GIAVAP Genetic Improvement of Algae for Value Added Products	FP 7: FP7-KBBE.2010.3	**GA No. 266401**
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GIAVAP NEWSLETTER		**15/9/2011**

PARTNERS:

Nr	Participant Organization Name	**Participant short name**	Country
1	Ben Gurion University of the Negev (BGU)	BGU	Israel
2	Rothamsted Research (RRES)	RRES	UK
3	J.W. Goethe Universität Frankfurt (GUF), Germany	GUF	Germany
4	Georg-August-University, Göttingen (UGOE)	UGOE	Germany
5	University College, London (UCL)	UCL	UK
6	AlgaFuel, S.A. (AlgaFuel)	AlgaFuel	Portugal
7	Rosetta Genomics/Rosetta Green (RGen)	RGen	Israel
8	Le Mans University, France (UM)	UM	France
9	CNRS/University Pierre et Marie Curie (CNRS)	CNRS	France
10	University of Firenze (UNIFI)	UNIFI	Italy
11	Algatech (ALGATECH)	ALGATECH	Israel
12	Nimrod Shaham & Amos Zamir C.P.A.	SHAHAM CPA	Israel

Concept

Microalgae produce a wide range of high-value products such as carotenoids and long chain Polyunsaturated Fatty Acids (PUFA's). Production of such chemicals by microalgae is one of the most promising approaches for high-value production from microalgae. In order for production costs to compete successfully with the synthetic products currently used in food, cosmetics, aquaculture and agriculture, or with fish oil harvested from unsustainable fishing, algal strains and production processes require improvements at various levels. Furthermore the suitability of microalgae as a potential source of biofuel has increased interest in microalgal biotechnology, though significant efforts in strain development and cultivation technologies are required to reduce currently high production costs for algal biomass. Microalgae accessible to genetic engineering can also play an increasingly important role in production of pharmaceutically active substances and transgenic protein products for therapeutic or industrial applications.

The purpose of project GIAVAP is addressing the problems and challenges of genetically modulating and successfully cultivating the wide variety of microalgae by integrating universally valid biological and engineering principles to redirect metabolic pathways for the efficient production of valuable algal products. Furthermore the challenges of large scale cultivation, harvesting and product extraction are being addressed using a range of approaches such as:

- Bioinformatics
- Genetic Engineering;
- Lipid and Pigment Analytics and Quantification;
- Stress biology;
- Upscaling, harvesting and extraction of high value products;

The detailed objectives of project GIAVAP are:

- Identification of novel genes involved in biosynthesis of high value products by bioinformatics and transcriptome or genome sequencing of selected species;
- Development of molecular tools, such as transformation vectors, promoters, dominant selectable markers etc for nuclear and chloroplast transformation of various algal strains, and testing of novel tools, such as short RNAs, microRNAs (miRNAs) and transposable elements for genetic modification and improvement of microalgal strains;
- Identification and development of the optimal transformation techniques for different microalgal species and production of stably transformed, improved algal strains;
- Identification and cloning of algal genes contributing to fatty acid, lipid or carotenoid biosynthesis, and enhancing the biogenesis of lipid globules for promoting lipid/carotenoid accumulation;
- Stable expression of transgenic enzymes or small regulatory RNAs in different algal strains to increase fatty acid, lipid and carotenoid biosynthesis;
- Stable expression of transgenes for improved stable algal growth, stress tolerance etc. with the aim of creating more stable and productive algal strains;
- Development and testing of universally applicable mutagenesis technologies and selection protocols for different algal strains with the aim of creating more stress resistant, more productive algal strains with higher content of oil and valuable by-products such as PUFA or carotenoids;
- Studying the metabolic pathways leading to accumulation of valuable products and in this context identifying mechanisms involved in formation of lipid globules;
- Demonstration and successful upscaling of algal biomass cultivation, harvesting and product extraction using existing algal mutants and transgenic algae produced within the framework of the project;

- Improving production technologies for algal biomass and oil for biofuel production, and harvesting and processing of algal biomass.

First Project Outcomes:

- DNA of two valuable species has been submitted to next generation sequencing, the resulting data are now being processed in expectation of first results of the assembly process within the next months;
- A large number of genes of potential importance for high value product or lipid accumulation have been cloned from different species and are being expressed and functionally characterized in algal and heterologous systems;
- Transformation of four algal species is successfully applied by different laboratories of the consortium, and novel cloning strategies are being employed to create optimized transformation and expression systems;
- Creation of herbicide resistant mutant strains, and characterization of transposons in different algal strains are under way;
- The subunit genes involved in carbon allocation, such as pyruvate kinase (PK), pyruvate dehydrogenase complex (PDC) and acetyl-CoA carboxylase (ACC) have been partly or fully cloned from *P. incisa* or *H. pluvialis*. A novel oil globule protein from *H. pluvialis* has also been cloned and characterized.
- *Phaeodactylum* carotenoid biosynthesis genes are being cloned and characterized;
- *Ostreococcus tauri* acyl-CoA dependent Δ6-desaturase OtD6 cDNA has been cloned for expression in other algae;
- The most favorable conditions for PUFAs biosynthesis were determined for *Pavlova lutheri* strain CCAP 931;
- Target protein genes for expression in *C. reinhardtii* were selected, and as proof of concept a plasmid encoding a secreted human Erythropoietin (pHsp70A/RbcS2-cEpo) was transformed and EPO production demonstrated by ELISA;

- Physiology and metabolism of five algal species were further characterized, fatty acid content and carotenoid content were determined under different growth conditions such as starvation, high light, varying salinity or temperature;
- Oil productivity of different *Nannochloropsis* isolates was assessed and compared to that of *Phaeodactylum*;
- Cultivation modes for maximizing lipid or high value product accumulation have been tested;
- Pilot scale cultivation of various wild type strains is being optimized at four partner's labs including tests for heterotrophic growth.

Job Openings:

The Microalgal Biotechnology Laboratories (MBL)

in Sde Boker, Israel, are looking for qualified, ambitious

Ph.D students or Postdocs

in all fields of algal Biotechnology, especially

Metabolic Engineering of Microalgae

Environmental Phycology

Algal Biofuels Production

For further Information please contact:

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