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Variation in oil content and fatty acid composition of some sesame (*Sesamum indicum* L.) genotypes of Indian origin

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Abstract

Fourteen sesame (*Sesamum indicum* L.) genotypes procured from Hill Agricultural Research and Extension Centre, Dhaulakuan of CSK HPKV were analyzed for oil content and fatty acid profiles. The oil content in these genotypes was in range of 33.43 to 49.35 per cent. Fatty acids (C16:0, C18:0, C18: 1n-9, C18: 2n-6, C18: 3n-3, C20:0) of these sesame genotypes were obtained in percentage of total fat. Oleic and linoleic acids were the major unsaturated fatty acids with range of variation from 28.42 to 47.56 per cent and 27.59 to 42.81 per cent, respectively. The major saturated fatty acids in sesame genotype were identified as palmitic and stearic acid. The range of variation was from 7.22 to 12.20 per cent and 4.09 to 6.78 per cent, respectively. The traces of arachidic acid were also detected.

Key words: Sesame, oil content, fatty acids.

Introduction

Sesame (*Sesamum indicum* L., Pedaliaceae) is one of the world's oldest oilseed crops and is being cultivated in Asia since ancient times (Bedigian and Harlan, 1986). It was highly prized oil crop of Babylon and Assyria at least 4,000 years ago (Oplinger *et al.* 1990). Sesame seed is an important source of edible oil and is widely used as a spice. The seed contains about 50 per cent oil, which is pale yellow in colour. It has pleasant odour and taste. Sesame oil has been valued for centuries as table and cooking oil. Apart from its use as edible oil, it finds its use in pharmaceuticals, perfumery (as fixative), cosmetics, insecticides (synergistic) and soap industry (Morris, 2002). Refined sesame oil and food fried in sesame oil have a better shelf life, taste and flavour because of its antioxidant properties (Home cooking, 1998). Sesame oil contains about 80 per cent unsaturated fatty acids mainly oleic (18:1) and linoleic (18:2) acids. The remaining 20 per cent is composed of saturated fatty acids mainly palmitic and stearic acids (Ashri, 1998). The fatty acid composition of sesame oil varies considerably among different cultivars (Yermanos *et al,* 1972; Brar, 1982). Its oil consists about 43 per cent oleic acid and linoleic acid each, 9 per cent palmitic and 4 per cent stearic fatty acids. Sesame oil is unique in containing several lignan antioxidants namely sesamin, sesamolin and sesamol (Ashri, 1998; Crews *et al.* 2006). The sesamin and sesamolin are responsible for characteristic colour reactions and insecticidal synergism of sesame oil. Sesamol, a phenolic antioxidant usually present in traces, is formed from sesamolin under certain processing conditions, and gives an excellent protection to oil against rancidity (Yermanos *et al.* 1972; Brar, 1982; Irvine, 1969). In addition to antioxidants, sesame oil contains different aromatic compound.

The exceptionally diverse germplasm, wider environment adaptation, varied oil content and fatty acid composition make sesame an ideal target of the study. Moreover, with growing health consciousness, the international demand and export of sesame, it has emerged as valuable export crop, presently earning over Rs. 1000/- crores of value (Duhoon *et al.* 2004). Keeping in view the importance of quality production in terms of export standards and demands of international market, the present investigation was carried out in order to provide baseline information regarding oil content and fatty acid profile of sesame genotypes.

Material and Methods

Dry mature seed samples of fourteen sesame varieties/genotypes were procured from Hill Agricultural Research and Extension Centre, Dhaulakuan (H.P.) during the month of June, 2005. Dry mature seeds were cleaned and freed of any

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extraneous substances and dried in a hot air oven at 60°C. The dried samples were ground in Willey Mill to pass through 1 mm sieve and stored in airtight storage boxes. These samples were properly labeled and kept at room temperature for further analysis. Analysis was performed in triplicates and results were calculated on dry weight basis. The crude oil of sesame samples was determined by the procedure described by AOAC (1965). 2 g of clean and moisture free samples were placed in fat-free thimbles and soxhlet-extracted using petroleum ether (40-60°C) for 8 h. The solvent was then removed by rotary evaporation and also re-evaporated by placing in oven at 70°C for 10 min.

