

Debabrata Das *Editor*

Algal Biorefinery: An Integrated Approach

 Springer

Algal Biorefinery Integrated Debabrata Das

Debabrata Das, Debayan Das



Algal Biorefinery Integrated Debabrata Das:

Algal Biorefinery: An Integrated Approach Debabrata Das, 2015-11-30 This book critically discusses different aspects of algal production systems and several of the drawbacks related to microalgal biomass production namely low biomass yield and energy consuming harvesting dewatering drying and extraction processes These provide a background to the state of the art technologies for algal cultivation CO₂ sequestration and large scale application of these systems In order to tap the commercial potential of algae a biorefinery concept has been proposed that could help to extract maximum benefits from algal biomass This refinery concept promotes the harvesting of multiple products from the feedstock so as to make the process economically attractive For the last few decades algal biomass has been explored for use in various products such as fuel agricultural crops pigments and pharmaceuticals as well as in bioremediation To meet the huge demand there has been a focus on large scale production of algal biomass in closed or open photobioreactors Different nutritional conditions for algal growth have been explored such as photoautotrophic heterotrophic mixotrophic and oleaginous This book is aimed at a wide audience including undergraduates postgraduates academics energy researchers scientists in industry energy specialists policy makers and others who wish to understand algal biorefineries and also keep abreast of the latest developments

Algae for Food Rathinam Raja, Shanmugam Hemaiswarya, Kulanthaiyesu Arunkumar, Isabel S. Carvalho, 2021-10-25 Algae for Food Cultivation Processing and Nutritional Benefits Algae are a primitive living photosynthetic form and they are the oldest living organism In the marine ecosystem algae are the primary producers that supply energy required to a diverse marine organism and especially seaweed provides a habitat for invertebrates and fishes There have been significant advances in many areas of phycology This book describes the advances related to food and nutrition of algae achieved during the last decades it also identifies gaps in the present knowledge and needs for the future The 17 chapters grouped into 6 parts are written by phycologists More insight on industrial exploitation of algae and their products is supported by current studies and will help academia The first part explains new technologies to improve the microalgal biomass strain improvement and different methods of seaweed cultivation In the second part food and nutraceutical applications of algae food safety aspects green nanotechnology and formulation methods for the extraction and isolation of algal functional foods are described The third part deals with pigments and carotenoids while the fourth part exploits the isolation and application of hydrocolloids nutritional implications of algal polysaccharides and the characterization and bioactivity of fucoidans In the fifth part the biomedical potential of seaweed followed by agricultural applications of algae are well described The book is an important resource for scholars that provides knowledge on wide range of topics Key Features Covers important fields of algae from biomass production to genetic engineering aspects of algae Useful in the field of algal biotechnology aquaculture marine micro and macrobiology microbial biotechnology and bioprocess technology Focuses on the therapeutic and nutritional areas of algae

Algal Biorefinery Debabrata Das, 2015 **Potential and Challenges of Low Carbon Fuels**

