CHAPTER I
INTRODUCTION

I.1 Background

World energy consumption for transportation, generating electricity, heating, etc. both in household and industrial scale are increased from time to time as a result the availability has been dramatically decreasing. On the other hand, fossil fuel utilization produce greenhouse gasses, which cause environmental problem and threaten environmental sustainability. Greenhouse gases, SO_x and NO_x gas from fossil fuel emission become the major problem concerned in term of use of fossil fuel. Recently research has been conduct to find another energy sources that more environmentally friendly and renewable such as biodiesel, bioethanol, hydrogen, etc.

Biodiesel is more environmental friendly fuel than fossil fuel. Biodiesel is considered as a potential energy source that has been produced commercially, therefore, many studies have been conducted to study the methods of producing and improving the yield production of biodiesel. Biodiesel can be produced from vegetables oil (Jatropa curcas L. oil (Koh and Tinia, 2011), soybean oil (Guo *et al.*, 2012), rapeseed (Dossin *et al.*, 2006), canola oil (Lee et al., 2012), etc.), used cooking oil (Demirbas, 2009) and animal tallow as feedstock through trans-esterification process. Although biodiesel is renewable and cleaner than fossil fuel, but there are limitations in producing of biodiesel such as cost of production, time and land required to grow the biomass, competition with food supply and can cause decreasing in biodiversity.

Biodiesel can be produced from fat solid waste such as chicken tallow (Bhatti et al., 2008; Marulanda et al., 2010)), beef tallow (Hoque et al., 2011), mutton tallow (Bhatti *et al.*, 2008), etc. Chicken has 3.1 grams of total fat from whole raw chicken (meat only) and 15.1 grams' total fat for whole raw chicken with skin in 85 grams of chicken meat which can be used as potentially feedstock for biodiesel production due to high availability that can be collected from food industrial such as chicken nugget, sausage, meatballs, etc.

Biodiesel can be produced by several methods such as blending, micro-emulsification, cracking, and trans-esterification. Blending is a process of making biodiesel by mixing petroleum-based diesel fuel with vegetable oil, while the micro-emulsification utilizes from adding a solvent into the biodiesel to reduce the viscosity. Cracking is a process of decomposition of long carbon chains with heat and catalyst through pyrolysis process, while trans-esterification process is producing biodiesel by reacting fat and alcohol with glycerin as byproduct (Ramadhas et al., 2004)

Trans-esterification is a reaction that occurs between fatty acids with an alcohol to form fatty acid alkyl ester and usually perform in atmospheric pressure using acid or base catalyst. Trans-esterification can be carried out in subcritical or supercritical condition. Subcritical process is better than supercritical process due to less energy consumption, while compare to conventional method it is less reaction time. In supercritical trans-esterification, the reaction time is very fast (only few seconds), however it cost more energy for heating pressurizing. Patil et al. (2009) studied the effect of addition co-solvent in supercritical (hexane) and subcritical process (potassium hydroxide) at optimum condition using Camelina sativa oil (Patil et al., 2010). It showed that the addition of co-solvent increased biodiesel yields more than 90%. Gunawan et al. (2014) indicates the excess of methanol make separation process of biodiesel yield more difficult and can make the equilibrium of reaction shift toward to the reactants (Gunawan *et al.*, 2014).

Conversion of animal fat as biodiesel feedstock has been done by Bhatti et al. (2008) using conventional method with acid and base catalyst. The result showed that the conventional methods obtained 99.01% ± 0.71% at 50°C for chicken tallow, and mutton tallow obtained 93.21% at 60°C with assisted acid catalyst. The use of base catalyst resulted on lower yield, i.e. 88.14%±1.12% for chicken tallow and 78.33%±1.23% for mutton tallow at 30±1ºC (Bhatti *et al.*, 2008). Hoque et al. (2011) showed that the use of 1.25% KOH as catalyst produces biodiesel yield of 82.1%, 88.7% and 85.6% for beef fat, chicken fat and used cooking oil, respectively (Hoque et al., 2011).

In this study, chicken fat had been converted to biodiesel through trans-esterification method with SCW-methanol without using catalyst. The product of trans-esterification process then separated and purified to get biodiesel with high purity.

I.2 Objectives

1. To study the effect of ratio of chicken fat and methanol and process temperature on biodiesel yield.
2. To obtain the optimum temperature and molar ratio for subcritical methanol-water process to produce highest biodiesel yield from chicken fat using Response Surface Methodology (RSM).

I.3 Problem limitation

1. Raw material (broilers fat) is obtained from waste slaughterhouses in Genteng market.
2. The method that used for process is Subcritical Methanol-Water process.