Brackish algae in Mekong Delta Vietnam - A sustainable material source for production of bioethanol, plant-based protein and bioactive peptides

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Growing fast and habiting in seawater and brackish water, green algae *Chaetomorpha* sp., also called blanket algae, are easily collected in the Mekong Delta. They also can be co-cultured with shrimp in brackish water shrimp ponds. Shrimp health and yield both increase when plants filter the water. In addition, algae are also capable of handling environmental pollution by absorbing CO_2 in photosynthesis process to produce biomass; therefore, will help protect the environment and reduce greenhouse gas.

Chaetomorpha sp. algae contain 40-47% w/w carbohydrate, 13-21% w/w protein, 3-4% w/w lipid, and 28-29% w/w ash. The algae carbohydrate contains 72-74% of glucose in monomeric sugar profile. The amount of essential amino acid accounts for more than 42% w/w of total amino acid in algae protein. Algae biomass is also very rich in mineral, especially calcium (Ca), magnesium (Mg), potassium (K) and iron (Fe).

Dried algae biomass was used for protein extraction by using NaOH solution and cellulase enzyme (Crestone Conc., Genecor). The protein extraction yield reached 84.11%. Difference on protein quality is related to processing condition and biochemical composition of algae protein isolate (API). Removing lipid and carbohydrate increased protein content, functional properties and protein digestibility. The API containing 82% w/w protein exhibited high digestibility (83.8%), similar ($p>0.05$) to soy protein isolate. According to the WHO/FAO/UNU protein standard for non-athletic adult, the API from *Chaetomorpha* sp. scored high AAS, the PDCAAS values were >1.0. Other nutritional values such as BV (Biological Value), PER (Protein Efficiency Ratio), NPR (Net Protein Ratio) determined by *in vivo* trials on white mouses (mice) also showed high nutritional value of algae protein. The API also exhibited good foaming and emulsifying properties, leading them to be widely used as food additives. Protein from algae was also hydrolyzed with 1% Alcalase enzyme at pH 7-8, temperature 40^{o}C for 2 hours to obtain bioactive peptides of 1-2kDa with strong antioxidant activity.

The algae residue following protein extraction was pretreated with dilute sulfuric acid solution at high temperature and then converted into bioethanol by Simultaneously Saccharification and Fermentation (SSF), using cellulase enzymes combined with *Saccharomyces cerevisiae.* At the optimum conditions, ethanol concentrations after SSF was approximately 2% (v/v), fermentation yield reached 80%.

Thus, *Chaetomorpha* sp. biomass can be considered as potential material source for production of bioethanol, plant-based protein and bioactive peptides.

Keyword: *Chaetomorpha brackish algae, biochemical composition, algae protein isolate, bioactive peptide, bioethanol*