Comment

Cold rush for drugs?

A wide variety of microbes lives in the icy wastes of Antarctica. Nick Russell believes that exploiting their commercial applications may not be in the interests of protecting this unique environment.

The early days of antibiotic and drug discovery were typified by the screening of soil bacteria as a primary search tool. Nowadays, a novel therapeutic agent is much more likely to be a chemical derivative of an existing compound or one that has been synthesized on the basis of computerized modelling of structure–activity relationships. In addition, the search has turned to more unusual sources, ranging from rare plants to micro-organisms that live in extreme environments, so-called extremophiles.

The initial focus of this new 'extreme biotechnology' was initially on thermophiles. However, it is generally recognized that, although thermophiles have provided very important thermostable polymerase enzymes for PCR (fundamental to most biotechnology), they have not fulfilled their promise in the broader sense of supplying new biotechnological tools.

ABOVE:
Mount Melbourne viewed across sea-ice in Wood Bay, Antarctica. Psychrophiles can be isolated from the ice, water and soil, and thermophiles from thermal vents near the top of this volcanic mountain, demonstrating the diversity of habitats and micro-organisms in this region.
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At the other end of the scale, psychrophiles that live in cold, even frozen habitats such as tundra and sea-ice have been investigated for their biotechnological potential. These cold-adapted bacteria and their enzymes, which function at temperatures as low as –20 °C have applications in a wide range of industrial applications from keeping ice-cream soft and cold-water washing to environmental biosensors and new drug discovery. The biodiversity of severely cold habitats is more diverse than first predicted and they contain new species with novel properties. For example, marine Antarctic bacteria have been considered as the source of dietary supplements, because their membrane lipids contain the same polyunsaturated fatty acids that are precursors of bioactive molecules such as prostaglandins found in mammals.

Although there are many cold habitats on Earth, it is Antarctica that continues to capture the imagination and to be the focus of research on 'cold biotechnology'. Fresh attention has been drawn to the biotechnological exploitation of Antarctic psychrophiles and their cold-active enzymes with the recent publication of a follow-up study to a 2003 report from the United Nations University, Institute of Advanced Studies UNU/ IAS. The initial report dealt with several issues of biodiplomacy, including as a specific topic '*The International Regime for Bioprospecting. Existing Policies and Emerging Issues for Antarctica*'. The follow-up study, based on interviews with representatives from industry, academia and national Antarctic organizations, has highlighted the inadequacy of current legislation and international organization for the protection of the natural resources of Antarctica. Ownership of intellectual property (e.g. bacterial culture collections, isolated enzymes) usually lies with the institution that collected the samples, and industry has not been much engaged in Antarctic research – a situation that does little to help scientists in their search for financial support.

So why the concern?

The Antarctic Treaty states clearly the principles of freedom of scientific investigation and access, that the results of scientific research should be freely available, and that living resources should be conserved, but it does not deal specifically with commercial exploitation. The Treaty's advisory body, the Scientific Committee on Antarctic Research, has raised the concern that bioprospecting should not put pressure on resources in such a delicately balanced ecosystem. Scientists and governments have concerns that individual patents may compromise the free advance of understanding and the concept of Antarctica as a continent free of national constraints. Regulations to control bioprospecting will need to be discussed and agreed upon by all those countries with jurisdiction over administering the various sectors of Antarctica. This will take time, and time has a habit of running out. The first full genomic sequences of Antarctic bacteria are now appearing and will stimulate biotechnological research of psychrophiles and interest in bioprospecting in Antarctica. Now is the time to act and for governments, industry and scientists to show that they can co-operate on an international scale in drawing up regulations to establish how the biotechnological resources of this continent can be harnessed within the principles of the Antarctic treaty and without compromising the proper exploitation of such a valuable biotechnological resource.

The full report on bioprospecting in Antarctica is available online at ***www.ias.unu.edu/binaries/UNUIAS_AntarcticaReport.pdf****. The Antarctic Treaty and related information can be accessed at www.scar.org/Treaty*

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