FAME of sesame seeds: The fatty acid methyl esters (FAME) were prepared from extracted lipids from each sesame genotypes by BF_3 - Methanol method (AOAC, 1990).

GC-MS analysis: The FAME of sesame seeds were analyzed by using GC-MS instrument fitted with flame ionization detector and Rtx-Wax column (thickness 0.25 µm x diameter 0.32 mm x 30 m). The gas chromatograph was temperature programmed to start at 40°C and to increase 10°C/min to 240 °C. Injector and detector temperatures were set to 245 °C and 250 °C, respectively. Carrier gas was helium at a flow rate 3ml/min and split ratio was 40:1. In the mass spectrophotometer the ion source temperatures were 200 °C and 250 °C, respectively. The detector gain was 0.7 KV.

Statistical analysis : The data on oil content were the mean of three replicates of each sample and were analyzed by using analysis of variance (Panse and Sukhatme, 1984).

Results and Discussion

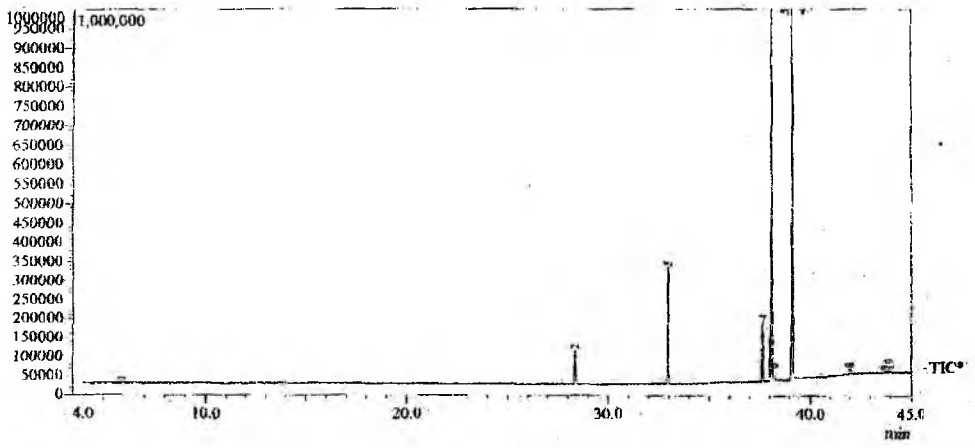
The data showing variability in oil content in sesame genotypes are presented in Table 1.Values in respect of this parameter showed significant variation to range from 33.43 to 49.35 per cent. MT-20-03 (49.35%) being statistically at par with the genotypes TKG-307 (49.29%) and TKG-22 (NC) (49.23%) had significantly higher oil content. The genotype showing the lowest oil content was found to be CT-10-94-10 (33.43%). The sesame varieties evaluated for oil content were found in the range 33.43%to 49.35 per cent. The trend of variation for oil content observed in this study is in close conformity with the findings of Daxa and Kothari, (1989) and Were *et al.* (2001). Earlier researchers also reported some what similar trends of variation in oil content in different sesame genotypes (Raheja *et al.*, 1989; Bahkali *et al.*, 1998 and Bandyopadhyay *et al.*, 2002).

The fatty acid profile of sesame varieties/genotypes was evaluated and the data are presented in Table 1.The chromatograms depicting different peaks of fatty acids at different Rt values are shown in Fig. 1.

The results showed that the major unsaturated fatty acids in sesame genotypes were oleic acid and linoleic acid. Oleic acid content ranged from 28.42 to 47.56 per cent with highest value noticed in the genotype CST-2001-3 followed by YLM-66 (43.03%) and CT-10-94-10 (42.39%). The lowest value of oleic acid was in local check (AVT-04 R_1 12-12). The linoleic acid (C18.2) was in the range of 27.59 to 42.81 per cent. The highest content of linoleic acid was in the MT-20-03 (42.81%) genotype. The genotypes AT-87, TKG-356 and LTK-4 were found to be the next superior genotypes for this fatty acid. The lowest content of linoleic acid was found in CST-2001-3 (27.59%). The findings of this study with regard to status of oleic acid and linoleic acid are in agreement with the observations of other investigators (Raheja *et al.* 1989; Kamal and Appelqvist, 1994 and Were *et al.* 2001).

