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ALGAECOM NEWSLETTER

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EDITORIAL

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Microalgae have the potential to revolutionize biotechnology in a number of areas including nutrition, aquaculture, pharmaceuticals, cosmeceuticals and biofuels. AlgaeCom project is a 4-year project bringing together 2 Academic (Agricultural University of Athens, AUA and Centre National de Rechreches Scientifique, CNRS) and 2 Industrial partners (APIVITA SA and FITOPLANCTON MARINO) from Greece, France and Spain.

The project is funded by the European Commission under the FP7-PEOPLE-2011-Industry-Academia. Partnerships and Pathways (IAPP) Marie Curie actions. AlgaeCom seeks to exploit the microalgae biodiversity, as a source for state-of-the- art high-added-value cosmeceuticals.

The project will combine both basic and applied research in the fields of –omics technologies, biochemistry and applied biotechnology in order to:

a) Develop catalomics, metabolomics and glycomics resources for marine and freshwater microalgae as a valuable source of novel high-added-value cosmeceuticals such as polysaccharides, enzymes and small molecule metabolites.

b) In vitro functional characterize and toxicologicaly analyse microalgae cosmeceuticals using human epidermal cell lines and in vitro skin model.

c) Develop and optimize application-based microalgae culture systems at different scales and optimize culture conditions for higher production rate of desired products.

d) Develop analytical molecular diagnostic tools for real-time monitoring of the microalgae carbohydrate and polysaccharide metabolism in large-scale cultures.

e) Develop, formulate and in vitro evaluate a new range of cosmetic products based on microalgae cosmeceuticals (enzymes, small secondary metabolites and polysaccharides).

Beyond the more direct impact on R&D activities of both the academic and industrial partners, the completion of the AlgaeCom project will offer the opportunity for the:

i) Development of well defined end products (cosmetic products, RT-qPCR molecular tools) to industrial partners.

ii) Reinforcement of European‟s capacity in the fields of microalgae biotechnology by exchanging complementary information related to well specified targets, developing joint activities, and strengthening the links between academia and industry.

iii) Know-how diffusion: help researchers to be trained on modern biotechnological areas related to health science and allow them to have access to facilities, techniques and methods not available in their institutions. The integration of advanced research with an efficient mechanism for transfer of knowledge, training and dissemination will contribute favorably to the reinforcement of green economy dimension of the FP7 thematic priorities. Thus, in parallel with the ingoing research activities we are planning a series of dissemination and outreach activities, with the aim to guarantee that the knowledge generated during the course of the project will be disseminated to the largest audience possible, including the academic, regulatory bodies, related industrial sector, and wider public. Both the commercial partners in the project will actively participate and organize the planned outreach activities, as they will greatly benefit from the increased publicity of the project (continued on page 4)

Algae Enzymes and Proteins in Cosmetics Industry.

The target

Proteins and enzymes are presently the most rapidly expanding category of cosmeceuticals and are being applied across a wide range of previously untreatable applications. The beneficial effects of using protein-rich substances in formulations of various cosmetic products are well established [1,2]. Proteins are considered as useful ingredients for maintaining a suitable environment for healthy skin and hair because of their ability to bind water with the horny layer skin and its annexes. In addition, their potential role as hair conditioning agents is explored. For example, proteins are considered useful for imparting gloss, softness, and manageability because of their substantivity. Hydrolyzed proteins are used for permanent waving treatments to prevent damage to hair fibres because of their amphoteric and buffering properties.

Where we are

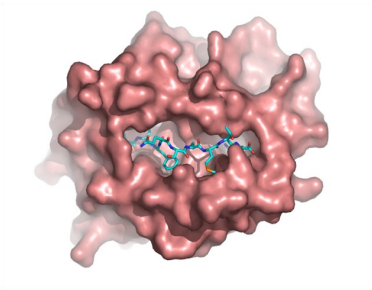
Microbial and animal proteins and enzymes were once the primary choice of industry, offering functional products of acceptable quality. However, due to negative media attention associated with microbial and animal derived products, consumers are demanding an alternative. Today's cosmetic chemists are faced with the challenge to replace traditional animal derived proteins and enzymes with ingredients that offer the same functionality. Therefore, the development of new protein and enzyme products from natural 'green' sources, such as algae as alternatives to animal or microbial derived products is of commercial and industrial importance. Europe holds a very leading position in the development and production of enzymes [3,4]. Around 64% of all enzyme companies are located in the EU. The main enzyme producers by volume are in Denmark, where Danish companies account for almost half of worldwide enzyme production. Because enzymes play a crucial role for applications in many other industrial sectors, this sector represents significant potential for the EU in terms of escalating global leadership in the area of biobased products and processes.

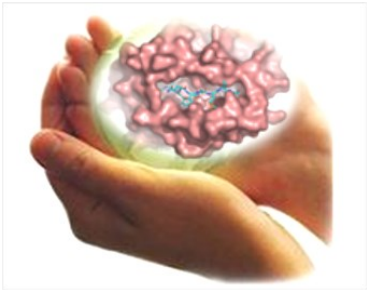
Where we're going

The large metabolic diversity of microalgae reflects similarly large enzyme and protein diversity that so far has been unexplored. Therefore microalgae diversity promises to provide new and diverse proteins and biocatalysts with novel properties. For example, research has demonstrated the presence of unique haloperoxidases in algae with a high degree of stability to thermal and organic solvent denaturatione [5].

