LETTER OF RECOMENDATION

for the dissertation work of Syrgabek Yerkanat Arkynuly
on the topic: "Development of methods for the determination of pesticides in grapes using solid-phase microextraction", submitted for the degree of Doctor of Philosophy (PhD) in the educational program 8D05301 – Chemistry.

Pesticides are an integral part of modern agriculture, providing crop protection against pests and diseases. However, their uncontrolled use leads to the accumulation of residues in food products, posing a serious threat to human health and the environment. In this regard, a relevant task of analytical chemistry is the development of sensitive, accurate, and environmentally safe methods for the determination of pesticides in food matrices, including grapes, which occupy an important place in the structure of the global agro-industrial complex.

The dissertation work of Syrgabek Y.A. is devoted to the development and optimization of modern "green" analytical methods for determining of pesticides in grapes based on vacuum and miniaturized solid-phase microextraction followed by gas chromatography and mass spectrometry. The relevance of the study is determined by the need to improve the efficiency of monitoring and quality control of agricultural products in accordance with international standards and food safety requirements.

In the course of the work, the author conducted an analysis and comparison of existing methods of sample preparation and pesticide analysis in grapes, identifying the main drawbacks of traditional approaches such as, multi-stage procedures, the use of large volumes of organic solvents, and significant time and financial costs. The scientific novelty of the research lies in the fact that, for the first time, methods for determining pesticides of different classes in grapes using vacuum and miniaturized solid-phase microextraction were developed and optimized, their validation was carried out, and their greenness was evaluated using modern tools such as GAPI, AGREEprep, and BAGI.

In the course of the research, the optimal extraction parameters for both methods were determined, achieving low limits of detection and quantification of pesticides, as well as high reproducibility and accuracy. All results were obtained using modern statistical data processing methods. The practical significance of the work is confirmed by implementing the developed methods in the Kazakh Scientific Research Institute of Fruit and Vegetable Growing LLP, as well as by the potential use of the obtained results to improve national standards and regulations.

During his studies, Syrgabek Y.A. proved himself to be a qualified, hardworking, and goal-oriented young scientist with deep knowledge in the field of analytical chemistry, capable of independently planning and carrying out complex research projects and quickly mastering modern analytical methods and data processing software. He completed an internship at the University of Valladolid (Spain, Valladolid) under the supervision of Professor Pedro Antonio García-Encina, where he demonstrated a high level of independence, scientific creativity, and the ability to work effectively in an international team.

The results of the dissertation research were discussed at international scientific conferences. Scientific articles such as:

1. Y. Syrgabek, M. Alimzhanova, Modern Analytical Methods for the Analysis of Pesticides in Grapes: A Review, Foods. 11 (2022) 16–23. https://doi.org/10.3390/foods11111623 (WoS - Q1, Impact Factor 5.2; Scopus - 97th percentile, CiteScore 5.8 according to 2022 data);

2. Y. Syrgabek, M. Alimzhanova, P.A. García-encina, J. Jose, L. Rebeca, Greenness evaluation of sample preparation methods by GAPI for the determination of pesticides in grape: A review, Trends in Environmental Analytical Chemistry. 39 (2023). https://doi.org/10.1016/j.teac.2023.e00206 (WoS - Q1, Impact Factor 11.1; Scopus - 99th percentile, CiteScore 21.2 according to 2023 data);

3. Y. Syrgabek, M. Alimzhanova, S. Yegemova, S. Batyrbekova, Vacuumassisted headspace-solid phase microextraction of pesticides in grape samples, Advances in Sample Preparation. 11 (2024) 1–15. https://doi.org/10.1016/j.sampre.2024.100123 (WoS - Q1, Impact Factor 6.5; Scopus - 82nd percentile, CiteScore 7.5 according to 2024 data);

4. M. Alimzhanova, Y. Syrgabek, P.A. García-encina, Eco-Friendly Miniaturized Solid Phase Microextraction for Pesticide Analysis in Grapes, Journal of Separation Science. 48 (2025). https://doi.org/10.1002/jssc.702041of14 (WoS – Q2, Impact Factor 2.8; Scopus – 66th percentile, CiteScore 6.1 according to 2024 data) have been published in international peer-reviewed journals, which indicates the recognition of the work by the scientific community.

This research was carried out within the framework of:

- grant funding for scientific and/or scientific-technical projects for 2020-2022 under the topic "Improvement and development of highly sensitive methods to ensure food safety in Kazakhstan" project IRN AP08857501;

- grant funding for scientific and/or scientific-technical projects for 2023-2025 under the topic "Development of a biological product to increase the yield of grapes" project IRN AP19680563;

- grant funding for research by young scientists under the "Zhas Galym" project for 2024-2026 on the topic "Development of highly sensitive "green" methods for the analysis of residual amounts of pesticides in grapes" project IRN AP22685606.

Taking into account the significance of the topic, the scope of the conducted research, the scientific novelty and practical value of the work, as well as the high professionalism of the applicant, the dissertation of Syrgabek Yerkanat Arkynuly titled "Development of methods for the determination of pesticides in grapes using solid-phase microextraction" fully meets the established requirements and deserves the awarding of the Doctor of Philosophy (PhD) degree in the educational program 8D05301 – Chemistry.

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