Marine biodiversity and SMEs

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Exploring the unknown

Collecting Arctic marine organisms in a search for unique, novel compounds

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The high biodiversity of the oceans represents a correspondingly rich source of chemical diversity. New technologies have, over time, made it possible to look into the rich structural diversity and complexity of natural compounds. To date, around 18,000 compounds have been reported from marine sources. With the potential of finding new, interesting molecules, scientists look in the oceans for novel treatments of human diseases and for compounds with other applications.

Natural products have inspired chemists and physicians for hundreds and thousands of years. Approximately 60% of the drugs on the market today are derived from or based on the structure of a natural chemical compound. An example of one drug on the shelves is Prialt®, a painkiller many times more potent than morphine. The active component of the drug is derived from the hunting venom of the Cone Snail, *Conus magus*. The discovery was initially based on knowledge about the Cone Snail, which paralyses its prey using a barb with poison. "Marine drugs" from other species – showing anti-tumour effects, for example – are under clinical trials.

Life-history strategies of marine benthic organisms involve myriads of molecules which may be beneficial for individual growth and survival. Variations in physical and biological conditions between habitats produce different physiological constraints on organisms. Some compounds may therefore be more frequent in larger animal groups, while others may be more species-specific or even present only in smaller groups of individuals of the same species. The marine biologist who is familiar with various marine habitats and the organisms inhabiting them has important knowledge about life-history strategies and the physiology of different species. This information gives a first indication of where to look for interesting biomolecules.

Marine bioprospecting is defined as the systematic search for interesting and unique genes, molecules and organisms from the marine environment with features that may be of value for commercial development. In addition to new drugs, marine natural products identified by bioprospecting could have potential as industrial enzymes, anti-freeze proteins, nutraceuticals and dietary supplements as well as ingredients in cosmetics. Other results from marine bioprospecting could be new technology for bioremediation and more efficient oil production.

Marine bioprospecting has been carried out since the 1970s. So far, the main focus for bioprospecting has been on organisms from tropical and temperate waters. However, the high Arctic is unparallelled with respect to its combination of temperature and light regimes.

This implies evolution of a variety of organisms with unique physiological and biochemical adaptations that are largely unexplored, and with correspondingly good prospects of finding novel bioactive compounds.

Norway has territorial waters and an exclusive economic zone that ranges from the northern part of the North Sea to polar areas surrounding Svalbard, Jan Mayen and parts of the Barents Sea. Fishery, aquaculture and offshore oil and gas drilling in these areas have made Norway a wealthy nation. Having access to diverse marine habitats in the Arctic and sub-Arctic areas, the country has long traditions within marine science, and now the Norwegian government has adapted several policy initiatives focused on further expanding Norway's marine biotech R&D.

With focus and concerted effort on marine bioprospecting, a marine biobank, Marbank, is established as an infrastructure to ease the access to marine samples. Marbank is funded by the Norwegian Ministry of Fisheries and Coastal Affairs. The biobank is responsible for collection and preservation of marine organisms for research, commercial and exploitation purposes. The mission of Marbank is to provide an accessible repository of frozen marine biological samples, legally collected, and maintained under rigorously controlled conditions. The material archived and stored in the repository includes taxonomy samples, genetic and biological material from marine microorganisms, plankton, algae, invertebrates and vertebrates.

The biobank has different strategies for collecting samples. Dedicated Marbank surveys are carried out, and marine biologists from Marbank participate in surveys initiated by other institutions. Receipt of living or frozen samples collected by researchers from other institutions is another option. For surveys, collection of species and taxonomy analyses, Marbank cooperates closely with other marine institutions in Norway: Institute of Marine Research, University of Tromsø, Norwegian Polar Institute and University of Bergen. Access to competence and infrastructure represented by these institutions is very important to Marbank. For complete taxonomic analysis of all species in the Marbank repository, it is necessary to have broad contact with taxonomists in Norway and abroad. In this context, cooperation with scientists at Russian PINRO is already established.

Marbank collects marine samples from the tidal zone to the deep sea. As the bioactive molecules in the organisms normally are present at very low concentrations, preferably up to 1kg of wet weight of each species is collected and extracted. Data on geographic sites for collection and routines and procedures used for sampling and long-time storage at low temperatures, etc, are stored in a database together with the information on the reference literature and documentation of taxonomy.

Marine extracts from Marbank are currently being tested for bioactivity by MabCent-CRI, a centre for research-based innovation on marine bioactives and drug discovery. With automated/high-throughput screening technology, the centre focuses on finding molecules from marine extracts that can fight cancer, bacteria and viruses, regulate the immune system or have anti-diabetic or antioxidant effects.

There is great potential for finding novel molecules in the cold Arctic oceans, and Marbank contributes to this exciting exploration by systematic collection and distribution of marine biological samples.

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