Preface

Ever increasing stress on the reserves of conventional energy resources due to their over exploitation and the resultant enhanced environmental pollution levels have led researchers to look for alternative renewable green fuels. The biomass based fuels are attracting increasing attention due to their economic viability and environmentally benign nature. Among various biofuels, biobutanol is being considered as a suitable and sustainable liquid fuel to replace petroleum derived gasoline. Various foody and non-foody biomass have been explored for the production of biobutanol. Presently algal biomass has started attracting the interest of researchers for this purpose due to its efficiency over other biomass. Among the various categories of algae, cyanobacterial biomass (blue-green algae) possesses large CO_2 sequestration property thereby is capable of reducing the green-house gas effect with resultant large biomass production that can be used for different purposes. Utilization of cyanobacterial biomass for the production of biobutanol is an attractive and renewable option due to its large carbohydrate content. The present work was planned to check the efficacy of cyanobacterial biomass for biobutanol production and to prove their potency at the industrial scale. The work conducted included collection of native algal biomass from local water bodies, their screening and characterization, optimization of various growth parameters for obtaining maximum carbohydrate accumulation, pretreatment of biomass for release of fermentable sugars and their use in batch fermentation studies. The details of experiments performed and results obtained are included in this thesis. The subject matter contained in this volume is organized in five different chapters.

Chapter 1 presents an overview of the global status of biofuel, particularly biobutanol and its production. General chemistry of butanol production and its comparison with

other commercially available fuels are also discussed to prove the superiority of biobutanol as an alternative energy source. Selection of suitable biomass controls the economics of the entire production process, in this regard the cyanobacterial biomass can be selected as a sustainable source of energy.

Chapter 2 describes the current research status of bioconversion processes for biobutanol production from various feedstocks, strategies used to improve its yield, and various downstream techniques used for its purification. A comparative analysis of various feedstocks available for butanol production is also presented. The review has revealed that inspite of substantial work done, there are several challenges associated with the processing of feedstocks and butanol yield and recovery that need to be addressed to make the butanol an economically sustainable biofuel.

Experimental protocols for various butanol production steps starting from the cyanobacterial biomass collection, processing to end-product recovery are given in Chapter 3. Various optimization studies related to cyanobacteria growth to increase carbohydrate content, biomass pretreatment to get maximum sugar concentration, fermentation to maximize butanol yield and recovery to extract maximum butanol content from fermentation broth are discussed within chapter. Pretreatment optimization tool, cyanobacterial biomass growth kinetic model, butanol production, substrate consumption and bacterial growth models are also described in detail. Mass balance during batch reactor study is also discussed to show the efficiency of fermentation process.

Chapter 4 incorporates the results of the experiments and their detailed discussion. Results of optimization studies related to cyanobacterial growth and its pretreatment to obtain sugar are discussed to show the effect of various process parameters on growth, carbohydrate content and sugar release. Details of studies on parameters affecting butanol fermentation are optimized using glucose as C-source and effects of individual parameter are discussed in terms of butanol yield. Mass balance and kinetic study are the backbone of present work that prove the relevance of experimental data. Recovery of butanol from fermentation broth controls the economics of the process, minimum energy consuming recovery techniques have adapted for butanol recovery are discussed to prove the process effectiveness with maximum butanol recovery.

A summary of the main conclusion drawn from the results of the present work together with some future directions to make the cyanobacterial biomass a viable feedstock for biobutanol production at industrial scale are summarized in Chapter 5.