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Oil content and fatty acid composition of *Ailanthus excelsa* Roxb. seed oil

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ABSTRACT

Fatty acid content of petroleum ether (60-80°) extracted oil of mature seeds of *Ailanthus excelsa*, has been analyzed for the first time by GC and GC-MS using standard fatty acids. Oil content of the seeds was found to be 65 $g.kg^{-1}$ (weight per kg dry seeds). The oil of the seeds contained seven identified fatty acids, accounting for 89.28% of the total fatty acids and five unidentified compounds. The predominant fatty acids were oleic acid (37.72%), linoleic acid (25.83%), palmitic acid (13.79%) and stearic acid (9.12%). DHA, eicosenoic acid, and arachidonic acid were present only in minor amounts. It is inferred that the seed oil of *Ailanthus excelsa* may be a good source of essential fatty acids.

Keywords : Fatty acids; seed oil; *Ailanthus excelsa*; GC analysis; GC-MS analysis.

INTRODUCTION

Plant seeds are important sources of oils of nutritional, industrial and pharmaceutical importance[1]. It is well known that the suitability of an oil for a particular purpose, however, is determined by its fatty acid composition and no oil from any single source has been found to be suitable for all purposes because oils from different sources generally differ in their fatty acid composition. The patterns of fatty acid variation in plant seed oils have also proven to be useful tools in taxonomic and phytogenetic studies[2]. In the search for a new source of oils, a large number of non-conventional plants have been surveyed[3]. One of such plants, *Mahanimba* (*Ailanthus excelsa* Roxb.) has been chosen for this study. The plant belongs to the family Simaroubaceae and is widely cultivated in road sides and gardens of central and southern India and also grows wild in some Indian forests[4]. It may be mentioned here that many parts of this plant i.e.; leaves, bark etc have folk medicinal uses in Indian villages e.g., its leaves are especially useful in asthma, bronchitis, dyspepsia and debility after child birth[5]. The barks of the plant are also used for dyspepsia, dysentery, asthma etc[5,6] Phytochemical studies on *A. excelsa* have demonstrated the presence of quassinoids, alkaloids and terpenoids[7-9]. Some bioactive constituents were also found in bark, leaves, roots etc. of this plant which have significant antibacterial, antifungal and antifertility activities[10-12]. But no reports are presently available on *Ailanthus excelsa* seed oil and its uses for edible as well as for medicinal purposes.

The present study deals with some investigations for characterization and fatty acid composition of the oil of *A. excelsa* seeds. Such information could have potential for possible future domestication and safe use for human consumption[13]. The information can also be used for taxonomic and evolutionary studies.

MATERIAL AND METHODS

Plant material and chemicals

All reagents and chemicals used in this investigation were of analytical grades. Fresh, mature fruits of *Ailanthus excelsa* were collected from the Burdwan Divisional Forest Department, Burdwan, West Bengal, India in the middle of April 2006 and authenticated by Prof. A. Mukherjee, Botany Department, University of Burdwan, Burdwan, West Bengal, India. Voucher specimen Burdwan, Kundu SS1 has been deposited at the Herbarium of the Botany Department, University of Burdwan, Burdwan, bearing acronym BURD. Standard fatty acids used in the experiment were purchased from Sigma Chemical Co., (USA).

Isolation and Characteristics of the Seed Oil

Fruits were initially de-coated and the seeds were dried in air. The finely powdered air dried seeds (850g) were extracted with 5L petroleum ether (60-80°) in a soxhlet for 60 hours and after complete removal of the solvent under vacuum, seed oil was obtained. The total oil were weighed and stored under nitrogen at 4°C for further analysis. The chemical analysis of the seed oil (including acid, iodine, and saponification values) were performed according to the methods of the Association of Official Analytical Chemists[14] and the results have been placed in Table 1.

Extraction and Identification of fatty acids

The extraction of fatty acids and its methyl ester preparation were performed according to the method described by Frederick A. Bettelheim and Joseph M. Landesberg[15]. Methyl esters of fatty acid mixture of the seed oil was purified by preparative TLC using hexane:ethyl acetate (1:1) as chromatographic solvent and the fatty acid methyl ester band was eluted with chloroform (Merck, India) and kept in freeze for further analysis.