The prominent saturated fatty acids in sesame genotypes were palmitic acid and stearic acid. Sesame genotypes contained 7.22 to 12.20 per cent of palmitic acid with its highest value observed in CST-2001-03 (12.20%) followed by MT-111 (10.29%) and LTK-4 (10.10%). The lowest value for this fatty acid was observed in local check. The stearic acid in sesame genotypes was noticed in the range of 4.09 to 6.78 per cent. The genotype CST-2001-3 possessed the highest value of stearic acid (6.78%). The genotypes YLM-66 and CT-10-94-10 exhibited the next higher value for stearic acid. The lowest value for stearic acid was in TKG-22 (NC). The findings of the study with regard to saturated fatty acids are in agreement with the observations of other investigators on this aspect (Raheja *et al.*, 1989 and Kamal and Appelquist, 1994), who reported almost the same range for palmitic and stearic fatty acids.

It was also observed that various sesame genotypes except TKG-22(NC) contained minor amounts of arachidic acid to vary from 0.45 to 0.74 per cent. The linolenic acid was present only in four genotypes TKG-201 (0.34%), TCSI-94-20 (0.29%), TKG-307 (0.26%) and CT-10-94-10 (0.21%) in traces only. These observations are in accordance with those of Bankali *et al.* (1998) and Were *et al.* (2001).



Peak Report TIC

Peak#	R.Time	I.Time	E.Time	Area	Height	Area%	Name
1	5.883	5.867	6.117	48955	5434	0.48	
2	28.360	28.300	28.458	305514	83230	3.01	Benzene, 1,2-dimethyl-4-nitro- (CAS) 4-Nitro-1,2-dimethylbenzene
3	32.931	32.858	33.017	977818	307734	9.63	Hexadecanoic acid, methyl ester (CAS) Methyl palmitate
4	37.653	37.575	37.750	554223	159418	5.46	Octadecanoic acid, methyl ester (CAS) Methyl stearate
5	38.087	37.992	38.192	3701705	1097055	36.45	9-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-9-ENO
6	38.249	38.192	38.317	98894	28213	0.97	9-Octadecenoic acid (Z)-, methyl ester (CAS) Methyl oleate
7	39.125	39.042	39.217	4348465	1338265	42.81	9,12-Octadecadienoic acid (Z,Z)-, methyl ester
8	42.018	41.983	42.075	46295	13346	0.46	18,18'-Bi-1,4,7,10,13,16-hexaoxacyclooctadecane
9	43.775	43.600	43.792	42460	8005	0.42	
10	43.942	43.908	44.075	32283	7588	0.32	18,18'-Bi-1,4,7,10,13,16-hexaoxacyclooctadecane
				10156612	3048288	100.00	

Fig. 1 Chromatogram depicting Rt values of Fatty Acids (MT-20-03)

Table 1. Variation in fatty acid profile of dry mature seeds of selected sesame varieties/genotypes

Varieties/ genotypes	Oil Content (%)	Palmitic acid (%) (C16:0)	Stearic acid (%) (C18:0)	Oleic acid (%) (C18:1n-9)	Linoleic acid (%) (C18:2n-6)	Linolenic acid (%) (C18:3n-3)	Arachidic acid (%) (C20:0)
PKDS-40	40.41	8.00	4.94	33.15	34.77	-	0.45
AT-87	43.44	9.79	4.93	37.74	42.65	-	0.53
LTK-4	47.40	10.10	5.35	39.59	40.17	-	0.50
TKG-201	48.03	9.69	5.15	33.61	36.91	0.34	0.62
TKG-356	36.82	9.93	5.38	36.86	42.31	-	0.59
TKG-22(NC)	49.23	7.88	4.09	28.50	33.53	-	-
CT-10-94-10	33.43	9.29	6.56	42.39	37.63	0.21	0.66
TCSI-94-20	35.01	8.71	4.97	34.01	35.53	0.29	0.60
MT-20-03	49.35	9.63	5.46	36.45	42.81	-	0.46
YLM-66	39.29	9.79	6.76	43.03	35.37	-	0.62
TKG-307	49.29	9.89	5.24	34.64	37.71	0.26	0.55
MT-111	42.17	10.29	5.81	40.59	37.86	-	0.52
CST-2001-3	47.17	12.20	6.78	47.56	27.59	-	0.74
Local check	47.96	7.22	4.17	28.42	29.11	-	-
SEm ±	0.43	-	-	-	-	-	-
C D (P=0.05)	1.20	-	-	-	-	-	-