for Sustainable Transport Avinash Kumar Agarwal,Hardikk Valera,2022-01-01 This book focuses on low carbon fuels a preferable class of fuels for Internal Combustion Engines ICEs highlighting the effect of low carbon fuels on tailpipe emissions This book aims to strengthen the knowledge base dealing with low carbon fuels as a sustainable transport fuel The volume includes recent results and are focused on current trends of automotive sector This book will be of interest to those in academia and industry involved in fuels IC engines engine instrumentation and environmental research Fundamentals of Biofuel Production Processes Debabrata Das,Jhansi L. Varanasi,2019-04-16 Focusing on fundamentals of biofuel production from renewable energy sources and biohydrogen production this book offers a complete understanding of the bioconversion processes Each chapter begins with a fundamental explanation for general readers and ends with in depth scientific details suitable for expert readers It discusses different types of production technologies covering basic concepts production strategies commercial usage and advances Biochemical Engineering Debabrata Das,Debayan Das,2021-01-10 Biochemical engineering mostly deals with the most complicated life systems as compared with chemical engineering A fermenter is the heart of biochemical processes It is essential to operate a system properly A description of enzymatic reaction kinetics is followed by cell growth kinetics to determine several kinetic parameters Operations and analyses of several biochemical processes are included to determine their special The book also covers the determination of several operational parameters such as volumetric mass transfer coefficient mixing time death rate constant chemical oxygen demand and heat of combustion This book provides a novel description of the experimental protocol to find out several operational parameters of biochemical processes A comprehensive collection of numerous experiments based on fundamentals it focuses on the determination of not only the characteristics of raw materials but also other essential parameters required for the operation of biochemical processes It also emphasizes the applicability of the analysis to various processes Equipped with illustrative diagrams neat flowcharts and exhaustive tables the book is ideal for young researchers teachers and scientists working towards developing a solid understanding of the experimental aspects of biochemical engineering **Industrial Biotechnology** Debabrata Das,Soumya Pandit,2021-05-06 Industrial Biotechnology offers a comprehensive overview of biochemical processes technologies and practical applications of industrial biotechnology The work comprises of chapters that discuss medium preparation inoculum preparation using industrial strain and upstream processing various fermentation processes and physico chemical separation processes for the purification of products and packaging Analyzes problems within biochemical processes Discusses stoichiometry of bioprocesses Covers upstream and downstream processing Offers a wealth of case studies of different biochemical production processes including those in development of food products vaccines and medicines single cell proteins amino acids cheese biodiesel biopesticides and more This book is aimed at advanced students industrial practitioners and researchers in biotechnology food engineering chemical engineering and environmental engineering International Conference on Algal Biorefinery Debabrata Das,2013

Energy and Sustainability Anand Chauhan, Harish Chandra Joshi, 2024-07-19 This volume addresses SDG 7 Affordable and Clean Energy and SDG 12 Sustainable Consumption and Production By 2030 therefore people have to substantially increase their share of renewable energy The book focuses on waste as primary sources of biomass that can fulfill energy requirements for sustainable development It also discusses various related topics such as energy production methods a mathematical model for the development of a sustainable biofuels supply chain economic analysis optimization techniques multiple criteria decision making and mixed integer linear programming and existing and emerging policies that encourage the switch to renewable energy It is committed to fusing science and technology in a way that assures a sustainable future and addresses major topics on biofuels biomass bioenergy biodiesel bioethanol biogas modelling and their supply chain management inventory control and optimization The 2030 Agenda for Sustainable Development adopted by all United Nations Member countries in 2015 provides a shared blueprint for peace and prosperity for people and the planet now and into the future The book uses an interdisciplinary approach and provides solutions to energy requirements by using emerging technology and nanotechnologies It explores a technical breakdown of the tools that may be utilized to convert biomass into usable energy forms At the end of the book a description of the social and economic aspects of renewable energy and minimization of bioenergy cost is presented The book is useful to students researchers industry experts and anybody in the adoption of renewable energy It covers the complete course in the fundamentals of biomass feedstock and their supply chain management resources at the graduate level in engineering

Algal Biorefinery Ajay K. Dalai, Vaibhav V. Goud, Sonil Nanda, Venu Babu Borugadda, 2021-07-07 This book enables readers to understand the theoretical aspects key steps and scientific techniques with a detailed mechanism to produce biofuels from algae Each chapter provides the latest developments and recent advancements starting from algal cultivation techniques to the production of value added green fuels chemicals and products with wide applications The volume brings together a broad range of international and interdisciplinary experts including chemical and biological engineers biotechnologists process engineers environmentalists pharmacists and nutritionists to one platform to explore the beneficial aspects and challenges for an algal based biorefinery Chapters address cutting edge issues surrounding algal cultivation including genetic modification of algal strains design and optimization of photobioreactors and open pond systems algal oil extraction techniques and algal derived fuel products biodiesel bio gasoline jet fuels and bio oil Finally the book considers the potential environmental impacts for establishing a sustainable algal biorefinery through lifecycle analysis techno economic assessment and supply chain management This book will be an important resource for students academics and professionals interested in algal cultivation biofuels and agricultural engineering and renewable energy and sustainable development more broadly

