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## High rate algal biomass production for food, biochemicals and Biofuels: An Indo-Danish collaboration project

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Increased population, shortage of fossil fuels and climatic changes constitute global challenges demanding actions and strategic planning for securing access of food, and energy supply. Algal biomass offers a great potential for meeting these future challenges. Sustainable production and utilization of biofuels have an enormous potential for energy supply source. An attractive alternative to land based biomass, is to use algae as a source of biomass for production of bioenergy as well as food, and various biochemicals. In this study we develop, optimise, evaluate and demonstrate sustainable biorefinery processes for the production of food supplements (alginates,  $\beta$ -carotene, omega 3 fatty acids), biochemicals (e.g. pigments, phenolic compounds), biofertilizer and biofuels (biohydrogen, biomethane, bioethanol) from algal biomass. The following macroalgae are included in the study: *Ulva lactuca*, *Enteromorpha* sp., *Saccharina latissima*, *Laminaria digitata* and *Palmaria palmata*, which are selected due to their high growth rates at relative cold temperatures appropriate for bioenergy production, or due to their concentrations of compounds such as fucoidan, laminaran, fucoxanthin, phycobiliproteins etc. *Pylaiella* sp. and *Ectocarpus* sp. are also considered, however little is known about their composition. For microalgae, *Haematococcus pluvialis*, *Spirulina platensis*, *Isochrysis* sp., *Nannochloropsis* sp., and *Tetraselmis* sp. are chosen due to their content of high value added products such as astaxanthin, phycocyanin and omega 3 fatty acids etc.

In this biorefinery concept, we are integrating biofuel production with algal cultivation, where effluents from bioenergy production are used as nutrients supply for algal cultivation. Additionally, exhaust gas from bioenergy utilisation is tested for CO<sub>2</sub> supply for algal cultivation. Furthermore, application of algae as biofertilizers on agricultural land to enhance rice and wheat production yields is considered. Finally, we evaluated the biorefinery to find out the sustainability of utilisation of algae for food, biochemicals and biofuels production.