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ALGAECOM NEWSLETTER

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EDITORIAL

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The present issue emphasized carbohydrates area, with the 3rd ALGAECOM Workshop organized at Cermav, France on "oligo-and polysaccharides" and a special focus in our "Did you know" section, about carbohydrates in general and polysaccharides in cosmetics.

New People in the ALGAECOM project

Four postdoctoral researchers have joined and are currently working for the ALGAECOM project. In the last Issue, three of them presented themselves giving information regarding their background, their role in the project and their expectations. Here is the presentation of the fourth one.

Centre de Recherches sur les Macromolécules Végétales
Cermav

Tinaïg Le Costaouëc

"I have been recruited by ALGAECOM project on the 1st of October 2013. I will be working for 22 months at Cermav-CNRS (Center for Research on Plant Macromolecules), located in Grenoble, France.

I have a background in biology, biochemistry and natural compounds extraction, analysis and applications from the Universities of Rennes, Montpellier and Brest, France. Then I specialized in carbohydrate biochemistry for my Ph.D. at IFREMER (French Research Institute for Exploitation of the Sea, Brest, France) where I worked on a marine bacterial exopolysaccharide: structural analysis, depolymerization and modifications. Then I reinforced those skills in complex carbohydrate purification and characterization by a first postdoctoral experience at Cermav on isolation and structural analysis of glucan-chitosaccharides from Oomycete cell wall extracts. Two other postdoctoral projects allowed me to enlarge my knowledge in carbohydrate-specific tools like carbohydrate-degrading enzymes by working with cellulases for lignocellulosic saccharification in order to produce bioethanol (University of Helsinki, Finland). Then I used lectin-affinity chromatography to enrich milk glycoproteins in specific glycans, and lectin-microarray to profile the enriched fractions within the Glycoscience group at NUIG, Ireland. I continued at NUIG with a project on extraction, purification, characterization and biological evaluation of algal carbohydrates in collaboration with an Irish seaweed company.

In the ALGAECOM project, I am investigating the complexity and analyzing the structure of polysaccharides from selected microalgae. Our aims are to implement the extraction protocols to isolate the intracellular and cell wall polysaccharides and to perform fine structural characterization of those complex polysaccharides. Thus, we expect to enrich the knowledge in microalgal polysaccharides and evaluate their potential application as ingredient in cosmetic. We are working in close collaboration with our partner Fitoplancton Marino who is producing the microalgae as well as preparing some carbohydrate containing extracts that we characterize deeper. Another part of our research is to screen for new enzymes able to depolymerize microalgal polysaccharides as such degrading enzymes are very useful tools to elucidate structure of polysaccharides. Enzymatically produced oligosaccharides could also be tested as bio-active ingredients.

I believe that working within ALGAECOM project is a great opportunity to develop research skills and knowledge in microalgal polysaccharides area. The experience of collaboration with multidisciplinary partners and the transfert of knowledge between academia and industry is very valuable to enlarge network in this applied field."

3rd AlgaeCom workshop

The 3rd ALGAECOM workshop entitled "Oligo- and polysaccharides: structure, biosynthesis and degradation" was held at Grenoble (France) from the 24th to the 28th of March 2014. It was organized by Cermav-CNRS. A number of members of Cermav also attended the workshop.

Dr. William Helbert, principal investigator from the Cermav research group involved in the AlgaeCom project, opened the workshop by presenting the Cermav: the different research groups as well as all the available facilities. Then he also introduced the polysaccharide diversity, explaining what are polysaccharides, their origins, biosynthesis, structural complexity and applications. The methods to analyse polysaccharides, including chromatography where presented by Dr. Claire Boisset-Helbert (head of analytical and chromatography service, Cermav). She presented the different steps and methods used to elucidate the structure of polysaccharides, emphasizing the chromatographical methods. Dr. Jean-Luc Putaux (permanent researcher in the group "Structure and properties of glycomaterials", Cermav), completed with the electron microscopy analysis, presenting the different methods. The information that can be obtained from electron microscopy where illustrated by many results obtain in the group.

