4289 SILIBACTS

Sponge reveals its secret healthcare powers

A substance produced by marine sponges has been shown to have potential application in manufacturing processes, microelectronics, medical and healthcare sectors. This natural bio-silica technology could soon be found in products as diverse as industrial enzymes, medical devices and nutritional supplements.

Nature is the ultimate innovator. Marine sponges have successfully survived on Earth for over 700 million years thanks to a particular biochemistry. Thanks to Eurostars funding, this is now being successfully exploited in applications ranging from industrial biotechnology to health care and microelectronics.

The sponge's secret is the enzyme, silicatein, which catalyses the formation of silica. "Bio-silica and the enzymes and proteins in marine sponges involved in bio-silica formation can become important materials and molecular tools for a variety of applications in nanobiotechnology and medicine," says Prof. Werner E.G. Müller of NanotecMARIN, a spin-off company of the Medical Center of the Johannes Gutenberg-University Mainz, Germany.

NanotecMARIN was the main coordinator of the SILIBACTS Eurostars project which looked at the potential use for bio-silica as a protective envelope for bio-active enzymes or bacteria used in manufacturing processes. Other project team members were Hungarian SME, MicroVacuum Ltd., and two academic partners: the University Medical Center of the Johannes Gutenberg University Mainz and the Université Pierre et Marie Curie. Total project funding was €904,266.

Protective shell

"Our incorporation of the bio-silica genetic material into bacteria allows them to build a protective silicate envelope making them much more resistant to material stress," explains Prof. Müller. This is a very important factor in extending their activity in bio-industrial processes for products such as pharmaceuticals or other fine chemicals. The commercial potential of this one aspect of silicatein technology is considerable as the global market for speciality enzymes in bio-processes is forecast to exceed $4 billion by 2015. Factors driving this market include the growing needs of the pharmaceutical industry and the biocatalyst sector, both of which would benefit from the outcome of SILIBACTS.

NanotecMARIN now has a strengthened portfolio of patents, and collaboration with large industrial companies is under way. It is also looking for venture capital investment to further expand the potential of the technologies. The work on silicatein has proved both an academic and commercial success story as Prof. Müller has also been awarded a prestigious European Research Council grant to progress fundamental studies on bio-silica.

Other major opportunities for NanotecMARIN's bio-silica technology abound. Research has shown that human bone-forming cells can be encapsulated in the bio-silica matrix which remains bioactive and can act as a bio-compatible protective layer. It also stimulates the production of new bone leading to applications in joint-replacement products – a global market worth almost $13.8 billion in 2011 – and in new, highly targeted bone-fracture therapy.

"There is also potential to develop the technology as a nutritional supplement to reinforce bone density and help alleviate the effects of osteoporosis," explains Prof. Müller. Osteoporosis is a major health issue that results in bone fractures for one in three women and one in five men aged 50 plus worldwide. The professor is also experimenting with 3D printing techniques to make bioactive scaffolds that enable human stem cells to proliferate and differentiate. In future, this may be a core technology for producing replacement organs for transplant.

> Joint-replacement products represented a global market worth almost $13.8 billion in 2011.

Project participants:
Germany, France, Hungary

Budget: **1.3 MEuro**
Duration: **40 months**

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