GC analysis

The purified methyl ester of fatty acids of the seed oil of *A. excelsa* was analysed directly by Gas Chromatography on a Hewlett Packard (HP; Palo Alto, CA, USA) model, Agilent 6890 series plus instrument fitted with HP-5 capillary column (30 m X 0.25 mm i.d) using a flame ionization detector (FID). The temperatures of the injection and detector ports were set at 250°C. The oven temperature program was: initially 160°C held for 2 min, then raised at 3°C/min to 220°C and finally held for 18 min at 220°C. The carrier gas was nitrogen at a flow rate of 20 ml/min; volume injected 1ml; split ratio, 1:20. Peaks were identified by comparison of their retention times with those of standard fatty acid (lauric acid, myristic acid, palmitic acid, linoleic acid, oleic acid, stearic acid, arachidonic acid, eicosenoic acid and DHA) methyl esters. The percentage composition of the samples was computed from the GC peak areas.

GC-MS analysis

The methyl esters of fatty acids were further analysed by Gas Chromatography-Mass Spectrometry on a Shimadzu GCMS-QP 5050A fitted with a ZB-5 (Phenomenex Company, Japan) capillary column (30 m C 0.25 mm i.d; film thickness 0.25 mm). GC operating conditions were similar to those in our above study. MS condition: ionization voltage 70 eV; ion source temperature, 270°C; and mass range was 30-700 mass units. The individual peaks were identified by comparison of their retention indices by comparing their mass spectra with the NIST/WILEY library mass spectral database.

RESULTS AND DISCUSSION

Oil (light yellow colored) content of this seed was found to be 65 $g.kg^{-1}$ (weight per kg dry matter of seeds). The characteristics of the seed oil of *A. excelsa* is given in Table 1. The low iodine value (Table 1) implies a more stable seed oil with a

Table 1: Characteristics of the *ailanthus excelsa* Roxb. Seed oil.

Parameters	*A. excelsa* seed oil*
Density (gm/ml)	0.91 ± 0.001
Specific gravity	0.90 ± 0.002
Acid value (mg KOH/g)	2.10 ± 0.140
Iodine value (g/100g)	30.90 ± 0.640
Saponification value (mg KOH)	189.00 ± 0.370

*Values are mean ± S.D., n = 6

longer shelf life. The acid value indicates the amount of free fatty acids present in oil. From both the GC analysis and GC-MS studies of the methyl esters of fatty acids present in oil of the matured seeds of *A. excelsa*, seven fatty acids were identified and quantified Table 2, represent 89.28% of the total fatty acids. The balance was made up of five unidentified compounds. Oleic acid (C18:1 n-9) was the principal unsaturated fatty acid (37.72%) followed by linoleic acid (C18:2 n-6) as the second main unsaturated fatty acid (25.83%). Palmitic acid (C16:0) and stearic acid (C18:0) were the major saturated fatty acids. Other identified fatty acids were DHA (decosahexaenoic acid; C22:6 n-3), eicosenoic acid (C20:1) and arachidonic acid (C20:4 n-6). Disregarding this unidentified fatty acids, the proportion of unsaturated and saturated fatty acids are 66.37% and 22.91% respectively.

Table 2: Fatty acid compositions of the seed oil of *Ailanthus excelsa* Roxb.

Name of the fatty acid	RT(Retention time) in minutes	Relative percentage*
Unidentified-1 (M^+ 252)	8.407	1.30 ± 0.026
Palmitic acid (C16:0)	11.534	13.79 ±0.036
Unidentified-2 (M^+ 278)	12.508	1.86 ± 0.020
Linoleic acid (C18:2 n-6)	15.977	25.83 ± 0.010
Oleic acid (C18:1 n-9)	16.141	37.72 ± 0.026
Stearic acid (C18:0)	16.864	9.12 ± 0.026
Unidentified-3 (M^+ 294)	17.960	3.47 ± 0.017
Unidentified-4 (M^+ 294)	18.692	3.54 ± 0.030
Arachidonic acid (C20:4 n-6)	20.397	0.30 ± 0.026
Eicosenoic acid (C20:1)	21.660	0.64 ± 0.010
DHA (C22:6 n-3)	26.192	1.88 ± 0.036
Unidentified-5 (M^+ 430)	28.350	0.55 ± 0.017

* Values are means ± S.D., n =3

The results of the present investigation indicate that *A. excelsa* seed oil may be a good source of essential fatty acids. The oil of this seeds was rich in two unsaturated fatty acids i.e, oleic and linoleic acids. Both acids are important from the nutritional point of view as well as for oil stability. It is well known that dietary fats rich in linoleic acid, prevent cardiovascular disorders such as coronary heart diseases and high blood pressure and also its derivatives also serve as structural components of the plasma membrane and as precursors of some metabolic regulatory compounds.[16] Therefore, the oil of *Ailanthus excelsa* seeds may be nutritionally valuable. The high content of linoleic acid may render the seed oil interesting for cosmetic industry. The trace amount eicosenoic acid and arachidonic acid are present in this oil Table 2. The reason for this variability may be genetic (plant cultivar or variety).

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