STRESZCZENIE W JĘZYKU ANGIELSKIM

Cardiovascular diseases represent one of the leading causes of mortality worldwide, with their progression being strongly associated with inflammatory processes and oxidative stress. These factors play a crucial role in the pathogenesis of various other disorders, including autoimmune and infectious diseases. In recent years, increasing attention has been devoted to identifying novel biomarkers that could serve as potential indicators of cardiovascular risk across multiple diseases. A particularly significant biomarker in this context is homocysteine, a thiol-containing compound with proven atherogenic effects. This amino acid contributes to endothelial dysfunction, promoting inflammation and elevating oxidative stress, which facilitates the development of atherosclerosis and other vascular disorders. Given these considerations, precise determination of plasma homocysteine concentration, combined with comprehensive monitoring of metabolically related sulfur compounds, serves as a foundation for early diagnosis and effective prevention of cardiovascular diseases. Additional markers reflecting pathological processes associated with vascular and myocardial damage include specific plasma proteins, particularly acute-phase proteins, which provide critical insights into the body's response to inflammation and oxidative stress. The biochemical profiling of bodily fluids, including the assessment of markers such as fibrinogen, hemoglobin, myoglobin, albumin, and transferrin, enables the detection of subtle changes indicating abnormalities within the cardiovascular system. Advanced analytical methods, such as high-performance liquid chromatography, facilitate accurate and rapid quantification of these compounds, thereby allowing for cardiovascular risk assessment and the monitoring of therapeutic interventions.

This doctoral dissertation focuses on the development and validation of three independent bioanalytical methods based on liquid chromatography, dedicated to the quantitative determination of low-molecular-weight thiol compounds and selected proteins in biological samples. Special attention is given to pathophysiological aspects, particularly the role of inflammatory processes and oxidative stress, which are key contributors to cardiovascular disease progression. The study provides a detailed discussion of the properties of thiol compounds and plasma proteins, serving as a basis for identifying their roles in the pathogenesis of chronic diseases, such as rheumatoid arthritis, as well as in the context of SARS-CoV-2 infection and related cardiovascular events. The conducted research involved monitoring biochemical transformations associated with thiol-disulfide homeostasis and the immune response, with a particular focus on significant correlations between analyzed marker levels and cardiovascular complication risk.

The dissertation begins with a comprehensive review of the current state of knowledge, thoroughly discussing the properties, biochemistry, and clinical significance of thiol compounds. Selected plasma proteins are also characterized, with an emphasis on their structure, function, and role in the pathogenesis of chronic diseases. Additionally, pathophysiological conditions such as rheumatoid arthritis and the epidemiology of SARS-CoV-2 are addressed. The literature review provides a strong theoretical foundation for the research problem, highlighting the need for rapid and precise biochemical marker quantification methods that could aid cardiovascular risk assessment. In the subsequent section, the research objectives are defined, focusing on the development of accurate and precise chromatographic methods for the simultaneous quantification of:

- six low-molecular-weight plasma thiols, including cysteine, homocysteine, cysteinylglycine, glutathione, α-lipoic acid, N-acetyl-L-cysteine, and human serum albumin, using pre-column chemical modification of analytes with monobromobimane and fluorescence detection,
- selected protein analytes, including albumin, insulin, fibrinogen, transferrin, myoglobin, and hemoglobin in human bodily fluids, utilizing evaporative light scattering detection,
- different redox forms of five key thiol compounds, namely homocysteine, cysteine, glutathione, cysteinylglycine, and γ-glutamyl-L-cysteine, following derivatization with 4-aminosulfonyl-7-fluoro-2,1,3-benzoxadiazole and fluorescence detection.

The methodological section provides a detailed description of the reagents, solutions, apparatus, chromatographic conditions, characteristics of patient groups, method validation, and statistical analysis of results. The dissertation also emphasizes the importance of implementing green analytical chemistry principles to minimize the environmental impact of research methodologies. The concluding section outlines key research findings. The results confirm the utility of the developed chromatographic methods in clinical analysis, allowing their application across various scientific and medical fields, particularly in the diagnosis of chronic diseases, oxidative stress research, and the evaluation of new therapeutic strategies. Their precision and ability to simultaneously analyze multiple biomarkers make them promising tools for both clinical studies and broader biomedical research.

This dissertation demonstrates interdisciplinary value by integrating analytical chemistry, biochemistry, and medicine. The conducted research not only expands knowledge on the role of thiol compounds and plasma proteins in chronic diseases and viral infections but also provides a basis for implementing new, environmentally friendly laboratory procedures

that could be utilized in routine diagnostic testing and in monitoring the effectiveness of cardiovascular disease treatment and prevention. This doctoral dissertation makes a significant contribution to the advancement of analytical methodologies, combining modern technological approaches with current global health challenges.