7th Workshop

SPECIFIC METHODS FOR FOOD SAFETY AND QUALITY

September 22nd 2021, Vinča Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

PROCEEDINGS

SPECIFIC METHODS FOR FOOD SAFETY AND QUALITY

7th WORKSHOP: SPECIFIC METHODS FOR FOOD SAFETY AND QUALITY

September 22nd, 2021, Belgrade, Serbia

is an *online satellite event* of

PHYSICAL CHEMISTRY 2021

15th International Conference on Fundamental and Applied Aspects of Physical Chemistry

Organized by

VINČA INSTITUTE OF NUCLEAR SCIENCES-NATIONAL INSTITUTE OF THE REPUBLIC OF SERBIA
Vinča – Belgrade, Serbia

in co-operation with

THE SOCIETY OF PHYSICAL CHEMISTS OF SERBIA

Held under the auspices of the

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGICAL DEVELOPMENT

Organizing Committee

Chairman
Branislav Nastasijević (Serbia)

Members
Milovan Stoiljković (Serbia)
Sandra Petrović (Serbia)
Andreja Leskovac (Serbia)
Tamara Lazarević-Pašti (Serbia)
Neda Đorđević (Serbia)
Vojislav Stanić (Serbia)

International Scientific Committee

Chairman
Mirjana Čolović (Serbia)

Members
Pierre-Michel Adam (France)
Giovanna Marazza (Italy)
Cecilia Cristea (Romania)
Goran Gajski (Croatia)
Klemen Bohinc (Slovenia)
Polonca Trebše (Slovenia)
Evgeniya Sheremet (Russia)
Andreja Leskovac (Serbia)
Sandra Petrović (Serbia)
Aleksandra Bondžić (Serbia)
Ana Vujačić Nikezić (Serbia)

PHYSICAL CHEMISTRY 2021

15th International Conference on Fundamental and Applied Aspects of Physical Chemistry

7th Workshop

SPECIFIC METHODS FOR FOOD SAFETY AND QUALITY

September 22nd, 2021, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, Belgrade, Serbia

PROCEEDINGS

BELGRADE, SERBIA 2021

7th WORKSHOP: SPECIFIC METHODS FOR FOOD SAFETY AND QUALITY

PROCEEDINGS

Publisher
VINČA INSTITUTE OF NUCLEAR SCIENCES-
NATIONAL INSTITUTE OF THE REPUBLIC OF SERBIA
Vinča - Belgrade, Serbia

Editors
Dr Mirjana Čolović
Dr Sandra Petrović

Reviewers
Dr Mirjana Čolović
Dr Sandra Petrović
Dr Andreja Leskovac
Dr Tamara Lazarević-Pašti
Dr Neda Đorđević
Dr Aleksandra Bondžić
Dr Ana Vujačić Nikezić

