CEFood & Congress

Novi Sad, Serbia
23 - 26 May, 2012

PROCEEDINGS

of 6th Central European Congress on Food

IUFoST International Union of Food Science and Technology

EFFoST European Federation of Food Science and Technology

CEI Central European Initiative

ISBN 978-86-7994-027-8

6TH CENTRAL EUROPEAN CONGRESS ON FOOD, Novi Sad 2012, SERBIA

Publisher

University of Novi Sad, Institute of Food Technology
Bulevar cara Lazara 1.
21000 Novi Sad, Serbia

Main editor
Dr. Jovanka Lević

Editors
Prof. Dr. Viktor Nedović
Dr. Nebojša Ilić
Dr. Vesna Tumbas
Ana Kalušević, dipl. ing.

Abstract/Paper Review
All abstracts and papers are reviewed by the International Board of Reviewers

Technical editors
Bojana Kokić
Miona Belović
Dubravka Jambrec
Nataša Nedeljković
Olivera Đuragić
Tanja Radusin
Ana Kalušević
Tamara Dapčević
Tatjana Tasić
Jovana Vučković
Tamara Sarafijanović

Cover
Boris Bartula, BIS, Novi Sad, Serbia

Printed by
“Futura” – Novi Sad, Serbia

Number of copies
600 copies

CONGRESS PRESIDENT

Prof. Dr. Viktor Nedović, Faculty of Agriculture, University of Belgrade, Serbia

INTERNATIONAL SCIENTIFIC COMMITTEE

Prof. Dr. Peter Raspor, Biotechnical Faculty, University of Ljubljana, Slovenia
Prof. Dr. Roger Fenwick, Institute of Food Research, Norwich, United Kingdom
Prof. Dr. Dietrich Knorr, Berlin University of Technology, Germany
Prof. Dr. Brian Mckenna, University College Dublin, Ireland
Prof. Dr. Viktor Nedović, Faculty of Agriculture, University of Belgrade, Serbia;
Dr. Jovanka Lević, Institute of Food Technology in Novi Sad, Serbia
Prof. Dr. Gustavo V. Barbosa-Cánovas, Center For Nonthermal Processing of Food, Washington State University, Usa
Prof. Dr. José Aguilera, Catholic University of Chile, Chile
Prof. Dr. Eyal Shimoni, Department Of Biotechnology And Food Engineering, Technion – Israel Institute of Technology, Israel
Dr. Nebojša Ilić, Institute of Food Technology in Novi Sad, Serbia
Dr. Vesna Tumbas, Faculty of Technology, University of Novi Sad, Serbia
Prof. Dr. Branko Bugarski, Faculty of Technology and Metallurgy, University of Belgrade, Serbia
Dr. Juan Valverde, Teagasc, Ireland
Prof. Dr. Laura Piazza, Department of Food Science and Technology, State University of Milan, Italy
Prof. Dr. Taoukis Petros, School of Chemical Engineering, National Technical University of Athens, Greece
Dr. Anamarija Mandić, Institute of Food Technology in Novi Sad, Serbia
Dr. Aleksandra Mišan, Institute of Food Technology in Novi Sad, Serbia
Dr. Marijana Sakač, Institute of Food Technology in Novi Sad, Serbia
Prof. Dr. Slađana Šobajić, Faculty of Pharmacy, University of Belgrade, Serbia
Prof. Dr. Francesco Capozzi, Faculty of Agriculture, University of Bologna, Italy
Dr. Huub Lelieveld, Ghi Association Netherlands and Effost Executive Committee, Netherlands
Prof. Dr. Dominique Bauchart, INRA, Clermont Ferrand, France
Prof. Dr. Bogdan Yegorov, Odessa National Academy of Food Technologies, Ukraine
Prof. Dr. Mark Shamtsyan, St. Petersburg State Institute of Technology, Technical University of Moscow, Russia
Prof. Dr. Jana Hajslova, Institute of Chemical Technology, Prague, Czech Republic
Prof. Dr. Giovanni Dinelli, Department of Agroenvironmental Sciences and Technologies, University of Bologna, Italy
Prof. Dr. Željko Knez, Faculty of Chemistry and Chemical Engineering, University of Maribor, Slovenia
Dr. Diego Moreno-Fernández, Spanish National Research Council, Spain
Prof. Dr. Gerhard Schleining, Boku, Vienna, Austria
Prof. Dr. Živko Nikolov, Department of Biological & Agricultural Engineering, Texas A&M University, USA
Prof. Dr. András Salgó, Faculty of Chemical and Biochemical Engineering, Budapest University of Technology and Economics, Hungary
Dr. Nastasia Belc, Institute of Food Bioresources, Bucharest, Romania
Prof. Dr. Vladimir Mrša, Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia
Prof. Dr. Draženka Komes, Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia
Prof. Dr. Radoslav Grujić, Faculty of Technology Zvornik, University of East Sarajevo, BIH Republic of Srpska
Prof. Dr. Vladimir Kakurinov, Veterinary Faculty, St. Kliment Ohridski University, Macedonia
Prof. Dr. Vural Gökmen, Food Engineering Department, Hacettepe University, Turkey

