INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE AND TECHNOLOGY
© VISHWASHANTI MULTIPURPOSE SOCIETY (Global Peace Multipurpose Society) R. No. MH-659/13(N)
www.ijrbat.in

OIL CONTENT AND FATTY ACID PROFILE OF PROMINENT MUTANTS OF SUNFLOWER (*HELIANTHUS ANNUUS* L.).

D. S. Ghogare* and G. S. Dhulgande[2]
*Department of Botany, Matsyodari Shikshan Sanstha's, Arts, Commerce and Science College, Ambad 431204 Dist. Jalna (M.S.), India.
2. Department of Botany, Sir Parashurambhau College, Pune-411030 (M.S.), India.
* Corresponding author: dr.dsghogare@gmail.com.

Abstract:
Sunflower (*Helianthus annuus* L.) is adapted well to both subtropical and temperate areas and is drought tolerant. Its main oil storage organ is an achene with 50% oil content. Sunflower oil accounts for 9% of the world plant oil production, the main producers being Russia (20%), Europe (19%), Ukraine (15%), and Argentina (13%). Triacylglycerols, the main constituents of sunflower oil, are liquid at room temperature and have a low melting point. It produces high-quality edible oil. Besides food, sunflower oil is the main feedstock for the oleo chemical and cosmetics industries, for the synthesis of polyester films, modified resins, lacquers, copolymers, plasticizers, etc. Also, the high-oleic acid sunflower variety is used for biodiesel production. There are basically two parameters to adjudge any oil as the healthiest cooking oil: 1. NQI (Nutritional Quality Index i.e. poly-unsaturated fatty acid (PUFA) / saturated fatty acid (SFA) ratio) 2. OSI (Oxidative stability index i.e. monounsaturated fatty acid (MUFA) / PUFA ratio.
The present studies were undertaken to study the variability in oil content and fatty acid composition of prominent mutants of sunflower.

Introduction

The sunflower, *Helianthus annuus* L. a member of family Asteraceae comprises the second most important edible oilseed crop in the world after soybean. It is grown on an area of 16.3 million hectares with a production of 22.1 million tonnes of seeds annually at the global level. It was introduced in Europe in 16th century from Mexico via Spain. It became very popular as an ornamental and was established as an oil seed crop in Eastern Europe. Sunflower as an edible oilseed crop was introduced in India for the first time in 1969. It became mostly popular due to special features like short duration, drought tolerance, photo and thermo insensitivity low seed rate, high seed multiplication ratio (1: 1000) and higher water use efficiency.

Sunflower is mainly grown for its oil. Commercially available sunflower varieties contain 39% to 49% oil in seeds. Sunflower oil is generally considered premium oil because of its light colour, high-level unsaturated fatty acids and lack of linolenic acid, bland flavour and high smoke point. The primary fatty acids in the oil are oleic and linoleic (typically 90% of unsaturated fatty acids). It has a great potential for fulfilling the gap of production and requirement of edible oil in Indian diet. Diets with fat content comprising a larger percentage of oleic and linoleic acids are an effective way to reduce plasma cholesterol and to avert coronary heart disease. This paper deals with oil content and fatty acid profile of prominent mutants of sunflower. The quality of sunflower oil is mainly determined by its fatty acid composition (Piva, et,al.,2000). Nutritional use requires a high oleic acid content and low level of saturated fatty acids. Sunflower oil from standard cultivars is characterized by its high linoleic acid, moderate oleic acid and low linolenic acid concentration. Saturated palmitic and stearic fatty acid make up less than 15% of this vegetable oil (Dorrel, 1978).

Materials and Methods

The healthy and dry seeds of sunflower varieties such as Solapur sunflower (SS-56) and Latur sunflower (LS-11) were treated with different doses of gamma rays (5,10 and 15 kR) and different concentration of sodium azide (0.01, 0.03 and 0.05%) for four hours. The M1 generation was raised by sowing the treated seeds in field following randomized block design (RBD) with three replication. The seeds of M1 plants were collected on individual plant basis. The M2 generation was raised from individual M1 plants during Rabi season. The whole process was repeated for recording the data in m3 generation. A wide range of viable mutants could be seen on the basis of morphological changes in M2 generation and sown in M3 generation for recording data. Scored out some prominent mutants from above mutation breeding plan.

The experimental material consisted of seeds of twenty prominent mutants of both varieties of sunflower.

Oil content and fatty acid composition:

Seed samples of each morphological different mutant's plant were subjected to oil extraction

using soxhlet apparatus and to oil extraction was determined. The fatty acid analysis was carried act by using gas chromatography (GC) Method with reference to sop-ASXL-1 at R&D, MIDC, Latur (M.S.).

Result and Discussion:

In the present investigation, oil content in some of the prominent mutants showed wide variability in both positive and negative direction as compared to control of both the varieties of sunflower (Table1 and 2). The degree of fluctuation induced in the oil level was relatively better in different mutants of variety LS-11 than variety SS-56. The variety LS-11 showed maximum oil content (44.54%) as compared to the variety SS-56 (42.38%). Giriraj, et. al., (1990) have been observed higher variability and shift in mean towards positive direction in M3 generation after EMS and gamma ray treatments in sunflower. Significantly higher oil content than the parent after gamma ray treatment in mustard showed by Ahuja, et. al.(1984). Similar results also recorded by Badere and Choudhary (2004) after using SA and EMS concentration in linseed.

