

Original Research Article

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Free Fatty Acid Profile of Seven Sesame (*Sesamum Indicum* L.) Verities

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ABSTRACT

Keywords

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Quality of oil is depending on the fatty acid composition. This is based on the palmitic, stearic, oleic and linoleic acid. Sesame is oldest indigenous oilseed crop of India 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 varieties were investigated. The oil content varied 39.33 to 46.4. percentage content of, linoleic acid, palmitic, Stearic acids, oleic acid and linolenic acid in the seed oil ranged between 31.84 to 41.73 %, 8.33 to 10.15% , 5.34 to 7.0 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). Sesame oil is cacique edible 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 varieties 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). Free Fatty acids that are present in glut are oleic (44 %), linoleic (34 %), palmitic (10 %) and stearic (7 %) acids which include about 95 % of the total fatty acids (Yoshida *et al.*, 2000).

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 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 varieties 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&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 anthrone 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. Fatty Acids were analyzed by gas chromatography using a Autosystem-2 version 6,32,0646 chromatograph equipped with a FID. The column used was a CP-Wax 52CB column (30 m 0.25 mm i.d.; autosystem 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°C and 230°C, respectively, and the temperature was increased by steps of 4°C/min. The injector and detector temperature was 230°C. 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 Fatty Acid present in the sample.

Estimation of protein by micro kjeldahl method

Multiplying the nitrogen content value of sesame seed with 6.25 will give the crude protein content, 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).

$$\frac{\text{Absorbance of unknown}}{\text{Concentration of unknown}} = \frac{\text{Absorbance of standard}}{\text{Concentration of standard}}$$

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)

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

Free fatty acid profile is given in figure 1 to 7 of all sesame seed oil.

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, Result of this study is similar to the oil content of some cultivars in Anatoly 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. 8). 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. 9a) 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. 9b). 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).

Table.1 Biochemical composition of different sesame varieties

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 varieties

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	Linolenic 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.1a Gas chromatogram for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

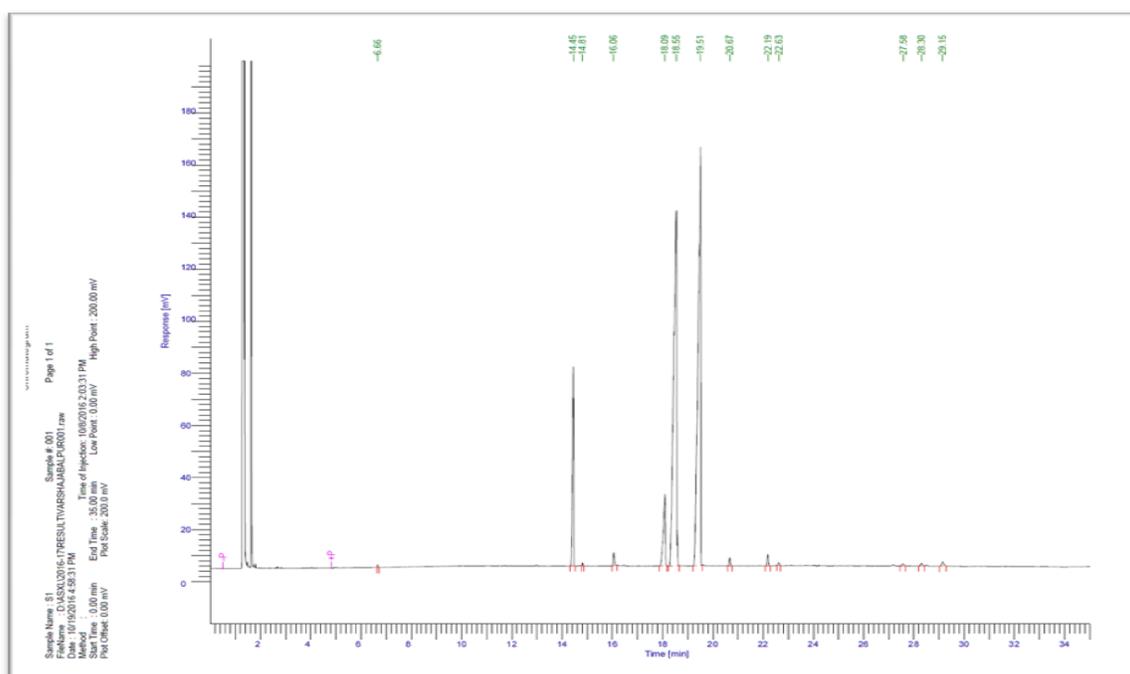


Fig.1b Area percentage for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

Page 1 of 1

Software Version : 6.3.2.0646	Date : 10/19/2016 4:57:33 PM
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Sample Amount : 2.000000	Dilution Factor : 1.000000
Cycle : 1	

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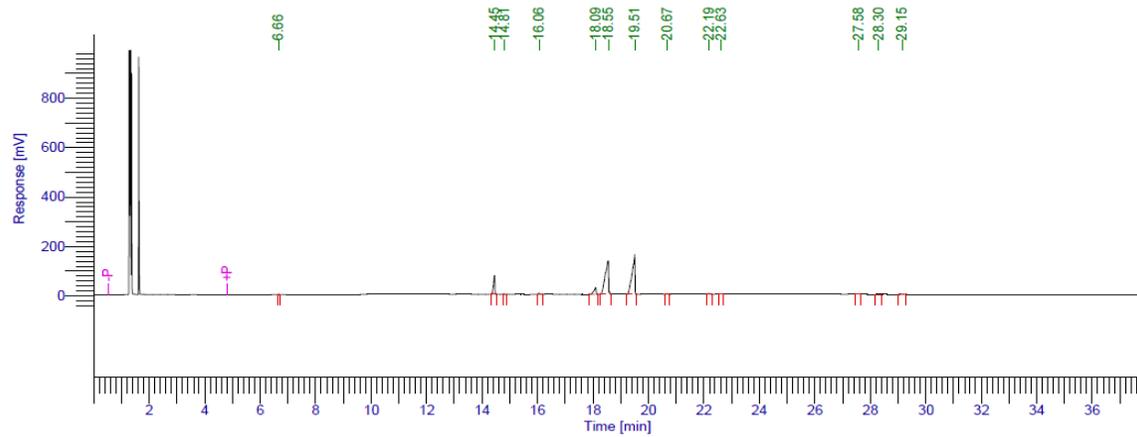


