STUDIA UNIVERSITATIS BABEŞ-BOLYAI, CHEMIA, LII, 2, 2007

DETERMINATION OF FATTY ACIDS AND TOTAL LIPID CONTENT IN OILSEED OF SUNFLOWER GENOTYPES GROWN IN ROMANIA

DORINA BRATFALEAN*, D. F .IRIMIE*, P. S. AGACHI*

ABSTRACT. The fatty acids composition of the seed oils from the 10 sunflower inbred lines and 4 hybrids obtained to the National Agricultural Research and Development Institute Fundulea, was qualitatively and quantitatively determined using analytical methodology.

Procedure of research for detection lipids content in sunflower seeds was the conventional extraction, using International Organization for Standardization (ISO). Soxhlet method (SO-extraction) involves the gravimetric determination of sunflower oil using the petroleum extract from oilseeds. The result of Soxhlet method has been detecting a large variability point of view of lipid percent content in hybrids and inbred lines of sunflower. The fatty acids profiles were obtained using laboratory analytical techniques, the methyl ester analysis were made through gas-chromatography. The groups of the fatty acids: C14:00, C15:00, C16:00, C16:01, C17:00, C18:00, C18:01, C18:02, C18:03, C20:00, C20:1 and C22:0 was determined by experiments. Great variation has been observed in fatty acid content of sunflower seeds from 14 Romania genotypes.

1. INTRODUCTION

The sunflower (*Helianthus annuus L.*) is an annual plant in the family *Asteraceae*, with a large flower head [1]. Sunflower is considered the most important oilseed in the world. Lipids play diverse and important roles in nutrition and health. Sunflower seed is considered an important oilseed source crop due its high nutrition oil composition. Sunflower oil, extracted from the seeds, is used for cooking (but is less cardio healthy than olive oil), as a carrier oil and to produce biodiessel, for which it is less expensive than the olive product.

* *"Babes Bolyai" University, Faculty of Chemistry and Chemical Engineering, 11 Arany Janos Street, RO-400028, Cluj-Napoca, Romania,*
Tel: +40264593833, Fax: +40264590818, E-mail: dorinet63@yahoo.com

Fats are an essential nutrient in the human diet, but an unbalanced diet is not healthful. For most individuals, it is appropriate to get 30% of one's daily food energy from fats and oils, evenly divided between monounsaturated, polyunsaturated, and saturated fats [2]. Sunflower is a widely found oilseed species of oleaginous grown in Romania [3]. A large quantity sunflower seeds are source of raw materials required for industrial purposes in human and animal food.

Vegetable oils nowadays are a great source of maintaining oil consummation in families and because of consumers concern with the saturated/unsaturated fatty acid ratio in the diet, the lipid composition of fruit and vegetable has lately received particular attention. Consumers are especially interested in essential fatty acids, with emphasis on the health potential of polyunsaturated fatty acids. These fatty acids play a natural preventive role in cardiovascular disease and in alleviation of some other health problem, because they promote the reduction of both total and HDL cholesterol [4].

2. METHODOLOGY

Samples

Mature sunflower seeds of four hybrids and ten inbred lines (14 genotyeps) were provided by the National Agricultural Research and Development Institute Fundulea. Sunflower seeds were stored at 5°C and low humidity until these were analyzed. Each sample was taken to the laboratory for dry weight determination. Approximately 10 g of sunflower seed at harvesting maturity was sampled for each variety, from which genotype composites were prepared. The genotypes variability is presented in Table 1.

Table 1

Inbreeds lines and hybrids under study

Genotype	LC-A1	LC-A2	LC-A3	LC-A4	LC-A5	EHPA	LC-A6
Type of variety	Semi-precocious	Semi-precocious	Precocious	Tardive	Semi-precocious	Semi-tardive	Semi-tardive
Genotype	LC-A7	LC-A8	LC-A9	H1	H2	H3	H4
Type of variety	Semi-precocious	Precocious	Tardive				

Extraction of total lipid (TL)

The method used for lipids extraction is Soxhlet extraction. The conventional extraction procedure followed in this research was realized according the International Organization for Standardization. Soxhlet method (SO-extraction) involves the gravimetric determination of the oil using the light the petroleum extract from oilseeds [5]. The petroleum extract is called "oil content". Thus, 10 grams of sample (seed material) were weighed and placed in a cellulose extraction cartridge. The cartridge was plugged with cotton wool and then placed in the Soxhlet extractor containing 250 mL of petroleum ether. The oils were recovered by distilling the solvent in a rotary evaporator at 40°C.