Algal Biorefineries Aleš Prokop, Rakesh K. Bajpai, Mark E. Zappi, 2015-10-19 Algae offer potential to produce renewable chemicals and fuels using solar energy and carbon dioxide from atmosphere or in flue gases while simultaneously reducing the generation of

greenhouse gases Since these can be grown on marginal lands with micronutrients and macronutrients often present in waste streams algae based chemicals and fuels do not compete with foods Still large scale production of algae based fuels and chemicals faces considerable technological and economical challenges and it would by necessity require a biorefinery approach wherein all the possible algal components are converted into value added compounds The present series on algal biorefineries represents a forum for reporting the state of the art of different technologies as well as the latest advances in this field The volume II of this series complements the volume I in terms of the current state of the art Different chapters in this volume address diverse issues ranging from genetically modifies algae to new products to life cycle analysis of algal products

Algal Biotechnology Ashfaq Ahmad, Fawzi Banat, Hanifa AlBlooshi, 2022-04-26 Algae Biotechnology Integrated Algal Engineering for Bioenergy Bioremediation and Biomedical Applications covers key applications of algae for bioenergy and how to integrate the production of biofuels with environmental nutraceutical and biomedical processes and products The book emphasizes cost effective biofuels production through integrated biorefinery combining continuous processes and various algae as feedstock to produce biofuel bioenergy and various high value biochemicals Novel algal culturing technologies and bioprocess engineering techniques are provided for the optimization of operational approaches for commercial scale production as well as to reduce the overall costs New and existing molecular methods for genetic and metabolic engineering of algae are also presented Furthermore methods for the optimization of existing biochemical pathways are explained and new pathways are introduced in order to maximize the potential for biofuels production and related nutraceutical and biomedical co products This book provides an ideal roadmap for bioenergy researchers and engineers who want to incorporate valuable nutraceutical and biomedical products and environmental practices into the production of biofuels Addresses issues faced by the bioenergy sector and how to resolve them through the integration of algal biotechnology and engineering Provides a guide to the efficient and cost effective production of bioenergy while simultaneously mitigating pollution and producing valuable nutraceutical and biomedical biproducts Covers new and emerging approaches in integrated algal biotechnology Offers a roadmap to their application in the production of biofuels alongside nutraceutical biomedical and environmental processes and products

Conceptual Basis and Techno-Economic Modeling for Integrated Algal Biorefinery Conversion of Microalgae to Fuels and Products. 2019 NREL TEA Update: Highlighting Paths to Future Cost Goals via a New Pathway for Combined Algal Processing, 2020 The report documents the conceptual basis for a new potential Combined Algal Processing design strategy which may allow more flexibility in accommodating different algal biomass feedstock compositions by enabling upgrading of both protein and carbohydrates in a single step without a strict requirement for either component to be in soluble or monomeric form while maintaining effective wet lipid extraction techniques to enable high lipid recoveries In light of previously established constraints around algal biomass costs which are significantly higher than lignocellulosic terrestrial

biomass the present CAP processing strategy reflects an integrated biorefinery concept producing both fuels and value added chemical coproducts as a means to improve profitability and generate coproduct revenues to help drive down the minimum fuel selling price MFSP towards economically viable levels Namely this report highlights an integrated CAP biorefinery process and associated technical targets that would be required to achieve U S Department of Energy target MFSP goals of 2 5 gallon gasoline equivalent by 2030 This is accomplished by a process involving low cost seasonal storage of algal biomass during high growth seasons rapid flash hydrolysis pretreatment of the biomass solvent extraction of pretreated biomass cleanup and fractionation of lipids into triglyceride and free fatty acid fractions and a series of thermochemical conversion steps to upgrade carbohydrates and protein to hydrocarbon fuels These steps include mild oxidative treatment MOT a process originally investigated at NREL for upgrading lignin followed by catalytic ketonization and hydrotreating of MOT products to fuels Isolated triglycerides are sent to a coproduct train with the base case focused on upgrading to polyurethane foams as a high value high market volume coproduct

