CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The main objective of this thesis was to investigate the mixed surfactants aqueous-based solution for Jatropha oil extraction process in order to compare the extraction efficiency with other conventional extraction processes; hexane solvent and mechanical pressing. Microemulsion technique introduced in this study was expected to provide several advantages. Firstly, to be utilized as a replacement of hexane extraction, this technique is environmentally friendly and inexpensive. It decreases the toxicity that has high potential to be occurred from the release of hexane into the environment and surfactants used in the process generally cause no human health impact as it is edible and biodegradable. Secondly, this technique requires very low energy input and is not time consuming. Thirdly, it is worth widely for application from small scale to commercial utilization toward both economical and environmental aspects because less energy consumption, no harmful chemical use, no potentially harmful pollution emission and waste generation. Lastly and most importantly, this technique can eliminate phorbol esters, the main toxic compounds in the oil, which is potentially useful for further application as biodiesel and the oleochemical products. Conclusively, the concept of this study aimed to propose the clean technology concept.

However, the complexity of microemulsion systems and the Jatropha itself have some limitations. Therefore, the optimum conditions of interfacial tension and solubilization among the surfactants phase and the kernels needed to be evaluated in order to enhance the highest Jatropha oil extraction. The results revealed that the major components and proportion of mixed surfactants aqueous-based solution are fatty alcohol C 12-14 (2) ethoxylate nonionic surfactant mixed with Alfoterra 145-4PO in cooperated with sodium chloride. The optimal selected system is 3% fatty alcohol C 12-14 (2) ethoxylate nonionic surfactant mixed with 0.02% Alfoterra 145-

4PO and 0.6% NaCl with the yield obtained up to 73% for single extraction and up to 90% for double extraction. The appropriate extraction conditions in this study were grain size 8-35 mesh, 1 min contact time with 130 rpm orbital shaking and 1 g of Jatropha kernel load per 10 mL of mixed surfactants aqueous-based solution or 1:10 solid to liquid ratio.

Furthermore, the oil quality from three extraction methods were compared and the result revealed that the oil extracted from the mixed surfactants aqueous-based solution is comparable to the hexane extraction and even better quality than the mechanical compress. And the concentration of phorbol esters in the oil obtained from mixed surfactants aqueous-based solution extraction found to be least among the three extraction methods.

Crop management and socio economical consideration

The Jatropha plantation tends to securing food supply by plantation on the rehabilitating unused degraded land. The chemical contaminated sites are also considered to be potential land-use for non-edible-oil bearing plant just like Jatropha. Along with this comes the potential of the thousand of sustainable jobs in the local community. Moreover, the Jatropha plant itself is easy for cultivation with low demand of fertilization. The Jatropha oil extraction using mixed surfactants aqueous-based solution was considered to be inexpensive process since it requires low energy input, no heat demand and to compare with hexane extraction, it requires less protective equipments as the process did not involve with heat and harmful chemical reagents. The two types of surfactant was commercialize and can be produced inbound with inexpensive expenditure. The numerous usages of Jatropha can be value added to the farmers. To consider from the oil extraction process itself, the shell can be further produced as biogas or carbon charcoal. The residue can be utilized as fertilizer or can be value-add product of animal feed after appropriate detoxification. In conlusion, from the plantation until the final product of Jatropha utilization, the value can be growth and also create many sustainable careers in the local community if adequate government intervention and support have been received.

5.2 Recommendations

Mixed surfactants aqueous-based solution extraction is break-through process. There were some limitations found from the experimental process; moreover, the relevant studies are still needed to be expanded in order to promote this technique. The recommendations for further study are as follow.

1. Too small grain size caused the kernels upfloated to the upper phase which is difficult for yielding process and also effects the oil quality. Therefore, the grain size was controlled at mesh no.8 and no.35 regardless of the effects from different grain size. However, too big grain size also would limit the oil yield due to the decrease of surface area, hence, the optimum grain size should be determined for highest oil yield obtained.
2. The extraction process should be done simultaneously in order to prevent the floatation and fermentation of Jatropha kernels as the nature of the plant easily be reacted and fermented.
3. The Jatropha seeds are recommended to be deshelled prior extraction process.
4. More studies on the oil quality obtained from the reuse of mixed surfactants aqueous-based solution and the double extraction should be investigated.
5. The other toxins in Jatropha should be determined.
6. The other parameter affected on the kinetics of the extraction process should be further investigated deeply in order to obtain an optimum condition in the dimension time and energy consumption.
7. The economical study shall be conducted in order to compare the efficiency with the other extraction method.
8. Further study of the elimination of phorbol esters shall be continuous because the its existing concentration in the oil is still does not meet the safe level for edible.
9. Mass balance of oil in each phases shall be determined and further discussed.
10. The method of oil extraction efficiency shall be conducted to be more scientific.
11. In order to commercial scale utilization, the processes overview of commercial scale shall be reviewed.

12. Since this thesis is under the patent registration process in Thailand, the further development and investigation in order to obtain a better oil yield or better oil quality shall be conducted for international patent.