CHAPTER V
CONCLUSIONS

All of the investigated solid catalysts (ZrO_2, ZnO, SO_4^{2-}/SnO_2, SO_4^{2-}/ZrO_2, KNO_3/KL zeolite and KNO_3/ZrO_2) have shown their potential to be used as the heterogeneous catalysts for the transesterification of crude palm kernel oil and crude coconut oil. Based on methyl esters yield, SO_4^{2-}/ZrO_2 superacid solid catalyst provides the highest yield of methyl esters when compare with the studied solid catalysts. The order of activity of solid catalysts for crude palm kernel oil transesterification is SO_4^{2-}/ZrO_2 > SO_4^{2-}/SnO_2 > ZnO > KNO_3/ZrO_2 > KNO_3/KL zeolite > ZrO_2. In case of crude coconut oil, the solid catalysts' activity can be shown from highest to lowest as following: SO_4^{2-}/ZrO_2 > SO_4^{2-}/SnO_2 > ZnO > KNO_3/KLzeolite > KNO_3/ZrO_2 > ZrO_2. The SO_4^{2-}/ZrO_2 can yield upto 90.3 wt% of esters from crude palm kernel oil and 86.3 wt% from crude coconut oil.

The SO_4^{2-}/ZrO_2 is then selected for further study as a solid catalyst for transesterification of crude palm kernel oil and crude coconut oil since it shows the highest activity for transesterification of both types of oils. It can be concluded that 1 hour reaction time is sufficient for the amount of methyl esters to reach maximum. In addition, only 1 wt% of SO_4^{2-}/ZrO_2 (based on weight of vegetable oil) is adequate to catalyze the transesterification of crude palm kernel oil and crude coconut oil. Moreover, the preliminary study of re-used catalysts indicates that the spent SO_4^{2-}/ZrO_2 is fully deactivated and cannot be directly reused for transesterification without further treatment. However, the spent SO_4^{2-}/ZrO_2 can be easily regenerated and results in the same activity as in fresh catalyst.

For the effect of nitrogen atmosphere, it can be concluded that nitrogen has no effect on the methyl esters content because the amount of methyl esters produced from the reaction in the presence of nitrogen is not significantly different from the results obtained the absence of nitrogen.