Fig.2a Gas chromatogram for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

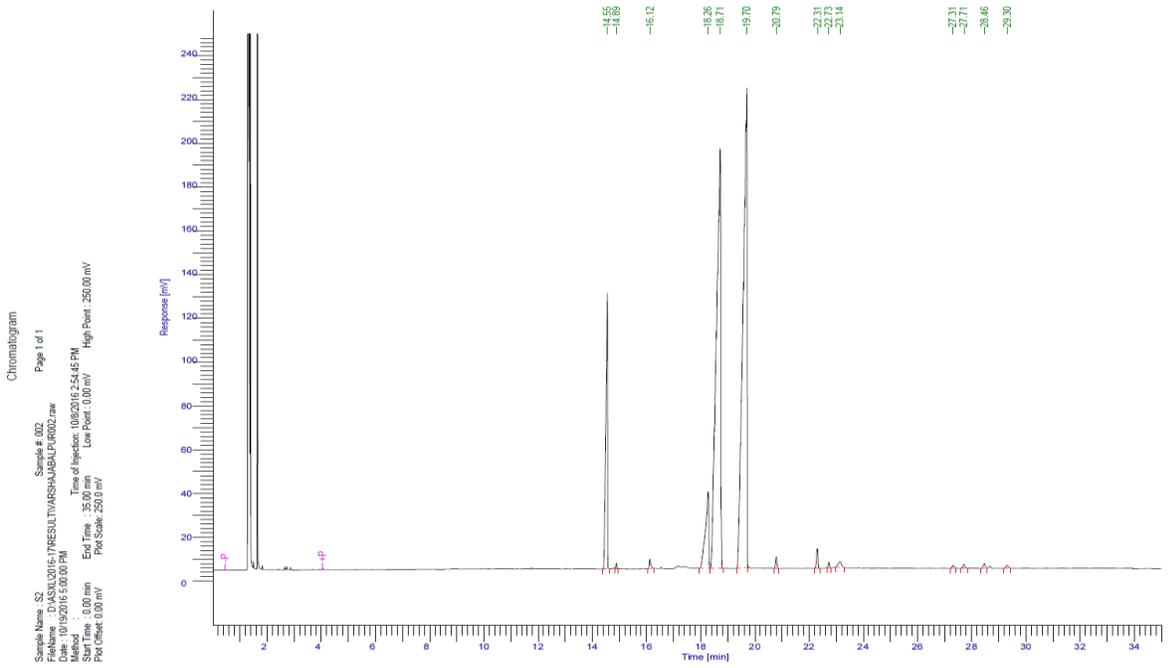


Fig.2b Area percentage for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

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Instrument Name : AUTOSYSTEM-2	Channel : A
Rack/Vial : 0/0	Operator : sicart
Sample Amount : 2.000000	Dilution Factor : 1.000000
Cycle : 2	

Result File : D:\ASXL\2016-17\RESULT\VARSHAJABALPUR002.rst
 Sequence File : D:\ASXL\2016-17\SEQUENCE\081016VARSHAJABALPUR.seq

