–	0.4
C22:0	1.7	–	tr
C22:1	10.3	43.1	43.1
C24:0	tr	–	tr
Total saturated	10.9		
Total unsaturated	89.1		

[a]Methyl esters as % of total methyl esters by gas chromatography.
[b]C20:0 also found (0.6%).

cosity. Our samples contained an average free fatty acid content of 2.3% (oleic), which is considerably higher than levels commonly encountered in other processed oils. The unusually high levels of unsaturated fatty acids (Table II), and particularly linolenic acid (36.2%) would encourage free fatty acid formation by hydrolysis of triglycerides. Microscopic examination of the seeds revealed that some degree of damage (ca. 10% seeds) had occurred during harvesting and transportation, and this is likely to have an added effect.

The fatty acid profile analysis revealed some major differences between the samples of this study and those of previous work. Of particular note is the erucic acid content (10.3%), which is considerably lower than previously found. Conversely, the linolenic acid levels (36.2%) are greatly elevated.

Sukhija and Bhatia (9) suggest that during germination of *E. sativa*, the seed triglycerides are used non-selectively. However, they suggest that erucic acid is less likely to be used as a source of energy than other, shorter-chain fatty acids and will therefore remain as the predominant fatty acid. These results vary considerably from those obtained from other seed oils of the *Cruciferae* family. The lower levels of erucic acid are, without doubt, desirable. However, such a high linolenic acid content would make the oil highly susceptible to free radical oxidative reactions.

Further studies currently are underway to determine whether rapid changes in the fatty acids of *E. sativa* oil occur during storage of the seed.

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