Int.J.Curr.Microbiol.App.Sci (2017) *6*(12): 1936-1943

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 12 (2017) pp. 1936-1943**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.612.221

Chemical Characterization and Fatty Acid Composition of Different Sesame Verities

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Keywords

Sesame (*sesamum indicum* L.), Free Fatty Acid composition and Chemical characterization.

Article Info

Accepted:
15 October 2017
Available Online:
10 December 2017

A B S T R A C T

The fatty acid composition is a great significance for determination of the oil quality. The quality is especially based on the palmitic, stearic, oleic and linoleic acid. Sesame is the most ancient crop traditionally it is grown during *kharif* season in most part of the country. Its seeds contain between 50 and 54% of very good semi-drying oil, mostly with palmitic and stearic acids. In this research, variation in oil content, oil yield, chemical composition and fatty acid composition of 7 different TKG-22, GT-10, PKVNT-11, PRACHI, HT-2, DSS-9 and TMV-7 sesame verities were investigated. The oil content varied 39.33 to 46.4. percentage content of, linoleic acid, palmitic, Stearic acids, oleic acid and linolinic acid in the seed oil ranged between 31.84 to 41.73 %, 8.33 to10.15%, 5.34 to7.0 and respectively. Oleic acids 39.88 to 48.81%, linoleic acids 0.25 to 0.50% and palmitoleic 0.10 to 0.13 % acids were the minor fatty acids of sesame as sesame were about 24.3% which increases the suitability of the sesame oil for human consumption. The oil could be useful as edible oils and for industrial applications. In conclusion, the fatty acid composition of determinate types was found to be satisfactory.

Introduction

For human nutrition fats and oils is one of the most intricate and arguable areas of analysis in nourishment science (Hayakawa *et al.*, 2000). Dietary fat is perceived to be the "worst" of all the nutrients in stimulating divers of ailment, akin cardiovascular disease (CVD), diabetes, obesity, and others. Nevertheless, among macronutrients, dietary fat is the most energy intensive; it does play an important role in assuring that we meet our daily energy requirements and enables the amalgamation of fat-soluble vitamins. The amount of TFA in the diet is of interest because of the possible adverse effects of these isomers with respect to cardiovascular disease, infant development, diabetes and inflammation (Schmidt, 2006). Oilseeds are second only to grain crops in the supply of plant proteins for human and animal consumption. Sesame seed (*Sesamum indicum*), an oilseed plant of the Pedaliaceae family, is cultivated on a worldwide basis for both oil and protein (Sen and Bhattacharyya, 2001). Sesame is an excellent source of oil (57-63%) (Uzun *et al.*, 2003), protein (23-25%) (Anilakumar *et al.*, 2010), carbohydrate

(20-25%) and ash (5 %) (Borchani *et al.*, 2010). Sesame Seeds contain significant amounts of oxalic acid (2.5%) (Kapadia *et al.*, 2002). Additionally, sesame seeds fats comprise about 2.25 times as much energy as the equal amount of carbohydrates from food-grains or forages (Choi *et al.*, 2008).

Sesame seed is rich in polyunsaturated fatty acids viz. omega-6-fatty acids and unsaturated fatty acids where the fatty acids composition is 14% saturated 39% mono-unsaturated and 46% poly-unsaturated fatty acids (Toma and Tabekhia, 1979). Sesame oil is a superior vegetable oil and has a pleasant flavor. It ranks second after olive oil with regard to nutritional value. Worldwide, fatty acids composition in sesame oil is variable among the different cultivars of sesame seeds such as black, brown and white.

Oil composition of sesame seeds depends on different factors such as climatic situation, soil condition and ripeness of plant (Rahman *et al.*, 2007). Fatty acids that are present in abundance are oleic (44 %), linoleic (34 %), palmitic (10 %) and Stearic (7 %) acids which mutually comprise about 95 % of the total fatty acids (Yoshida *et al.*, 2000).

Sesame oil is used after exposure to wind or sun to calm the burns. It nourishes and feeds the scalp to control dry scalp, and kill dandruff causing bacteria. It has been successfully used in the children's hair to kill lice infestations. Sesame oil is mildly laxative, emollient and demulcent. The oil has wide medical and pharmaceutical application.

Materials and Methods

The experimental study has been conducted at the Biochemistry laboratory, Project Coordinating Unit (Sesame and Niger), JNKVV. Jabalpur. The material used and method employed during the course of investigation on identification of suitable genotypes for expression for chemical traits in sesame are presented in this chapter

Procurement of raw material

In this study seven sesame varieties are taken Two national checks TKG-22 (national check), GT-10 (National check), and five verities PKVNT-11, PRACHI, HT-2, DSS-9 and TMV-7) of four different seed colors (viz. white, black, light brown and dark brown) procured from Project Coordinating Unit (Sesame and Niger) JNKVV, Jabalpur.

