Experimental investigations were carried out to evaluate and compare the use of two different vegetable oils and an essential oil as diesel fuel substitutes in a single cylinder direct injection diesel engine.

The tests were conducted using poon oil, paradise oil and eucalyptus oil and their diesel blends. In order to replace standard diesel fully (100%) with eucalyptus oil two methods were tried; eucalyptus oil with methyl esters of poon oil and paradise oil and the other with ignition enhancer namely DEE. The engine was operated at a speed of 1500 rpm and at entire load spectrum. In each test, emission characteristics such as oxides of nitrogen (NO$_x$), smoke, carbon monoxide (CO) and unburned hydrocarbon (HC) were measured. The brake thermal efficiency was compared from the measured fuel volumetric flow rate and heating values. Combustion history was computed with the pressure crank angle data. The following conclusions are drawn from the present study.

- The experimental results showed that there was not much variation between poon oil and paradise oil when they were used in blended form. However, the trend was slightly changed when methyl esters were used. MEPO40 blend performed better than other blends and standard diesel in terms of brake thermal efficiency and smoke emission.
Improvement in brake thermal efficiency and smoke emission were achieved when eucalyptus oil was blended with standard diesel. Higher brake thermal efficiency and lower smoke emission were achieved for EU50 blend than other blends and standard diesel.

Further improvement was observed when eucalyptus oil was blended with methyl ester. The performance and emission characteristics of EU20-MEPS80 blend are closer to those of standard diesel.

When the engine was run on neat eucalyptus oil, it resulted in higher NO$_x$ emission, longer ignition delay and higher maximum rate of pressure rise at full load due to lower cetane number of eucalyptus oil.

To improve the performance of the engine when operated on neat eucalyptus oil, di ethyl ether (DEE) was used as an ignition enhancer and aspirated along with intake air. This resulted in smoother engine operation with reduced NO$_x$ and smoke emissions.

At optimised DEE flow rate and injection timing of eucalyptus oil, the eucalyptus oil engine resulted in higher brake thermal efficiency and simultaneous reduction of oxides of nitrogen emission and smoke emissions.

A statistical model for the prediction of ignition delay was developed by using the fatty acid composition of the given methyl esters. The ignition delay values of the methyl esters obtained in the present work were in good agreement with the experimental values of the present work and the data found in
the literature. The model can be used for any type of methyl esters used in direct injection diesel engine

7.1 SUGGESTIONS FOR FUTURE WORK

- The methodology used for ignition enhancer aspiration and optimisation applied in the present work to use eucalyptus oil as fuel can be extended to wide range of low cetane fuels like methanol and ethanol.

- A control system to regulate the admission of the DEE into the engine needs to be designed and built.

- Study of the effects of oxidised fuel on engine performance and its durability.

- Emission testing with wide range of feed stocks.

- The continued engine performance, emission and durability testing in a variety of engine types and sizes need to be developed.