

**4<sup>th</sup> Congress of the International  
Society for Applied Phycology**

June 19 – 24, 2011  Halifax, Canada



**A** Acadian  
Seaplants

 **BioNOVA**  
BIODIVERSITY FOR A BETTER WORLD

**Scaling-up for new opportunities  
in applied phycology**

**Program  
and  
Abstracts**

Organized by  
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**ISAP 2011**

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## DAILY PROGRAMS

Thursday, June 23		
	Breakout A	Breakout B
13:00 – 14:40	<b>Contributed Papers #12</b> Use of algae in aquaculture, feed / food Session Chair: Stefan Kraan	<b>Contributed Papers #13</b> Scaling-up production and the mass cultivation of algae Session Chair: John Hewson
13:00 – 13:20	<b>Stefan Kraan - Ocean Harvest Technology (065)</b> Applications of macroalgae in aquaculture feeds	<b>John Hewson - Sandia National Laboratories (070)</b> Toward an understanding of algae flocculation and its dependence on water chemistry
13:20 – 13:40	<b>Graziella Chini Zittelli - CNR - Istituto Per Lo Studio Degli Ecosistemi (066)</b> Production of <i>Tetraselmis</i> biomass for aquaculture feed	<b>Theo Kalaitzidis - University Of Adelaide (071)</b> Microalgal harvesting
13:40 – 14:00	<b>Eneko Ganuza - CleanAlgae S.L. (067)</b> Large scale microalgae production and processing for the hatchery market	<b>Benjamin Le Gouic - GEPEA (072)</b> Biofixation of CO <sub>2</sub> in an enclosed raceway: investigation of various CO <sub>2</sub> feeding strategies
14:00 – 14:20	<b>Jose Zertuche-González - Universidad Autonoma De Baja California (068)</b> <i>Eisenia arborea</i> (Areschoung) domestication and mariculture development on the Pacific coast of Baja California, México	<b>Quang Doan - University of Adelaide (073)</b> Hypersaline challenge for the fermentation of marine microalgae biomass to ethanol
14:20 – 14:40	<b>Nihal Shams El Din - National Institute of Oceanography, Egypt (069)</b> Nutritional value of some algae along the North Western Mediterranean Coast of Egypt	<b>Annette Bruhn - Aarhus University (074)</b> CO <sub>2</sub> bioremediation - flue gas as carbon source for cultivation of the green macroalgae <i>Ulva lactuca</i>
14:40 – 15:00	<b>Coffee Break - Foyer</b>	

**066****Production of *Tetraselmis* biomass for aquaculture feeds**

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Marine microalgae show large potential as alternatives to fish-based feeds for aquaculture, due to their high content of good-quality protein, vitamins, minerals and long-chain PUFAs. However, the high production cost of microalgae biomass still prevents its commercial exploitation as raw material for aquafeeds. Further R&D efforts are needed to achieve the ambitious goal of producing algal biomass at costs competitive with those of fish meal (US\$ 1.3-2.0 kg<sup>-1</sup>).

Aim of this work was to develop an economically sound cultivation process for outdoor mass production of the marine microalga *Tetraselmis* thanks to low-cost cultivation systems and inexpensive nutrients.

Several strains were tested in the laboratory for their growth characteristics, biochemical composition, stress resistance and mixotrophic capacity. Hence, the most promising strain was cultivated outdoors in a "Green Wall Panel" photobioreactor (WO2004/074423) and in raceway ponds. The two systems were compared in terms of productivity and cost. A 70% cost reduction in growth medium was achieved using cheap industrial salts available on the market. *Tetraselmis* has shown a potential for producing about 60 tons of dry biomass ha<sup>-1</sup> year<sup>-1</sup>, of which 30 tons may be protein. Since this microalga is also robust and versatile and shows a well balanced nutritional composition, it seems feasible to produce the biomass at relatively low costs. In feeding experiments with seabass, *Tetraselmis suecica* was able to replace up to 20% of fish meal protein without decreasing fish growth performance. Techniques of cell disruption are under test to increase its digestibility.

**067****Large Scale Microalgae Production and Processing for the Hatchery Market**

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The aquaculture hatcheries rely on the in-house microalgae production, which is labor consuming and risky. Alternatively, algae dedicated companies could produce and deliver microalgae at a larger scale while saving time and money. Microalgae commercial products are processed as a fresh paste concentrate, frozen paste, dry powder or a designed blend of different algae species. The hatchery growers are gaining confidence on these products but still there are no quality criteria that will help to consolidate these products into the market. CleanAlgae has studied a wide range of commercial products with the aim to establish the quality criteria. In particular the greening capacity, precipitation rate, cell numbers, ash, moisture, cell size, fatty acid profile and dispersion capacity were studied according to the processing of the product. The quality characteristics were not affected by the processing of the microalgae, except for the dispersion capacity, which depending on the drying technique applied ranged between a particle size of 4 and 17 µm due to the cell clustering and aggregation. Several drying techniques (drum drying, spray drying, lyophilisation, and supercritical drying) and dispersants (EDTA, cationic detergent, polyphosphate) were implemented in the processing of dry powder. Lyophilisation and supercritical drying were the only techniques that would disperse the microalgae powder in water with single celled particles (4 µm) and therefore maintain the original cell counts. In conclusion, new processing requirements and implications of hatchery products were defined and the supercritical drying was successfully implemented for the first time in algae products.