# “Federico II” University of Naples

## PhD in Biology XXXV Cycle

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# Ecological role and biotechnological applications of marine sponges and benthic diatoms and their natural products


Coordinator:

Prof. Sergio Esposito

Tutors:

Dr. Maria Costantini, Stazione Zoologica Anton Dohrn, Naples

Dr. Valerio Zupo, Stazione Zoologica Anton Dohrn, Naples

Dr. Stefania Crispi, Istituto di Bioscienze e Biorisorse, IBBR-CNR, Naples

Dr. Adele Cutignano, Istituto di Chimica Biomolecolare, ICB-CNR, Pozzuoli

Prof. Simona Carfagna, Università Federico II, Naples

Candidate:

Roberta Esposito


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**Abstract**

The oceans cover over 70% of our planet, hosting a biodiversity of tremendous wealth. Sponges are one of the major ecosystem engineers on the seafloor, providing habitat for a wide variety of species to be considered a good source of bioactive compounds. On the same line, microalgae are extremely diverse and heterogeneous from evolutionary and ecological viewpoints with a great biotechnological potential. Among microalgae diatoms are well-studied, mainly planktonic species. On the contrary, few information reported on the chemical ecology of benthic diatoms, because of difficulties in the isolation and massive culturing.

In this PhD project marine sponges and benthic diatoms were deeply explored for both their ecological role and biotechnological applications in pharmacological, cosmeceutical and nutraceutical fields. To this aim a multidisciplinary approach was applied by integrating ecology, chemistry, cellular biology and molecular biology. More in details, the following sponges were collected and identified joining morphological and molecular approaches: *Tethya aurantium, Axinella damicornis*, *Oceanapia* cf. *perforata*, *Sarcotragus spinosulus*, *Agelas oroides* and *Geodia cydonium*. Then, bio-assay guided fractionation was performed on various cancer cell lines. The results showed that all the sponges analysed had biotechnological potential. The most striking results demonstrated that three fractions from *Agelas oroides* and one from *Oceanapia* cf. *perforata* had specific cytotoxic effect on human pancreatic cancer cell line (MIA PaCa-2). Three compounds were identified and chemically characterized from *A. oroides* applying High Performance Liquid Chromatrography (HPLC), Nuclear Magnetic Resonance ($^{1}$H-NMR) and High Resolution Mass Spectrometry (HRESI-MS).

In the case of the sponge *G. cydonium*, the organic extract demonstrated cytotoxic activity against three human mesothelioma cell lines, MSTO-211H (MSTO), NCI-H2452 (NCI) and Ist-Mes2 (Mes2), reducing self-renewal, cell migration and arresting cell cycle in G0/G1 stage, thus blocking cell proliferation. Metataxonomic analysis also showed that the analysed

sponges had species-specific and site-specific associated bacterial community, confirming their possible role in the synthesis of bioactive compounds. In addition, antioxidant activity was also detected, little studied in the case of marine sponges, showing *G. cydonium* as the strongest one. Concerning the diatoms, only two species were analysed until now: *Cylindrotheca closterium* and *Nanofrustulum shiloi*. Preliminary results were obtained only on a fraction from *N. shiloi*, showing cytotoxicity on mesothelioma cell line (MSTO-211H). Our findings confirmed that marine sponges and benthic diatoms are able to produce bioactive compounds with challenging activities, applications in the pharmacological, cosmeceutical and nutraceutical fields.