Methods

Proximate analysis of *Sesamum indicum* L. seed crude protein (micro-Kjeldahl), crude oil contents were determined using the NMR equipment (*Oxford Analytical Make*), whereas the total carbohydrate was determined by an-throne method. Free Fatty Acid composition by Gas Chromatography method. Oxalic acid was determined using the method of titration by (AOAC). All determinations were done in triplicate.

Estimation of oil in seed sample

Oil content of each sesame varieties was estimated by using NMR equipment (*Oxford Analytical Make*) in the laboratory, Project Coordinating Unit (Sesame and Niger), J.N.K.V.V. Jabalpur. A composite seed sample of each treatment was taken to analyze the oil content (%).

Estimation of free fatty acid in seed sample

Composition of fatty acid was determined using method ISO 5508 (1990). Before analysis, fatty acids (FAs) were converted to fatty acid methyl esters (FAMEs) by shaking a solution of 60 mg oil and 3 mL of hexane with 0.3 mL of 2 N methanolic potassium

hydroxide. FAs were analyzed by gas chromatography using a Varian CP-3800 (Varian Inc.) chromatograph equipped with a FID. The column used was a CP-Wax 52CB column (30 m · 0.25 mm i.d.; Varian Inc., Middelburg, The Netherlands). The carrier gas was helium and the total gas flow rate was 1 mL/min.

The initial and final column temperature was 170^0C and 230^0C, respectively, and the temperature was increased by steps of 4^0C/min. The injector and detector temperature was 230^0C. Data were processed using a Varian Star Workstation v 6.30 (Varian Inc., Walnut Creek, CA, USA). Results were expressed as the relative percentage of each individual FA present in the sample.

Estimation of protein by micro kjeldahl method

Multiplying the nitrogen content value 6.25 with protein content of sesame seed, which also includes non-protein nitrogen. To get true protein content, deduce the non-protein nitrogen from crude protein content and then multiplying with the factor. The crude protein content (%) sesame seed was worked out by following formula (A.O.A.C. 1965).

Crude protein % = N content (%) X 6.25 (as a constant factor).

Carbohydrate content by an-throne method

Carbohydrate content of the sesame seed sample was determined according to an-throne method as described by (AOAC, 1990).

Absorbance of unknown / Concentration of unknown = Absorbance of standard / Concentration of standard.

Oxalic acid percentage by titration method

Oxalic acid content of the sesame seed sample was determined according to titration method as described by (AOCS, 1980)

$$\text{Oxalic acid \%} = \frac{6.303 \times \text{normality of } KMnO_4 \times \text{Volume of } KMnO_4}{\text{Weight of seed sample (gm.)}}$$

Statistical analysis

Values represented are the means and standard deviations for three replicates. Statistical analysis was carried out by Excel Version 8.0.

The economic importance of sesame is determined by the quantity of oil contains. The highest oil content was recorded in variety GT-10 (46.4±0.4) Lowest value of oil content was recorded in varieties PKVNT-11 (39.33±1.15) (Table 1 and Fig. 1) respectively. The oil content of some cultivars in Anotaly a located in the Mediterranean Region of Turkey was reported to be range of 43.42 to 49.47 % by (Yilmaz *et al.*, 2005).

Protein (%)

The highest protein content was recorded in variety TKG-22 (16.7±0.17). Lowest value of protein content was recorded in varieties DSS-9 (11.7±0.52) (Table 1 and Fig. 2). This is less than mean values of 24.63 and 21.78 reported by Borchani *et al.*, (2010).

Carbohydrate (%)

The highest carbohydrate content was recorded in variety GT-10 (18.5±0.4).Lowest value of carbohydrate content was recorded in varieties DSS-9 (11.47±0.75) (Table 1 and Fig. 3) is also low when is compared with the reported by (Ogbonna *et al.*, 2013).

Oxalic acid (%)

The highest oxalic acid content was recorded in variety GT-10 (1.63±0.2). Lowest value of oxalic acid content was recorded in varieties PKVNT-11 (0.15±0.03) (Table 1 and Fig. 4). This is close to 1.64 reported by (Borchani *et al.*, 2010).