Due to the positive consumer opinion on proteins and enzymes, efforts are made to find new areas of biocatalysis in cosmetic products. This becomes a realistic goal since stable protein and enzyme systems can be development using modern nanomaterials and encapsulation technologies [6]. For example, one area is the application of enzymes in skin protection. Enzymes with the ability to capture free radicals and thereby preventing damage to the skin caused by environmental pollution, bacteria, smoke, sunlight or other harmful factors may be explored and used in topical preparations. In this case, the most effective enzyme type is superoxide dismutase (SOD, EC 1.15.1.1) [7,8].

It has been proposed that the combination of SOD and peroxidase as free radical scavengers in cosmetic products reduce UV-induced erythema when topically applied [4]. However nowadays, these algae protein and enzyme products have a high production cost, low purity and low yield due to the absence of suitable extraction and purification technology. The inevitable rapid progression of these molecules through product development requires significant reduction of manufacturing costs as well as streamlining process development activities in order to produce an affordable product with high quality and low cost. This is one of the main goals of the AlgaeCom project.





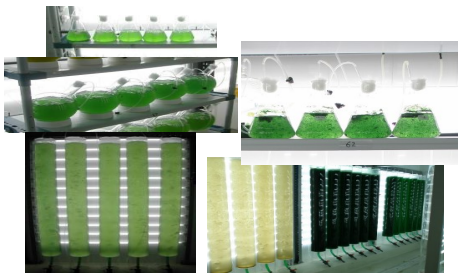
Fitoplancton Marino is a biotechnology company located in El Puerto de Santa María, in the south of Spain.

In its facility it produces marine microalgae biomass for different applications, such as aquaculture, cosmetics and aquariums. The biomass is produced in state of the art tubular photobioreactors that are located outdoors and uses the natural sunlight for the microalgae growth. Microalgae are grown naturally until they reach a certain biomass, time when they are automatically harvested. The biomass obtained is then freeze-dried and vacuum packed for its preservation. All these processes are strictly controlled to obtain a high quality biomass.

There are thousands of microalgae species and each species needs different culture conditions or different culture systems. Fitoplancton Marino has more than 10 years of experience with microalgae cultures. During this time the company has developed different technologies for the culture of different microalgae species and has the knowledge on how different culture conditions affect the microalgae composition.

Due to these facts Fitoplancton Marino can contribute in the ALGAECOM project in order to select the most appropriate microalgae species and enhance the production of certain bioproducts of interest in the microalgae cultures. For this purpose different culture regimes and different microalgae strains will be tested and the obtained biomass will be then screened for high added value metabolites. These different culture regimes will be tested first at lab scale and finally in industrial scale photobioreactors.

During the project RT-qPCR platform for real time monitoring of different metabolites and metabolism would be developed and this would be used as an analytical tool in the industrial scale cultures for the monitoring in real-time of the algae metabolism. This tool will help to maximize the production of metabolites in the industrial cultures.



Oceans are an explored reservoir of polysaccharides diversity

The annual production of dry biomass by photosynthetic organisms, including terrestrial plants, macro- and micro-algae, is estimated to about 140-220 billion tons. It results in roughly 77 billion tons of carbon that are accumulated annually in marine and terrestrial biomasses. Carbohydrates, mainly polysaccharides, are the most abundant constituents amounting to 75% of the biomass (i.e. 123 billion tons/year). However, only 1.4 – 2 % of the marine and terrestrial biomass (6 billion tons) is exploited in food and non-food applications. Marine biomass represents about 20-30% of the biomass found on Earth. However, in marine environments, there are many taxonomic levels, such as phyla and orders indicating a broader genetic variation compared to terrestrial environments. More than 90% of all classes of organisms are represented in oceans. As a consequence, from the biological point of view, one can expect a broad diversity of polysaccharide structures, which remains essentially unexplored.

Carrageenans (50,000 t/y), alginates (26,500 t/y) and agars (9,600 t/y) are the three most exploited marine polysaccharides. They are well-known because of their unique rheological and gelling properties appreciated in food and cosmetic industries. Excepted these three families of polysaccharides, few data are available dealing with the chemical structure, and therefore structure/function relationships of marine polysaccharides. This lack of knowledges can be illustrated by two examples. The first, green macro-algae which are well-known because of their proliferation also called “green tides” possess polysaccharides which represent an important exploitable biomass with high potential of exploitation because of their unique chemical structure. The second example is polysaccharides from micro-algae which include a very broad diversity of organisms. Despite increasing interest for this class of organisms there are only very few examples of structural analysis of their polysaccharides.

In conclusion, marine polysaccharides offer a very wide structural diversity when considering marine biological diversity. However, it is obvious that exploration and, therefore, exploitation of marine polysaccharides remains challenging but promising.

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The above specific aims will be realized by the following activities:

1) Electronic dissemination of information: create and maintain the AlgaeCom web site (www.algaecom.aua.gr) and database for wide external communication and dissemination.

2) Education and Public Outreach (EPO) web page: A special web page will be dedicated to education and general public outreach in general issues concerning algae biotechnology and cosmetology.

3) AlgaeCom e-Newsletters: These periodically published e-Newsletters will be available through the dedicated project EPO web page. On-line visitors will have the option to electronically subscribe to the e-newsletter.

4) Multimedia releases: Industrial partners will be responsible for the preparation of video-clips to be released on the project EPO web page, with the aim to familiarize the public with algae production and application in cosmetology.

5) Public talks, TV-Talks, podcasts and articles in Newspapers: Industrial partners, in collaboration with the academic partners will be responsible for the wider possible outreach of the project objectives and achievements through a series of well planned public talks, TV-Talks and articles in public newspapers. These activities will also have a positive impact in the marketing strategy of our Industrial partners.