Design
Dr Andreja Leskovac

Printed by
Apollo Plus d.o.o., Beograd

Print run
30 copies

ISBN
978-86-7306-163-4

BELGRADE, SERBIA 2021

CONTENTS

SESSION A:
SPECIFIC METHODS IN FOOD QUALITY CONTROL

PL A1	ELECTROANALYTICAL METHODS FOR FOOD SAFETY AND QUALITY CONTROL ASSESSMENT C. Cristea, O. Hosu, B. Feier and M. Tertis	**1**
IL A1	PRECISE TESTING OF PESTICIDES IN FOOD USING THE SCIEX TRIPLE QUAD^{TM} 7500 LC-MS/MS SYSTEM- QTRAP$^{®}$ READY- HIGHLY SENSITIVE ANALYSIS OF MULTI-COMPOUND PANELS IN VARIOUS MATRICES FOR FOOD REGULATIONS D. McMillan, J. Stahl-Zeng, I. Moore, T. Biesenthal, J. Steed and W. Broer	**6**
IL A2	DEVELOPMENT OF NOVEL ANALYTICAL PLATFORMS FOR THE RAPID, POINT-OF-USE QUANTIFICATION OF MULTIPLE CONTAMINANTS IN FOOD SAMPLES G. Selvolini and G. Marrazza	**10**
IL A3	APPLICATION OF GCE AND FTIR METHODS FOR THE DETERMINATION OF GLIADINS FROM WHEAT FLOUR V. Gojković Cvjetković, Ž. Marjanović-Balaban, D. Rajić and D. Vujadinović	**16**
OP A1	ANALYSIS OF SPICE PAPRIKA POWDERS FROM SERBIAN MARKET V. Vasić, M. Radenković, M. Pavlović, J. Petrović, K. Nikolić, M. Momčilović and S. Živković	**24**
P A1	VISUAL DETECTION OF QUERCETIN USING GOLD NANOPARTICLES M. Nemoda, M. Pavlović, M. Stoiljković and T. Momić	**28**
P A2	ALUMINA-MODIFIED CARBON PASTE ELECTRODE FOR DETERMINATION OF TOTAL PHENOLIC CONTENT IN WINE T. Novaković, M. Pagnacco, P. Banković and Z. Mojović	**32**
P A3	REVERSED-PHASE ULTA HIGH PERFORMANCE LIQUID CHROMATOGRAPHY ANALYSIS OF TRIAZINE PESTICIDES WITH ACYCLIC AND CYCLIC SUBSTITUENTS B. Salaković, S. Kovačević, M. Karadžić Banjac, J. Anojčić, L. Jevrić, S. Podunavac-Kuzmanović, S. Gadžurić and D. Antonović	**36**
P A4	POLAROGRAPHY IN DETERMINATION OF RED WINE ANTIOXIDANT ACTIVITY S. Pejić, N. Đorđević, S. Gorjanović, F. Pastor, N. Todorović Vukotić, V. Tešević and S. B. Pajović	**40**

SESSION B:
FOOD SAFETY

IL B1	TOXICOLOGICAL PROFILE OF MARINE TOXIN DOMOIC ACID IN HUMAN BLOOD CELLS G. Gajski, M. Gerić, A-M. Domijan and B. Žegura	**44**
IL B2	BACTERIAL ADHESION RATE ON FOOD CONTACT SURFACES K. Bohinc	**51**
IL B3	CHITOSAN-COATINGS IN EXTENDING SHELF-LIFE OF APPLES N. Mavrič, K. Bohinc, R. Vidrih, K. Godič Torkar and M. Bavcon Kralj	**54**
IL B4	IMPACT OF GAMMA IRRADIATION ON AFLATOXIN B1 AND OCHRATOXIN A TOXICITY A.-M. Domijan, B. Mihaljević, K. Markov, J. Pleadin and A.M. Marjanović Čermak	**61**
IL B5	TOXIC METALS CONTENT IN MUSCLE TISSUE OF COMMON CARP FROM LOCATIONS NEAR BELGRADE D. Jovanović, R. Marković, D. Šefer, M. Krstić, V. Stanić, D. Perić and M. Ž. Baltić	**69**
P B1	BIOWASTE-BASED CARBON MATERIAL FOR MALATHION REMOVAL FROM WATER A. Jocić, S. Brković and T. Lazarević-Pašti	**75**
P B2	VISCOSE-BASED ACTIVATED CARBON MATERIAL FOR CHLORPYRIFOS REMEDIATION V.Milanković , S. Breitenbach , C. Unterweger, C. Fürst and T. Lazarević-Pašti	**79**
P B3	ECO-FRIENDLY ACTIVATED CARBON AS AN ADSORBENT FOR DIMETHOATE REMOVAL FROM WATER V. Anićijević, S. Breitenbach, C. Unterweger, C. Fürst and T. Lazarević-Pašti	**83**
P B4	ANTIRADICAL ACTIVITY OF GRAPE SKIN EXTRACTS - THE EPR STUDY Đ. Nakarada, M. Stojanović, Z. Dajić-Stevanović and M. Mojović	**87**
P B5	DETERMINING OF INDIGO CARMINE (E132) IN CANDY J. Senćanski, J. Maksimović, S. Blagojević and M. Pagnacco	**91**
P B6	CYTOTOXIC ACTIVITY OF RED WINE ON HCT 116 AND PANC-1 CELL LINES J. Žakula, N. Đorđević, N. Todorović Vukotić, L. Korićanac, V. Kovačević and S.B. Pajović	**95**