At present there is a growing awareness regarding the usefulness of oil and fats in human nutrition because of their high energetic property. But the nutritional quality of oil is mainly dependent upon its fatty acid composition. (Robbelen, et.al., 1989). In the present investigation, the acid composition among the mutants revealed significant alteration in the linoleic and oleic acid and in regard to other fatty acids only slight change in their content could be noticed in both the varieties of sunflower. The major fatty acid components of sunflower seed oil are palmitic, stearic, oleic and linoleic. Highest oleic acid value (39.481%) was found in the early maturing mutant 'H' among all the viable mutants. High-oleic mutant showed no substantial variation in fatty acid composition in response to change in environmental condition (Fick, 1984). High oleic acid content mutants in sunflower noted by soldatov (1976) and Vick and Miller (1996). Proportions of linoleic acid ranged from 49.85 to 62.696% and oleic acid ranged from 23.297 to 35.05% were the highest followed by palmitic acid (5.327 to 8.366%) and stearic acid (4.161 to 6.853%) among the mutants. Higher amount of linoleic acid (62.696%) could be noticed in the early maturing mutant 'S'. The dwarf mutant 'P' of sunflower showed low saturated fatty acid. Low stearic acid content mutants in sunflower reported by Miller and Vick (1999), Vick and Miller (1996), Osorio et.al.,(1995).Success in the alteration of fatty acid profile of soybean mutants and study of the number of genes and loci controlling different fatty acid content in soybean have been reported by Rahman and Takagi, (1997).

Results on statistical parameters and mean values for fatty acid profile, NQI and OSI ratio for twenty prominent mutants of both the varieties of sunflower are presented in Table3 and 4. The observation noticed slight variation for palmitic and stearic acid and oleic and linoleic acid showed great variation observed in both the varieties of sunflower. In case of variety ss.56 NQI values among the mutants ranged from 5.5 to 9.0 the highest NQI values were displayed by dwarf mutant 'P' (9.0). Ratio of MUFA to PUFA is an indicator of oxidative stability of the oil. In sunflower oil in both varieties showed great variation. The highest value of OSI noted in the early maturing mutant 'H' (0.86) of variety SS-56.

Sunflower oil is nutritionally better oil because it contains less than 15% of saturated fatty acid as per health parameters recommend by WHO for dietary use vegetable oils. (Coated by Patil, et.al., 2004)

In sunflower oil, high PUFA content oxidative stability is low as compared to other vegetable oil. Hence mutation breeding are used to increase oleic acid content (Coated by Patil, et.al., 2004).

From the foregoing it can be conclude that present studies indicate both mutagenic treatments have very much succeeded in inducing genetic variability with significant alteration in oil constant fatty acid composition

Conclusion:

During study, water sample from of Chulband River, Soundad, Gondia district (M.S) were collected for the period of 2 years (Feb 2010 to Jan 2012) and season wise analysis of various physico-chemical parameters had been carried out. The results revealed that there was significant alterations in the physicochemical parameters and some of the parameters were in the normal range and Turbidity, DO, BOD and Phosphorus results are indicated not good quality of river water. Our findings highlighted the deterioration of water quality in the river due to industrialization, discharge of domestic, agricultural and human activities. To improve quality of water there should be continuous monitoring of pollution level and maintain the

favourable conditions essential for aquatic organism's survival, growth and reproduction.

References:

Ahuja, K. L., Labana, K.S., Rahaja R.K. and Badwal, S.S. 1984. Oil Content and fatty acids in mutants of Brassica juncea L. Czern & Coss. J. Oilseed. Res. (1): 71-75.

Badere, R.S. and Choudhary, A.D. 2004. Induced mutation in Linseed (Linum Usitatissimum L.). Indian J. Genet. 64 (2): 159-160.

Dorrel, D.G. 1978. Processing utilization of oilseed sunflower. In: J.F. Carter (ed.) Sunflower science and technology. Agon. Monogr. 19. ASA, CSSA, and SSSA, Madison, WI.

Fick, G.H. 1984. Inheritance of high oleic acid in the seed of sunflower. In: Proc. Sunflower Res. Workshop, 6th, Bismarck, ND. Natl. Sunflower Assoc., Bismarck, ND.p.9.

Giriraj, K., Hiremath, S.R. and Seetharam, A. 1990 Induced variability for flowering seed weight and oil content in parental liner of sunflower hybrid BSH-1. Indian J. Genet., 50 (1): 1-7.

Miller, J.F. and Vick, B.A., 1999. Inheritance of reduced stearic and palmitic acid content in sunflower seed oil. Crop Sci. 39: 346-367.

Osorio, J., Fernandez-Martinez, J. M., Mancha, M.M. and Garces, R. 1995. Mutant sunflowers with high concentration of saturated fatty acids in the oil. Crop Sci. 35: 739-742.

