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GENETIC ENGINEERING OF DIATOM PLASTIDS TO EXPLORE PHOTOSYNTHESIS REGULATION AND BOOST BIOTECHNOLOGICAL EXPLOITATION OF MARINE PHYTOPLANKTON

SPEAKER:
ANGELA FALCIATORE, PhD
angela.falciatore@ibpc.fr

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Diatoms are the world's most diverse group of algae, standing at the crossroads of several evolutionary lineages. Contributing 20% of annual global carbon fixation, they underpin major aquatic food webs and drive global biogeochemical cycles. Over the past two decades, breakthroughs in genomics and ecosystem biology, as well as the development of genetic resources in diatom model species have led to a better understanding of the cell biology, evolution and metabolic adaptations of this important class of microalgae.
Major objective of our research is to identify the mechanisms controlling diatom growth and distribution within the ecological niches and oceanic provinces they inhabit. As diatoms rely on light, both as their main source of energy and information about their environment, we are performing a comprehensive characterization of the light sensing and light-driven regulatory processes controlling major cellular and metabolic processes in these algae. By integrating physiological, biophysical, biochemical and genomic molecular approaches in the model species Phaeodactylum tricornutum, we uncovered the critical role of the stress-related light-harvesting proteins, LHCXs, in plastid photoprotection and showed that different levels of LHCX proteins explain the natural variability in photoresponses in ecotypes isolated at different latitudes. More recently, we successfully transformed the nuclear and plastid genome of the facultative phototrophic species Cyclotella cryptica and generated the first photosynthetic diatom mutant using CRISPR/Cas technology, paving the way for further exploration of plastid function and biogenesis in diatoms. Because in addition to photosynthesis, plastids are involved in many other crucial cellular and metabolic activities, plastid engineering opens unprecedented opportunities for the production of high-value metabolites and proteins in these microalgae. Our latest results will be presented.

Presso l' Istituto di Chimica Biomolecolare,
sala Conferenza dell'Area di ricerca Napoli 3
Via Campi Flegrei, 34
Comprensorio Olivetti
80078 Pozzuoli (Napoli)

gdl.outreach@icb.cnr.it
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