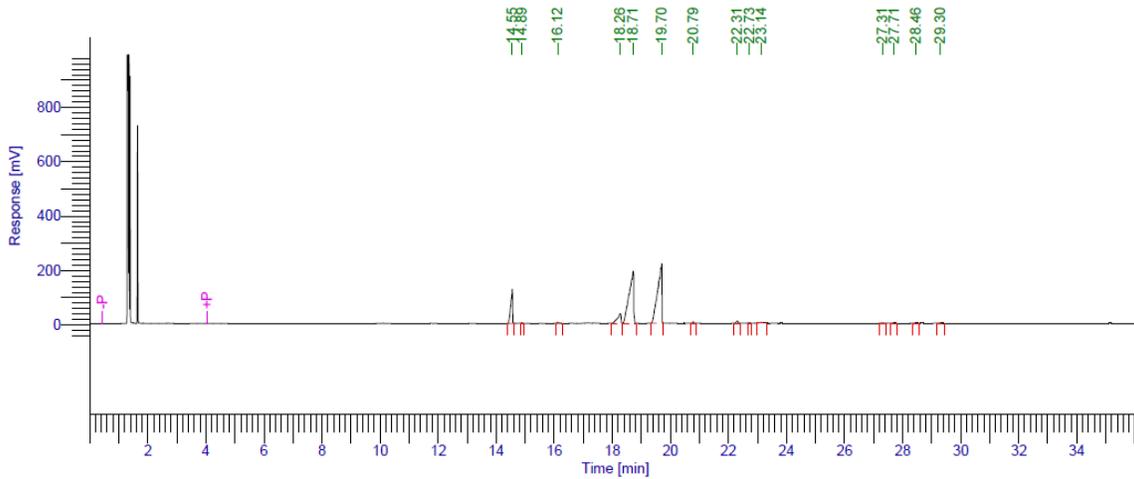


Fig.3a Gas chromatogram for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

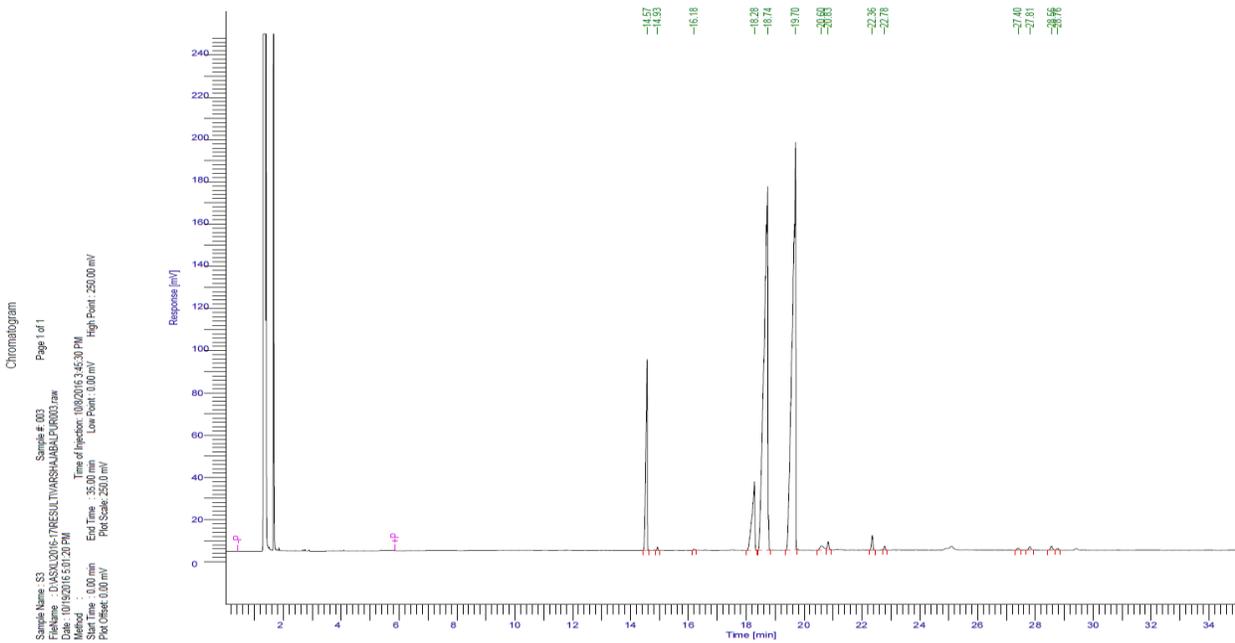


Fig.3b Area percentage for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

Page 1 of 1

Software Version : 6.3.2.0646	Date : 10/19/2016 5:00:42 PM
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Instrument Name : AUTOSYSTEM-2	Channel : A
Rack/Vial : 0/0	Operator : sicart
Sample Amount : 2.000000	Dilution Factor : 1.000000
Cycle : 3	

Result File : D:\ASXL\2016-17\RESULT\VARSHAJABALPUR003.rst
 Sequence File : D:\ASXL\2016-17\SEQUENCE\081016\VARSHAJABALPUR.seq

