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PhD Thesis

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**MicroRNAs-mediated environmental adaptation in marine microalgae:
from physiological responses to biotechnology applications**

PhD candidate: Gabriele De Falco

Director of Studies: Dr. Sabrina Carrella

Internal Supervisor: Dr. Chiara Lauritano

External Supervisor: Prof. Sandro Banfi

Abstract

MicroRNAs (miRNAs) are small non-coding RNAs that can regulate gene expression post-transcriptionally by interacting with mRNAs. They are fine-tune modulators that have a pleiotropic effect, interacting with different targets. Thus, they are deeply embedded in gene regulatory networks. Indeed, their modulation can directly or indirectly regulate pathways without energetically stress the cell. Although, their importance is well known and they are widely investigated in human, mouse, and other model organisms, they remain poorly studied in marine organism, even in models such as *Phaeodactylum tricornutum*. Therefore, we wanted to identify and characterize miRNAs in this diatom, observing their differential expression under three different stress conditions: low salinity, nitrogen limited, and metals contamination (Cd + Pb). It is known that in these conditions there is an increase in the production of high-value bioproducts in the microalga. The total RNA of the diatom has been isolated and sequenced by small-seq TruSeq (Illumina). Subsequently, we have identified novel miRNAs with the combined use of miRDeep2 and miRDeepP2. Then, targets of the identified miRNAs have been in silico predicted by using the miRanda and psRNATarget tools and further analysed via mRNA sequencing. Furthermore, the processing and functionality of a selection of miRNAs have been characterized via overexpression of precursor sequences. In the end, a public available database called “miRnutum” has been created, which contain information about mature and precursor miRNAs annotation, differential expression of miRNAs in the three different conditions used, possible gene regulatory network in which identified miRNAs could be involved and their predicted direct targets. The database may provide novel insights on gene regulatory networks and metabolic pathways in diatoms and will be of support for marine researchers worldwide in the generation of novel strategies for biotechnological applications.