A very limited number of literature reviews are available on the use of algal oil biodiesel blends as a fuel for compression ignition engine. A few of them are reviewed in the present study with their objective and outcomes.

Demirbas (2011) studied the production of biodiesel from two algae samples (Cladophora fracta and Chlorella protothecoid). He stated that microalgae can be converted into biodiesel, bio-ethanol, bio oil, bio hydrogen and bio methane via thermo chemical and bio chemical methods. In this study, the yield of hydrogen fuel by pyrolysis and steam gasification with temperature variation were investigated. It resulted in 54.7% and 57.6% increase by volume for C.fracta and C.protothecoid.

Araiyo et al. (2011) evaluated ten Microalgal strains on its oil producing capability. In this study ten species of microalgae were used to analyze their oil production suitability: Chaetoceros gracilis, Chaetoceros mulleri, Chlorella vulgaris, Dunaliella Spp., Isochyrysis Spp., Nannochloropsis oculata, Tetraselmis Spp., Tetraselmis chui, Tetraselmis terтратhele and Thalassiosira weissflogii. Bligh and Dyer method was used for oil extraction and concluded that Chlorella vulgaris had the highest content of oil.

Morowvat et al. (2010) produced biodiesel forma naturally isolated strain of Chlamydomonas from paddy field. After the growth phase, the lipid
content was separated, esterified and characterized through TLC and GC/MS analysis. The results revealed that there are 25% of fatty acid content with Docosanoic acid methyl ester, Tetradecanoic acid methyl ester, Hexadecanoic acid methyl ester and nonanoic acid methyl ester as their main constituents.

Haik et al. (2011) experimentally studied the use of algal oil (raw and diesel blends) in indirect injection diesel engine. They have used Ankistrodesmus braunii and Nannachloropsis for algal oil production and modified Bold 3N medium was used for primary algal growth. Open pond system was employed to cultivate the microalgae and ultrasonic / soxhlet extraction methods were used to extract algal oil. They have converted the algal oil into fatty acid methyl ester by transesterification process using 3.5 gms of sodium hydroxide and 20% by volume of methanol. The chemical analysis of algal oil showed the presence of Myristic acid, Palmitic acid, Stearic acid, Oleic acid, Linoleic acid, Linolenic acid, Archidic acid and Behenic acid. In this study Ricardo E6 IDI engine was used and effect of engine speed, load, injection timing, output torque, combustion noise, maximum pressure rise and maximum heat release was studied. Finally it has been shown that the properties of algal oil methyl ester were similar to diesel fuel and its use has been successful in running the diesel engine smoothly.

Ahmad et al. (2011) compared microalgae and palm oil as biodiesel feed stocks and found that microalgae are more suitable source of biodiesel. He also stated that microalgae appears to be promising renewable energy because it can be directly converted into biodiesel.

Oca et al. (2011) studied different methods of extracting lipid content from alga namely Chlorella pyrenoidosa with solvents like chloroform, methanol, ethanol and hexane. 2% of chloroform: methanol showed maximum extraction of lipids. Direct transesterification (in situ) process and acidic transesterification process were carried out for FAME
production. He also stated that higher FAME’s is yielded from algal oil using methanol than in direct transesterification process.

Singh et al. (2011) suggested that cultivation of algal biomass on the non-arable area could be the best solution to replace depleting fossil fuel. He also suggested that the process of algal cultivation could be improved by selection of better algal strains and good screening methodologies.

Sorguven and Ozilgen (2010) assessed the exergetic efficiency of algal biodiesel and renewability of algal biodiesel-CO₂ cycle thermodynamically. He suggested that an increase in the algal lipid content reduces the carbon di oxide accumulation in the atmosphere and there by improves the efficiency of the process.

Vasudevan and Fu (2010) reviewed on the advances in biofuels, transesterification and cultivation of algae. Their study was focused on biomass and acyl-acceptors, the transesterification with acidic and base catalyst, reaction mechanism, solvents used for oil extraction and cultivation of algae in continuous culture and batch process.