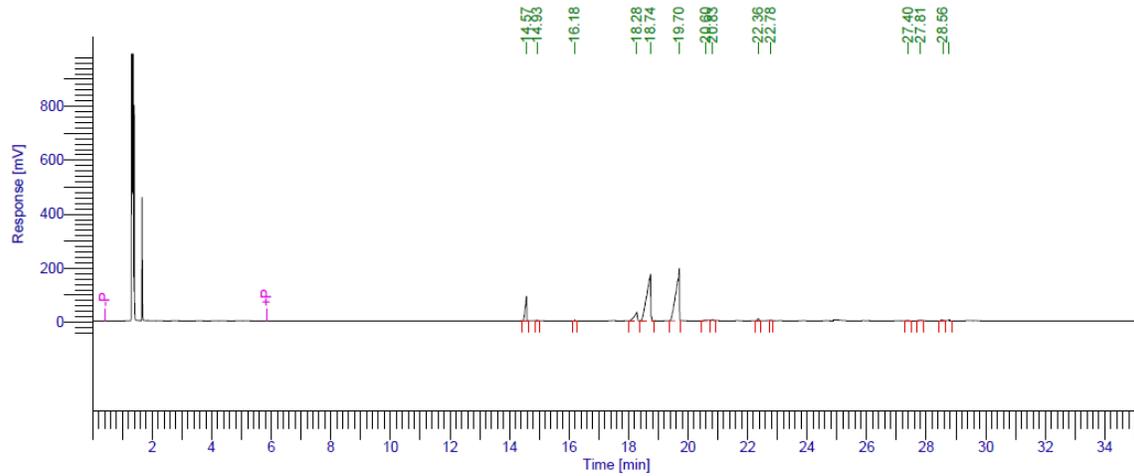


Fig.4a Gas chromatogram for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

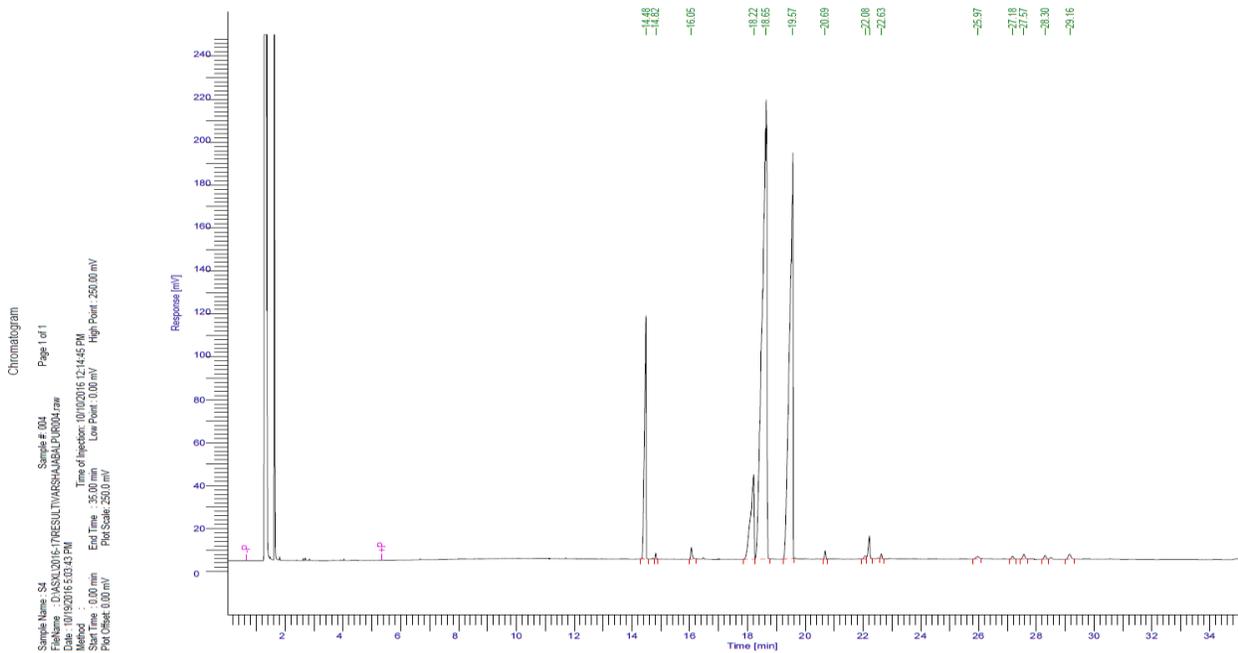


Fig.4b Area percentage for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

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Rack/Vial : 0/0	Operator : sicart
Sample Amount : 2.000000	Dilution Factor : 1.000000
Cycle : 1	

Result File : D:\ASXL\2016-17\RESULT\VARSHAJABALPUR004.rst
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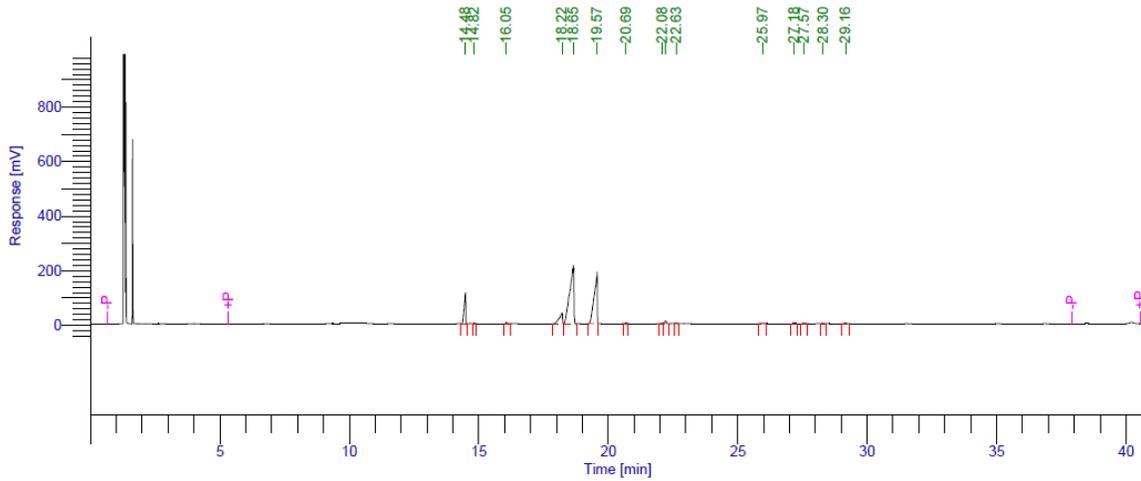
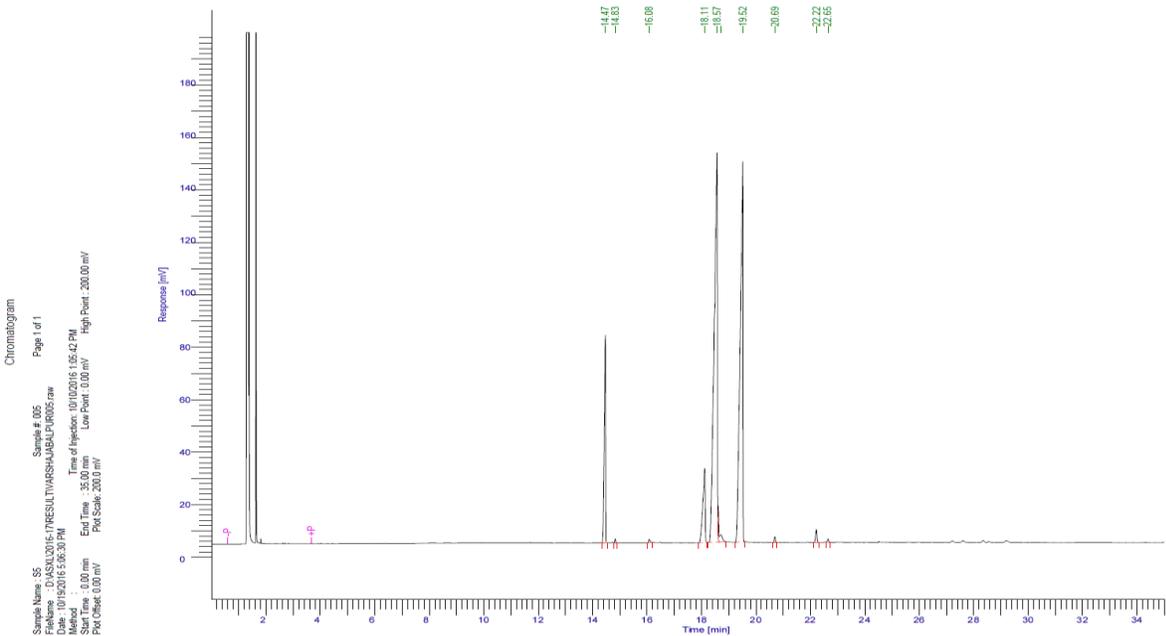