Fatty acid methyl ester (FAMEs) preparation

FAMEs were produced to measure content of total fatty acids [6]. First step for FAMEs consist in saponification procedure. Two samples of 0.1g lipid extract from each sunflower variety were esterified with 1 mL methanolic NaOH solution by refluxing for 1h at 100°C. After removal of free fatty acid, the samples were esterified putting 50µL sample with methanolic H_2SO_4 solution was warmed 2h at 80°C. The FAMEs were extracted from a salt saturated mixture with petroleum ether (3.mL). From drying FAMEs, anhydride Na_2SO_4 was added, and then upper part was poured in specific cell.

Gas chromatography system

The fatty acid have been analyses by gas chromatography (GC) following the published methods [5]. The esters were separated by GC (FRATOVAP, Carlo Elba) fitted with a column ((L=2m; d=3mm). Argon was used as carrier gas with the flow of 24mL/min. The temperature of injection port and detector were maintained at 190°C and respectively 225°C. The peaks were identified based on their retention times using authentic standard fatty acids methyl esters and all samples were run in duplicate.

3. RESULTS AND DISCUSSIONS

The results shows values of the oil extraction by extraction with solvents (also raw fat content of the sunflower seeds) (SO) the oil rated capacity was from 41.93% at the LC6 genotype to 49.12% from H1 genotype. In all case, the extract was dependent of genotypes (to see table 2) summarizes

lipophilic extract weight as a percentage of total seed weight. The percentage of lipids in Romanian hybrids is under 45%. (from H3 47.13% to H2 49.12%). A large majority of the total lipids extract weight was corresponding to the twelve detected fatty acids, in all these cases. The groups of the fatty acids detected (C14:00, C15:00, C16:00, C16:01, C17:00, C18:00, C18:01, C18:02, C18:03, C20:00, C20:01, C22:00) were determinate by experiments. Great variation has been observed in fatty acid content of sunflower seeds from 14 Romania genotypes (10 inbred line, and four hybrids).

Table 2

Total lipids and fatty acid composition [a] of Romania sunflower seeds

Geno-types	Lipids (%)	Fatty acid %											
		C14:0	C15:0	C16:0	C16:1	C17:0	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	C22:0
LC1	46.79	0.017	0.008	6.742	0.067	0.113	3.892	31.592	56.468	0.372	0.100	0.060	0.569
LC2	47.80	0.023	0.014	7.353	0.074	0.178	4.508	48.599	37.501	0.484	0.098	0.051	1.117
LC3	42.98	0.016	0.009	6.699	0.117	0.019	3.021	41.931	46.814	0.39	0.056	0.096	0.832
LC4	46.06	0.020	0.017	6.769	0.166	0.093	4.808	40.271	46.271	0.436	0.224	0.091	0.834
LC5	45.95	0.121	0.087	5.569	0.121	0.084	3.79	38.688	49.936	0.345	0.185	0.206	0.868
LC6	41.93	0.180	0.027	4.978	0.104	0.057	3.797	41.43	47.762	0.515	0.144	0.182	0.824
LC7	45.13	0.133	0.027	6.947	0.185	0.078	5.671	39.624	45.702	0.439	0.073	0.056	1.065
LC8	48.05	0.158	0.103	6.226	0.194	0.045	4.245	46.63	39.73	0.739	0.167	0.275	1.488
LC9	44.05	0.161	0.021	6.978	0.114	0.107	5.465	43.159	42.000	0.698	0.042	0.072	1.183
LC10	45.21	0.141	0.076	6.647	0.232	0.078	2.598	35.42	53.200	0.524	0.132	0.079	0.873
H1	47.75	0.138	0.065	7.381	0.079	0.035	3.661	28.966	58.337	0.444	0.072	0.093	0.729
H2	49.12	0.113	0.05	7.375	0.195	0.064	4.754	25.024	60.788	0.568	0.042	0.150	0.877
H3	47.13	0.206	0.061	7.569	0.123	0.127	5.014	27.037	58.107	0.503	0.155	0.170	0.928
H4	48.95	0.196	0.007	7.215	0.195	0.103	5.235	25.65	60.112	0.408	0.145	0.165	0.569

