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Sustainable marine actives from biotechnology

There is an enormous potential for obtaining new active substances from the oceans. More than 230,000 known marine plant and animal species provide us each year with approximately 100 million tonnes of raw material, mainly used by the food, pharmaceutical and cosmetic industries. Sustaining and protecting marine biodiversity therefore involves improving the awareness of all the industrial and economic players.

Codif Recherche et Nature is committed to developing leading-edge biotechnological tools in order to ensure regular, equitable and high-quality provisioning of marine plant raw materials. The company therefore continues to benefit from the remarkable and innovating cosmetic properties of the marine flora, without depleting natural resources.

"Biological diversity means the variability among living organisms from all sources including, inter alia, *terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."*

Article 2 of the Convention on biological diversity, 1992

According to an Ipsos survey, only 12% of the Top 100 cosmetic brands take biodiversity into account in their sourcing.[1] However, at least a third of the technologies used by these companies depend directly or indirectly on the living world.[2]

In 2010, biodiversity year, it has to be admitted that much still has to be done to protect biodiversity. In this context, a rapid expansion of biotechnologies seems to be the economically equitable solution between man and nature.

Aware of these problems, Codif developed an algal culture laboratory. This laboratory thereby draws the minimum natural resources required to seed cultures in the bioreactor and avoids any excessive harvesting as this would not be perennial for a species or for the ecosystem harbouring it overall.

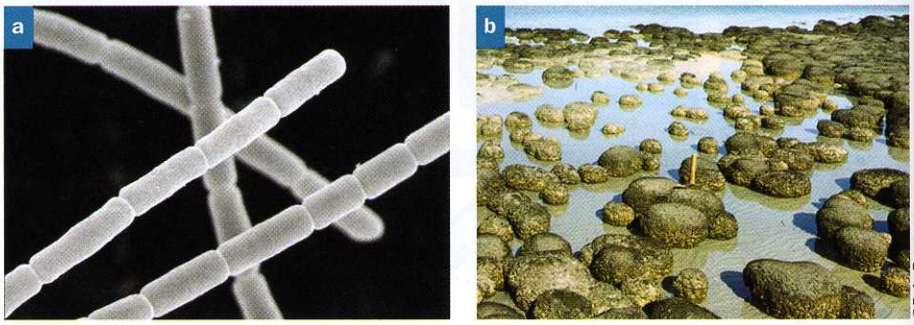

Figure 1: *Electron microscope examination of (**a**)* Phormidium persicium *and (**b**) stromatolites built by* Phormidium *visible at Shark Bay in Australia.*

There are three different types of culture: culture of microalgae and macroalgae in a photobioreactor and culture of macroalgae in the open sea illustrate our desire to develop cosmetics through the sustained and equitable use of marine biodiversity.

Growth of a blue-green microalga in a photobioreactor for the development of an anti-ageing ingredient

Phormiskin Bioprotech G is a skin rejuvenator which owes its anti-ageing properties to an immortal cyanobacterium called *Phormidium persicinum*. This microorganism belongs to the Cyanophyceae family, often referred to as the blue-green algae (Fig. 1a).

Cyanophyceae are qualified as primitive micro-organisms as they first appeared approximately 3.8 billion years ago, and form part of the species at the origin of the expansion of life on earth. Like algae, they produce oxygen by photosynthesis and this led to the filling of the earth's atmosphere with oxygen and allowed the development of life on Earth. They are also responsible for the appearance of the protective ozone layer, and the first large carbon well which decreases the greenhouse effect as the sun's temperature increases.

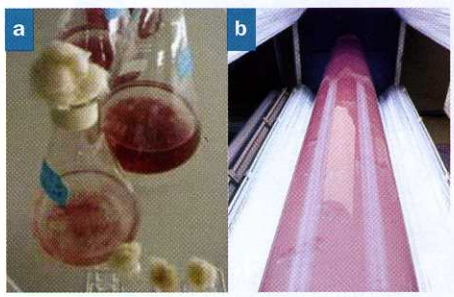

Figure 2: *Culture of* Phormidium persicinum *in (**a**) flasks, and (**b**) a photobioreactor .*

By organising itself into mucilage-producing colonies, *Phormidium persicinum* generates geological formations called stromatolites, (from the Greek strôma, carpet and lithos, stone), cushion- or pillar-shaped rocky domes (Fig. 1b). This stromatolite organisation plays several fundamental roles in the survival of phormidium in very varied ecosystems. This specific protective system has a protective effect against UV light, but also heavy metal chelation and depollution capacities. Hence, *Phormidium* lives nearly everywhere, including under extreme conditions, from polar ice to desert sands. It survives in the very hot and/or acid lakes of volcanic craters and in geysers.

These remarkable adaptive capacities are characteristic of highly effective enzymatic systems which may therefore be used for cosmetic applications. However we very rapidly came up against the problem of provisioning. As it is impossible to collect *Phormidium persicinum* in its natural environment, Codif Recherche et Nature research laboratories developed cultures of the microalgae in flasks and then in photobioreactors (Fig. 2). Three years of