African Journal of Botany Vol. 1 (1), pp. 008-011, June, 2013. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Genetic diversity of seed lipid content and fatty acid composition in some species of *Sesamum* L. (Pedaliaceae)

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Accepted 8 May, 2013

Genetic diversity in seed oil content and fatty acid composition in six wild species of genus *Sesamum* viz., *Sesamum mulayanum*, *Sesamum capense*, *Sesamum laciniatum*, *Sesamum latifolium*, *Sesamum occidentale* and *Sesamum schinzianum* were studied and compared with the cultivated species *Sesamum indicum* or sesame. Seed oil content ranged from 46.13 to 53.8% in cultivated sesame and 20.3 to 33.9% in wild species. Palmitic ($C_{16:0}$), stearic ($C_{18:0}$), oleic ($C_{18:1}$) and linoleic ($C_{18:2}$) acids are the principal fatty acids in all the wild species and cultivated sesame studied here. Wild species exhibit wide range of variation in palmitic and stearic acid contents. Stearic acid content in all the wild species is significantly higher than the cultivated sesame. Lower oleic acid and higher linoleic acid contents are apparent in wild species. Genetic diversity in seed oil content and fatty acid contents are apparent in wild and cultivated sesame.

Key words: Fatty acid, genetic diversity, seed oil, wild and cultivated *Sesamum* species.

INTRODUCTION

Sesame, *Sesamum indicum* L., is an important oil seed crop widely cultivated in the tropical parts of Africa and Asia. It yields high quality premium oil and is stable against prolonged storage and heating. Sesame belongs to the genus *Sesamum* of Pedaliaceae family and contains about 20 odd species including the only cultivated species *S. indicum* (Ihlenfeldt and Seidensticker, 1968, 1979; Merxmuller, 1968; Bruce, 1953; Stapf, 1906).

Several workers have studied the genetic diversity of seed oil content and fatty acid composition in cultivated species *S. indicum* and these results have been reviewed by Kamal- Eldin et al. (1992) . In cultivated sesame, seed oil content ranged from 40.4 to 59.8%. Fatty acids of this seed oil are mainly oleic (32.7 to 53.9%), linoleic (39.3 to 59%), palmitic (8.3 to 10.9%) and stearic (3.4 to 6.0%) acids (Yermanos et al., 1972).

Investigations on seed oil content and fatty acid composition in wild species of *Sesamum* has been neglected. FAO consultative committee (Anonymous, 1981, 1985) has strongly recommended the collection and investigations on these wild species. *Sesamum angustifolium* (Oliv) Engl. seeds from Tanzania and Nigeria had 28.9% and 13.2% oil, respectively. Nigerian accession of *Sesamum radiatum* Schumach seeds contained 25.5% oil (Anonymous, 1929; Uzo et al., 1985). Kamal-Eldin et al. (1992) have determined the seed oil content, fatty acid composition and triglyceride profile in wild species *Sesamum alatum* Thonn., *S. angustifolium*, *S. radiatum* and compared them with cultivated *S. indicum* collected from Sudan. Seed oil content was 28.9, 36.2, 28.9 and 47.3 to 54.2% in *S. alatum*, *S. angustifolium*, *S. radiatum* and *S. indicum*, respectively. However, wild species have different proportions of saturated and unsaturated fatty acid composition compared to cultivated *S. indicum*. Stearic

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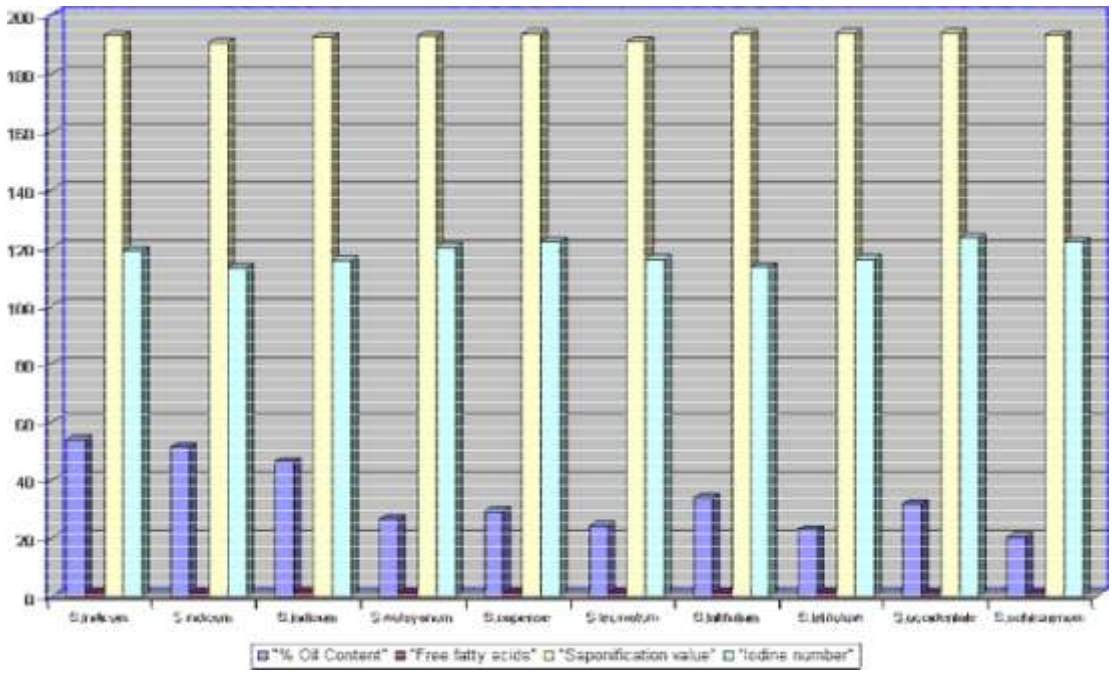