P B7	GROSS ALPHA AND GROSS BETA ACTIVITY AND OSCILLATORY RESPONSE OF *Sardina pilchardus* FISH SPECIES FROM ADRIATIC SEA M. Janković, J. Maksimović, B. Janković, N. Bošković, M. Rajačić and D. Šuković	**99**
P B8	THE COMPARISON OF HEAVY METAL CONTENT OF *Sardina pilchardus* SPECIES COLLECTED FROM BAY AND OPEN ADRIATIC SEA A. Pesić, D. Joksimović, M. Janković, N. Sarap, J. Maksimović and M. Pagnacco	**103**
P B9	CYTOTOXICITY AND GENOTOXICITY OF *Juniperus communis* ESSENTIAL OIL AND POST-DISTILLATION WASTE B. Vasilijević, S. Cvetković, S. Đukanović, D. Mitić-Ćulafić, M. Jovanović and B. Nikolić	**107**
P B10	ASSESSMENT OF CADMIUM MOBILITY IN BIOAPATITE AMENDED SOIL: LEACHING TESTS AND AVAILABILITY TO THE TOBACCO PLANT M. Jović, J. Marković, M. Šljivić-Ivanović and I. Smičiklas	**111**
P B11	EFFECTS OF CHRONIC ORAL D-GALACTOSE TREATMENT ON GENERAL HEALTH STATUS IN MALE WISTAR RATS J. Martinović, I. Guševac Stojanović, M. Zarić, A. Todorović, F. Veljković, S. Pejić, Z. Stojanović, N. Mitrović, I. Grković and D. Drakulić	**115**
P B12	A SINGLE DOSE OF MICROPLASTIC PARTICLES INDUCES CHANGES IN ORGAN WEIGHT OF MALE WISTAR RATS Z. Stojanović, A. Todorović, J. Martinović, N. Filipović, F. Veljković and I. Guševac Stojanović	**119**
P B13	YELLOW GENTIAN ROOT EXTRACT AND ITS MONOTERPENE COMPOUNDS EXHIBIT ANTICANCER POTENTIAL A. Valenta Šobot, D. Drakulić, J. Savić, G. Joksić and J. Filipović Tričković	**123**
P B14	GENOTOXICITY TESTING OF ACACIA HONEYS OF DIFFERENT GEOGRAPHICAL ORIGIN S. Petrović, A. Bondžić, B. Nastasijević and A. Leskovac	**127**
P B15	CYTOGENOTOXICITY OF DEOXYNIVALENOL AND ZEARALENONE A.-M. Domijan, K. Hercog, M. Filipič, M. Sokolović, M. Gerić, G. Gajski and B. Žegura	**131**

P B16	IN VITRO EVALUATION OF CHLORPYRIFOS CYTOTOXIC EFFECTS M. Čolović, A. Leskovac, A. Vujačić Nikezić and D. Krstić	**135**
P B17	EFFECT OF CHLORPYRIFOS-OXON ON MEMBRANE DAMAGE AND CELL VIABILITY D. Krstić, S. Petrović, A. Vujačić Nikezić and M. Čolović	**139**
P B18	INFLUENCE OF CAVITATION EFFECT ON STABILITY OF AFLATOXIN IN MILK V. Stanić, B.K. Adnadjević, S. Stefanović, S. Tanasković, B. Nastasijević, D. Jovanović and V. Živković	**143**
P B19	ANTIFUNGAL ACTIVITY OF *Gentiana lutea* EXTRACTS B. Nastasijević, M. Milutinović, V. Stanić and S. Dimitrijević-Branković	**147**

