

## 9. Streszczenie w języku angielskim:

This doctoral dissertation was prepared based on a series of four thematically related full-text publications (1 review paper, 3 original papers) concerning the toxicological analysis of selected elements (As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, Zn) contained in dietary supplements for special medical purposes dedicated to oncological patients. The literature review included studies on the role of selected essential elements (Zn, Cu, Se, Fe, Mn) in the holistic care of oncological patients. The work collected literature on the physiological functions of these elements, as well as the effects of their deficit and excess. The analysis took into account the latest guidelines of the European Food Safety Authority and the European Society for Clinical Nutrition and Metabolism. Based on the literature, data were collected on the levels of elements in cancer patients, as well as the content of these elements in 100 mL of FSMP, as declared by the manufacturers. The results suggest that the elements included in the review (Zn, Cu, Se, Fe, Mn) in foods for special medical purposes (FSMP) for cancer patients are insufficiently considered in the context of their safety and physiological functions. The study indicates the need for further optimization of these products to ensure their safe use in cancer patients. FSMP available in pharmacies play an important role in providing adequate nutrients to cancer patients. Despite this, there is a lack of comprehensive studies on the safety of trace elements in these products. One study aimed to investigate the levels of Cu, Fe, Mn, and Zn in 23 FSMPs available in Polish pharmacies. Using inductively coupled plasma mass spectrometry (ICP-MS) after microwave digestion, the levels of these elements in the products were assessed. The results indicate discrepancies between the actual and declared levels of the elements. Although all products were considered safe, the study highlights the need for clear guidelines on FSMP in the care of cancer patients. This study is a pioneering approach to assess the safety and quality of FSMPs, taking into account both toxicological and nutritional aspects, which highlights the need for harmonization of protocols in FSMP standardization.

Another study focused on the toxicological profiles of Ni, Cr, and Se in FSMPs available on the Polish market. The results of the analysis, performed using ICP-MS, indicate significant variability of Ni, Cr, and Se concentrations in different samples. Some products exceeded the permissible limits set by regulatory guidelines, which may pose a health risk, especially related to nickel, which in excess can lead to skin inflammation and potential carcinogenic processes. The results for selenium revealed discrepancies compared to the declarations of the manufacturers. Although the average intake values of Ni, Cr, and Se did not exceed the tolerable weekly intake (PTWI), the nickel content in some products reached 30.58% PTWI, raising

concerns about long-term health effects. The results for chromium also emphasize the need to monitor its levels due to the potential toxic effects of cumulative doses of this element.

Additionally, the study focused on the toxicological assessment of the health risk associated with the presence of heavy metals (As, Cd, Hg, Pb) in FSMP. The study assessed the concentrations of heavy metals per serving of the product and the daily and weekly exposure, related to the PTWI. Although most of the samples were below the established PTWI limits, the Cd content raised concerns due to the possibility of cumulative exposure, especially in cancer patients who regularly consume these products. The study reveals hidden risks associated with heavy metal contamination in FSMP, emphasizing the need for close monitoring and stringent regulations to ensure patient safety.

In conclusion, the review and studies on physiological elements, problematic elements, and heavy metals in FSMP for cancer patients indicate the need for closer monitoring of these products. Significant discrepancies between declared and actual content of elements were demonstrated, which may affect the effectiveness of holistic treatment and patient health. The results suggest the need to introduce unified guidelines and monitor elemental contamination in FSMP available on the European and Polish markets.