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References

AOAC 1965. Official Methods of Analysis, 6th edition. AOAC . Washington, DC.

AOAC 1990. Official Methods of Analysis, 15th edition. AOAC. Washington DC.

Ashri A 1998. Sesame Breeding. Plant Breed. Rev. **16**: 197-201.

Bahkali A H, Hussain M A and Basahy A.Y 1998 . Protein and oil composition of sesame seeds (*Sesamum indicum* L.) grown in Gizan area of Saudi Arabia. International J. Food Sci. and Nutri. **49** (6): 409-414.

Bandyopadhyay K, Ghosh M and Ghosh 2002. A comparative study on the physical and biochemical properties of sesame seed varieties and their corresponding meals. J. Oil Techno-Assoc. India **34** (3): 103-112.

Bedigian D and Harlan J R 1986. Evidence for cultivation of sesame in the ancient world. Eco. Bot. **40**: 137-154.

Brar G S 1982. Variation and correlation in oil content and fatty acid composition of sesame. Indian J. Agric. Sci. **52**: 434-439.

Daxa A and Kothari I L 1989. Seed composition of some new varieties of sesame. J. Oil Techno-Assoc. India **21**(1): 15-16.

Crews C, Hough P, Brereton P, Godward J, Lees M , Guiet S and Winkelman W 2006.Quantitation of the main constituents of some authentic sesame seed oils of different origin. J. Agric. Food Chem. **54**: 6266-6270.

Duhoon S S, Jyotishi A,Deshmukh M R and Singh W B 2004. Optimization of sesame production through bio/natural inputs.http://www. Cropscience.org.au/icsc.

Home Cooking 1998. Sesame seeds homecooking.about.com/library/weekly/aa060898.htm

Irvine F R 1969. West African crops. Oxford University press, London, pp: 72-73.

Kamal E A and Appelqvist L A 1994 . Variation in fatty acid composition of the different acyl lipids in seed oils from four sesamum species. J. American Oil Chem. Soc. **71**(2): 135-139.

Morris J B 2002. Food, industrial, nutraceutical and pharmaceutical uses of sesame genetic resources. Trends in new crops and new uses. ASHS press, Alexandria, VA. pp. 153-156.

Oplinger E S , Putnam D H, Kaminski A R, Hanson CV, Oelke E A, Schulte E E and Doll J D. 1990. Sesame. University Wisconsin Ext. univ. Minnesota Ext, Maddison, WI and St. Paul, MN.

The Nut Factory. 1999. The sesame seed family. The nutfactory.com/kitchen/edible/facts-sesame.html

Panse V G and Sukhatme P V 1984. *Statistical Methods for Agricultural Workers*, ICAR, New Delhi.

Raheja R K, Ahuja K L, Batta S K, Labana K S and Chourasia, B D 1989. Evaluation of some promising Indian genotypes of sesame for oil content and component fatty acids. Annals of Bio. Ludhiana **5**(1): 33-38.

Were B A, Lee M and Stymne S 2001.Variation in seed oil content and fatty acid composition of *Sesamum indicum* L. and its wild relatives in Kenya. Sveriges Utsadesforenings Tidskrift **111**(4): 178-183.

Yermanos D M, Hemstreet S, Saeeb S and Huszar C K 1972. Oil content and composition of the seed in the world collection of sesame introductions. J American Oil Chem. Soc. **49**:20-23.