Pak J Sci Ind Res 2000 ***43*** *(1) 23 - 25*

FATTY ACID AND LIPID COMPOSITION OF *SESAMUM INDICUM* DC

M. Akhtar Javed*[a], Nusrullah Akhtar [b] ***and Abdul Jabbar*** [b]

[a] *PCSIR Laboratories Complex, Sharah-e-Jalaluddin Roomi, Lahore-54600, Pakistan*

[b] *Chemistry Department, Islamia University, Bahawalpur, Pakistan*

(Received 6 January 1999, accepted 5 July 1999)

Sesamum indicum DC (sesame) seeds contained moisture 4.7% and lipids 53.9%. The lipids were fractionated into neutral lipids (96.3%) and polar lipids (3.7%) by thin layer chromatography. The neutral lipids identified were hydrocarbons (0.3%), sterol esters (0.7%), triacylglycerols (80.6%), free fatty acids (2.1%), 1,3-diacylglycerols (3.5%), 1,2-diacylglycerols (4.7%), sterols (1.9%) and monoacylglycerols (2.5%). The polar lipids were phosphatidylethanolamines (0.6%), phosphatidylcholines (1.3%), lysophosphatidylethanolamines (0.4%), lysophosphatidylcholines (0.5%) and phosphatidlinositols (0.9%). The fatty acids range of all the esterified lipids was ($C_{12:0}$-$C_{20:0}$) showing higher percentages of saturated fatty acids except in triacylglycerols. The major fatty acids were palmitic, stearic, oleic and linoleic acids.

Key words: *Sesamum indicum* DC, Lipids, Fatty acids, Triacylglycerols.

Introduction

Sesamum indicum DC (Sesame, Vern. till) belongs to pedaliaceae or Sesame family. It is a small family consisting of 20 genera and 60 species, mostly tropical, occuring chiefly in South Africa, Madagascar, Indo-Malaya and Australia Chopra 1977. There are two varieties of sesame, the black seeded and the white seeded. The black seeded variety yields oil which is consumed for culinary purposes and for burning, while the white seeded variety is eaten in the form of sweatmeets. Its oil is rekoned equal to olive oil in medicinal properties, especially in the treatment of ulcers and wounds (Nadkarni 1982). The oil with other oils is recommended for use in psoriasis, prurigo, leucoderma etc. The present work is about the investigation of lipid compounds present in the oil of white seeded variety abundantly available in Pakistan. Although work on sesame lipids has been carried out previously (Vijayalakshami and Venkob 1972; Arefeva *et al* 1980; Li Li and Fangsheng 1990; Kamal Eldinand Appelqvist 1994; Yoshida *et al* 1995), a comparatively thorough and systematic study is presented in this paper.

Materials and Methods

Extraction of lipids. The total lipids from 10g powdered seeds were extracted with 300 ml chloroform: methanol (2:1, V/V) mixture (Akhtar *et al* 1981) at room temperature by stirring on a magnetic stirrer for half an hour. After filteration the residual material was treated three times with 100 ml of chloroform: methanol mixture as above. All the extracts were combined and washed with 100 ml chloroform: methanol: 0.9% aqueous sodium chloride (3:48:47, V/V/V) solution (Akhtar *et al* 1980) in a separating funnel. After the removal of non lipid impurities the pure lipids were obtained (5.4g) under reduced pressure which were stored under an atmosphere of nitrogen.

Separation and identification of lipid classes. The neutral and polar lipids were separated on 0.5 mm thick TLC plates using hexane: ether: acetic acid (80:20:2, V/V/V) and chloroform:methanol: 30% ammonium hydroxide: water (60:35:5:2.5, V/V/V/V) solvent systems respectively (Javed *et al* 1991). The different components of the lipids were identified by comparing them with the standards and then verified by applying specific spray reagents (Raie *etal* 1989) to the TLC plates Table 1.

For quantitative determination of the lipid classes, 5 mg of the total lipids (50 µl of a 10% solution) was applied in the form of a 10 cm long band on a 0.5 mm plate. After development the bands were located and scraped after spraying the plate with 0.2% 2,7-dichlorofluorescein solution in methanol and viewing under ultraviolet light. The scraped bands were extracted with chloroform:methanol mixture (2:1 v/v) separately. The solvent was removed under reduced pressure and respective lipids were weighed for quantification in duplicate.