Patil Archna, Taware, S. P. and Raut, V. M. 2004. Quality of Indian soybean (Glycine max (L.)Merrill.) Varieties in relation to fatty acid composition. Indian J. Genet.; 64(3) 245-246.

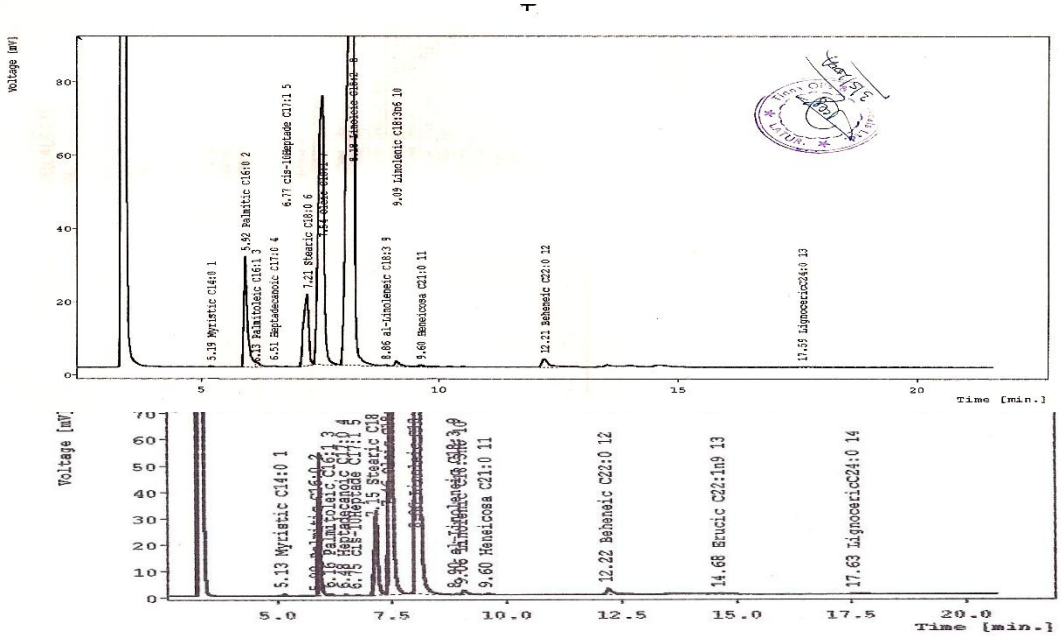
Piva, G., Bouniols, A. and Mondies, G. 2000. Effect of cultural conditions on yield, oil content and fatty acid composition of sunflower kernel. pp. 61-66. In Proc. Int. Sunflower Conf., 15th, Toulouse, France. 12-15 June 2000.

Rahman, S.M. and Takagi, 1997. Inheritance of reduced linolenic acid content in soybean seed oil. Th. & App. Genet., 97 (3): 299-302.

Robbelen, G., Doweny, R. K.and Ashri, A. 1989. Oil crops of the World -Their Breeding and Utilazation. McGraw - Hill Publishing Co., New York.

Soldatov, K.I. 1976. Chemical mutagenesis for sunflower breeding pp. 57-58. In; Abstr. Paper 7th Int. sunflower conf. Krasnodar, USSR.

Vick, B.A. and Miller, J.F. 1996. Utilization of mutagens for fatty acid alteration in sunflower. In: proc. 18th Sunflower Research Workshop. National Sunflower Association. Fargo. pp 11-17.



Result Table – Calculation Method Norm

Peak No.	Reten. time	Area [mV.s]	Amount [ul]	Amount [%]	Peak Type	Component Name
1	5.127	1.8174	5.0989E-02	0.075	Ordnr	Myristic C14:0
2	5.897	160.2543	4.4771	6.560	Ordnr	Palmitic C16:0
3	6.160	3.4664	9.7019E-02	0.142	Ordnr	Palmitoleic C16:1
4	6.477	1.4560	4.0514E-02	0.059	Ordnr	Heptadecanoic C17:0
5	6.750	0.8744	0.0000	0.000	Free	cis-10Heptade C17:1
6	7.147	154.5775	4.3267	6.339	Ordnr	Stearic C18:0
7	7.463	962.0230	26.9463	39.481	Ordnr	Oleic C18:1
8	8.060	1101.4949	30.8526	45.204	Ordnr	Linoleic C18:2
9	8.903	1.0463	2.9270E-02	0.043	Ordnr	al-Linolenic C18:3
10	9.063	10.2744	0.2890	0.423	Ordnr	Linolenic C18:3n6
11	9.603	3.5015	9.7899E-02	0.143	Ordnr	Heneicosa C21:0
12	12.217	24.3986	0.6821	0.999	Ordnr	Behenic C22:0
13	14.677	6.1089	0.1709	0.250	Ordnr	Erucic C22:1n9
14	17.627	6.8514	0.1908	0.282	Ordnr	LignocericC24:0
-	Total	2437.9450	68.2512	100.000		

Graph .1: Fatty acid profile of dwarf mutant 'P' of sunflower showing low saturated acid (variety LS-11)