INTERNATIONAL ADVISORY BOARD

Prof. Dr. Peter Raspor, Biotechnical Faculty, University of Ljubljana, Slovenia
Prof. Dr. Diana Banati, Corvinus University of Budapest, Hungary
Prof. Dr. Kostadin Fikiin, Refrigeration Science and Technology Division, Technical University of Sofia, Bulgaria
Prof. Dr. Kata Galić, Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia
Prof. Dr. Peter Šimko, Food Research Institute, Bratislava, Slovakia

HONORARY BOARD

Prof. Dr. Radivoje Mitrović, Ministry of Education And Science, Government of The Republic Of Serbia
Prof. Dr. Nada Dragović, Ministry Of Education and Science, Government of The Republic of Serbia
Prof. Dr. Tibor Sabo, Ministry of Education and Science, Government of The Republic of Serbia
Prof. Dr. Dragoslav Petrović, Provincial Secretariat for Science and Technological Development, Autonomous Province of Vojvodina, Serbia
Prof. Dr. Miroslav Vesković, Rector of the University of Novi Sad, Serbia
Prof. Dr. Nebojša Ralević, Faculty of Agriculture, University of Belgrade, Serbia
Dr. Jovanka Lević, Institute of Food Technology in Novi Sad, Serbia
Prof. Dr. Zoltan Zavargo, Faculty of Technology, University of Novi Sad, Serbia
Prof. Dr. Ivanka Popović, Faculty of Technology and Metallurgy, University of Belgrade, Serbia
Dr. Radoslav Cerović, Maize Research Institute Zemun Polje, Serbia
Prof. Dr. Miodrag Janković, Faculty of Agriculture, University of Belgrade, Serbia

EXECUTIVE COMMITTEE

Dr. Jovanka Lević, Institute of Food Technology in Novi Sad, Serbia
Prof. Dr. Viktor Nedović, Faculty of Agriculture, University of Belgrade, Serbia
Dr. Vesna Tumbas, Faculty of Technology, University of Novi Sad, Serbia
Dr. Nebojša Ilić, Institute of Food Technology in Novi Sad, Serbia
Ana Kalušević, Faculty of Agriculture, University of Belgrade, Serbia