Esterification of separated lipids and purification of methyl esters. The classified lipids were esterified with

*Author for correspondence

boron trifluoridemethanol reagent (Javed *et al* 1992) for half an hour in test tubes with teflon lined screw caps. The methyl esters so formed were extracted with hexane and purified quantitatively on TLC plates using hexane:ether (9:1, V/V) solvent system (Raie *et al* 1983). The material (R_f 0.6) was extracted with chloroform and the solvent was removed by distillation to get purified methyl esters prior to the application of gas liquid chromatography.

Resolution and identification of fatty acids by gas chromatography. Methyl esters of the fatty acids were analysed on Shimadzu GC 14A gas chromatography with flame ionization detector using 1.6 m x 3 mm (i.d.) glass column packed with diethylene glycol succinate (15%) coated on Shimalite AW 201 (60-80 mesh). Column temperature was programmed 150°C for two minutes and then with a rise of 5°C min^{-1} to 200°C which was maintained for 15 min. Injector and detector temperatures were 250 and 300°C, respectively. Nitrogen was used as carrier gas with a flow rate of 40 ml min^{-1}. The methyl esters were identified by comparing their retention times with those of authentic methyl fatty esters under the same conditions. The percentage of various acids was determined by Shimadzu C-R4 A Chromatopac computing integrator and reported in Table 2.

Results and discussion

The total lipids (53.9 %) were classified into neutral and polar lipids by TLC in respective solvent systems (Javed *et al* 1991). The neutral lipids were the main constituents (96.3%) and polar lipids were in minor amounts (3.7%). The neutral lipids were further fractionated into seven fractions, which were hydrocarbons, sterol esters, triacylglycerols, free fatty acids, 1,3-diacylglycerols, 1,2-diacylglycerols and

Table 1
Moisture and lipid content of sesame seeds

Moisture	4.7 %
Lipids	53.9 %
Neutral lipids	96.3 %
Polar lipids	3.7 %
Neutral/polar lipids	26.0

Table 2
Percentage and R_f values of lipid fractions of sesame seeds

Lipid Classes	Percentage	R_f Value
Neutral Lipids		
Hydrocarbons (HC)	0.3	0.96
Sterol esters (SE)	0.7	0.67
Triacylglycerols (TAG)	80.6	0.59
Free fatty acids (FFA)	2.1	0.40
1,3-Diacylglycerols (1,3-DAG)	3.5	0.33
1,2-Diacylglycerols (1,2-DAG)	4.7	0.30
Sterols (S)	1.9	0.21
Monoacylglycerols (MAG)	2.5	0.18
Polar Lipids		
Phosphatidylethanolamines (PE)	0.6	0.65
Phosphatidylcholines (PC)	1.3	0.53
Lysophosphatidylethanolamines (LPE)	0.4	0.46
Lysophosphatidylcholines (LPC)	0.5	0.42
Phosphatidylinositols (PI)	0.9	0.17

Table 3
Fatty acid composition % of different lipids in sesame

Lipid classes	$C_{12:0}$	$C_{14:0}$	$C_{16:0}$	$C_{16:1}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{20:0}$
TAG	0.1	0.1	9.5	0.4	5.8	40.9	41.4	1.3	0.5
SE	0.2	2.3	34.7	0.8	10.9	22.6	24.5	1.9	2.1
FFA	T	T	39.6	0.1	11.3	21.7	23.2	1.0	3.1
1,3-DAG	-	-	41.3	-	10.9	20.5	23.9	0.4	3.0
1,2-DAG	0.1	1.4	41.7	0.7	11.5	19.8	21.6	0.3	2.9
MAG	0.7	0.9	37.5	3.7	11.6	20.9	22.0	-	2.7
PE	1.2	7.1	35.8	0.5	12.8	19.6	20.7	0.7	1.8
PC	-	3.5	39.9	0.2	13.7	19.6	20.1	-	3.0
LPE	1.3	1.0	44.7	0.3	11.5	18.7	19.4	0.5	2.6
LPC	2.0	2.3	38.8	0.1	12.9	19.9	20.5	1.2	2.3
PI	0.8	10.7	37.6	0.8	10.5	17.4	19.3	0.9	2.0