Figure 1. Oil content, free fatty acids, saponification value and iodine number in some species of S*esamum*.

acid content was more in *S. angustifolium* and *S. radiatum*, but *S. alatum* contained more palmitic acid. This last species possessed more amounts of oleic acid and lesser amounts of linoleic acid. Seed oil content and fatty acid composition in remaining 16 wild species are not known.

The present work was undertaken to assess the genetic diversity in seed oil content and fatty acid composition in six wild species namely *Sesamum mulayanum* Nair. (2n = 2x = 26), *Sesamum capense* Baum. (2n = 2x = 26), *Sesamum laciniatum* Klein. (2n = 4x = 32), *Sesamum latifolium Gillet.* (2n = 4x = 32), *Sesamum occidentale* Heer and Regel (2n = 8x = 64) and *Sesamum schinzianum* Aschers (2n = 8x = 64). These results were compared with cultivated sesame, *S. indicum*.

MATERIAL AND METHODS

Chinese and African genotypes of cultivated species *S. indicum* or sesame were obtained from USDA, USA, and Indian variety was personally collected by the author. Majority of the wild species are distributed in inaccessible tropical Africa and are not presently represented in the gene banks. Seeds of wild species *S. capense*, *S. latifolium*, *S. occidentale* and *S. schinzianum* were procured from various botanists. Indian wild species *S. mulayanum* and *S. laciniatum* were personally collected by the author.

Seed oil was estimated by conventional Soxhlet method using petroleum ether as extraction solvent. Free fatty acids were estimated by titrating oil with 0.1 N KOH using phenolphthalein indicator (Cox and Pearson, 1962) . Saponification value was calculated by refluxing oil with alcoholic KOH for one hour and titrating it against 0.5 N HCl by using phenolphthalein indicator (Horowitz, 1975) (Figure 1) . Iodine number was determined by Hanus method (Horowitz, 1975).

Identification and quantification of fatty acids was done by converting oil in to its methyl esters and then injecting 0.15 µl of methyl ester of the oil in to Perkin Elmer Sigma- 3 GLC using 10% DEGS (diethylene glycol succinate) column and nitrogen gas as a carrier (30 ml/min). Fatty acid methyl esters from Sigma chemical Company were used as standard to calibrate the instrument and to provide the information on retention time for identification of sample compounds.

RESULTS AND DISCUSSION

The seed oil content and fatty acid profile in six wild species viz., *S. mulayanum*, *S. capense*, *S. laciniatum*, *S. latifolium*, *S. occidentale* and *S. schinzianum* and the only cultivated species *S. indicum* or sesame are presented in Tables 1 and 2. Seed oil content ranges from 46.13 to 53.8% in *S. indicum*, 27% in *S. mulayanum*, 29.2% in *S. capense*, 24.4% in *S. laciniatum*, 22.9 to 33.9% in *S. latifolium*, 31.7% in *S. occidentale* and 20.3% in *S. schinzianum.* This clearly reveals the genetic diversity in seed oil content in wild and cultivated species. In the cultivated sesame, the range of seed oil content in this work is similar to those reported by Kamal-Eldin et al. (1992) but is slightly higher than the values (42.2 to 52.2%) obtained by Tinay et al. (1976) and lower (40.4 to 59.8%) than reported by Yermanos et al. (1972). Obviously wild species contain less seed oil content as compared to cultivated sesame. All the wild species of *Sesamum* have black or brown thick, rough seed coat.

