

Brief information about the project

Name of the project	AP09058561 “Effective development of highly sensitive methods for food analysis based on miniaturized solid-phase microextraction” (0121PK00061)
Relevance	This project is aimed at developing analytical techniques based on the miniature solid-phase microextraction (mini-SPME) method. The developed new techniques based on the SPME method will make it possible to determine the main organic components, including hazardous substances such as endocrine disruptors, preservatives and flavorings in food products, as well as to conduct comprehensive monitoring and assess the risk of food safety, in accordance with established requirements and the declared value of food products.
Purpose	The goal of this project is to develop modern express methods for analyzing food products using a “green” innovative method - miniaturized solid-phase microextraction.
Objectives	<p>To achieve this goal, within the framework of the project in accordance with the calendar plan provided for in Agreement No. 86-KMU2 dated 03/02/2021, concluded between the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan and the Al-Farabi Kazakh National University, there were The following tasks have been set:</p> <p>Task 1. Monitoring and screening of bottled water and tea from domestic and foreign manufacturers for the content of toxicants and preservatives. As part of this task, it is planned to develop new rapid analysis methods based on miniaturized solid-phase microextraction (mini-SPME) in combination with gas chromatography-mass spectrometry and high-performance liquid chromatography of everyday drinks to study the component composition. The safety of beverages will also be assessed for the presence of organic contaminants that may affect the safety of the consumed product. Products from major cities of the Republic of Kazakhstan will be studied.</p> <p>New food analysis techniques will be developed based on miniaturized solid phase microextraction (mini-SPME):</p> <p>Quantitative analysis of alkylphenols in bottled drinking water using miniaturized solid-phase microextraction combined with gas chromatography-mass spectrometry.</p> <p>Research and quantitative analysis of the component composition of leaf and granulated tea of black and green varieties in order to assess the quality of the product using the method of miniaturized solid-phase microextraction.</p> <p>Task 2. To accomplish this task, it is necessary to develop methods for the analysis of alcoholic and non-alcoholic beverages using GC/MS methods in combination with mini-SPME, which involves optimizing all parameters of each stage of sample preparation of mini-SPME and analysis.</p>

	<p>New methods for food analysis will be developed based on mini-SPME in combination with gas chromatography-mass spectrometry and high-performance liquid chromatography: Identification and quantitative analysis of preservatives in alcoholic and non-alcoholic drinks by the method of miniaturized solid-phase microextraction and identification of falsified honey products by the method of solid-phase microextraction.</p> <p>Determination and quantitative analysis of beneficial components (vitamins, flavonoids) in natural juices and wine using miniaturized solid-phase microextraction in combination with chromatographic methods.</p> <p>Thus, the set goals and objectives of the Project will help establish the content of toxicants and preservatives in bottled water, alcoholic and non-alcoholic drinks, tea, as well as the content of beneficial components (vitamins, flavonoids) in natural juices and wine, as well as the identification of falsified honey products.</p>
Expected and achieved results	<p>As a result of the implementation of this project, completely new innovative methods were obtained based on miniaturized solid-phase microextraction that meet the principles of green chemistry:</p> <ol style="list-style-type: none"> 1) An effective method for determining alkylphenols and endocrine disruptors in drinking water using miniaturized solid-phase microextraction; 2) Express method for determining caffeine in tea samples using miniaturized solid-phase microextraction; 3) Methods for determining preservatives in alcoholic beverages (wine) and methods for determining flavors in juice products using miniaturized solid-phase microextraction; 4) Methodology for identifying counterfeit honey products using solid-phase microextraction. <p>The conducted research provides reliable and effective methods for the analysis and detection of chemicals in various matrices. Consequently, the developed mini-SPME-based techniques are rapid and can improve analytical efficiency, improve laboratory accuracy and reliability, contributing to the overall safety of human health and the environment. Further research and practical application of mini-SPME may help develop more reliable and environmentally friendly approaches to the analysis and detection of chemicals in a variety of samples. The results of this project contribute to improving the system of control over the quality and safety of food products, improving the work of standardization and certification bodies, as well as the development of new state standards for basic food products in order to ensure their compliance with international standards.</p> <p>The level of scientific development of this work is due to the fact that it calculated the concentrations of analytes, such as alkylphenols, endocrine disruptors, caffeine, preservatives</p>