SESSION C:
FUNCTIONAL FOOD

IL C1	BIOACCESSIBILITY OF OLIVE-DERIVED NUTRACEUTICALS DETERMINED BY NOVEL STANDARDIZED PROTOCOLS K. Radić	**151**
OP C1	THE ROLE OF SUSTAINABLE AGRICULTURE IN PRODUCTION OF NUTRIENT DENSE FOOD V. Dragičević, M. Stoiljković, M. Simić, M. Brankov, M. Šenk, M. Dodevska and M. Tolimir	**157**
OP C2	PHENOLIC PROFILE OF PLUM WINES AND THEIR ACTIVITY IN THE PROTECTION AGAINST FREE RADICALS U. Čakar, N. Lisov, I. Plavšić, A. Petrović, D. Krstić, I. Stanković and B. Đorđević	**164**
P C1	ANTIMICROBIAL AND PRO-METABOLIC PROPERTIES OF *Salvia officinalis* AQUEOUS EXTRACT J. Filipović Tričković, B. Ćetenović, G. Joksić, Đ. Katnić, A. Krstić and A. Valenta Šobot	**168**
P C2	APPLICATION OF TOMATO (*S. lycopersicum*) WASTE PECTINS IN BIOGENIC SYNTHESIS OF SELENIUM NANOPARTICLES N. Golub, K. Radić, D. Anić, E. Galić, T. Vinković, M. Dutour Sikirić and D. Vitali Čepo	**172**
P C3	ANTIBACTERIAL ACTIVITY OF AQUEOUS-ETHANOLIC EXTRACTS OF *Alchemilla vulgaris* AND *Frangula alnus* COMBINED WITH STREPTOMYCIN S. Đukanović, S. Cvetković, T. Ganić, B. Nikolić, N. Tomić, D. Kekić and D. Mitić-Ćulafić	**176**

P C4	MODULATION OF REDOX PARAMETERS IN RAT LIVER INDUCED BY FLAXSEED OIL A. Todorović, I. Pavlović, S. Pejić, J. Miletić Vukajlović, F. Veljković, J. Filipović Tričković, A. Valenta Šobot, J. Martinović, I. Guševac Stojanović, Z. Stojanović and D. Drakulić	**180**
P C5	COMPARISON OF EXTRACTION KINETICS OF PHENOLIC COMPOUNDS DURING SPONTANEOUS AND INOCULATED FERMENTATION CV. CABERNET SAUVIGNON N. Lisov, I. Plavšić, U. Čakar, A. Petrović and Lj. Gojković-Bukarica	**184**
P C6	ANTIBACTERIAL ACTIVITY OF RED WINE N. Đorđević, I. Novaković, N. Todorović Vukotić, V. Tešević and S. B. Pajović	**188**
P C7	N-ACETYLCYSTEINE AS REGULATOR OF THE CELLULAR HOMEOSTASIS A. Leskovac, M. Čolović, A. Bondžić and S. Petrović	**192**

P B18

INFLUENCE OF CAVITATION EFFECT ON STABILITY OF AFLATOXIN IN MILK

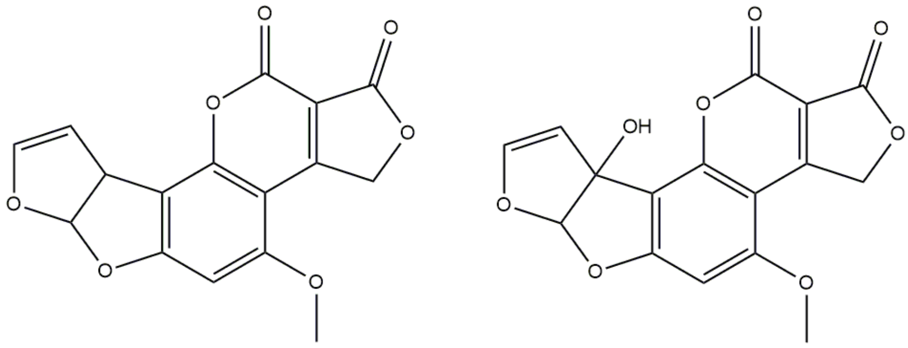
V. Stanić[1], B.K. Adnadjević[2], S. Stefanović[3], S. Tanasković[4], B. Nastasijević[1], D. Jovanović[5] and V. Živković[6]