Algal Biorefineries Rakesh Bajpai,Aleš Prokop,Mark Zappi,2013-10-01 This book reviews efforts to produce chemicals and fuels from forest and plant products agricultural residues and more Algae can potentially capture solar energy and atmospheric CO₂ the book details needed research and legislative initiatives

Algal Biorefinery Sanjeet Mehariya,Bikash Kumar,Shashi Kant Bhatia,Obulisamy Parthiba Karthikeyan,2025-03-21 Algal Biorefinery A Sustainable Solution for Environmental Applications focuses on algae s possibilities assets and functions as a renewable and sustainable resource that can act as an excellent alternative to withstand adverse environmental conditions to generate useful products Thus apart from helping reduce environmental pollution and the carbon footprint algae can help mitigate factors causing rapid climate change via concurrent bioremediation resource recovery and environmental sustainability This comprehensive book will examine dedicated state of the art information on the topic of how algae can act as a cushion against climate change It will also explain how algal based biorefineries can act as a potential solution to climate change lack of natural resources and environmental pollution Elucidates algal biorefinery as a sustainable solution for carbon emission reduction and fossil fuels alternatives Offers up to date information on algal based wastewater treatment and resource recovery to assist in climate change Provides flowcharts schematic diagrams and figures showing mechanisms and processes for the depiction of strategies for algal based technologies Examines the environmental impact assessment of existing and developing algal based technologies for future environmental sustainability

Algal Biorefineries and the Circular Bioeconomy OBULISAMY PARTHIBA KARTHIKEYAN,Sanjeet Mehariya,Shashi Kant Bhatia,2022-04-19 Algae are mysterious and fascinating organisms that hold great potential for discovery and biotechnology Dr Thierry Tonon Department of Biology University of York Science is a beautiful gift to humanity we should not distort it A P J Abdul Kalam In this book we emphasise the importance of algal biotechnology as a sustainable platform to replace the conventional fossil based economy With this focus Volume 2

summarizes up to date literature knowledge and discusses the advances in algal cultivation genetic improvement wastewater treatment resource recovery commercial operation and technoeconomic analysis of algal biotechnology FEATURES Discusses in detail recent developments in algae cultivation and biomass harvesting Provides an overview of genetic engineering and algal bacteria consortia to improve productivity Presents applications of algae in the area of wastewater treatment and resource recovery Provides case studies and technoeconomic analysis to understand the algal biorefinery Shashi Kant Bhatia PhD is an Associate Professor in the Department of Biological Engineering Konkuk University Seoul South Korea Sanjeet Mehariya PhD is a Postdoctoral Researcher in the Department of Chemistry Ume University Ume Sweden Obulisamy Parthiba Karthikeyan PhD is a Research Scientist and Lecturer Adjunct in the Department of Civil and Environmental Engineering South Dakota School of Mines and Technology Rapid City South Dakota USA Handbook of Algal Biofuels Mostafa El-Sheekh, Abd El-Fatah Abomohra, 2021-12-02 Handbook of Algal Biofuels Aspects of Cultivation Conversion and Biorefinery comprehensively covers the cultivation harvesting conversion and utilization of microalgae and seaweeds for different kinds of biofuels The book addresses four main topics in the algal biofuel value chain First it explores algal diversity and composition covering micro and macroalgal diversity classification and composition their cultivation biotechnological applications current use within industry for biofuels and value added products and their application in CO2 sequestration wastewater treatment and water desalination Next the book addresses algal biofuel production presenting detailed guidelines and protocols for different production routes of biodiesel biogas bioethanol biobutanol biohydrogen jet fuel and thermochemical conversion methods Then the authors discuss integrated approaches for enhanced biofuel production This includes updates on the recent advances breakthroughs and challenges of algal biomass utilization as a feedstock for alternative biofuels process intensification techniques life cycle analysis and integrated approaches such as wastewater treatment with CO2 sequestration using cost effective and eco friendly techniques In addition different routes for waste recycling for enhanced biofuel production are discussed alongside economic analyses Finally this book presents case studies for algal biomass and biofuel production including BIQ algae house Renewable Energy Laboratory project Aquatic Species Program and the current status of algal industry for biofuel production Handbook of Algal Biofuels offers an all in one resource for researchers graduate students and industry professionals working in the areas of biofuels and phycology and will be of interest to engineers working in renewable energy bioenergy alternative fuels biotechnology and chemical engineering Furthermore this book includes structured foundational content on algae and algal biofuels for undergraduate and graduate students working in biology and life sciences Provides complete coverage of the biofuel production process from cultivation to biorefinery Includes a detailed discussion of process intensification lifecycle analysis and biofuel byproducts Describes key aspects of algal diversity and composition including their cultivation harvesting and advantages over conventional biomass **Recovery Act** ,2014 Sustainable Downstream Processing of Microalgae for Industrial