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A visit of the analytical facilities available at Cermav, electron microscopy, chromatography and nuclear magnetic resonance services allowed the participants to better understand and get aware of the polysaccharide analysis area and the various analysis possibilities available at Cermav.

Workshop's opening

The presentations also emphasized the enzymes existing around polysaccharides, with a focus on the screening of glycoside hydrolases and polysaccharide lyases to degrade polysaccharide, the chemoenzymatic synthesis of glycoconjugates, presented by Dr. Sébastien Fort (head of the "Chemistry and biotechnology of oligosaccharides" group, Cermav) and the oligosaccharide production by metabolically engineered bacteria, presented by Eric Samain (engineer in the same group at Cermav).

Dr. Jean-François Sassi, invited speaker from CEA, gave an overview of the applications of marine polysaccharides. He introduced the microalgae current industry, the macroalgae aquaculture industry and the seaweed business, showing the current and emerging markets. He detailed the industrial biopolymers from algae: the phycocolloids and other algal polysaccharides industry and pointed out the underexploited diversity of marine polysaccharides.

He also focused on overlooked algal polysaccharides like starch, cellulose and chitin, and presented some orientation of metabolic pathways toward the production of specific biopolymers.

Talk of Jean-François Sassi, invited speaker from CEA

Midterm Meeting

The ALGAECOM midterm meeting was held on March, the 27th and 28th. Representatives of all the partners, involved in the ALGAECOM project, presented their current state of research.

The ALGAECOM partners at Cermav

The PI's of ALGAECOM, meeting at Cermav

Dr. Tinaïg Le Costaouëc (Cermav-CNRS, France) gave an update on the work progress for extraction of the polysaccharides from the three selected microalgae. The extraction and purification protocols and obtained yields were presented. The progress on the structure elucidation of two polysaccharides from *Phaeodactylum tricornutum* were also presented.

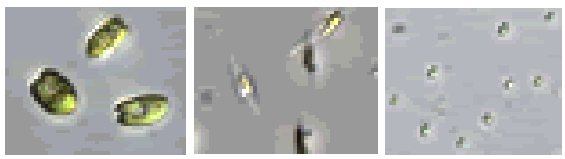
Dr. Flavien Dardelle (FITMAR, Spain) summarized the results obtained at Fitoplancton Marino in collaboration with Dr. Carlos Infante. The set-up protocol to extract the carbohydrates has been detailed and preliminary results of carbohydrate and protein contents for microalgae extracts were presented. Likewise, all the results advancement concerning the relation with each partners were presented.

Dr. Dörte Randewig (AUA, Greece) presented the results of omega-fatty acid analysis from the microalgae *Nannochloropsis gaditana*, *Phaeodactylum tricornutum* and *Tetraselmis chuii* and the variations observed depending on the cultivation conditions (salinity, nitrogen, temperature).

Dr. Sophia Letsiou (APIVITA, Greece) presented the genes database (API-Genes) that includes up to 200 genes involved in different cellular processes. Moreover, she gave an overview of the *in vitro* experiments of algae derived products that will be carried out using human dermal cells.

The postdoctoral researchers of ALGAECOM, meeting at Cermav

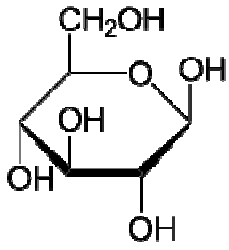
A management session and a round table took place, as well as informal discussions between the partners, principal investigators and postdoctoral researchers to exchange about the different tasks and micro-algal polysaccharide perspectives in ALGAECOM project.



Photos of the microalgae of the project. From the left to the right: Tetraselmis, Phaeodactylum and Nannochloropsis sp.

DID YOU KNOW .....

Found in every living organism on Earth, carbohydrates are molecules made up of the simple Carbon, Oxygen and Hydrogen atoms. Their associations lead to create cyclic molecules that are called monosaccharides. Undoubtedly, the most famous is the Glucose while existing many others such as Fructose, Galactose, Xylose, Fucose, *etc*. These monosaccharides can be linked themselves to create oligosaccharides that consists of 2 to 20 units. In this way, the association gives rise to new molecules where every combination is possible, each having its own property. For instance, an oligosaccharide made up of 2 residues is enough to give a high sweetness molecule, as the sucrose (combination of glucose + fructose), or to be an essential food element for young mammals, as the lactose (glucose + galactose). At upper scale, monosaccharides can be associated to reach over 1000 residues that lead to the formation of polysaccharides. Among them, we can name the cellulose (main constituent of the wood and cotton) or the starch (a plant storage carbohydrate and main component of flours).



