

During stressful situations—including environmental pollution, improper diet, chronic psychological stress, very intense and prolonged physical exertion, starvation diets leading to significant malnutrition, surgeries, broadly understood infections—the cells of the human body are susceptible to the excessive synthesis of reactive oxygen species (ROS). ROS are highly reactive chemical molecules, especially with proteins and lipids, meaning that if they are present in excessive amounts, they will cause DNA damage, lipid peroxidation and chronic inflammation. Long-term accumulation of ROS and the intracellular damage caused by them underlies a number of lifestyle diseases, including cardiovascular diseases, inflammatory diseases, cancer, metabolic diseases, including obesity and diabetes, as well as neurodegenerative diseases. In order to prevent the negative consequences of excessive ROS exposure, the human body has developed a defence system protecting cells. It is the so-called endogenous antioxidant system, restoring redox homeostasis. Nevertheless, despite its capacity to synthesise endogenous antioxidants, the body also requires an adequate supply of exogenous antioxidants. These are capable of enhancing the activity of antioxidant enzymes, neutralising ROS, and increasing the overall antioxidant capacity of cells. Maintaining a neutral redox balance is essential for preserving normal bodily functions, and requires notably an adequate antioxidant supply and activity. Our knowledge on the harm caused by free radicals drives the pursuit of natural substances offering potential for supporting antioxidant defence. According to the latest reports, plant-derived products are a valuable source of natural antioxidants improving bodily functions and helping maintain homeostasis.

Matcha is Japanese powdered green tea (*Camellia sinensis*), which is becoming increasingly popular. It is particularly rich in antioxidant compounds due to the special way it is cultivated. According to the traditional method, the tea bushes for the majority of the growth period are covered using bamboo mats to shade the leaves from excessive direct sunlight. In the course of this process, the plant is able to synthesise higher amounts of amino acids and bioactive compounds, including chlorophyll, flavonoids and theanine, resulting in a unique, non-bitter taste, intense colour as well as unparalleled chemical composition. Additionally, the synthesis of high levels of amino acids is associated with high antioxidant potential. As a result, matcha is highly valued for its quality and regarded as the most aromatic green tea variety. It is also recognised as a valuable product with antioxidant properties.

Unfortunately, little is known about the immediate effect of matcha tea on oxidative stress regulation or the molecular mechanisms of its action. Its only partly known chemical composition, underlying its health benefits, and the scarce number of studies involving cell lines or clinical trials are incentives driving the efforts to extend our knowledge. That is why the primary objective of this project is to evaluate the antioxidant properties and safety in terms of cytotoxicity of matcha tea extracts using the THP-1 cell line. Additionally, the project will employ environmentally friendly methods, minimising waste production during processing. Furthermore, the deliverables of the project include a phytochemical analysis of bioactive compounds, including polyphenols determining the antioxidant potential of plant-derived products, and a comprehensive specification of the nutritional value of matcha tea extracts. Findings from this study will add to our knowledge on the antioxidant properties of matcha tea, which is already widely credited with exceptional health benefits. They will also enable us to develop a comprehensive product specification in terms of phytochemicals determining antioxidant properties, filling a gap in existing research. Moreover, by proving the effects of matcha tea supporting the internal antioxidant defence system, we can improve the prophylaxis of lifestyle diseases, by recommending that it be included in the diet of particularly vulnerable populations.