CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

Conclusions

In an effort to improve ethanol fermentation process, in this study, a new ethanol fermentation system by immobilization of the mixed cultures of *S. cerevisiae* M30 and *K. marxianus* DMKU 3-1042 using thin shell silk cocoon / alginate-loofa as cell carriers was developed and evaluated. Under batch fermentations in 500 ml Erlenmeyer flask, *S. cerevisiae* M30 was more efficient at 33-37 °C in cane molasses medium, whereas *K. marxianus* DMKU 3-1042 was found to be the better strain for high-temperature (40-45 °C) especially in sugar cane juice medium. It was found that the mixed culture manifested the highest activity for ethanol production for all conditions. The immobilized mixed cell culture, especially with thin shell silk cocoon carrier was capable of highly efficient ethanol production from sugar cane juice/ cane molasses at high temperatures of 37 and 40°C, resulting in the final ethanol concentration of 71.84-80.65 g/l. Continuous ethanol production was successfully carried out in a 1-litre packed-bed reactor under uncontrolled operating temperature. The maximum ethanol productivity of 18.24 ± 0.44 g/l h with ethanol concentration of 45.61 ± 1.10 g/l could be obtained with the feed of cane molasses at 0.41 h^{-1} dilution rate, while the highest ethanol concentration of 86.33 ± 1.34 g/l was obtained at 0.1h^{-1} dilution rate for using sugar cane juice under the wide range of operating temperature between 29.84 to 39.36 °C. In this regard, the immobilized mixed culture of *S. cerevisiae* M30 and *K. marxianus* DMKU 3-1042 was promising for continuous fermentation process under uncontrolled operating temperature. This developed process could reduce the costs associated with heating and cooling system during the fermentation process.

Recommendations

A pilot-plant for the fermentation studies is considered necessary in order to apply the TSSC immobilized cell packed bed bioreactor for industrial ethanol

production. Moreover, the development of a mixed culture system which could be able to use agriculture waste such as cellulosic waste materials or other low-priced substrates is suggested.