ORGANIZING COMMITTEE

Dr. Olivera Đuragić, Institute of Food Technology in Novi Sad, Serbia
Bojana Kokić, Institute of Food Technology in Novi Sad, Serbia
Predrag Ikonić, Institute of Food Technology in Novi Sad, Serbia
Dr. Tanja Petrović, Faculty of Agriculture, University of Belgrade, Serbia
Olivera Šimurina, Institute of Food Technology in Novi Sad, Serbia
Saša Despotović, Faculty of Agriculture, University of Belgrade, Serbia
Dr. Mirjana Pešić, Faculty of Agriculture, University of Belgrade, Serbia
Aleksandra Novaković, Institute of Food Technology in Novi Sad, Serbia
Tatjana Tasić, Institute of Food Technology in Novi Sad, Serbia
Slavica Sredanović, Msc, Institute of Food Technology in Novi Sad, Serbia
Miona Belović, Institute of Food Technology in Novi Sad, Serbia
Dubravka Jambrec, Institute of Food Technology in Novi Sad, Serbia
Nataša Nedeljković, Institute of Food Technology in Novi Sad, Serbia
Tamara Dapčević, Institute of Food Technology in Novi Sad, Serbia
Tanja Radusin, Institute of Food Technology in Novi Sad, Serbia
Dr. Slađana Žilić, Maize Research Institute Zemun Polje, Serbia
Jovana Vučković, Institute of Food Technology in Novi Sad, Serbia
Dr. Zorica Radulović, Faculty of Agriculture, University of Belgrade, Serbia
Dr. Verica Đorđević, Faculty of Technology and Metallurgy, University of Belgrade, Serbia
Zdenka Marković, Institute of Food Technology in Novi Sad, Serbia
Steva Lević, Faculty of Agriculture, University of Belgrade, Serbia
Željka Dukić, Ministry of Education and Science, Serbia
Dr. Jelena Pejin, Faculty of Technology, University of Novi Sad, Serbia
Dr. Ivana Sedej, Institute of Food Technology in Novi Sad, Serbia

CONGRESS ORGANIZERS:

Faculty of Agriculture, University of Belgrade

Institute of Food Technology, University of Novi Sad

Faculty of Technology, University of Novi Sad

SAFT, Serbian Association of Food Technologists

Faculty of Technology and Metallurgy, University of Belgrade

CONGRESS SUPPORTED BY:

Ministry of Education and Science, Republic of Serbia

Vojvodina Province, Provincial Secretariat for Science and Technological Development - Novi Sad

Sojaprotein A.D., Bečej, Serbia

Institute of Field and Vegetable Crops, Novi Sad, Serbia

Cimbria HEID GMBH, Austria

LECO, Novi Sad, Serbia

Delta Agrar, Belgrade, Serbia

Institute of Food Research, Norwich-UK

Maize Research Institute „Zemun Polje“, Zemun polje, Serbia

CEI, Central European Initiative

Center for the Promotion of Science, Belgrade, Serbia
(Enjoy Food Science event)

IUFOST, International Union of Food Science and Technology

BioMérieux, Belgrade, Serbia

Cluster d.o.o, Belgrade, Serbia

NOACK&Co South East d.o.o, Novi Sad, Serbia

Superlab, Belgrade, Serbia

Promedia, Kikinda, Serbia

Buhler AG, Belgrade, Serbia

Shimadzu branch, Belgrade, Serbia

V.I.A., Belgrade, Serbia

CONGRESS FOOD FAIR
SUPPORTED BY:

"Perutnina Ptuj – Topiko" A.D.,
Bačka Topola, Serbia

Prerada mesa "Štrand",
Novi Sad, Serbia

"Kosanović",
Martinci, Serbia

"Agropapuk",
Kukujevci, Serbia

"Sojaprotein" A.D.,
Bečej, Serbia

"Mlekara Subotica",
Subotica, Serbia

Udruženje "Futoški kupus",
Futog, Serbia

Udruženje poljoprivrednika Gložan,
Gložan, Serbia

Međunarodni festival šunke i pršute
"Šunka fest", Novi Sad, Serbia

"Mokrin-Mlek",
Mokrin, Serbia

Udruženje žena "Banstolka",
Banstol, Serbia

Udruženje žena "Dolovke",
Pančevo, Serbia

"Pčelarstvo Radić",
Šimanovci,Serbia

Mira Kovačević, "Karlovački kuglof",
Sremski Karlovci, Serbia

Milorad Živković, "Sremski kulen",
Kuzmin, Serbia

Živan Vladisavljević, "Sremski kulen",
Laćarak, Serbia

"Panmlek",
Pančevo, Serbia

"Eugenchocolate",
Gložan,Serbia

AD "Imlek",
Beograd, Serbia

"Vino Župa" A.D.,
Aleksandrovac, Serbia

Vinarija "Bononija",
Banoštor, Serbia

Vinarija "Ačanski",
Banoštor, Serbia

Vinarija "Stojković",
Banoštor, Serbia

"Vinovita",
Beograd, Serbia

Vinarija "Kiš",
Sremski Karlovci, Serbia

Vinarija "Aleks",
Novi Sad, Serbia

Vinarija "Živanović",
Sremski Karlovci, Serbia

"DiBonis Winery" D.O.O.,
Subotica, Serbia

"Top Spirit",
Beograd, Serbia

Poljoprivredni Fakultet,
O.D. "Radmilovac",
Beograd, Serbia

"BIP" A.D., industrija piva,
Beograd, Serbia

Udruženje Srbije za Celijakiju,
Stara Pazova, Serbia

"Pretti Organica" D.O.O,
Beograd, Serbia

Bio farm "Vozar",
Kisač, Serbia

"Kendy Ltd" D.O.O.,
Beograd, Serbia

"Foodland" D.O.O.,
Beograd, Serbia

Miloš Nikolić, kajmak,
Požarevac, Serbia

"Suncokret"
Hajdukovo, Serbia

Božić Radisav, smrznuta malina,
Požarevac, Serbia

“Hemija komerc” D.O.O.,
Novi Sad, Serbia

SZR “Susam”,
Novi Sad, Serbia

“Ms Čin Komerc“ D.O.O.,
Zemun, Serbia

“Univerexport“ D.O.O.,
Novi Sad, Serbia

IL Primo, Pekara Žarković
Novi Sad, Serbia

“Pekara Milan“,
Novi Sad, Serbia

“Rio Export-Import“ D.O.O.,
Ravno Selo, Serbia

“Atler-Fontana” D.O.O.,
Kikinda, Serbia

SZTR “Danica Co“,
Novi Sad, Serbia

“PIP“ D.O.O.,
Novi Sad, Serbia

Pekara “Banatski Hleb“
Iđoš, Serbia

Serbia Organica,
Belgrade, Serbia

“Delta Agrar“,
Beograd, Serbia

NUTRITIONAL VALUE OF THE OIL EXTRACTED FROM THE PUMPKIN SEED OIL CAKE

Biljana B. Rabrenović[1*], Etelka B. Dimić[2], Vesna B. Vujasinović[3], Mirjana A. Demin[1], Slađana Šobajić[4], Zorica N. Basić[5]

[1]University of Belgrade, Faculty of Agriculture, 11080 Zemun, Nemanjina 6, Serbia
[2]University of Novi Sad, Faculty of Technology, 21000 Novi Sad, Bulevar cara Lazara 1, Serbia
[3]College of Professional Studies in Business Management and Communications, 21205 Sremski Karlovci, Mitropolita Stratimirovića 110, Serbia
[4] University of Belgrade, Faculty of Pharmacy, 11000 Belgrade, 450 Vojvode Stepe, Serbia
[5]Military Medical Academy, Institute of Hygiene, 11000 Belgrade, Crnotravska 17, Serbia

*Corresponding author:
Phone: +381112615315
Fax: +381112199711
E-mail address: biljanar@agrif.bg.ac.rs

ABSTRACT: Oil cake is a by-product which remains after the pressing of pumpkin seeds. Until recently, it was mainly used as animal fodder, but lately it has been increasingly used for nutritious food products or ingredients. As the cake retains a considerable portion of oil, the aim of this research was to determine the content of oil in the cakes obtained after pressing 7 samples of naked pumpkin seeds and 3 samples of husk pumpkin seeds, and the nutritional value of the residual oil. The content of oil varied from 11.0 to 16.0 % in dry matter. After that, in the next 24 hours, the oil left behind in the cake was extracted by hexane, at room temperature. The composition and content of fatty acids and the total content of tocopherols were determined. The dominant acids were oleic acid (37.1 – 43.9%) and linoleic acid (30.8 – 44.5%), an ω-6 fatty acid. There was also a small portion (0.1 – 0.3%) of linolenic acid, an ω-3 fatty acid. The total content of tocopherols was considerably high (28.7 – 64.5 mg/100g), with the γ-isomer being the dominant one (73.6 – 85.3% of the total content).
Key words: *pumpkin seed, oil cake, fatty acids, tocopherols*

INTRODUCTION

The utilization of by-products of oil processing is a very important issue for the edible oil industry. Oil cakes, remaining after pressing the seeds, contain considerable amounts of oil, proteins and nutrients, which contribute to the nutritional value of the cake. However, certain kinds also contain antinutrients, which are unacceptable and must be removed in order to ensure the edible status of the cake.