*Percentage by weight of total fatty acids identified by GC as FAMEs

Based on our study, the sunflower seeds of all 14 genotyeps so far had similar, fatty acid compositions and low amount of saturated fatty acids. Intervarietal differences in fatty acids composition were found and they can be used to establish chemotaxonomic differences, which have also been shown in some other species. A large variability of saturated fatty

acids content was detected between sunflower inbred lines and hybrids (from 10.007% to 14.060%). The unsaturated fatty acids variability is between 85.94% - 89.99%. Sunflower genotypes seed can be classified taking into account linoleic acid/oleic acid ratio (from 0.77% inbred line LC2 to 2.43% hybrid H2).

Table 3

Acids profile in 14 sunflower genotypes and ratio between saturated and unsaturated acid

Geno-types	Total % Saturated fatty acids	Total % Mono saturated fatty acids	Total % Poly saturated fatty acids	Total % Unsaturated fatty acids	Saturated/ unsaturated acid ratio	Linoleic acid/oleic acid ratio
LC1	11.441	31.719	56.840	88.559	0.129	1.787
LC2	13.291	48.724	37.985	86.709	0.153	0.772
LC3	10.652	42.144	47.204	89.348	0.119	1.116
LC4	12.765	40.528	46.707	87.235	0.146	1.149
LC5	10.704	39.015	50.281	89.296	0.120	1.291
LC6	10.007	41.716	48.277	89.993	0.111	1.153
LC7	13.994	39.865	46.141	86.006	0.163	1.153
LC8	12.432	47.099	40.469	87.568	0.142	0.852
LC9	13.957	43.345	42.698	86.043	0.162	0.973
LC10	10.545	35.731	53.724	89.455	0.118	1.502
H1	12.081	29.138	58.781	87.919	0.137	2.014
H2	13.275	25.369	61.356	86.725	0.153	2.429
H3	14.060	27.330	58.610	85.940	0.164	2.149
H4	13.470	26.010	60.520	86.530	0.156	2.344

4. CONCLUSIONS

Acid profile obtained after GC analysis is helpful to choose the possible utilization of the oil: food industry or carrier oil. These cultivars might contain useful genetic resource for the development of novel varieties. The four Romania hybrids (H1, H2, H3, H4) used in this study contain highly unsaturated fatty acids, having good nutritional quality.

ACKNOWLEDGEMENTS

The authors would like to acknowledged the support for providing the sunflower seeds genotypes at Agricultural Research and Development Institute Fundulea, Romania

REFERENCES

Amy E. Bionkoski and the group "*Balance of unsaturated fatty acids .Is important to a cholesterol –Lowering Diet*" Journal of the American Dietetic Association. **2005**

AOAC, "*Official Method of Analysis*". Association of Official Analytical Cereal Chemists, Washington, DC, USA. **1999**.

D. Brătfălean, F.D. Irimie, S.P. Agachi, D. Stanciu, I. Sorega, "*Variability study of fats acids on 13 Romanian genotype of sunflower oil by Gas Chromatography*", Cercetari de genetica vegetala si animala, Bucuresti **2006,** pp33-38

P. Melgarejo and F. Artes, "*Total lipids and fatty acid composition of oil seed from lesser known sweet pomegranate clones*", Journal of the Science of Food and Agriculture 80(**2000**), pp1452-1454

R. Shostek, "Flowers and Plants. An International Lexicon with Biographical Notes". Quadrangle /The New York Times Book Co. **1974**, pp 329