Food and Agriculture Organization of the United Nations

5
WORK PACKAGE

Biotechnological potential

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Objectives

We are studying deep-sea sponges of the North Atlantic to discover new sponge-derived products and processes with applications in human health, biomaterials, and other industrial applications. The aim of the Work Package is to improve innovation and industrial application by unlocking the biotechnological potential of sponge grounds ecosystems.

To reach this aim, the following objectives are being addressed:

- Assess the metabolic diversity of key sponge ground species using metabolomics to identify sponge ground bioproducts with industrial potential.
- Search for genes responsible for secondary metabolite production using an integrated metagenomics, metatranscriptomics, and metabolomics approach, and conduct bioprospecting of marine sponge microbiomes.
- Assess the biomedical potential of inorganic silica on tissue regeneration, and synthesize analogous silica particles, mimicking sponge composition, with biomedical applications.
- Develop novel 3-D printed tissue engineering scaffolds inspired by the composition and/or architecture of deep-sea sponges.

Focus

Work Package 5 focuses on the biology of deep-sea sponges and their associated microorganisms to identify products or processes with pharmaceutical and biotechnological applications. In addition, their chemical and morphological features are being studied, to serve as inspiration for the development of biomaterials for tissue regeneration, in a marine biomimetics strategy.

Why is this important?

Sponges are the most prolific source of marine-derived chemicals with pharmaceutical applications; some of these chemicals are in clinical development as drugs to treat diseases such as cancer. How and why they produce these chemicals, and what role microbial

The scanning electron microscopic (SEM) observation of the bioceramics obtained after calcination (at 800°C) of deep-sea sponge, *Geodia barretti* (P. Tiago Henriques da Silva, University of Minho).

SponGES

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symbionts play, is not well understood, especially in the deep sea, where only recent technological advances allow to explore. In addition, deep-sea sponges produce intricate and hierarchic silica skeletons that are inspiring not only exquisite building architecture and notably research on bone tissue engineering within regenerative medicine.

Nevertheless, deep-sea sponges are still a relatively unknown world.

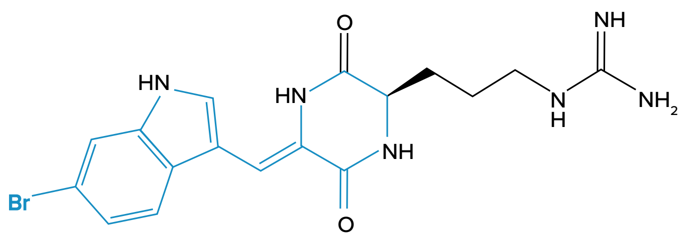
Our aim is to develop novel products and processes that can be applied to human health, biotechnology materials science, and other industrial applications. This will boost the Blue (Bio) Economy and will help create new job opportunities. By demonstrating the value of deep-sea sponge grounds, we aim to raise awareness on the need to plan for their conservation and sustainable management.

What are the key knowledge gaps to address?

Sponge-grounds have been poorly explored, so we expect that many of the chemicals they produce may be completely novel and with potential human health and industrial relevance. The use of biostructures derived from the marine environment is very recent, and marine sponges have not yet been fully characterized. These structures have exciting potential for the development of innovative biomaterials for tissue regeneration.

Expected major outputs

- Identification of bioactive compounds with industrial potential from sponge-ground sponges



The brominated antifouling compound called barettin, isolated from the deep-sea sponge *Geodia barretti* at the University of Uppsala, Sweden

The EU-funded SponGES project will contribute to the sustainable management of deep-sea fisheries, and the protection of sponge-dominated vulnerable marine ecosystems in the North Atlantic through the collection of data and the development of knowledge on the vulnerability and threats as well as protection measures leading to a sustainable use of the deep-sea areas.

- Annotated databases of encoded enzymes and gene clusters relevant to production of compounds with pharmaceutical and industrial relevance
- Evaluation of sponge inspired silica-based materials on the fate of human stem cells
- Evaluation of deep-sea sponge inspired architectures as tissue-engineering scaffolds

Results achieved so far

- High-throughput sponge metabolic fingerprinting protocols are being developed.
- Metagenomic/metatranscriptomic
- data from deep-sea sponges and their associated microbiomes are being assembled and annotated
- 3D printing methodology has been established for sponge cell culture scaffolds.

What methods/technologies/approaches are you using

We use a novel approach - metabolic fingerprinting - for rapid, untargeted, high-throughput screening of the metabolic diversity of the meta-genome (i.e., the sponge and its symbionts). Next generation sequencing is used to screen for genes encoding for enzymes with pharmaceutical and industrial applicability. Sponge biosilica mimics and derived composites are being processed exploring conventional and 3D printing technologies to render biomaterials with biomedical potential.

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