CHAPTER 5

CONCLUSION

5.1 Research Summary

Selection of the effective chemical pretreatment (2% (v/v) H_2SO_4) on banana trunk as lignocellulosic biomass to ensure a promising optimum glucose production in subsequent enzymatic hydrolysis was carried out by operating with three selected influencing pretreatment process parameters which are the substrate (biomass) concentration, treatment duration, and treatment temperature. The OFAT studies investigated out that substrate concentration of 10% (w/v), treatment duration of 30 minutes, and treatment temperature of 100 ℃ provided a high yield of glucose (64.67 g/L) in subsequent hydrolysis process. This finding suggested the precise ranges for both substrate concentration (10% (w/v) – 30% (w/v)) and treatment duration (25 minutes – 35 minutes) for further design of experiment (DOE) in RSM. Retaining the treatment temperature constant at 100 ℃ without further considering in optimization studies was the preferable choice to reduce the energy consumption and eliminate the risk of enzymatic inhibitors formation in acidic (H_2SO_4) pretreatment process. According to the analysis evaluation of Design-Expert software, it indicated that the optimum pretreatment conditions to contribute the highest glucose production of 97.69 g/L are 25% (w/v) of substrate concentration and 35 minutes of treatment duration.

5.2 Research Recommendation

The recommendations for future research are listed below.

i. Further study on comparing the effectiveness between chemicals of acid solvent and organic solvent (e.g. alcohol and organic acid) in pretreatment of lignocellulosic materials.
ii. Further study on including more pretreatment process influencing factors such as chemical solvent concentration and agitation effect.
iii. Improving and increasing the parameter levels in OFAT studies to obtain significant optimum point in the range settings for each studied parameters.
iv. Implantation of paraffin oil usage to replace water bath as heating solution medium to eliminate the limitation of water bath only can highest reaching 100 ℃ which restrict the optimization study on pretreatment temperature.
v. Improving the sugar determination analysis using high performance liquid chromatography method.

5.3 Commercialization Potential

Glucose is the final product of this research study which known as hexose monosaccharide with six carbon atoms. It plays the most important role in bio-industries nowadays since it's highly availability to be utilized in conversion to value added bio-products as listed below.

i. Bioethanol. Bioethanol can be obtained through the fermentation of glucose with addition of yeast *Saccharomyces cerevisiae* under optimum fermentation conditions including temperature, pH, and agitation speed in a bioreactor.
ii. Acetic acid. Acetic acid can be obtained through the further oxidation of the bioethanol with addition of bacteria *Acetobacter* under presence of excess oxygen.

iii. Citric acid. Citric acid can be obtained through the fermentation breakdown of glucose to pyruvate and further to the formation of oxaloacetate and accumulation of citrate with addition of fungi *Aspergillus niger* under presence of carbon dioxide.

Optimum studies on the glucose production and extraction from the lignocellulosic materials such as banana trunk biomass wastes has a good commercialization potential due to highly demand in its conversion of value added bio-products mentioned above from market nowadays. As the examples, bioethanol has the great potential to be used as biofuel for transports; acetic acids are needed in food industries (vinegar making) and also medical industries (used as solvent in photographic film); and citric acids are demanded in confectionery industries (used as general additive and flavouring) and also pharmaceutical industry (used as fungicide).