

## Algae for aquaculture and wastewater treatment Production and Use of Microalgae Biomass for Aquaculture Feeds



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### Abstract

For a sustainable aquaculture industry, current levels of fish meals/oils in aquafeeds need to be drastically reduced and mostly replaced by vegetable counterparts. 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 ( $\text{€ } 1\text{-}2 \text{ kg}^{-1}$ ).

Aim of this work was to develop an economically sound cultivation process for outdoor mass production of marine microalgae thanks to low-cost cultivation systems and reduced operational costs (mixing, cooling and fertilizers). Several microalgae species were tested in laboratory for their growth characteristics, stress resistance, biochemical composition and "in vitro" digestibility. Hence, among the most promising species, the marine *Tetraselmis suecica* was cultivated outdoors in "Green Wall Panel" photobioreactors (WO2004/074423; WO 2011/013104), evaluating its performance in terms of productivity and energy balance. *Tetraselmis* has shown a potential for producing about 60 tons of dry biomass  $\text{ha}^{-1} \text{ year}^{-1}$ , 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, diets including graded levels of dried *T. suecica*, *Isochrysis* sp. (T-ISO) or a blend of the two marine microalgae showed similar growth performance and feed utilisation compared to the control diets. The effects of the dietary microalgae inclusion on fillet proximate and fatty acid composition were also considered. Techniques of algal cell disruption are under test to increase microalgae digestibility and will be discussed.





### Company Profile

The basic and applied research activity of the Institute of Ecosystem Study-CNR is in the field of water and land ecosystems, and is involved in understanding how ecosystems react to the impact of global climate change and anthropogenic pressure. Its main objective is to generate the scientific knowledge for the valorisation and the protection of the natural environment.

In particular the Florence section of the Institute has specific competencies in the ecology, physiology, biochemistry, taxonomy and biotechnology of photosynthetic microorganism with particular regard to organisms that have applicative interest. The main fields of research activity are:

- 1) Bioenergy and high value products from microalgae;
- 2) Biology and physiology of photosynthetic microorganisms of industrial interest;
- 3) Agro-industrial waste treatment and valorisation

(<http://www.ise.cnr.it/research/photosynthetic-micro-organisms> )

### Curriculum Vitae

M. Sc. in Biological Sciences, Ph.D. in Soil Science, Researcher at the National Research Council-Institute of Ecosystem Study. Field of interest: Biology and biotechnology of photosynthetic microorganisms (cyanobacteria and microalgae) of industrial interest. Research topics: Selection and laboratory cultivation of microalgae strains; Evaluation of the different physiological or stress conditions that favour the accumulation of high value products or allow to produce bio-energy through the induction of lipid/sugar synthesis; Development and optimization of new photobioreactor designs for outdoor mass cultivation of microalgae and cyanobacteria; Mass cultivation of selected microalgal species for production of biomass as aquaculture feeds, food ingredients and nutraceuticals, and as source of biofuels. Experience working with microalgae and cyanobacteria of more than 20 years. Member of the EABA Scientific Committee and of the Novel Food working group



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