



## CHAPTER V

### CONCLUSIONS AND RECOMMENDATIONS

The heterogeneous catalyst NaOH/ZrO<sub>2</sub> could be successfully used as solid catalyst for biodiesel production via transesterification. The 91% conversion was obtained by the transesterification of palm oil using 1% NaOH in methanol loaded on zirconia as heterogeneous catalyst. The optimal conditions studied were follows; 1:15 molar ratio of oil to methanol with the addition of 3% catalyst, and heating for 90 min at 70°C. The content analysis of the fatty acid methyl ester products using gas chromatography, as followed EN 14103, was found around 92%. Analyses of the biodiesel products obtained on linolenic methyl ester content, kinematic viscosity, flash point, and heating value were found to be 0.23%, 4.54 cSt, 182±2°C, and 40858±199.50 kJ/kg, respectively. These values are relatively compatible to the standard biodiesel.

For further study, a catalyst should be tested its basicity by using Hammet indicator or CO<sub>2</sub>-TPD to compare between pure zirconia and NaOH modified zirconia. In addition, the leaching of catalyst should be investigated to propose mechanism of this catalyst and to prove its function whether it is homogeneous or heterogeneous.