	<p>and flavorings in various matrices, and also assessed the error and uncertainty in measurements associated with the identification of these compounds. To check the repeatability and consistency of the results, an extensive set of experimental data obtained in several independent series of experiments was used, followed by statistical processing using methods such as hierarchical cluster analysis, principal component analysis and heat map. A graphical representation of the errors for each obtained value is presented in all obtained figures and graphs.</p> <p>Based on the research results, 2 articles were published in international journals with an impact factor based on the Web of Science (Food Analytical Methods and Food Chemistry:X) and 1 article was submitted on the topic “Miniaturized solid-phase microextraction for analysis of food additives in beverages” international peer-reviewed journal Microchemical Journal (Q1, https://www.scopus.com/sourceid/20922?origin=resultslist), date of submission October 27, 2023. The article was submitted upon completion of all research work, according to the calendar plan. The developed methods for analyzing food products were introduced into the laboratory "Ecology of the Biosphere" of the Center for Physical and Chemical Methods of Research and Analysis of the NAO KazNU named after. al-Farabi.</p> <p>3 articles were published in journals recommended by KOKSNVO MNHE RK (Bulletin of the Kazakh-British Technical University, International Journal of Biology and Chemistry, Reports of the National Academy of Sciences of the Republic of Kazakhstan).</p> <p>The number of published articles fully corresponds to the planned calendar according to the project application. The project also made it possible to train two undergraduate students and two doctoral students at Al-Farabi Kazakh National University, who in the future will contribute to the development of science in the Republic of Kazakhstan.</p>
<p>Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles</p>	<ol style="list-style-type: none"> 1. Alimzhanova Mereke Baurzhanovna, Candidate of Chemical Sciences, PhD, assoc. professor Hirsch index – 7, Researcher ID K-3756–2013, ORCID: 0000-0003-2641-0828, Scopus author ID: 35083073100. 2. Syrgabek Erkanat Arkynuly, Master of Technical Sciences Hirsch Index – 1, Scopus Author ID – 57736408100, ResearcherID – GMH-2154-2022, ORCID – 0000-0003-2165-1294. 3. Madina Ruslankyzy Mamedova, Master of Science Hirsch Index – 2, Scopus Author ID – 57322979800, ResearcherID – P9842-2017, ORCID – 0000-0001-6. 4. Ibraimov Aibat Bolatbekovich, Master of Science Hirsch Index – 1, Hirsch Index – 1, Scopus Author ID – 57323449900, Researcher ID – AAS-5992–2020, ORCID – 0000-0003-2342-5960

List of publications with links to them

- Alimzhanova M., Mamedova M., Ashimuly K., Alipuly A., Adilbekov Y. Miniaturized solid-phase microextraction coupled with gas chromatography-mass spectrometry for determination of endocrine disruptors in drinking water // Food chemistry - X. – 2022. – Vol. 14. – 100345. <https://doi.org/10.1016/j.fochx.2022.100345> (процентиль по CiteScore в базе Scopus – 88, Q1);
- Mamedova M., Alimzhanova M.B. Determination of Biomarkers in Multifloral Honey by Vacuum-Assisted Headspace Solid-Phase Microextraction // Food Analytical Methods. – 2023. – Vol. 16. – P. 1180-1190. <https://doi.org/10.1007/s12161-023-02499-0> (percentile according to CiteScore in the Scopus database – 62, Q2).
in domestic journals recommended by KOKSNVO:
- Mamedova M.R., Orynbasar A.B., Alimzhanova M.B. Determination of biomarkers of buckwheat honey by solid-phase microextraction to establish authenticity // Bulletin of the Kazakh-British Technical University. – 2022. – T. 19. – P. 23-32. <https://doi.org/10.55452/1998-6688-2022-19-3-23-32>;
- Syrgabek Y.A., Ibraimov A.B., Mamedova M.R., Ashimuly K., Alimzhanova M.B., Yegemova S.S., Batyrbekova S.E. Miniaturized solid-phase microextraction of caffeine in tea samples: assessing the environmental friendliness of the methods with the GAPI tool // International Journal of Biology and Chemistry. – 2023. – Vol. 16 (1). – P. 68-77. <https://doi.org/10.26577/ijbch.2023.v16.i1.07>. (KOKCHBO, WoS Q4);
- Ibraimov A.B., Mamedova M.R., Ashimuly K., Yegemova S.S., Alimzhanova M.B. // Научный журнал «Доклады НАН РК». – 2023. – Т. 345 (1). – С. 265-281. <https://doi.org/10.32014/2023.2518-1483.200> (KOKCHBO).
- Adylkhan D.Zh., Alipuly A., Ibraimov A.B. Shyryn onimderinin sapasyn physicist-chemist admin baqylau // Materials of the international scientific conference of students and young scientists “FARABI ALEMI”. April 4-8, 2022 – Almaty: Kazakh University, 2022. – P. 286. ISBN 978-601-04-5965-6;
- Myrzai A.D. Ibraimov A.B. Chromato mass spectrometry tasilmen sharapty taldau adistemessin validation // Materials of the international scientific conference of students and young scientists “FARABI ALEMI”. April 4-8, 2022 – Almaty: Kazakh University, 2022. – P. 326. ISBN 978-601-04-5965-6;
- Alimzhanova M.B., Ibraimov A.B., Ashimuly K., Syrgabek E.A., Mamedova M.R. Application of miniaturized solid-phase microextraction coupled with gas chromatography-mass spectrometry for determination of food additives in beverages // Biannual international conference Euroanalysis XXI. 27-31 August 2023, Switzerland. – P. 204-205;

	- Dzhumabekova A.E., Ibraimov A.B. Chromatography қәдіспн суындар құғамындғы сінтетикалік гоғыш затutory анһтау әдістемінінһ metrologyalһһ sipattamalaryn анықтау // Materials of the international scientific conference of students and young scientists “FARABI ALEMІ”. April 6-8, 2023 – Almaty: Kazakh University, 2023. – P. 247. ISBN 978-601-04-6253-3;- Mamedova M.R., Alimzhanova M. B., Syrgabek E.A. Monofloral honey analysis using vacuum assisted HS-SPME // 25th International Symposium on Advances in Extraction Technologies. 18-21 July 2023. – P. 292. - ISBN 978-84-09-52974-2.
Patents	-


Determination of endocrine disruptors in water


Oc1ccc(R)cc1

Determination of organic components in tea samples


Oc1cc(O)c2c(c1)oc(O)c(O)c2

Determination of preservatives in alcoholic and non-alcoholic beverages


O=C1C(=C(C=C1)OC2=CC=CC=C2)C(=O)R
