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Production of Microalgae Biomass (MAB): A cost-efficient, profitable, sustainable and quality upscaling of five commercial microalgae strains in greenhouse at northern latitudes

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Statement of the Problem: The feasibility, sustainability, profitability and quality of a low-cost upscaling of microalgae biomass (MAB) production at Norwegian latitudes in greenhouse as an energy source.

Methodology & Theoretical Orientation: Two marine(m) and three freshwater(f) algae were cultivated in duplicate, from inoculum batch to upscale in polypropylene open Tray PhotoBioReactor (TPBR, 25 L). Chlorella vulgaris(f), Dunaliella salina(m), Nannochloropsis oculata(m), cultivated for 63 days (20.06.12-23.08.12), and Scenedesmus sp(f), Chlorella wild mix Årungen(f), cultivated for 42 days (20.07.12-23.08.12), at semi-continuous operation system, enriched CO2 air (3%) and prepared *in situ*, trifold nitrogen nutrition bold media (3N-BBM+Vit) and tap water, with volumes replenished when need. Effects investigated: 1- Irradiance and temperature on specific growth rate and daily growth. At 23°C Scenedesmus sp grew faster at 1,2d-1 and fivefold when doubling the irradiation energy input, meanwhile Dunaliella salina, reported 0,576d-1 and 71,4% growth increase. 2- Outside weather condition in conjugation with irradiation and temperature on oxygen evolution (dissolved, DO) showed that cloudy days generated 31% more DO with 2,64 times less PAR irradiation than sunny days. 3- Optimized Dilution(D) and Mixing(M) regimes on biomass productivity(P) of marine algae increased by 60%. 4- Irradiance(I) on Photosynthetic Efficiency(PE), for marine strains, 61% lower irradiance gave 4 times higher PE, and for freshwater strains, a four times lower irradiance gave 4,6 times higher PE. 5- Irradiance on areal CO_2 fixation rate, the mean CO2 fixation rate was 55,44gCO2m-2d-1, which is 2,6 times higher values than found by Hulatt (2011). 6- Outdoors weather conditions on TPBRs energetic efficiency found the overall Irradiation Utilization Efficiency(IUE) provided by the TPBR. Nannochloropsis oculata, performed best with 1,37gMJ-1, and optical pathway 9cm.

Conclusion & Significance: A cost-efficient greenhouse MAB production at northern latitudes shows great potential as sustainable, profitable energy supplier as substitute of] soy meal in fish feed diet.

Figure 1: Registered MAB production summer period 2012 - Volume of algae culture need to produce 1kg DW algae: 3251ls culture of Chlorella vulgaris and 1830ls culture of Dunaliella salina

Biography

Henry T. Bedoya Has background in biological, botanical and microbiological studies and degrees from Kharkov´s National State University, Ukraine; University of Oslo, Norway and The University of Life Sciences of Norway. Field studies in food production at greenhouse conditions and specialization in microalgae biomass (MAB) production in greenhouse at northern latitudes. This journey started in Ukraine and continued in Norway with production and delivery of the MAB for the EU project under the Research for SME program titled, "Operation SWAT" under contract n: 286840 and comprehended cost-effective MAB production in two processes: upscaling and harvesting by flocculation and filtration. SWAT involved R&D institutions from Czech Republic, Germany, Poland, Spain UK and Norway. Bedoya´s work at NMBU and IGV-GmbH results and findings, generated the core data for the recreation of a conveyor belt filter device from the wastewater treatment industry (Salsnes Filter Series), into a device specialized in MAB harvesting.

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