Sander and Murthy (2010) investigated on the life cycle of algal biodiesel. They studied the overall sustainability and net energy balance of algal biodiesel process. The study was conducted through thermal dewatering techniques in which 7500 MJ of energy was used to produce 24 kg of algal biodiesel.

Wahal and Viamajala (2010) suggested a sequential change in illumination of a batch reactor to maximize the growth of algae. They studied the growth of Neochloris oleoabudans in batch photobioreactor. The intensity of illumination was based on cell density because low denser culture could result in photo inhibition and high denser culture results in sub optimal
growth. The results revealed that sequential change in illumination improves the algal growth by two folds and periodic increase in light intensity showed effective increase in performance of photobioreactor.

Mandal and Mallick (2009) analyzed the lipid accumulation (oil content) of Scenedesmus obliquus microalgae under various culture conditions. They identified that under nitrates deficiency condition, the lipid reached 43% of dry weight (against 12.7% normally) and phosphate deficiency with thio sulphate supplementation, the lipid content reached 30% of dry weight (against 22% normally). They also noticed that the lipid content was increased from 58.3% to 61.3% by combining response surface methodology with central composite rotary design in the oil extraction process.

Gouveia and Oliveira (2009) screened Chlorella vulgaris, Spirulina Spp., Nannochloropsis Spp., Neochloris oleabundans, Scenedesmus obliquus and Dunaliella tertiolecta for analyzing the biodiesel production capabilities. Neochloris oleabundans, Nannochloropsis Spp. and Spirulina Spp. proved to be suitable raw material for biodiesel production due to their high oil content (29.1%, 28.7% and 21.2% respectively). 50% more oil content was noticed when all the three algae were grown in nitrogen deficit condition.

Tariq et al. (2011) reported on identification and characterization of rocket seed oil through IR, NMR and GC/MS studies. He found the properties of synthesized biodiesel using ASTM methods. The FAME’s were identified as methyl 9 hexadecenoate, 14 methyl pentadecanoate, methyl 9,12 octacadienoate, methyl 9 octadecenoate, methyl octadecanoate, methyl 11 eicosenoate, methyl eicosanoate, methyl 13 docosenoate, methyl docosanoate, methyl 15 tetracosenoate and methyl tetracosanoate.
Vardon et al. (2011) studied the biocrude oil properties and physio-chemical characteristics of Spirulina algae from hydrothermal liquefaction process at 30°C, 10-12 Mpa and 30 mins of reaction duration. He noticed that the biocrude oil was 32.6% from Spirulina Spp.

Gami et al. (2011) investigated the growth of Spirulina Spp. on different liquid medium conditions like synthetic medium, sea water medium and fertilizer medium with a pH level between 9.1 to 10.4. They noticed a gradual increase in weight of the dry biomass, especially in sea water medium and finally arrived at a conclusion to use sea water medium for the commercial cultivation of Spirulina Spp.

Pandey (2011) experimentally investigated the biomass and metabolic activities of Spirulina Spp. under different culture medium composition includes Zarrouk media, Rao media, CFTRI media, OFERR media, BG11 media and revised media 6. Zarrouk and BG11 medium was found to be more suitable for algal growth.

Colla et al. (2004) studied the effect of nitrogenous compounds on Spirulina Spp. under different temperature conditions. The concentration of sodium nitrate was varied and maximum γ-linolenic acid was obtained at 30°C along with minimal quantity of Palmitic acid, Linolenic acid and Linoleic acid.

Masil et al (2011) attempted to grow Spirulina Spp. in a mixotrophic culture with bicarbonates, inorganic and organic constituents on concentration basis. They described the influence of constituents on chlorophyll and carotenoids contents. The biomass, chlorophyll and carotenoids were produced at higher rate in Na₂CO₃ than in NaHCO₃.
Pelizer et al. (2002) estimated the growth of Spirulina Spp. by analyzing its pH value under different environmental conditions. They have estimated the cell growth, protein production and cell content by pH determination.

