



Latvijas Zinātnes padome



APP Dārzkopības institūts

Project: Izp-2020/1-0422

“Dicotyledonous plant families and green tools as a promising alternative approach to increase the accessibility of tocotrienols from unconventional sources”

Summary (01.01. – 31.12.2022)

In 2022, cooperation with Botanical Gardens was continued in order to increase the number of previously not investigated species as well as to re-examine already analyzed species in order to take into account environmental factors' which may effect the profile of tocochromanols. During this period we focused more on the specific families characterized by the presence of tocotrienols and unknown compounds detected during the tocochromanols determination using fluorescence detection (potential tocochromanol-related compounds). The application of the chemotaxonomic approach exceeded our wildest expectations. Using this tool, we were able to select over 1000 species rich in tocotrienols in over ten families. Performed analysis in 2022 allowed us to state, that reports on the presence of tocotrienols in the Lamiaceae family was incorrect. We investigated over 200 species and, if any tocotrienols were detected, they were in very low concentrations. Generally, γ -T dominated in this family.

Green technologies (cold-pressing) were applied to obtain seed oils rich in tocotrienols from selected species – healthier alternatives to palm oil (the most widely used source of tocotrienols, but also rich in saturated fatty acids). We have found at least three richer sources of specific tocotrienols. α -T3 dominated in cumin (*Cuminum cyminum*) seed oil (91.14 mg/100 g), β -T3 dominated in nigella (*Nigella sativa*) (24.52 mg/100 g), and γ -T3 dominated in caraway (*Carum carvi*) (131.17 mg/100 g). For comparison, the popular unrefined/fined palm (*Elaeis guineensis*) oil contains 17.52 mg α -T3, 3.04 mg β -T3, 31.67 mg γ -T3, and 3.49 mg δ -T3 on 100 g-1 oil.

It has been found that by applying optimized conditions of extraction by using ‘green’ solvents and ultrasound-assisted method tocochromanols from seeds can be extracted with 80–99% effectivity in comparison to the most common saponification protocol. This finding can mainly help to reduce the number of used solvents and simplify the routine analysis of tocochromanols.

To increase the potential of finding new sources of bonded forms, the samples were directly extracted without applying the saponification protocol. During sample screening, several unidentified peaks were notified, which will be identified in the 3th year of the project by IT-TOF. The process of synthesis of tocochromanol esters is in the process.

It has been developed first prototype of the pentafluorophenyl (PFP) monolithic column. The PFP monolithic column was obtained by the procedure to chemically bond a new selectivity to the surface of the silica monolith column performed in-situ involving a HPLC pump to deliver a PFP silane solution in heptane at elevated temperature. The developed PFP monolithic column allows relative separation of isomers gamma and beta.



Activities in 2022:

1) Published the following papers for this project:

„Free tocopherols and tocotrienols in 82 plant species’ oil: Chemotaxonomic relation as demonstrated by PCA and HCA. Food Research International, 2023, 164, 112386”

<https://doi.org/10.1016/j.foodres.2022.112386>

„Crab apple (*Malus* spp.) seed tocopherol profile: impact of genotype, species, purpose and rootstock. Agronomy, 2022, 12, 2736”

<https://doi.org/10.3390/agronomy12112736>

„Seven underutilized species of the Fabaceae family with high potential for industrial application as alternative sources of oil and lipophilic bioactive compounds. Industrial Crops and Products, 2022, 186, 115251”

<https://doi.org/10.1016/j.indcrop.2022.115251>

„Analytical scale supercritical fluid chromatography for the analysis of nine tocochromanols in 24 different cold-pressed plant oils: Method development, validation, and isolation of tocotrienols and plastochromanol-8. Journal of Food Composition and Analysis, 2022, 110, 104586”

<https://doi.org/10.1016/j.jfca.2022.104586>

2) International conferences, local events:

G. Baškirovs, P. Gornas “Isolation of four Tocotrienol homologues and Plastochromanol-8 from Plant Oils and the Rapid ‘Green’ analysis of nine tocochromanols in cold-pressed plant oils via Superficially Porous Particle Packed Column Technology and Supercritical Fluid Chromatography”. The 80th International Scientific Conference of the UL, 11.02.23022 (oral presentation). Book of abstracts: <https://doi.org/10.22364/iscul.80.cs.ba> (pp. 10).

Danija Lazdiņa, Zanda Krūma, Paweł Górnaś. CHEMICAL COMPOSITION AND CHEMICAL STABILITY OF SELECTED SPICE SEED OILS. 17th International Scientific Conference STUDENTS ON THEIR WAY TO SCIENCE, April 21, 2023, Latvia University of Life Sciences and Technologies. (Oral presentation). Abstracts proceedings, p.43, <https://www.sws.llu.lv/proceedings>

Danija Lazdiņa "Triacilglicerīdi, taukskābes, steroli, tokohromanoli garšaugu sēklu eļļās un to oksidatīvā stabilitāte". Pūres Pētījumu centra ēkas atklāšana, 15 septembris, Dārzkopības Institūts (oral presentation). <https://www.darzkopibasinstitutus.lv/lv/raksts/2022-09-20/pures-petijumu-centra-ekas-atklasana>