T;Traces

Table 4
Percentage of saturated and unsaturated fatty acids in different lipids

Lipid fractions	Saturated fatty acid %	Unsaturated fatty acid %
TAG	16.0	84.0
SE	50.2	49.8
FFA	54.0	46.0
1,3-DAG	55.2	44.8
1,2-DAG	57.6	42.4
MAG	53.4	46.6
PE	58.7	41.3
PC	60.1	39.9
LPE	61.1	38.9
LPC	58.3	41.7
PI	61.6	38.4

monoacylglycerols. Triacylglycerols were the predominant class (80.6 %) of the total lipids whereas the hydrocarbons (0.3%) were the minor components (Table 2). Polar lipids revealed the presence of phosphatidylethanolamines, phosphatidylcholines,lysophosphatidylethanolamines, lysophosphatidylcholines and phosphatidylinositols (Table 2). All lipid classes except hydrocarbons, and sterols were analysed for their fatty acids composition (Table 3).

The fatty acid range was ($C_{12:0}$-$C_{20:0}$). All the lipids classes showed higher percentage of saturated fatty acids except for triacylglycerols in which unsaturated fatty acid were of predominant (84.0%) (Table 4). The essential fatty acid $C_{18:02}$ was the main contributor among the unsaturated fatty acid profile in all the lipid classes. Fatty acids $C_{12:0}$, $C_{16:1}$ and $C_{18:3}$ were present in small amount in almost all the lipid fraction. The fatty acid $C_{16:0}$ was predominant in all the lipids except that of triglycerides where $C_{18:2}$ was the highest (41.4%) The other fatty acids found were $C_{14:0}$, $C_{18:0}$, $C_{18:1}$ and $C_{20:0}$ (Table3). In the present work the fatty acid composition of each lipid fraction containing fatty acids has been reported which so far has not been given in any other work published on this oil.

References

Akhtar M W, Iqbal M Z, Nawazish M N 1980 Lipid class and fatty acid composition of pumpkin seed oil. *Pak J Sci Res* **32** 239-41

Akhtar M W, Kausar N, Nawazish M N, Hussain Z 1981 Variation in the composition of polar and nonpolar lipids and their fatty acids in the germinating seeds of Cucumis melo. *Pak J Biochem* **16** (2) 71-81.

Arefeva N V, Nikiforova V N, Kibrik E D 1980 Changes in sesame oil lipids during the thermal treatment of Sesame seed. *Khlebopek Konditer Prom-st* **12** 32-33.

Chopra G L 1977 *Angiosperms.* unique publishers 9th ed Lahore, 287-89.

Javed M A, Raie M Y, Ali H 1991 Lipid studies of *Citrullus vulgaris* of the family Cucurbitaceae. *Pak J Sci Ind Res* **34** (5) 181-83.

Javed M A, Raie MY, Ali H 1992 Lipid studies of *Citrullus Colocynthis* of the family Cucurbitaceae. *Acta Scientia* **2** (1) 67-72.

Kamal Eldin A, Appelqvist L A 1994 Variation in fatty acid composition of the different acyl lipids in seed oils from four Sesamum species. *J Am Oil Chem Soc* **71** (2) 135-39.

Li Li Sun Qian, Fangsheng L, 1990 The contents of total lipids, total phospholipids and main phospholipids in 25 common foods. *Ying Yang Xuebao* **12** (4) 423-25.

Nadkarni A K 1982 *Sesamum indicum Dc, The Indian Material Medica.* 1, part-II **3rd** ed Popular Prakashan Bombay **7,** 1126-29.

Raie M Y, Ahmad I, Javed M A, Waheed I 1989 Lipid classes of Apium graveolens oil of the family Umbelliferae. *Proc Pak Acad Sci* **26** (3) 199-206.

Raie M Y, Zaka S, Saleem M 1983 Chromatographic analysis of Eriobotrya japonica Fat. *Fette Seifen Anstrichmittel* **85** (8) 325-26.

Vijayalakshmi B, Venkob R S 1972 Nature of Sesame seed phospholipids. *J Oil Technol Ass India* **4** (2) 53-8.

Yoshida H, Shigezake J, Takagi S, Kajimoto G 1995 Variation in the composition of various acyl lipids, tocopherols and lignans in Sesame seed oils roasted in a microwave oven. *J Sci Food Agric* **68** (4) 407-15.