

# NOVEL PHOTOBIOREACTOR FOR MASS CULTIVATION OF MICROALGAE

**P** PATENTED TECHNOLOGY



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## ABSTRACT

The research group Polymer processing and pyrolysis of the University of Alicante has developed a novel photobioreactor in order to grow massively different species of microalgae, even on industrial scale and with automation.

The main advantages of this technology are: high productivity, better CO<sub>2</sub> consumption, better light transfer to the culture, more effective shaking and less cleaning and maintenance time. It can be used in the following industrial sectors: biofuels, aquaculture, food, pharmaceutical, cosmetics, etc.

The research group is looking for companies acquiring this technology for licensing agreement and technical cooperation.

## TECHNOLOGY ADVANTAGES AND INNOVATIVE ASPECTS

The main innovation of this invention is that this novel photobioreactor combines the mechanism of a bubble column with the air-lift type for higher biomass production than that obtained for both systems separately.

Moreover, the main advantages of this technology are:

- High productivity.
- The stirring is more effective because the effects of both types of reactor (bubble column and air-lift type) are added, which allows a faster microalgae exchange between areas of light and dark.
- Better light transfer to the culture because the bubbles generated directly mix the culture resulting in an expansion thereof.
- Maintenance of the uniformity in the distribution of gas in the system.
- Improves nutrient solution: the way in which is injected CO<sub>2</sub> to maintain the pH of the culture allows that the residence time of CO<sub>2</sub> in the medium increases, thus making better use of it (the whole culture must be crossed to reach the surface).
- Better control of the culture conditions (pH, temperature, etc.).
- There is a lower adhesion of microalgae on the photobioreactor walls, which achieves a greater use of light when the culture reaches high concentrations, and it barely requires cleaning and maintenance.
- CO<sub>2</sub> consumption to reach a suitable microalgae growth is significantly reduced compared with other systems. The best use of this nutrient compared to the conventional air-lift reactor is due to the higher residence time of CO<sub>2</sub> it is in the culture: there is a higher concentration dissolved and therefore higher availability for microalgae. Figure 3 shows how the number of CO<sub>2</sub> injections performed in a culture of *Nannochloropsis oculata* in a given time interval is reduced with respect to a reactor of conventional air-lift type:

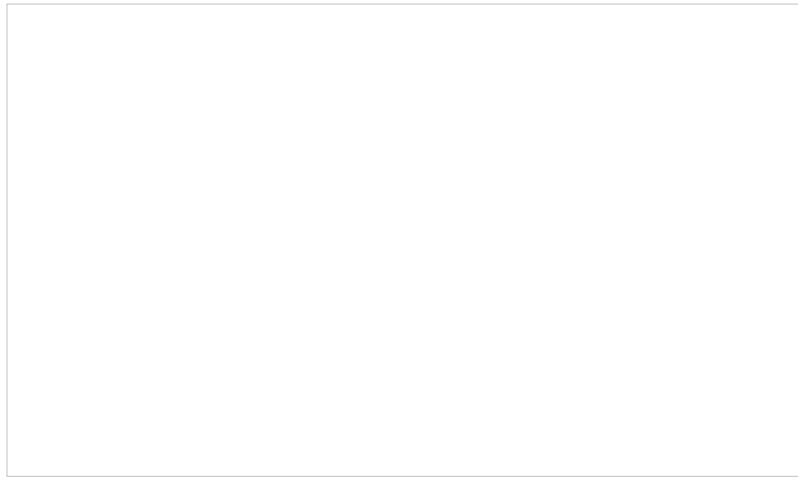


Figure 3: Comparison of the pH profiles using the photobioreactor described in this invention and a conventional air-lift reactor

- Due to its configuration, it allows easy scaling on industrial level.
- It is robust and easy to install and operate (technical experience is not required for its management).
- The better use of sunlight minimizes energy consumption and cost.
- It is able to be automated (it has aeration, circulation, feeding and harvesting circuits).
- It is thermostated for optimum growth of microalgae.
- It has an automatic pH probe for CO<sub>2</sub> injection.
- It allows to cultivate some microalgae species, such as: Chlorella, Nannochloropsis oculata, Nannochloropsis gaditana, Isochrysis aff. Galbana, Spirulina platensis, Dunaliella salina, Odontella aurita, Phaeodactylum tricornutum, Porphyridium cruentum, etc.
- The culture conditions have been optimized for Nannochloropsis oculata, a kind of microalgae particularly resistant to pollution (fungi, yeasts, bacteria, viruses, etc.).

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#### MARKET APPLICATIONS

The present invention consists in a photobioreactor combining a bubble column with the air-lift type mechanisms to achieve higher biomass production than both systems separately.

Microalgae have high photosynthetic efficiency, so their growth is faster than plants. In this sense, microalgae are a very interesting material for the generation of biofuels.

Addition of biomass to produce biofuels, microalgae can be used to obtain other valuable substances on different industry sectors: food, pharmaceuticals, cosmetics, nutraceuticals, etc.

Depending on the species cultured, it can be obtained:

Antibiotics

Enzymes

Proteins

Peptides

Pigments

Vitamins

Biopolymers

Polysaccharides

Polyunsaturated fatty acids

Triglycerides

Essential lipids

Oxylipins

Antioxidants

Etc.

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**COLLABORATION SOUGHT**

The research group is looking for companies interested in acquiring this technology for commercial exploitation by:

- Licensing agreement.
  - Technical cooperation to test new applications (biofuels, cosmetics, pharmaceuticals, nutraceuticals, food, etc.) and to adapt it to microalgae species, such as: *Chlorella*, *Nannochloropsis oculata*, *Nannochloropsis gaditana*, *Isochrysis aff. Galbana*, *Spirulina platensis*, *Dunaliella salina*, *Odontella aurita*, *Phaedactylum tricorutum*, *Porphyridium cruentum*, etc.
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