Fatty acid distribution of sesame oils is presented in Table 2. The major saturated fatty acids in *Sesamum indicum* L seed oil were palmitic, Stearic acids and main unsaturated fatty acids are linoleic and oleic acids Linoleic acid which is one of the most important polyunsaturated fatty acids in human food because of its prevention of distinct heart vascular diseases (Boelhouwer, 1983).

Palmitic acid

Palmitic acid is the major saturated fatty acid of sesame seed oil (Crews *et al.*, 2006) in this study highest palmitic acid (%) was recorded in variety GT-10 (10.15%).Lowest value of palmitic acid (%) was recorded in varieties PRACHI (8.33%) (Table 2) Turgut and Baydar (1996) reported the sesame cultivars of the South East Region of Turkey were palmitic acid (9.7%), the findings of this study are close to the results of Sowmya *et al.*, (2009) and palmitic (8.67%), illustrated by Nzikou *et al.*, (2009).

Table.1 Biochemical composition of different sesame verities

S.NO.	Verities name	Oil percentage	Protein	Carbohydrate	Oxalic Acid
1	TKG-22	40.33±1.15	16.7±0.17	17.6±0.49	0.92±0.02
2	GT-10	46.4±0.4	16.43±0.45	18.5±0.4	1.63±0.2
3	PKVNT-11	39.33±1.15	12.13±0.35	12.76±0.23	0.15±0.03
4	PRACHI	44.47±0.45	16.4±1.45	11.97±0.3	0.87±0.03
5	HT-2	40.5±0.45	12±0.45	17.3±0.52	0.33±0.05
6	DSS-9	40.33±0.57	11.7±0.52	11.47±0.75	0.68±0.2
7	TMV-7	44.7±0.43	15..37±0.41	16.43±0.5	0.94±0.03

Table.2 Fatty acid compositions of different sesame verities

S.No	Fatty Acid	S-1 Area (%)	S-2Area (%)	S-3 Area (%)	S-4Area (%)	S-5Area (%)	S-6Area (%)	S-7Area (%)
1	Palmitic Acid	9.39	10.15	9.94	8.33	9.77	9.70	9.36
2	Palmitolic Acid	0.10	0.11	0.13	0.10	0.13	0.12	0.13
3	Stearic Acid	5.51	5.61	6.14	5.68	6.86	5.34	7.00
4	Oleic Acid	41.36	39.88	43.86	41.71	42.48	41.60	48.81
5	Linoleic Acid	41.25	41.73	37.24	41.67	38.26	41.52	31.84
6	Linolinic Acid	0.35	0.32	0.26	0.50	0.26	0.28	0.25

Where S1- TKG-22, S2- GT-10, S3- PKVNT-11, S4- PRACHI, S5- HT-2, S6-DSS-9 and S7-TMV-7

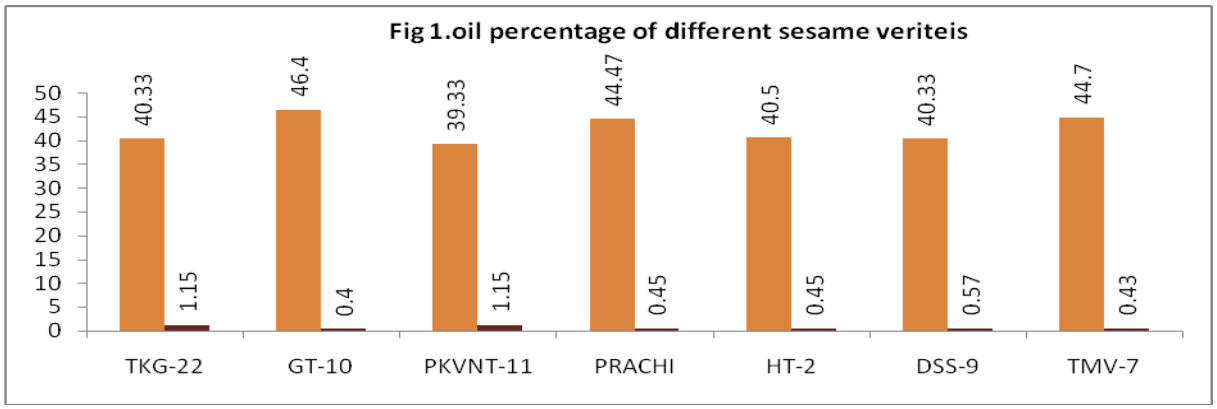
Fig 1.oil percentage of different sesame veriteis
50
45
40
35
30
25
20
15
10
5
0
40.33
1.15
46.4
0.4
39.33
1.15
44.47
0.45
40.5
0.45
40.33
0.57
44.7
0.43
TKG-22
GT-10
PKVNT-11
PRACHI
HT-2
DSS-9
TMV-7

