Chapter 6

Conclusion and future prospects
Assam, India with its unique climatic profile encourages and facilitates the ubiquitous growth of numerous species of microalgae. The atmosphere is packed with high humidity, has an alteration of summer and winter of which neither is extreme. A strong correlation seems to exist between the high humidity and temperature with the prevalence of microalgal vegetation in the region. The fresh water ecosystem of the state is the natural abode for countless species of microalgae (Chlorophyceae, Bacillariophyceae and Cyanophyceae) which have hitherto remained unexploited.

The present investigation explores the feasibility of biodiesel production from the indigenously isolated microalgal strains. Economic evaluation or feasibility studies of fresh water microalgae for biodiesel production are unlikely to make economic sense if the focus is on the final product. As such the study also takes into account the feasibility of production of bio-oil from the microalgal deoiled cakes (low value biomass refuse) which are otherwise used as aquaculture feeds. The non energy prospects (antimicrobial and antioxidant properties) from microalgae are also taken into consideration in the present study as a part of value addition to the microalgal biomass. Finally, the study also reports the practicability of biodiesel production from yeast (S. cerevisiae) and kitchen chimney dump lard (KCDL) as reference to biodiesel production from microalgae.

6.1 Conclusion

The following conclusions were drawn from the present investigation:

- High biomass yield, attractive biochemical profile and high energy content in the microalgal strains namely *Chlorella* spp. KJ499988, *Scenedesmus* spp. KF279644 and *Parachlorella kessleri* KF163441 offers strong candidature as bioenergy feedstocks.
Culture of *P. kessleri* KF163441 in representative water samples from PMCS suggested the practicability of mass culture of *P. kessleri* in permanently inundated water bodies which are otherwise considered as wastelands.

*Chlorella* spp. KJ499988 biomass could be used as feedstock for bio and thermochemical conversions, whereas the deoiled cake for thermochemical conversion.

The fuel properties of microalgal biodiesel such as density, calorific value and cetane number were within ASTM ranges.

Biodiesel from yeast was superior to microalgal biodiesel with regard to calorific value and cetane number.

*P. kessleri* KF163441 deoiled cake could be directly used as a feedstock for bio-oil production.

Production of biodiesel from KCDL is feasible. The application of RSM is quite helpful in designing conversions for biodiesel production.

Bio-oil from *P. kessleri* KF163441 deoiled cake was found to be moderately effective against the prokaryotic system, whereas completely ineffective against eukaryotic system. The study suggests that microalgal bio-oil offer prospective applicability as a bioactive agent besides being an increasingly attractive fuel option. The study also suggests that bio-oil from the different algal feedstocks can be evaluated for antimicrobial activity against multidrug resistant bacteria (MDR) and phytopathogens.

Free radical scavenging potential of the aqueous extracts of *Chlorella* spp. KJ499988, *Scenedesmus* spp. KF279644 and *Parachlorella kessleri* KF163441deoiled cakes was 53.20, 40.75 and 31.75% respectively.

Molecular docking studies revealed that the compounds present in *P. kessleri* bio-oil inhibit the bacterial and fungal enzymes (PDB ID: 1AC4, 1AV8, 1T2P, 1ZAP, 2QDF, 4JQC).
6.2 Future prospects

In the context of the present investigation the following research may be undertaken to improve the prospects of microalgae:

- Genome sequencing of microalgal strains would enable comprehensive understanding of nucleotide sequences for the novel genes, proteins and important metabolites of commercial interests.
- Identification of suitable stress triggers for lipid modulation in microalgae will lead to better understanding of biofuel productivity.
- Process parameters for biodiesel production needs to be optimized.
- Co-culture of the strains and assessment of their feasibility as bioenergy feedstock needs to be initiated.
- Microalgal culturing in raceways and tubular photobioreactors needs to be initiated for comparative analysis of their capabilities with regard to biomass production.
- There is a need to assess the prospect of omega-3-fatty acid production from the microalgal strains

The proposed future work has direct biorefinery applications. The choice of proper microalgal strains for biofuel production, combined with cheap methods of culturing, following optimization of growth parameters, in conjugation with co-product generation should lead to rich dividends in biorefining endeavors.