Application Kalyan Gayen, Tridib Kumar Bhowmick, Sunil Kumar Maity, 2019-09-05 Microalgae can be future resource for industrial biotechnology In current energy crisis era microalgae are under tremendous research focus for the production of biodiesel due to their high photosynthetic efficiency growth rate and high lipid content compared to territorial plants However the large scale production of algal biomass and downstream processing of harvested algae towards bio fuels are facing several challenges from economic viability perspective Apart from bio fuels the microalgae synthesize number of bio molecules such as pigments e g chlorophyll carotenoid protein e g lectin phycobiliprotein and carbohydrates e g agar carrageenan alginate fucodan which are available in the various forms of microalgal products Therefore developing a strategy for large scale production and use of algal biomass for the co production of these value added macromolecules is thus imperative for the improvement of the economics of algal biorefinery In the above context this book covers three major areas i commercial scale production of bio molecules from microalgae ii sustainable approach for industrial scale operation and iii optimization of downstream processes Each of these sections is composed of several chapters written by the renowned academicians industry experts Furthermore in this book a significant weightage is given to the industry experts around 50% to enrich the industrial perspectives We hope that amalgamate of fundamental knowledge from academicians and applied research information from industry experts will be useful for forthcoming implementation of a sustainable integrated microalgal biorefinery This book highlights following Explores biomolecules from microalgae and their applications Discusses microalgae cultivations and harvesting Examines downstream processing of biomolecules Explores sustainable integrated approaches for industrial scale operations Examines purification techniques specific for microalgal proteins Omega 3 fatty Acids carbohydrates and pigments

Integrated Wastewater Management and Valorization using Algal Cultures

Goksel N. Demirer, Sibel Uludag-Demirer, 2022-03-24 Integrated Wastewater Management and Valorization using Algal Cultures provides a holistic view on coupled wastewater treatment and biomass production for energy and value added products using algal cultures Algal cultures provide low cost nutrient nitrogen and phosphorus treatment and recovery from wastewaters carbon dioxide sequestration from waste gases value added generation in the form of bio energy and bio based chemicals biosorption of heavy metals and biogas upgrading The book addresses all these aspects in terms of role of algal cultures in environmental sustainability and circular economy The production of high value products is addressed through pretreatment and anaerobic co digestion of wastewater derived microalgal biomass and microalgal biorefineries The simultaneous dissolution and uptake of nutrients in microalgal treatment of anaerobic digestate is discussed as is coupled electrocoagulation and algal cultivation for the treatment of anaerobic digestate and algal biomass production Finally optimization of algal biomass production is discussed using metagenomics and machine learning tools and scale up potential and the limitations of integrated wastewater derived microalgal biorefineries is discussed Integrated Wastewater Management and Valorization using Algal Cultures offers an integrated resource on wastewater treatment biomass

production bioenergy and value added product generation for researchers in bioenergy and renewable energy environmental science and wastewater treatment as well as environmental and chemical engineering Comprehensively covers methods of wastewater treatment by algal cultivation and algal utilization Integrates the applications of algal cultures across wastewater treatment nutrient recycling CO₂ sequestration bio energy and bio based product generation Provides several international case studies to showcase actual algae based pilot projects and facilities

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