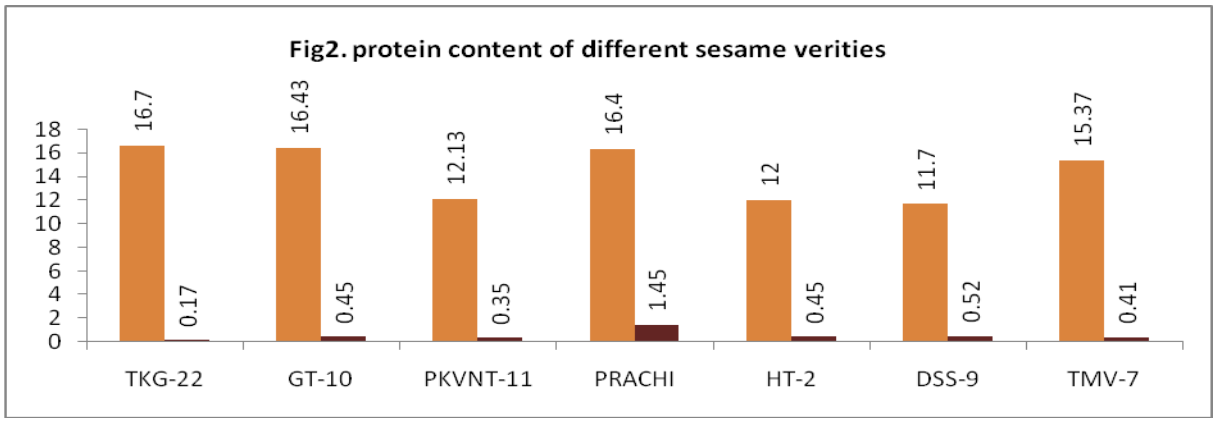
Fig2. protein content of different sesame verities
18
16
14
12
10
8
6
4
2
0
16.7
0.17
16.43
0.45
12.13
0.35
16.4
1.45
12
0.45
11.7
0.52
15.37
0.41
TKG-22
GT-10
PKVNT-11
PRACHI
HT-2
DSS-9
TMV-7

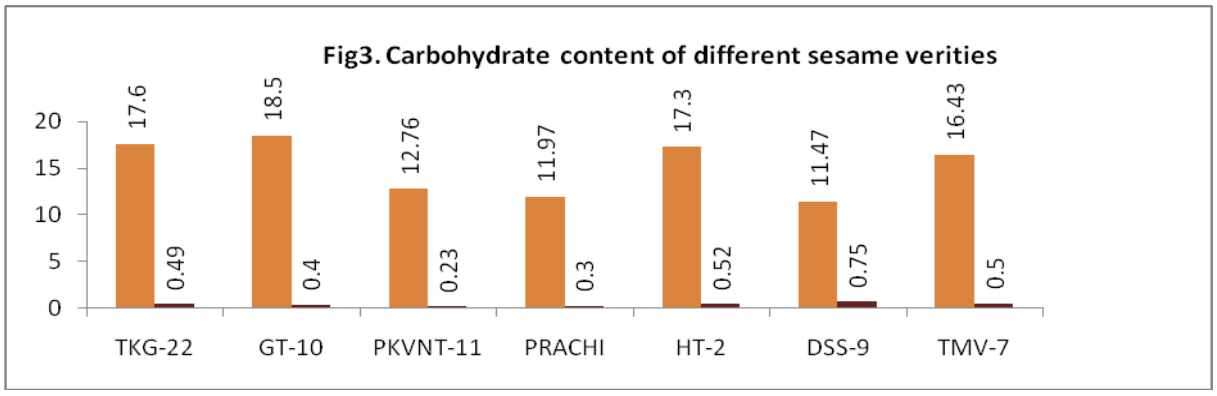
Fig3. Carbohydrate content of different sesame verities
20
15
10
5
0
17.6
0.49
18.5
0.4
12.76
0.23
11.97
0.3
17.3
0.52
11.47
0.75
16.43
0.5
TKG-22
GT-10
PKVNT-11
PRACHI
HT-2
DSS-9
TMV-7