But this is not the case with the pumpkin seed oil cake, a by-product of cold pressing. To date, scientific papers have reported data regarding the use of pumpkin seed oil cake flour in producing cookies, bread and a spread similar to peanut butter (Radočaj et al., 2011).

Since oil, present in a significant percentage in the cake, has not been, so far, a subject of scientific research, the objective of this study was to assess the remained oil by the means of organic solvent extraction, and then estimate the nutritional quality of the oil. To that end, the composition of fatty acids and the total content of tocopherols were determined.

According to the majority of literature data, linoleic (C18:2), oleic (C18:1), palmitic (C16:0) and stearic acid (C18:0) are the most abundant ones. These four acids make up 98% of the total fatty acid content, while the content of other acids does not exceed 0.5% (Murkovic et al., 2004; Nakić et al., 2006; Vujsinović et al., 2010). Fatty acid content may vary depending on diverse factors, such as: the variety of pumpkin, the area of cultivation, weather conditions, stage of ripeness, etc (Griffith et al., 1997; Younis et al., 2000; Siegmund and Murkovic, 2004).

Tocopherols belong to non-glyceride constituents of vegetable oils. Given that they slow down the autoxidation process, their presence is of high importance to the stability of vegetable oils. They have the ability to stabilize free radicals and transform peroxides into stable products, thus ending the chain reaction (Schuler, 1990). Variations in total tocopherol content are relatively high, as a result of the influence of genotype and cultivation conditions,

and the method of oil extraction. However, regardless of these variations in total content, the composition of tocopherols in the pumpkin oil is quite stable. The predominant tocopherol isomers in the pumpkin oil are γ- and α-isomers (Murkovic and Pfannhauser, 2000; Fruhwirth et al., 2003; Gorjanović et al., 2011).

MATERIAL AND METHODS

The starting materials were 7 samples of pumpkin naked seed oil cakes and 3 samples of pumpkin husk seed oil cakes, remained after cold pressing.

Total oil content and moisture content

Contents of oil and moisture were determined according the standard analytical methods, respectively: ISO 659: 2007 and ISO 665: 2008.

Oil extraction

The oil that was left over after cold pressing was extracted from the cake by organic solvent, hexane, at room temperature, over 24 hours. The proportion of cake and solvent was 1:3. After that, the solvent was evaporated in the rotary vacuum evaporator, at the temperature of 40 ^{o}C.

Fatty acid determination

Fatty acids were transformed to fatty acid methyl ester by direct transesterification for the neutral samples and with boron trifluoride solution for samples with higher content of free fatty acids (*ISO 5509,2000).* Fatty acid composition was determined by gas chromatography (GC; VARIAN chromatograph, model 1400; Varian Associates, Walnut Creek, CA), equipped with a flame ionization detector and a 3.0 m × 0.32 cm steel column, packed with LAC-3R-728 (20%; Cambridge Ind. Co., Cambridge, UK) on ChromosorbW/AW(80-100 mesh; Merck, Darmstadt, Germany). Nitrogen was used as a carrier gas (flow rate, 24 mL/min) (*ISO 5508,1990).* Fatty acids were identified by comparison of their retention times (Rt) with those of standards (SupelcoTM FAME Mix). All determinations were carried out in triplicates.

Tocopherol content

Quantification of tocopherols was carried out using high performance liquid chromatography (Waters M600E, USA) on a Nucleosil 50-5 C18 reversed phase column with fluorescence detection and external standard solutions of different tocopherols. The following procedures were applied: n-hexane extraction, extract vaporization and reconstitution in methanol using membrane filtration. Mobile phase was 95% ethanol with a flow rate of 1.2 ml/min. The fluorescence detector (Shimadzu RF-535, Japan) operated with the excitation wavelength at 290 nm and the emission wavelength at 330 nm.

Statistical analysis

Data are reported as means ± SD (n = 3). Statistical analysis was performed using Statistica 7 software package.

