CHAPTER I
INTRODUCTION

Today world's population growth has caused a surge of energy demand, especially in transportation sector. One fifth of the total oil produced is consumed by the transportation sector, including both land and air transportations.

Growth in the total volume of air transportation has important environmental ramifications associated with climate change and stratospheric ozone reduction on a global scale. On local to regional scales, issues such as noise, decreased air quality, roadway congestion, and local water quality are recognized as important consequences of air transportation.

The total mass of emissions from an aircraft is directly related to the amount of fuel it consumes. Of the exhaust emitted from the engine core, 7–8% is composed of carbon dioxide (CO_2) and water vapor (H_2O), with another 0.5% composed of nitrogen oxides (NO_x), unburned hydrocarbons (HC), carbon monoxide (CO), and sulfur oxides (SO_x). The International Air Transport Association (IATA) has set an ambitious goal of reduction in CO_2 emissions of 50% by 2050, relative to 2005 levels.

The rapidly increasing consumption of the finite fossil fuel resources and growing environmental concerns compelled many countries to explore other alternatives, especially renewable energy sources to meet the sustainable future energy and transportation fuel supply and to reduce CO_2 emissions from fossil fuels. Although many renewable sources such as solar, wind, biomass, geothermal, etc. are available, conversion of biomass into transportation fuels is a more promising option in the near future term. Currently, several biomass conversion technologies are being explored and developed for the production of biofuels.

Vegetable oil is considered to be a pivotal solution to combat global warming and to stabilize the climate, through the reduction of carbon dioxide emissions. A variety of vegetable oils can be used to produce biofuel. As the current demand for edible oils such as soybean, corn, and palm oil for biofuel is growing fast and their prices are rising, one of the solutions to these disadvantages is to employ a cheaper and non-edible feedstock such as waste vegetable oil or jatropha oil. The jatropha oil may be the key to addressing the problems of energy and food self-sufficiency.

Conversion of vegetable oil to biofuel can be done through different methods such as thermal cracking (pyrolysis), transesterification (alcoholysis) and hydroprocessing (hydrotreating) processes. Hydroprocessing is a newer technology and the main advantage of this method is that it requires infrastructure which is widely available in all refinery units. Many researchers have investigated the hydrotreatment of vegetable oils such as palm oil, rapeseed oil, sunflower oil, and jatropha oil over conventional catalysts. Results showed that complete conversion of vegetable oils to hydrocarbons is attainable in suitable conditions and these liquid hydrocarbon products consisted mainly of *n*-alkanes of C_{15}–C_{18}.

The hydroconversion step serves two main functions: (1) to crack the long chain hydrocarbon to a middle distillate range; and (2) to isomerize the *n*-paraffin rich feed to improve cold flow properties of the fuel, since during hydroconversion processes, both cracking and isomerization always occur simultaneously. Hydrocracking and hydroisomerization are performed over a wide range of catalysts developed for specific applications. Such as bifunctional catalysts, which are characterized by the presence of acidic sites which provide the isomerization/cracking function and metal sites with hydrogenation–dehydrogenation function.

The hydrocracking and hydroisomerization of long chain paraffins over bifunctional catalysts have received increasing attention in the last two decades and zeolite loaded with Pt and Pd were largely used for such a purpose.

The aim of this work is to study the effects of long chain *n*-paraffin feedstock and catalyst preparation technique on catalytic hydrocracking activity. The feedstocks used in this study were *n*-paraffin with various chain lengths (C_{15} - C_{18}) as the hydrogenated biodiesel feedstock derived from jatropha oil contains mainly *n*-paraffins of C_{15} - C_{18}. The effect of catalyst preparation technique i.e. incipient wetness impregnation (IWI) and ion-exchange (IE) techniques are also investigated.