REVIEW
of the scientific advisor
on the Ph.D. thesis of Mr. Marat Bektassov
"Development of comprehensive methods for organic compounds determination in water"
presented for the defense of a Ph.D. degree in the educational program
"8D05301 – Chemistry"

Biogenic volatile organic compounds (BVOCs) account for approximately 75%-90% of global volatile organic compound (VOC) emissions, markedly exceeding those from anthropogenic sources. BVOCs play a vital role in tropospheric photochemical processes and are responsible for over 75% of secondary organic aerosol (SOA) formation and 20% of global ozone generation. Monitoring BVOCs is essential for safeguarding water quality, protecting public health, and advancing understanding of global climate mechanisms. Quantifying BVOCs at trace levels using conventional methods requires labor-intensive, time-consuming sample preparation and calibration procedures, often involving toxic solvents for chemical desorption. Consequently, determination requires sophisticated analytical techniques to ensure precision, along with a focus on rapidity and field portability to capture the dynamic nature of BVOCs.

The Ph.D. project focuses on developing, optimizing, and validating advanced analytical techniques to detect BVOCs and biogenic sulfur compounds, including dimethyl sulfide (DMS) and dimethylsulfoniopropionate (DMSP), in aquatic environmental samples. The research primarily employs dynamic headspace extraction coupled with gas chromatography-mass spectrometry (DHS-GC-MS).

The Ph.D. thesis presents a systematic and well-organized study of dynamic headspace extraction (DHS), including the optimization of incubation temperature, trapping and drying gas volumes, sorbent selection, moisture control, and desorption conditions. As a result, a sensitive and reproducible analytical workflow capable of quantifying five representative BVOCs (2-pentanone, dibromomethane, α-pinene, Δ^3-carene, and nonanal) at trace levels in freshwater and marine samples was developed. The proposed method demonstrates high analytical performance, as evidenced by low limits of detection (0.05–0.31 μg L^{-1}), excellent linearity, and satisfactory recovery rates.

A significant contribution of the Ph.D. thesis is the extension of the DHS-GC-MS platform to sulfur-containing compounds. The study convincingly demonstrated that Carbopack B sorbent tubes outperform Tenax TA for DMS analysis, with a 34–53-fold increase in signal response. Successfully integrating alkaline hydrolysis into the DHS workflow allowed for indirect yet reliable quantification of DMSP, maintaining stable conversion efficiency and high analytical accuracy. These findings mark a significant methodological advancement in measuring biogenic sulfur compounds in water.

Furthermore, special attention was given to evaluating matrix effects in complex aquatic samples, including freshwater, seawater, wastewater, and microalgae-enriched systems. The results demonstrate that the developed methods are robust to variations in salinity and organic matter and provide valuable insights into matrix-induced signal suppression for selected analytes.

An additional strength of the Ph.D. thesis is the application of the validated DHS methods in laboratory aerosolization experiments. This investigation demonstrated that bubble-bursting processes can both aerosolize viable microalgal cells and release DMS into the gas phase, experimentally linking aquatic microbial activity with atmospheric sulfur emissions. These

findings highlight the broader environmental importance of the developed methods and their relevance to studies of air–water interactions and climate-related processes.

During the study, Marat Bektassov demonstrated himself to be a qualified, hardworking, and motivated young scientist capable of conducting research independently and proposing hypotheses to address complex problems. He successfully completed part of his Ph.D. thesis in the Department of Chemistry at Aarhus University under the supervision of Prof. Glasius Marianne, who was highly satisfied with his internship. Mr. Bektassov published two articles in peer-reviewed international journals in analytical and environmental chemistry: Trends in Environmental Analytical Chemistry (IF = 13.4) and Microchemical Journal (IF = 5.1). Mr. Bektassov also has one accepted manuscript in the Nature portfolio journal, Climate and Atmospheric Science (IF = 8.4). All requirements for publications prior to the defense were met.

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In my opinion, regarding the importance of the topic, scientific novelty, practical value, and volume of the research, the Ph.D thesis of Mr. Bektassov "Development of comprehensive methods for organic compounds determination in water" fulfills all requirements of the Ministry of Science Higher Education of the Republic of Kazakhstan to the Ph.D. thesis, and Marat Bektassov deserves the Ph.D. degree on the educational program "8D05301 - Chemistry".

Scientific supervisor:
Ph.D., Associate Professor of the Department of Analytical, Colloid Chemistry and Technology of Rare Elements
Head of the Laboratory of EACL
Al-Farabi Kazakh National University

Nassiba Baimatova