RESULTS AND DISCUSSION

Contents of oil and moisture in the samples of cakes remained after pressing the seeds are displayed in Table 1.

Table 1. Amounts of remained oil and moisture content in the samples of cakes

Cake sample	Oil content		Moisture content (%)
	(% tel quel)	(% d.m.)	
Pumpkin naked seed oil cake			
OLINKA	11.2	12.1	7.93
SB	11.1	12.1	8.28
F1 OLINKAxG	10.3	11.2	8.31
F1 OLINKA x 371B	14.1	15.2	7.63
GLEISDORFER EXPRESS	14.7	16.2	8.84
GLEISDORFER DIAMANT	13.5	14.8	8.77
K2	12.4	13.5	8.15
Pumpkin husk seed oil cake			
OLIVIJA	12.7	13.8	8.06
DAKI 802	10.0	11.0	8.80
K1	13.3	14.2	8.23

Data are the means ± standard deviation values (n = 3)

As shown in Table 1, the moisture contents in the cakes were rather steady, ranging from 7.63 to 8.84%. On the other hand, the results regarding the amounts of oil remaining in the cakes were not so homogenous – the contents varied from 11.0 to 16.2 % d.m. and were considerably high. Berenji (2007) reports that the content of remained oil may vary from 10 to 18%, depending on the pressing method.

Table 2 shows the composition and content of fatty acids in the samples of oil extracted from press cakes. As for the composition of fatty acids, pumpkin seed oil belongs to the oleic-linoleic type. As seen in Table 2, oleic acid content ranged from 37.1±0.11 to 43.9±0.04%, while that of linoleic acid, belonging to ω-6 fatty acids, varied from 30.8±0.09 to 44.5±0.015%. In addition, the presence of a small percentage (0.1 do 0.3%) of α-Linolenic acid, an ω-3 fatty acid, was detected, which increased oil's nutritional value. The measured data are in accordance with the results obtained for the oil extracted from seeds, reported by various authors (Schuster, 1983; Wentzel, 1987; Karlović et al., 2001; Fruhwirth et al., 2003; Vukša et al., 2003; Vujasinović et al., 2010). Namely, the literature does not provide specific data on the composition of fatty acids in the oil extracted from pumpkin seed press cake.

Considering that the composition of fatty acids is a major indicator of both nutritional value and oxidative stability of vegetable oils, it was important to determine the total saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) content as well. A higher SFA content contributes to oxidative stability, but from the nutritional point of view and in terms of preventing coronary disease, oils with higher MUFA and PUFA contents are preferred. The total content of unsaturated fatty acids in the examined oils was on average four times higher than that of saturated fatty acids.

Table 2. Fatty acid composition (% w/w) of the oil extracted from pumpkin seed press cake

Fatty acid	***Oli extracted from naked pumpkin seed cake***						***Oli extracted from husk pumpkin seed cake***			
	Olinka	SB	F1 Olinka x G	F1 Olinka x 371B	Gleisdorfer Express	Gleisdorfer Diamant	K2	Olivija	DAKI 802	K1
Myristic acid C14:0	nd	0.1±0.03	0.2±0.04	nd	0.2±0.03	0.2±0.00	nd	nd	nd	nd
Palmitic acid C16:0	12.9±0.09	11.6±0.06	11.8±0.09	11.4±0.02	11.5±0.11	15.3±0.30	13.3±0.09	11.9±0.12	15.5±0.10	11.2±0.02
Stearic acid C18:0	6.2±0.05	5.1±0.01	6.2±0.03	6.1±0.09	6.2±0.09	9.3±0.02	5.6±0.06	6.5±0.10	5.3±0.08	5.2±0.08
Oleic acid C18:1	43.9±0.04	42.9±0.02	40.7±0.06	41.7±0.01	37.5±0.08	43.5±0.03	43.6±0.11	42.3±0.05	37.1±0.109	39.2±0.10
Linoleic acid C18:2	36.7±0.06	40.2±0.20	40.8±0.07	40.3±0.31	44.3±0.04	30.8±0.09	37.3±0.01	39.0±0.12	41.7±0.17	44.5±0.15
Linolenic acid C18:3	0.1±0.12	0.1±0.21	0.2±0.19	0.3±0.21	0.2±0.29	0.1±0.10	0.3±0.19	0.2±0.18	0.1±0.16	0.2±0.22
Behenic acid C22:0	nd	nd	nd	0.4±0.17	0.1±0.00	0.5±0.15	nd	nd	0.3±0.00	nd
SFA	19.1±0.14	16.8±0.10	18.2±0.16	17.9±0.28	18.0±0.23	25.5±0.59	18.9±0.15	18.5±0.22	21.1±0.18	16.4±0.10
MUFA	43.9±0.78	42.9±0.67	40.7±0.66	41.9±0.78	37.5±0.55	43.7±0.71	43.6±0.69	42.3±0.70	37.1±0.70	39.2±0.69
PUFA	36.8±0.79	40.3±0.88	41.0±0.79	40.6±0.66	44.5±0.59	30.9±0.60	37.6±0.88	39.2±0.69	41.8±0.70	44.7±0.78