[1]Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, M. Petrovića Alasa 12-14, 11351 Belgrade, Serbia (voyo@vinca.rs)
[2]University of Belgrade, Faculty of Physical Chemistry, Studentski Trg 12-16, Belgrade, Serbia
[3]Institute of Meat Hygiene and Technology, 13 Kaćanskog st., 11040 Belgrade
[4]University of Belgrade, Faculty of Pharmacy, Vojvode Stepe 450, 11000 Belgrade, Serbia
[5]University of Belgrade, Faculty of Veterinary Medicine, Bulevar Oslobođenja18, 11000 Belgrade, Serbia
[6]University of Belgrade, Faculty of Chemistry, Studentski Trg 12-16, Belgrade, Serbia

ABSTRACT
Mycotoxins are common natural food contaminants which pose a risk to human and animal health. The cavitation effect is often used to break down harmful materials in a liquid medium. In this study, we used a cavitation effect to reduce the amount of aflatoxins in milk. The results showed a 24.2% reduction in aflatoxin content in milk compared to the control sample. These findings indicate that the cavitation effect could be useful for the degradation of aflatoxin M1 in milk.

INTRODUCTION
Contamination of food products with mycotoxins is a problem for human and animal health around the world. Mycotoxins are secondary metabolites produced by fungal species from the *Aspergillus*, *Penicillium*, and *Fusarium* genera. Aflatoxins are toxic metabolites of fungus *Aspergillus*, especially *Aspergillus flavus* and *Aspergillus parasiticus*. There are about 20 different types of aflatoxins, the most important of which are aflatoxins: B1 (AFB1), B2 (AFB2), G1 (AFG1), G2 (AFG1), M1 (AFM1) and M2 (AFM2). Aflatoxins AFM1, AFM2 are 4-hydroxylated derivatives of AFB1 and AFB2 and occur in the milk of mammals fed plant nutrients that contained mentioned B aflatoxins [1]. Figure 1 shows the chemical structural formulas of aflatoxins: AFB1 and AFM1. Diseases caused by aflatoxins are called aflatoxicosis. Although, the

target organ of aflatoxins action is the liver, they also show other undesirable properties, immunosuppression, mutagenicity, teratogenicity and carcinogenicity [2-4].



AFB1 AFM1

Figure 1. Chemical structural formulas of aflatoxins: AFB1 and AFM1.

The level of AFM1 permitted in milk is strictly regulated in many countries: the regulatory limit for AFM1 in milk is 0.25 μg/kg in the Republic of Serbia. AFM1 concentration in milk and dairy products depends on its amounts of nutrients, age, species and breed of animals, lactation period, animal health, season, and other factors [5]. AFM1 is relatively thermostable in raw and processed milk and stays unaffected in pasteurized milk and in dairy products. Several strategies to inactivation of aflatoxins in contaminated products have been reported [6, 7]. An effective inactivation procedure of mycotoxins in food should be performed without creating toxic compounds, and compromising the technological and rheological properties. Also, it is important to maintain the pleasant characteristics of food products, preserving the nutritional values and reducing the loss of nutrients [7]. The objective of this study was to examine the efficacy of the cavitation effect on the degradation of AFM1 in milk under laboratory conditions.

EXPERIMENTAL

Cavitation effect was tested using milk sample obtained from an individual agricultural farm in the vicinity of Valjevo. An Ultra Turrax® homogenizer (T-25 basic, IKA, Germany) was used to create a cavitation effect. The milk sample (500 mL) is mixed at a speed of 20000 rpm for 6 min, while aliquots for the ELISE test were taken at the time intervals shown in Table 1.

