The main goal of the project is to understand the basics of carbon monoxide (CO) formation during biowaste composting: to determine the impact of the process conditions (temperature, properties of biowaste, its moisture and oxygenation) on the production of CO, the types of bacteria responsible for this formation and their ability to produce the enzyme that is crucial for this purpose – carbon monoxide dehydrogenase (CODH). Due to its bidirectional nature, this enzyme can both contribute to the production of CO and its conversion into biohydrogen as a result of the biologically mediated water-gas shift reaction (BMWGS). For this reason, composting is becoming a potential environment for combining CO and H_2 production processes, which is in line with the goals of the circular bioeconomy, using biomass and biowaste as raw materials for the production of valuable products. However, this requires increasing the efficiency of CO production during composting biowaste and understanding its mechanism.

Three mixtures of biowaste will be composted in laboratory conditions with different ratios of mass components (branches, kitchen waste, leaves). Among the parameters influencing the composting process, the following will be analyzed: the content of organic matter in biowaste mixtures (50, 70, 90%), process temperature (45, 60, 70°C), biowaste moisture (40, 50, 60%) and oxygenation (5, 10, 15, 20%). The process will last 7 days for each sample in temperature-controlled reactors with a volume of 0.25 to 4 dm3 placed in a climate chamber. Measurements of CO concentrations during composting will be carried out twice a day every 12 hours using a thermochemical analyzer. On their basis, the kinetic parameters of CO production during composting will be determined. Biowaste properties will be determined as initial values as well as the properties of the obtained composts to calculate the composting process efficiency. After selecting the most favorable conditions for CO production during composting process, additional experiment will be carried out in larger-scale bioreactors. Samples taken from the process will be subjected to microbiological analyzes aimed at determining the types of bacteria present in the composted mass of waste and their ability to produce CODH by identification of genes encoding CODH as well as the conditions of their expression.

The assumed effect of the research will be the acquisition of new knowledge in the field of waste composting and the development of a theoretical concept related to the possibility of using the produced CO and microorganisms present in the composting process for the BMWGS reaction. The growing amount of biowaste covers a wide range of substrates that can be used for this purpose. The research results will make composting process more attractive not only as a method of biowaste neutralization, but also to obtain two valuable products – compost and CO.