Table 1. Oil content, free fatty acids, saponification value and iodine number in some species of *Sesamum*.

Accession No.	Species	Source	Oil Content (%)	Free fatty acids	Saponification value	Iodine number
241	*S. indicum*	Africa	53.80	1.00	193.35	118.88
108	*S. indicum*	India	51.20	1.12	190.74	113.05
203	*S. indicum*	China	46.13	1.31	192.50	115.52
105	*S. mulayanum*	Goa,India	26.66	1.05	192.80	120.20
116	*S. capense*	Cameroon	29.24	1.07	193.60	121.94
103	*S. laciniatum*	Badami, India	24.40	1.08	191.08	116.14
117	*S. latifolium*	Kenya	33.91	1.10	193.57	113.23
136	*S. latifolium*	Sudan	22.93	0.93	193.90	116.11
112	*S. occidentale*	Cameroon	31.70	0.70	194.09	123.43
124	*S. schinzianum*	Namibia	20.35	0.80	193.12	122.14

Table 2. Fatty acid composition in oil of some species of *Sesamum.*

Fatty acids	*S. indicum*		*S. mulayanum*		*S. capense*		*S. laciniatum*		*S. latifolium*		*S. occidentale*		*S. schinzianum*	
(%)	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
$C_{16:0}$	10.50	0.28	09.53	0.03	10.25	0.08	08.49	0.04	07.34	0.33	09.51	0.24	09.53	0.24
$C_{18:0}$	04.90	0.92	05.39	0.04	04.18	0.07	06.52	0.08	08.15	0.25	06.86	0.07	06.75	0.07
$C_{18:1}$	46.30	1.19	32.27	1.22	32.63	0.15	35.51	0.06	36.41	0.68	27.68	0.45	30.73	0.23
$C_{18:2}$	36.10	0.42	51.24	0.96	50.41	0.20	48.48	0.12	43.46	1.81	53.72	0.12	50.20	0.05
$C_{20:0}$	01.10	0.19	01.24	0.23	02.15	0.11	00.92	0.03	01.33	0.11	02.27	0.08	01.74	0.02
Minor acids	00.35	0.14	00.17	0.03	00.70	0.03	00.47	0.04	01.21	0.06	00.27	0.04	00.86	0.04

$C_{16:0}$ - Palmitic acid, $C_{18:0}$ - Stearic acid, $C_{18:1}$ - Oleic acid, $C_{18:2}$ - Linoleic acid, $C_{20:0}$ - Arachidic acid.

The domesticated sesame, *S. indicum* has thin and smooth seed coat with various shades of brown or black colour (Kamal-Eldin, 1993). Thus seed oil content can possibly be increased in wild species if selections are made for thinner seed coat (Kamal-Eldin, 1993).

Genetic diversity in fatty acid composition in cultivated sesame has been previously documented by Tinay et al. (1976) in studies with 46 accessions and Yermanos et al. (1972) with world collection of 721 accessions. Also, Kamal-Eldin et al. (1992) examined 12 Sudanese accessions and did not find any significant genetic diversity in fatty acid composition in these genotypes. Principal fatty acids in sesame seed oil are palmitic ($C_{16:0}$), stearic ($C_{18:0}$), Oleic ($C_{18:1}$) and linoleic ($C_{18:2}$) acids (Kamal- Eldin et al., 1992). Fatty acid composition studies reported here in 3 accessions of cultivated sesame show similar fatty acid composition in Indian and Chinese accessions (Table 2). However, African accession showed a higher amount of linoleic acid content and lower amounts of oleic and stearic acid contents as compared to Asian genotypes. It appears that there is a substantial genetic diversity in fatty acid composition in cultivated sesame seed oil. Fatty acid profile of wild species from qualitative parameters is similar to cultivated sesame in having the same 4 major fatty acids (Table 2). However, the wild species differ from cultivated sesame in possessing different ranges of these fatty acid contents.

Among the saturated fatty acids, palmitic acid ranges from 7.3% in *S. latifolium* to 10.5% in *S. indicum*. However, stearic acid content varies from 4.1 to 8.1% in *S. capense* and *S. latifolium*. Thus there is significantly higher stearic acid content in *S. latifolium* as compared to cultivated sesame. Small amount of arachidic acid ($C_{20:0}$) is present (>2.2 %) in most of the species of *Sesamum* reported. Saturated fatty acids have more industrial uses than human consumption but prevent the oil from oxidative rancidity (Figure 2).