The ELISE experiment

Determination of AFM1 in milk was conducted using “Aflatoxin M1” ELISA kit (Tecna S.r.l., Italy). Sample preparation was carried out according to the instructions from the manufacturer. Optical density was measured using

ELISA-reader Thermo Scientific (Waltham, MA, SAD), model 364, at the wavelength of 450 nm. Data aquisition and processing were enabled using Ascent software (v. 1.0). The method detection limit was 0.005 Pg/kg, specificity was 100% for the AFM1. Relative standard deviation of reproducibility was 6%.

RESULTS AND DISCUSSION

Cavitation bubbles generate extreme temperatures (5000 K) and pressures (500 atm) in a very short time. The collapse of a cavitation bubble gives rise to physical and chemical effects in the liquid such as micro-streaming, agitation, turbulence, shock waves, generation of chemical radicals, etc. [8]. The formation of highly reactive chemical radical species can lead to mycotoxin degradation [9]. The main applications of ultrasound in the dairy industry include microbial reduction, fat homogenization, viscosity change, and improved fermentation. Hernández-Falcón *et al.* reported that the lowest levels of AFM1 were found in the unhomogenized milk after 10 minutes of treatment by thermostated ultrasound, one day after storage [10]. Table 1 shows the results of aflatoxin content in milk depending on the mixing time. In all samples, there was a decrease in the concentration of aflatoxins due to mixing, i.e. cavitation effect. Homogenization devices can create a cavitation effect when mixing liquids.

Table 1. Aflatoxin content in milk depending on the homogenization time.

Sample	Time (seconds)	aflatoxin concentration (μg/kg)
1	0	0.190
2	15	0.183
3	30	0.182
4	45	0.176
5	60	0.173
6	90	0.160
7	120	0.154
8	180	0.149
9	240	0.147
10	360	0.144

CONCLUSION

In this work, an IKA homogenizer was used to create a cavitation effect to remove aflatoxins from milk. The results showed a 24.2% reduction in aflatoxin in milk compared to the control sample.

Acknowledgments
The study was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Contract number 451-03-9/2021-14/200017).

REFERENCES

[1] U. Diener, N. Davis, Phytopathology, 1996, 56, 390-393.
[2] A. Magnussen, M. A. Parsi, World Journal of Gastroenterology, 2013, 14, 1508–1512.
[3] S. Marchese, A. Polo, A. Ariano, S. Velotto, S. Costantini, L. Severino, Toxins 2018, 10, 214.
[4] O. Adejumo, O. Atanda, A. Raiola, Y. Somorin, R. Bandyopadhyay, A. Ritieni, Food and Chemical Toxicology, 2013, 56, 171-177.
[5] H. P. Van Egmond, S. Dragacci. In: Mycotoxin Protocols. M. W. Trucksess, A. E. Pohland (Eds.), Liquid chromatographic method for aflatoxin M1 in milk. Humana Press, Totowa, USA 2001, 59-69.
[6] Z. Peng, L. Chen, Y. Zhu, Y. Huang, X. Hu, Q. Wu, A. K. Nüssler, L. Liu, W.Yan, Trends in Food Science and Technology, 2018, 80, 155-166.
[7] A. M. Alizadeh, F. Hashempour-Baltork, A. M. Khaneghah, H. Hosseini, Current Opinion in Food Science 39, 2021,7–15.
[8] L. M. Carrillo-Lopez, I. A. Garcia-Galicia, J. M. Tirado-Gallegos, R. Sanchez-Vega, M. Huerta-Jimenez, M. Ashokkumar, A. D.Alarcon-Rojo, Ultrasonics Sonochemistry, 2021, 73, 105467.
[9] Y. Liu, M. Li,Y. Liu, K. Bian, Toxins 11, 2019, 526.
[10] T. A. Hernández-Falcón, A. Monter-Arciniega, N. S. Cruz-Cansino, E. Alanís-García, G. M. Rodríguez-Serrano, A. Castañeda-Ovando, M. García-Garibay, E. Ramírez-Moreno, J. Jaimez-Ordaz, Ultrasonics Sonochemistry 2018, 48, 396-403.