Data are the means ± standard deviation values (n = 3)

Total tocopherols were measured and the results are shown in Figure 1.

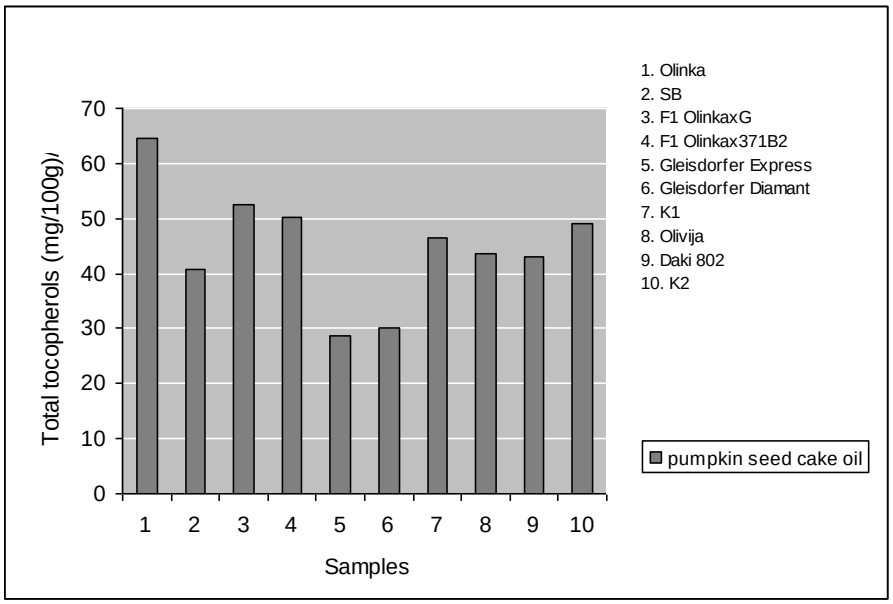

Figure 1. Total tocopherols content in oil from pumpkin seed press cake

The total content of tocopherols in the oil extracted from pumpkin seed press cakes was relatively high, ranging from 28.76 to 64.53 mg/100g and contributing to the nutritional value of the samples. The content was highest in the oil obtained from the Serbian “Olinka” pumpkin cake, and lowest in the oil extracted from the cake remained after pressing the seeds of the Austrian “Geisdorfer Express” hybrid. γ-Tocopherol as the dominant tocopherol isomer in all samples, accounting for 73.64 – 85.28% of total content.

CONCLUSIONS

From the point of view of the composition of fatty acids all samples regardless of the type of cake used for their extraction corresponded to the oleic-linoleic type, which indicates a high nutritional value of the oil. Considering that the amount of tocopherol detected in the examined oil was considerably high, we can draw a conclusion that a large percentage of tocopherol remains in the cake. Therefore, the oil left over in the cake should be considered for use, taking into account its nutritional value and its high presence in the cake.

ACKNOWLEDGEMENT

The authors would like to thank the Ministry of Education and Science, Republic of Serbia, for the grant 46010.