Fig.5a Gas chromatogram for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids



Chromatogram
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 File Name: D:\ASXL\2016-17\RESULT\VARSHAJABALPUR005.rst
 Date: 10/19/2016 5:06:30 PM
 Method: FID
 Inlet Temp: 350.00 min
 PRT (90sec): 0.00 min
 Time of Injection: 10/10/2016 1:05:42 PM
 Low Point: 0.00 mV
 High Point: 200.00 mV
 Page 1 of 1

Fig.5b Area percentage for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

Software Version : 6.3.2.0646 Date : 10/19/2016 5:05:39 PM
Sample Name : S5 Data Acquisition Time : 10/10/2016 1:05:42 PM
Instrument Name : AUTOSYSTEM-2 Channel : A
Rack/Vial : 0/0 Operator : sicart
Sample Amount : 2.000000 Dilution Factor : 1.000000
Cycle : 2

Result File : D:\ASXL\2016-17\RESULT\VARSHAJABALPUR005.rst
Sequence File : D:\ASXL\2016-17\SEQUENCE\081016\VARSHAJABALPUR.seq

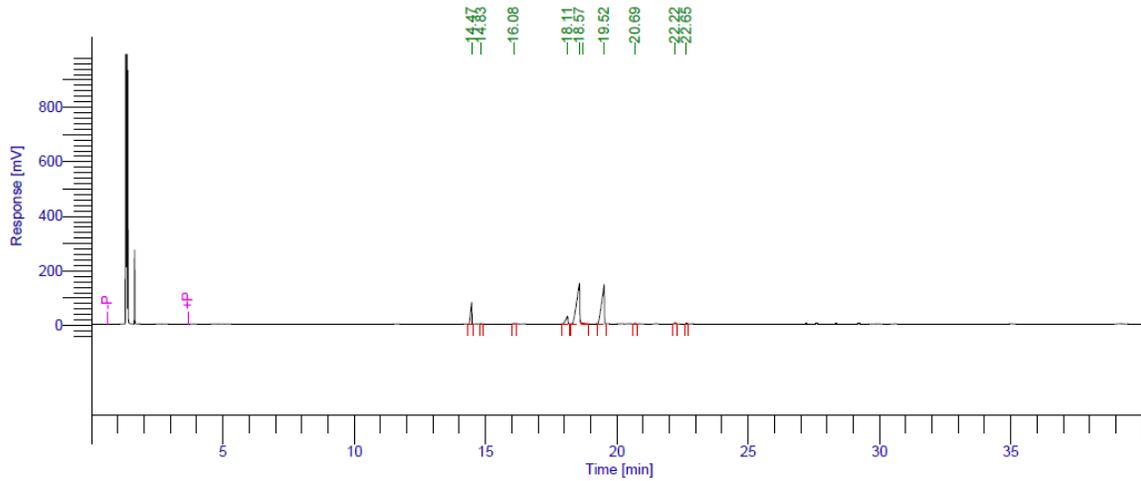


Fig.6a Gas chromatogram for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

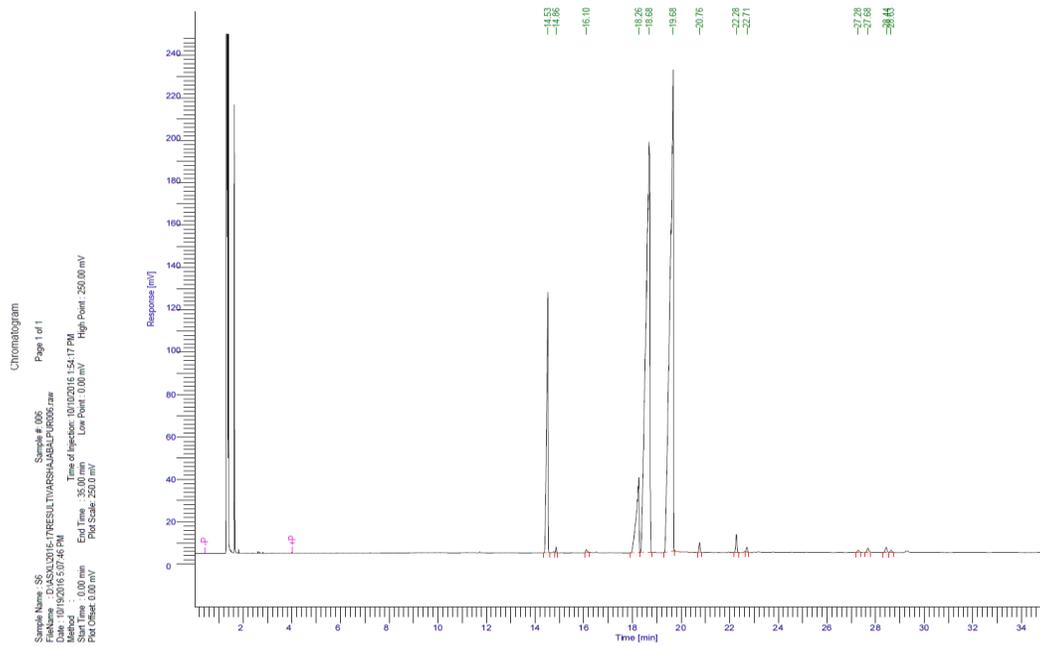


Fig.6b Area percentage for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

Software Version : 6.3.2.0646	Date : 10/19/2016 5:07:09 PM
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Sample Amount : 2.000000	Dilution Factor : 1.000000
Cycle : 3	

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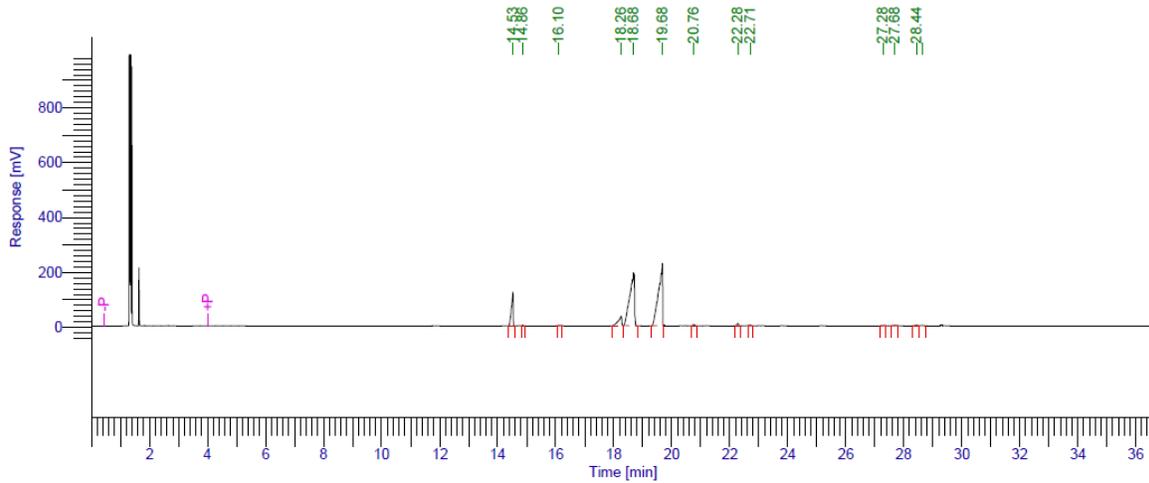


Fig.7a Gas chromatogram for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

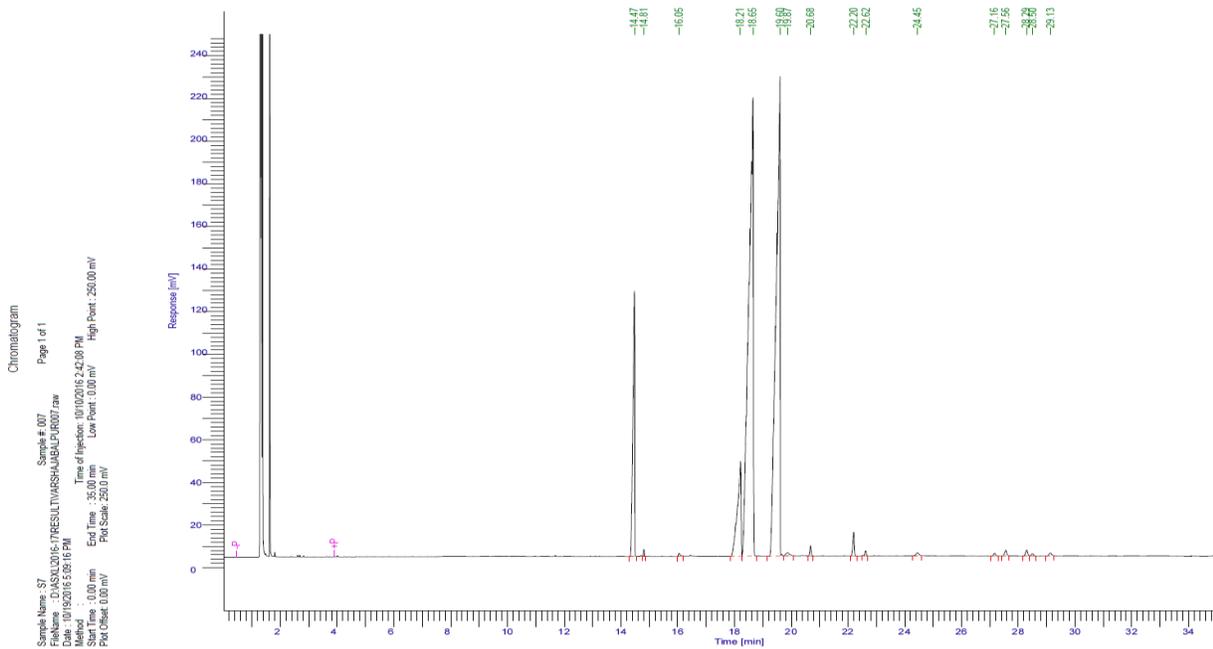


Fig.7b Area percentage for the extracted oil from the seeds of Sesame. The peaks show presence of different fatty acids

