



## CHAPTER V

### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Conclusions

The production of hydrogenated biodiesel via deoxygenation of jatropha oil over Pd/Al<sub>2</sub>O<sub>3</sub>, Pt/Al<sub>2</sub>O<sub>3</sub>, Cu/Al<sub>2</sub>O<sub>3</sub>, NiCu/Al<sub>2</sub>O<sub>3</sub>, NiMo/Al<sub>2</sub>O<sub>3</sub>, and CoMo/Al<sub>2</sub>O<sub>3</sub> catalysts was done under temperature of 325 °C, pressure of 500 psig, a H<sub>2</sub>/feed molar ratio of 30, and liquid hourly space velocities of 0.5-4 h<sup>-1</sup>. The catalytic activity of deoxygenation of the tested catalysts decreased in the order Pt/Al<sub>2</sub>O<sub>3</sub>, NiCu/Al<sub>2</sub>O<sub>3</sub>, Pd/Al<sub>2</sub>O<sub>3</sub>, NiMo/Al<sub>2</sub>O<sub>3</sub>, CoMo/Al<sub>2</sub>O<sub>3</sub>, and Cu/Al<sub>2</sub>O<sub>3</sub>. The different catalysts gave different product distributions. There were two main groups of liquid products which were hydrocarbons and oxygenates (fatty acids, fatty alcohols, and fatty esters). Hydrocarbons were the final products yielded from the conversion of oxygenate intermediates in consecutive steps. The obtained hydrocarbon products from all catalysts were in the diesel range which mainly consisted of n-pentadecane (n-C15), n-hexadecane (n-C16), n-heptadecane (n-C17), and n-(octadecane). Isomerized isomers and short chain hydrocarbons detected in very small amount suggest that cracking and isomerization activity of the catalyst were relatively low. The selectivity to hydrocarbons of Pt/Al<sub>2</sub>O<sub>3</sub> catalyst is higher than the other catalysts corresponding to lower selectivity to oxygenateds. It can be indicated that Pt/Al<sub>2</sub>O<sub>3</sub> catalysts has the highest performance in deoxygenation of jatropha oil into ultimate hydrocarbon products under studied condition. The hydrocarbons obtained over Pd/Al<sub>2</sub>O<sub>3</sub>, Pt/Al<sub>2</sub>O<sub>3</sub>, and NiCu/Al<sub>2</sub>O<sub>3</sub> catalysts are mainly n-heptadecane (n-C17). Gas analysis showed that CO<sub>2</sub> was mainly detected over Pd and NiCu catalysts while CO was significantly observed over Pt catalyst. Therefore, it can be concluded that deoxygenation over over Pd and NiCu catalysts preferably proceeded via decarboxylation pathway whereas Pt catalyst preferably performed via decarbonylation pathway. On the other hand, Cu/Al<sub>2</sub>O<sub>3</sub>, NiMo/Al<sub>2</sub>O<sub>3</sub>, and CoMo/Al<sub>2</sub>O<sub>3</sub> give n-octadecane (n-C18) as the main product. Carbon oxide gas was found in the small amount. However, there was the formation of water observed in liquid product. This can be inferred that hydrodeoxygenation step is faster than

decarboxylation and decarbonylation step for these three catalysts. Moreover, the results of catalytic stability testing showed that Pt/Al<sub>2</sub>O<sub>3</sub> catalyst had better catalytic stability than NiCu/Al<sub>2</sub>O<sub>3</sub> catalyst.

## 5.2 Recommendations

In this study, the mechanism pathways of deoxygenation of triglyceride-containing jatropha oil over Pd/Al<sub>2</sub>O<sub>3</sub>, Pt/Al<sub>2</sub>O<sub>3</sub>, Cu/Al<sub>2</sub>O<sub>3</sub>, NiCu/Al<sub>2</sub>O<sub>3</sub>, NiMo/Al<sub>2</sub>O<sub>3</sub>, and CoMo/Al<sub>2</sub>O<sub>3</sub> catalysts were proposed. Since, the deoxygenation reaction proceeded in consecutive steps and the different reaction pathway was observed over different catalyst. Therefore, the kinetic behavior of deoxygenation over these catalysts is interesting for further study, for purpose of optimization and improvement of hydrogenated biodiesel production from jatropha oils.