Costa et al. (2002) experimentally investigated the feasibility of cultivating Spirulina Spp. in fresh water with nutrients like carbon, nitrogen and metallic ions. The Spirulina Spp. biomass was produced in race way ponds with 400 hrs culture duration. The nutrients like sodium bicarbonate, urea, phosphates, sulphates, ferric ions, magnesium and potassium were added. The study resulted in biomass increase from 1.23 g/l to 1.34 g/l of Spirulina biomass.

Gumus (2010) experimentally investigated the combustion characteristics and heat release characteristics of a direct injection compression ignition engine using hazelnut oil biodiesel. The transesterification process was carried out using methanol and potassium hydroxide as catalyst. He analyzed the combustion parameters with variations in biodiesel blends, injection timing and injection pressure. As the blend ratio was increased, the start of combustion was earlier with gradual decrease in cylinder pressure, rate of pressure rise and rate of heat release. A marginal increase in combustion duration and brake specific fuel consumption was also noted.

Sahoo and Das (2009) studied the combustion characteristics of diesel engine with Jatropha, Karanja and Polanga biodiesels. The experiments were conducted with blends of biodiesel at 20% and 50% by volume with diesel. They analyzed the pressure data, occurrence of peak pressure, heat release rate and ignition timing, and concluded that with increase in biodiesel blends, the ignition delay gets shortened (i.e lower than diesel) which resulted in the increase of maximum peak cylinder pressure than diesel.
Qi et al. (2009) prepared the biodiesel from soyabean by alkaline catalyzed transesterification process. They have compared the properties of biodiesel with diesel and analyzed the performance, combustion and emission parameters. The result revealed that the combustion parameters like peak cylinder pressure, rate of pressure rise and rate of heat release were higher for biodiesel blends at low loads and almost identical at higher loads. They also stated that the power output of biodiesel and diesel were almost similar with higher BSFC for biodiesel. The emission includes HC, CO, NO\textsubscript{x} and smoke was also considerably decreased with biodiesel.

Donghui Qi et al. (2011) studied the effect of injection timing and exhaust gas recirculation on combustion and emission characteristics of split type direct injection compression ignition engine with biodiesel. They have used soyabean biodiesel in ford lion V6 DI engine and reported that with an increase in EGR rate, the BSFC and particulate emission was slightly increased with a marginal reduction in NO\textsubscript{x}.

Yoon and Siklee (2011) reported on the combustion and emission characteristics of a dual fuel engine in which they have used biogas and biodiesel for combustion study. They have analyzed combustion pressure and rate of heat release under various conditions with diesel, biodiesel, biogas-diesel and biogas-biodiesel. The performance study was also carried out by analyzing the fuel consumption, exhaust gas temperature and emissions of all the modes.

Kegl (2011) experimentally investigated the influence of biodiesel on engine combustion and emission characteristics using rapeseed biodiesel blends as a fuel for compression ignition engine. He compared the experimental results with simulated values and analyzed the injection pressure, injection timing, ignition delay, in-cylinder gas pressure and
temperature, heat release rate, exhaust gas temperature, brake specific fuel consumption, engine power and emissions.

Ganapathy et al. (2011) reported on the effect of injection timing on performance, combustion and emission parameters of compression ignition engine using Jatropha biodiesel as a fuel. He conducted the experiment with full factorial design runs (3^3) for each fuel blend ratio. He noticed that on advancement of injection timing from the rated value, BSFC, CO, HC and smoke levels were reduced with increase of BTE, $P_{\text{max}}$, $HRR_{\text{max}}$ and NOx increase. At retardment of the injection timing, the effects were in the other way. The results concluded that advancement of injection timing from the rated value shows better combustion and performance with minimal emissions.