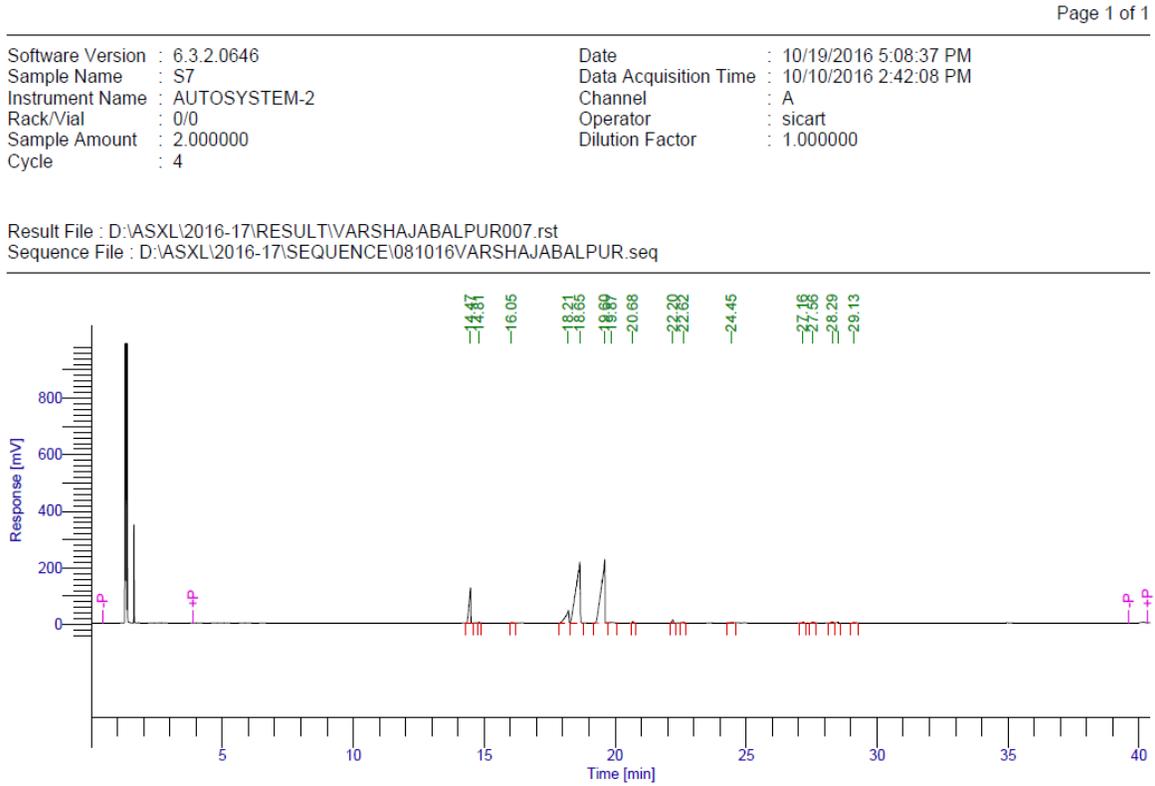


Fig.8a Oil content (%) of different sesame varieties (*Kharif* season)

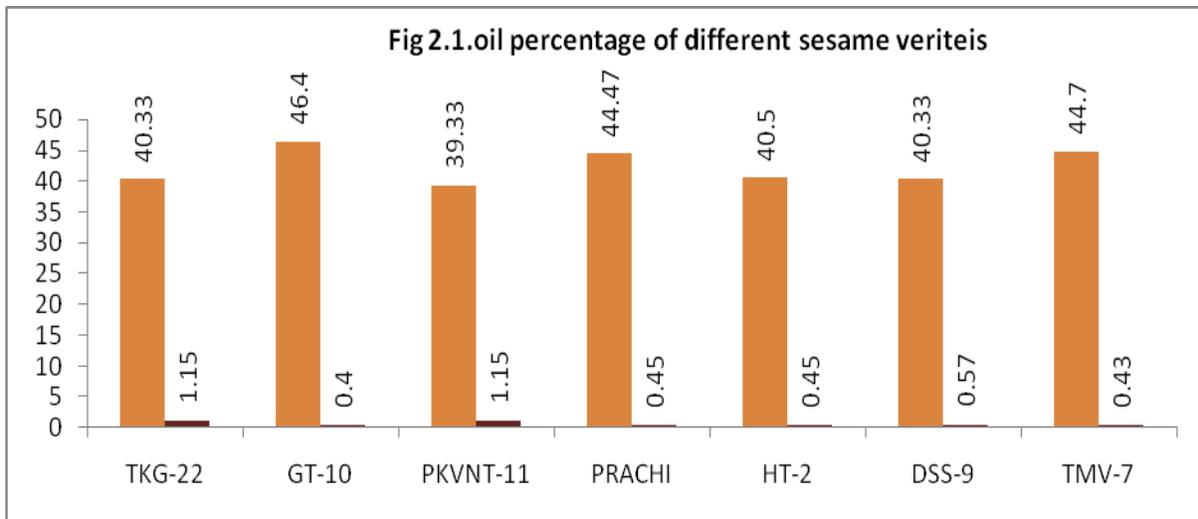


Fig.8b Protein content (%) of different sesame varieties (*Kharif* season)