REFERENCES

1. Berenji, J. (2007). Hemijska, nutritivna i farmakološka vrednost uljane tikve-golice (*Cucurbita pepo* L.). *Zbornik radova Instituta za ratarstvo i povrtarstvo, 43,* 149-159.
2. Fruhwirth, G. O., Wenzl, T., El-Toukhy, R., Wagner F. S., Hermetter A. (2003). Fluorescence screening of antioxidant capacity in pumpkin seed oils and other natural oils, *European Journal of Lipid Science and Technology, 105,* 266–274.
3. Gorjanović, S., Rabrenović, B., Novaković, M., Dimić, E., Basić, Z., Sužnjević, D. (2011). Cold-pressed pumpkin seed oil antioxidant activity as determined by a dc polarographic assay based on hydrogen peroxide scavenge, *Journal of the American Oil Chemists' Society*, *88*, 1875–1882.

4. ISO 659: 2007, Oilseeds - Determination of oil content.
5. ISO 665: 2000, Oilseeds - Determination of moisture and volatile matter content.
6. ISO 5508:1990, Analysis by gas chromatography of methyl esters of fatty acids.
7. ISO 5509:2000, Animal and vegetable fats and oils — Preparation of methyl esters of fatty acids.
8. Karlović Đ., Berenji J., Recseg K., Kővári K. (2001). Savremeni pristup uljanoj tikvi (*Cucurbita pepo* L.) sa posebnim osvrtom na tikvino ulje (Oleaum cucurbitae). 42. Savetovanja industrije ulja, "Proizvodnja i prerada uljarica", *Zbornik radova*, pp. 177-182, Herceg Novi.
9. Murković, M. and Pfannhauser, W. (2000). Stability of pumpkin seed oil, *European Journal of Lipid Science and Technology, 102*, 607–611.
10. Murković, M., Piironen, V., Lampi, V., Kraushofer, T., Sontag, G. (2004). Changes in chemical composition of pumpkin seeds during the roasting process for production of pumpkin seed oil Part 1: Non-volatile compounds, *Food Chemistry, 84* , 359–365.
11. Nakić-Nedjeral, S., Rade, D., Skevin, D., Strucelj, D., Mokrovcak, Z., Bartolic, M. (2006). Chemical characteristics of oils from naked and husk seeds of *Cucurbita pepo* L., *European Journal of Lipid Science and Technology, 108,* 936–943.
12. Radočaj, O., Dimić, E., Diosady, L.L., Vujasinović, V. (2011). Optimizing the texture attributes of a fat-based spread using instrumental measurements, *Journal of Texture Studies, 42,* 394-403.
13. Schuler, P. (1990). Natural ***antioxidants*** exploited commer cially. In Hudson B.F. (Ed.) Food Antioxidants*,* Elsevier Science, pp. 99 -105.
14. Schuster, W., Zipse, W., Marquard, R. (1983). The Influence of Genotype and Growing Location on several Substances of Seeds of the pumpkin (*Cucurbita pepo L*.), *European Journal of Lipid Science and Technology* , *85* , 56–64.
15. Siegmund, B. and Murkovic, M. (2004). Changes in chemical composition of pumpkin seeds during the roasting process for production of pumpkin seed oil (Part 2: volatile compounds), *Food Chemistry 84* : 367–374.
16. Vujasinović, V., Đilas, S., Dimić, E., Romanić, R., Takači, A. (2010). Shelf life of cold – pressed pumpkin (Cucurbita pepo L.) seed oil obtained with a screw press, *Journal of the American Oil Chemists' Society, 87*,1497–1505.
17. Vukša V., Dimić E., Dimić V. (2003). Characteristics of cold pressed pumpkin seed oil. 9th Symposium: Vitamine und Zusatzstoffe in der Ernährung von Mensch und Tier, *Proceedings*, pp 493-496, Jena/Thüringen.
18. Wentzel C. (1987). Recent Studies on the Fatty Acid Composition of Sytrian Pumpkin Seed Oils, *Ernährung/Nutrition*, *11*, 752–755.
19. Younis, Y.M.H., Ghirmayb, S., Al-Shihryc, S.S. (2000). African *Cucurbita pepo* L.: properties of seed and variability in fatty acid composition of seed oil, *Phytochemistry 54,* 71-75