Sustainable Water Management Doctoral Programme (Water4All)

Title of the PhD Project	Microalgae Applications with Biorefinery Approach
Acronym	BioAlgae
Research Fields of the Project	Molecular Biology, Microbial Ecology, Biorefinery, Metabolomics, Materials Science
Keywords	Microalgae, omega fatty acids, adaptive stress, high value product recovery, bioplastic
Host Institution, Department and Campus Location	Istanbul Technical University, Department of Environmental Engineering, ITU Ayazaga Campuss, Maslak, 34467 Istanbul
PhD Awarding Institution and Graduate Programme	Istanbul Technical University, Graduate School, PhD in Department of Environmental Engineering
Name and Affiliation of Main Supervisor	Assoc. Prof. Dr. Mahmut Altınbaş
Name and Affiliation of Co-Supervisors	Dr. Ece Polat
Research Environment and Infrastructure	Istanbul Technical University is an institution that plays a leading role in science, technology, arts, and sports. ITU aims to be the center of science, which connects the past to the present by producing projects for the future. The ITU Environmental Engineering Laboratories (https://cevmuhlab.itu.edu.tr) consist of 2400 square meters of management offices, 2300 square meters of research laboratories, and 350 square meters of student laboratories. The ITU Environmental Engineering department has 17 different laboratory infrastructures, including Molecular Biology Laboratory, Instrumental Analysis Laboratory, and Physical Processes Laboratory.

Scientific Context of the Project	Biorefinery is an approach that aims to obtain various products from biomass resources. Biorefinery can produce a multi-product and multi-value chain that includes the production of biofuels, biochemicals, bioenergy, and other valuable products derived from plant, animal, or microbial sources. It aims for environmentally friendly chemical production processes with the biorefinery approach. This encourages sustainable resources and reduces fossil fuel dependence. Biorefinery has significant potential for economic, environmental, and social sustainability and is seen as a critical component of sustainable resource use in the future. Microalgae can be utilized versatilely in biorefinery processes. These microorganisms produce various biomass and biochemicals through photosynthesis. Microalgae can produce bioactive substances such as omega-3 fatty acids, carotenoids, and phenolic compounds. These substances can be used in many industrial applications, such as food supplements, cosmetics, or pharmaceuticals. Additionally, microalgae can be used in biochemical production (e.g., bioplastic monomers). This enables the use of sustainable chemicals as an alternative to petrochemical sources. Microalgae demonstrate their potential to provide environmentally friendly and sustainable solutions for biorefinery processes. However, a better focus is needed on studies on microalgae cultivation technologies and process optimization to improve commercial-scale applicability. In this study, microalgae with bioplastic production capacity will be produced under adaptive stress conditions to increase plastic raw material production. Afterward, the final product will be obtained using different extraction methods and bioplastic production techniques. The microalgal biomass that increases during the production process is also recycled within zero waste and used as fertilizer, etc. Its capacity to be used in a wide range of sectors will be examined.
Brief Workplan	Microalgae cultivation, development of adaptive stress for enhanced metabolites, characterization of metabolites, analysis of bioplastic properties, production, and characterization of bioplastics
Innovative Aspects of the Project	This study will demonstrate that microalgae-based bioplastics can reduce environmental impacts by providing a sustainable approach to plastic consumption. It is anticipated that environmental pollution will be minimized with the use of biodegradable bioplastics, which will be produced more rapidly and less permanently in nature when thrown into the environment.

Training Opportunities of the Project	The researcher will be trained in the area of molecular biology techniques, and microalga cultivation in conjunction with biomolecule and metabolite characterization. There will be an opportunity for the participation of the researcher in materials production and characterization.
Interdisciplinary Aspects	This highly multidisciplinary project involves molecular biology (gene expression), chemical biology (adaptive stress techniques), analytical biotechnology (characterization and purification techniques), and materials engineering (bioplastic production techniques).
Intersectoral Mobility **☐ Short Visit** **☐ Secondment**	Host: RS Research Context of Mobility: Training in bioplastic production
Intersectoral Mobility **☐ Short Visit** **☐ Secondment**	TBD
International Academic Secondment	TBD

Sustainable Water Management
Doctoral Programme (Water4All)

Main Supervisor	
Brief CV	**Assoc. Prof. Dr. Mahmut ALTINBAŞ** **E-mail:** altinbasm1@itu.edu.tr **Academic Degrees** Ph.D. Environmental Engineering, Istanbul Technical University, Türkiye 2007 M.Sc. Environmental Engineering, Istanbul Technical University, Türkiye 2000 B.Sc. Environmental Engineering, Istanbul Technical University, Türkiye 1997 **Professional Networks** Google Scholar: https://scholar.google.com/citations?user=xqbpVMYAAAAJ&hl=en&oi=ao ResearchGate: https://www.researchgate.net/profile/Mahmut-Altinbas Scopus: https://www.scopus.com/authid/detail.uri?authorId=23003289800 ORCID: https://orcid.org/0000-0003-3946-741X
Co-supervisors	
Brief CV	**Dr. Ece Polat** **E-mail:** polatec@itu.edu.tr **Academic Degrees** Ph.D. Environmental Biotechnology, Istanbul Technical University, Turkey 2023 M.Sc. Environmental Engineering, Gebze Technical University, Turkey 2019 M.Sc. NanoScience & NanoEngineering, Istanbul Technical University, Turkey 2012 B.Sc. Environmental Engineering, Istanbul Technical University, Turkey 2011 B.Sc. Molecular Biology and Genetics, Istanbul Technical University, Turkey 2011 **Professional Networks**

	Google Scholar: https://scholar.google.com/citations?user=ACCXc0oAAAAJ&hl=tr ResearchGate: https://www.researchgate.net/profile/Ece-Polat Scopus: https://www.scopus.com/authid/detail.uri?authorId=57189055721 ORCID: https://orcid.org/0000-0001-7173-9126