In wild species also, principal unsaturated fatty acids are oleic and linoleic acids, which constitute more than 8% of the seed oil. Oleic acid ranges from 27.6% in *S. occidentale* to 46.30% in *S. indicum*. In contrast wild taxa exhibit higher proportion of linoleic acid and it ranges from 43.4% in *S. latifolium* to 53.7% in *S. occidentale*. Linoleic acid and its derivative fatty acids are essential fatty acids and human being cannot synthesize these but must obtain it from dietary sources. High level of linoleic acids in the oil reduces the blood cholesterol level and plays an important role in preventing atherosclerosis (Ghafoorunissa, 1994). Thus, edible oil with high linoleic acid content is premium oil. Some of the wild species with

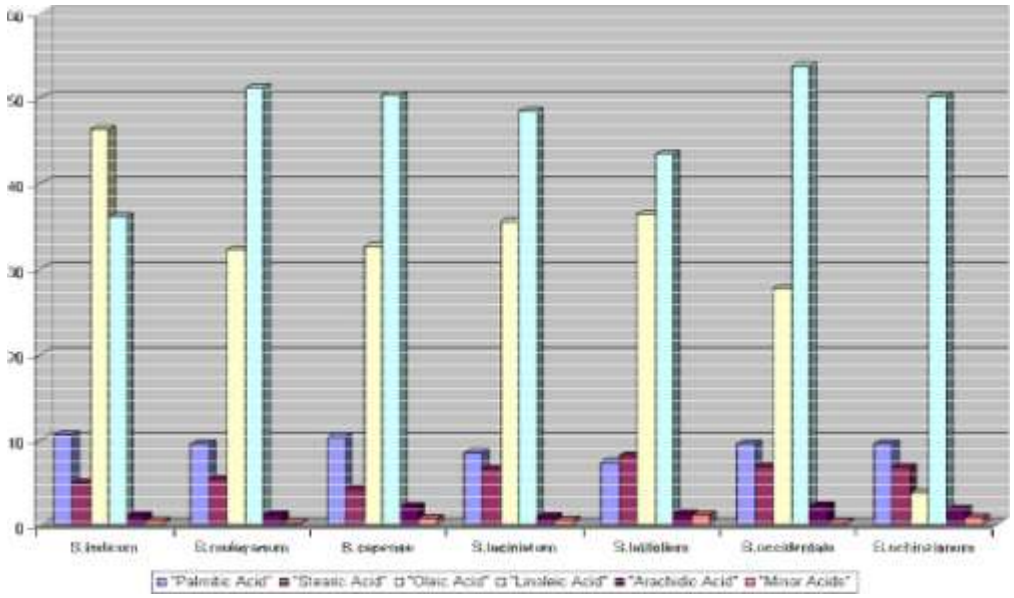

Figure 2. Fatty acids in the oil of some species of *Sesamum*.

Table 3. Fatty acid composition of wild and cultivated *Sesamum* species analyzed and compared to the Codex Alimentarius ranges (%).

Fatty acids	*Sesamum indicum*			Wild *Sesamum* species present work
	Codex Alimentarius Range	Previous work (Yermanos et. al. 1972)	Present work	
Palmitic acid	7.0 – 12.0	8.3 – 10.9	10.18 – 10.72	7.0 – 10.2
Stearic acid	3.5 – 6.0	3.4 – 6.0	3.8 – 5.7	4.1 – 8.3
Oleic acid	35 – 50	32.7 – 53.9	37.3 – 47.2	27.4 – 40.6
Linoleic acid	35 – 50	39.3 – 59.0	36.1 – 46.5	42.2 – 50.4

high linoleic acid content notably *S. mulayanum*, a wild progenitor of cultivated sesame (Hiremath and Patil, 1999), could be used in improving the linoleic acid content of sesame through breeding.

The range of fatty acid contents in cultivated sesame and wild species are compared in Table 3 to the ranges for sesame seed oil adapted by FAO/WHO Codex Alimentarius committee on oil and fats (O'Coonor and Herb, 1970; Spencer et al., 1976). Thus fatty acid content in wild species generally falls within the range previously reported for world collection of cultivated sesame (Yermanos et al., 1972). The present work obviously shows the presence of genetic diversity in fatty acid contents of wild species of sesame.

ACKNOWLEDGEMANTS

The authors are grateful to Dr. G. A. White, USDA, USA, Dr. K. Masuda, Department of Botany, Toyama University, Toyama, Japan, Dr. Kamal-Eldin, Department of Food Hygiene, Swedish University of Agriculture Sciences, Uppsala, Sweden and Dr. H. Kolberg, NPGRC, Windhoek, Namibia for the kind supply of seeds of cultivated and wild *Sesamum* species. We are also grateful to Mr. V.R. Patel, Managing Director, Karnataka Soaps and Detergents Limited, Bangalore for allowing us to use their GLC facility.

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