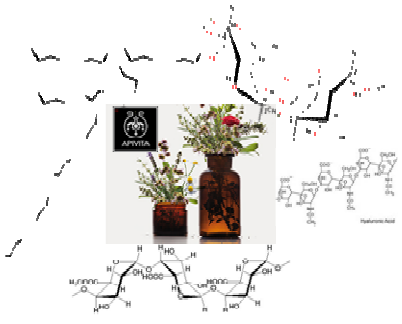
Glucose

Since ever, carbohydrates are used by humans in different industries: in textile to make clothes (*e.g.* cotton), in pharmaceutics (*e.g.* heparin), in material to stick the wallpaper (*e.g.* starch) as well as in food (*e.g.* sugar and flour). To summarize, carbohydrates are widely used because of their multiple functions such as rheological, physical, chemical or biological that open the field of possibilities. Moreover, considering that these functions can be combined, carbohydrates revealed to be excellent candidates for cosmetology. Thus, previous years were devoted to research molecules for cream improvement. Today, cream ingredients often display the use of gum, alginate or agar that are used as texturing agents by thickening the solution. Also cyclodextrins, used as a carrier and preventing molecule degradation, are currently associated to cream formulation. Finally, carbohydrates are also often found as selling points for cosmetic creams. The best examples are probably hyaluronic acid and rhamnose for their activities (roles in skin hydration and inflammatory reaction inhibition, respectively).

But what's their origin? Carbohydrates are coming from various living species, terrestrial plants being to date the main suppliers. We can also notice that honey - *a flagship product used by Apivita* - is made up of 82 % of carbohydrates! Algae also produce carbohydrates, some of them having specific properties as the gelatinous polymer agar-agar. So, the *AlgaeCom* project occurs in this way, participating to determine new polysaccharides that may be useful for cosmetic industries.

Polysaccharides in Cosmetics

Polysaccharides have a multifunctional role in cosmetics. They do an ultimate job far away from the all-too fleeting active agents in silence, and that is why we are no longer aware of them. The majority of polysaccharides are natural or semi natural having a significant role in cosmetic formulation technology. The tendency to use polysaccharides in cosmetic formulations is outstanding due to suggestive effects in skin water content and micro-relief improvement, as well as in the stimulation of cell renewal and glycosaminoglycan biosynthesis. So, polysaccharides act as thickeners, suspending agents, hair conditioners, moisturizers, emulsifiers, emollients, and even wound-healing agents.



Example of carbohydrates used by Apivita

APIVITA is aware of the high added value of polysaccharides, and natural polysaccharides are included in most APIVITA products. First of all, APIVITA's DNA based on the honey bee that considers being a natural rich source of polysaccharides. Biotechnologically-originated or marine-derived polysaccharides such as Alginate, Carageenan and Xanthan Gum are used in APIVITA formulations to enhance cell renewal, skin hydration and micro-relief. In natural serums that boost all the hydration processes of the skin as well as the skin vitality Hyaluronic acid is used. In face moisturizers and cleansing products, plant or algae extracts enriched with polysaccharides are introduced leading to an effective protection of oxidative stress, cellular longevity and maintenance of microcapillary integrity upon UV exposure. In hair products such as Shampoo and Conditioners, Bio Cotton Protection System (Cotton-Oligosaccharide-Arginine) is used. Bio Cotton Protection System, APIVITA's exclusive innovation, aims at keeping both scalp and hair fiber in good condition by boosting defense mechanisms against environmental aggressions. Prebiotic oligosaccharide with bio selective action reinforces skin and scalp ecosystem by keeping the micro flora in balance. Cotton Bloom Extract acts as a protective shield for the fiber against all external attacks. Arginine hydrates skin and nourishes hair so as to be able to complete properly their functions.