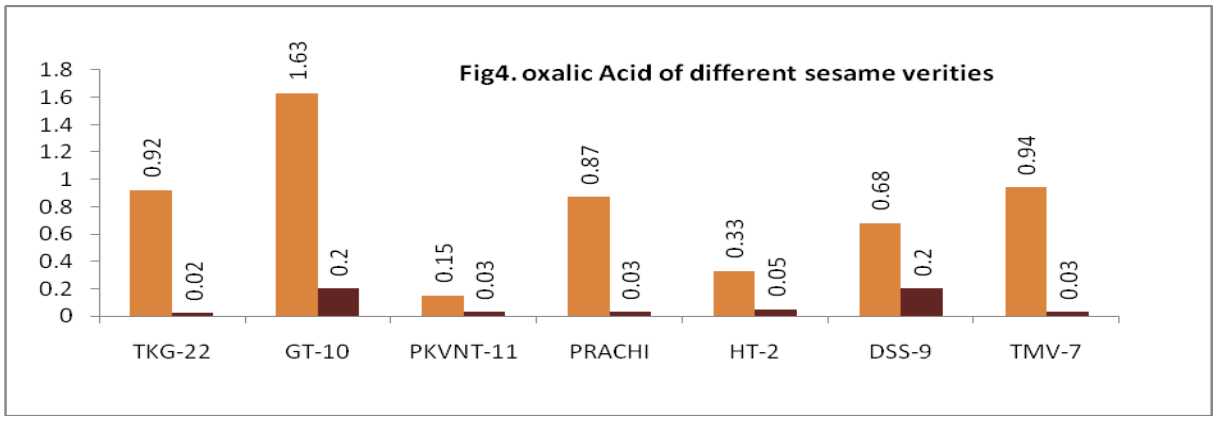
Fig4. oxalic Acid of different sesame verities
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.92
0.02
1.63
0.2
0.15
0.03
0.87
0.03
0.33
0.05
0.68
0.2
0.94
0.03
TKG-22
GT-10
PKVNT-11
PRACHI
HT-2
DSS-9
TMV-7

Palmitolic acid

Different sesame verities are not showed a major difference in palmitolic acid of sesame oil according to this study highest palmitolic acid was recorded in variety TMV-7, PKVNT-11 and HT-2 (0.13 %).Lowest value of palmitolic acid was recorded in varieties TKG-22 and PRACHI (0.10%) (Table 2).

Stearic acid

It is the main saturated fatty acid in sesame oil. In this study highest Stearic acid percentage was recorded in variety TMV-7 (7.0%). Lowest value of Stearic acid (%) was recorded in varieties DSS-9 (5.34%) (Table 2). These results are agreement with Stearic (5.56%) acids as illustrated by Nzikou *et al.,* (2009) and (Murwan *et al.,* 2007).

Oleic acid

It is the main monounsaturated fatty acid of sesame seed oil (Crews *et al.,* 2006) in this study highest oleic acid percentage was recorded in variety TMV-7 (48.81%).

Lowest value of oleic acid percentage was recorded in varieties GT-10 (39.88%) (Table 2). Turgut and Baydar (1996) reported the sesame cultivars of the South East Region of Turkey were oleic acid (45.3%).

The findings of this study are close to the results of Sowmya *et al.,* (2009) and (Murwan *et al.,* 2007).

Linoleic acid

The highest linoleic acid percentage was recorded in variety GT-10 (41.73%). Lowest value of linoleic acid content was recorded in varieties TMV-7 (31.84%) (Table 2) these findings are close to the results of Sowmya *et al.,* (2009) and Murwan *et al.,* (2007).

Linolinic acid

The highest linolinic acid percentage was recorded in variety PRACHI (0.50%). Lowest value of linolinic acid content was recorded in varieties TMV-7(0.25%) (Table 2) this study is close to the results of Sowmya *et al.,* (2009). Results of all free fatty acids are agreement with the findings of other authors (Hassan, 2012; Sabah El Khier *et al.,* 2008; Ogbonna and Ukaan; 2013; Nzikou *et al.,* 2009; Unal and Yalcın, 2008).

The aim of this study is to determine the fatty-acid compositions of sesame samples obtained from different varieties and to compare it. Seven sesame samples were collected from JNKVV Jabalpur in order to determine the oil yield, chemical composition and fatty-acid compositions. The oil squeez exhibited good chemical properties and could be useful for industrial application.

Acknowledgement

Authors are owe heartfelt thanks to Head, Dept. of P.G. Studies and Research in Biological Science, R.D. University, and Project Coordination Unit, All India Coordination Project (Sesame and Niger), Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur for bestowing Lab facilities

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How to cite this article:

Varsha Thakur, Seema Paroha and Ravi Prakash Mishra. 2017. Chemical Characterization and Fatty Acid Composition of Different Sesame Verities. *Int.J.Curr.Microbiol.App.Sci.* 6(12): 1936-1943. doi: https://doi.org/10.20546/ijcmas.2017.612.221