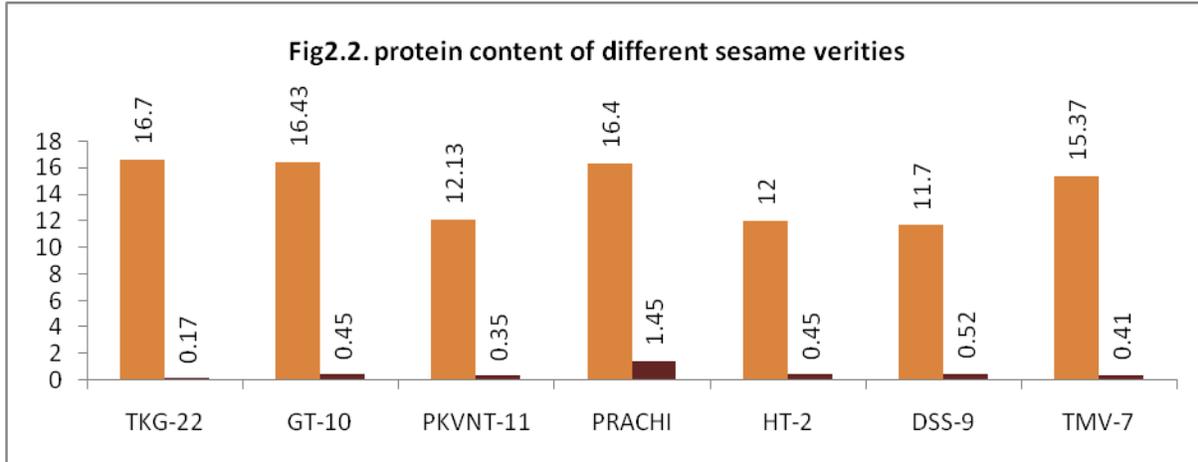


Fig.9a Carbohydrate content (%) of different sesame varieties (*Kharif* season)

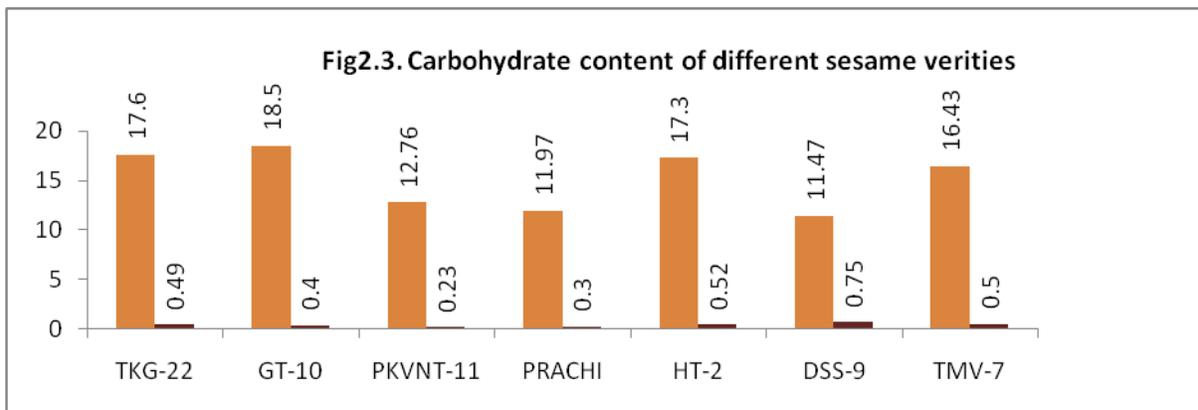
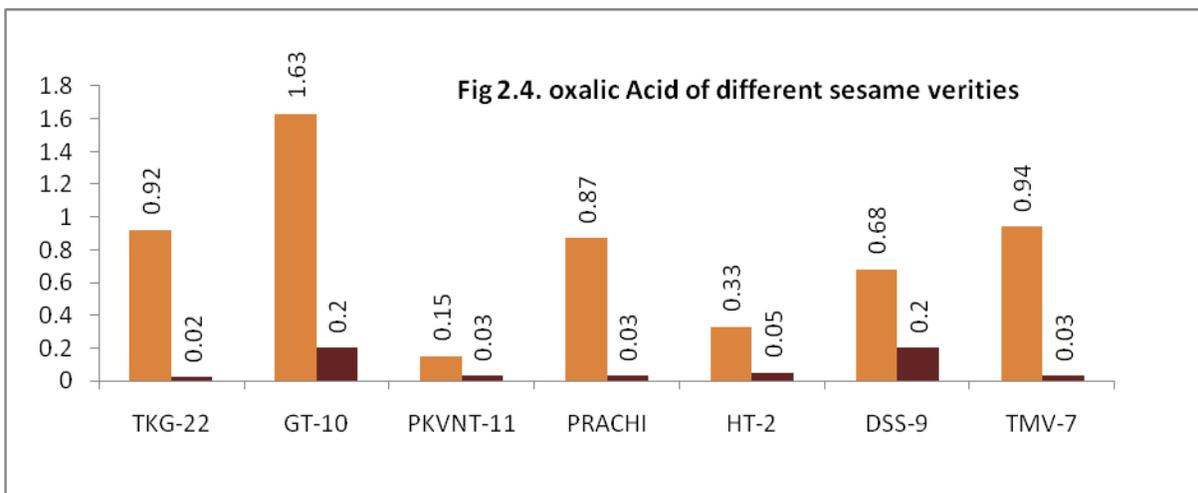


Fig.9b Oxalic acid content (%) of different sesame varieties (*Kharif* season)



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). palmitic acid (8.67%), Illustrated by Nzikou *et al.*, (2009).

Palmitolic acid

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

Linolenic acid

The highest linolenic acid percentage was recorded in variety PRACHI (0.50%). Lowest value of linolenic acid content was recorded in varieties TMV-7 (0.25%) (Table-2) this study are 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).

In conclusion, 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 squeeze exhibited good chemical properties and could be useful for industrial application.

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