INTRODUCTION

PhD Student: **Nguyễn Minh Hải**

Thesis topic: **Obtaining ethanol from brackish algae *Chaetomorpha* sp.**

Major: **Food Technology**

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Training institute: **Ho Chi Minh City University of Technology, VNU-HCMC**

Scientific supervisors: **- Prof. Dr. Lê Văn Việt Mẫn**

- Associate Prof. Dr. Hoàng Kim Anh

CONTENT

- Investigating chemical composition of the brackish algae *Chaetomorpha* sp. biomass in the Mekong Delta region.
- Converting *Chaetomorpha* sp. into bioethanol by appropriate methods and proposing new method to improve the efficiency.

Scientific contributions

In term of academics

- Chemical components of *Chaetomorpha* sp. such as polysaccharides, proteins and minerals were investigated to be the basis information/data for studies on converting its biomass to bioethanol. Polysaccharide of algae contained 74.4% 1,4-glucopyranosyl linkage so cellulase was appropriate for converting biomass into fermentable sugar. Nutritional value of protein was so high because 42.11% of protein was essential amino acids. Heavy metals were not available and the content of lipid was very low (3,4-4,5% w/w).
- Rules which technical factors affected efficiency of removing protein and minerals of algae by NaOH solution and ultrasound were determined so that polysaccharide content of algae biomass were increased effectively.
- Rules which technical factors affected the decrease of crystallization index of algae polysaccharides in the process of treating biomass with H_2SO_4 solution were determined.
- Determined the influence rules of the technical factors which affect the process of converting biomass into bioethanol with SHF (Separate Hydrolysis and Fermentation) and SSF (Simultaneous Saccharification and Fermentation) methods. These technical factors are the basis for enhanced method.
- Determined the influence rules of technical factors which affect the converting of biomass into ethanol by enhanced method (combination of SHF and SSF).
- Rules of carbon metabolism in 3 methods for fermentation were determined. The fermentation efficiency of these methods was investigated and compared.

In term of applications

- The appropriate technical parameters were determined. They included:

* Algae was treated by NaOH solution and ultrasound. The ratio of raw material and NaOH solution was 1:25. The concentration of NaOH was 1.0% and the ultrasonic power was 45W per gram of material. Raw material was treated by ultrasound for 5 minutes. The following treatment conditions were 60^0C and 60 minutes. By this process, the content of polysaccharide in raw materials increased approximately 63% while the particle size of biomass decreased by about 32% and its surface area increased nearly 50%.

* Algae was pretreated by H_2SO_4 1.75% (w/v) at 120^0C for 30 minutes and the percentage of raw material in the mixture was 12.5% (w/v). After the treatment process, crystallization index decreased nearly 34%. the particle size was 4.1 times lower than sample pretreated by NaOH solution and ultrasound. In addition, the particle surface area increased by 4.8 times.

* In SHF method, biomass was converted into bioethanol by endoglucanase and β-glucosidase with 30 FPU/g and 10 CBU/g material respectively. The duration of hydrolysis process was 40 hours and the raw material obtained 10% (w/v) of the mixture. After hydrolysis stage, 10×10^6 CFU/mL of yeast was inserted to the mixture and the fermentation was carried out in 40 hours at 35^0C. The concentration of ethanol in the fermented broth reached 1.83% (v/v) and the fermentation efficiency was 54.8%.

* In SSF method, biomass was converted into bioethanol by endoglucanase and β-glucosidase with 25 FPU/g and 4 CBU/g of material respectively. The raw material obtained 10% (w/v) of the mixture. 10×10^6 CFU/mL of yeast was inserted to the mixture and the fermentation was carried out in 36 hours at 38^0C. The concentration of ethanol in the fermented broth reached 2.1% (v/v) and the fermentation efficiency was 70%.

* In SHF-SSF method, the amount of supplementary material was equivalent to 37.5% initial materials, endoglucanase and β-glucosidase were used at 20 FPU/g and 5 CBU/g of supplementary material respectively. 20×10^6 CFU/mL of yeast was inserted to the mixture and the fermentation was carried out in 36 hours at 38^0C. The concentration of ethanol in the fermented broth reached 3.93 % (v/v) and the fermentation efficiency was 89.6%.

* This study exploited that SHF and SSF methods were equivalent in the efficiency of converting carbon from carbohydrate of the raw material (55.8% and 56.3%). This efficiency was much higher in the new method which the SHF and SSF were combined (66.8%).