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EDITORIAL

Integrating biological processes to facilitate the generation of 'Biofuel'

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There are relatively few near-term potential replacements for petroleum-based liquid fuels. Hydrogen, whose combustion yields the ideal byproduct of water, is energetically costly to produce, and electricity, which is relatively clean to produce, cannot yet be stored efficiently enough for large-scale use in transportation vehicles. Biofuels, however, especially cellulosic ethanol and biodiesel, offer the potential for near-term, large-scale production and reasonable compatibility with existing vehicles and distribution systems. To bridge the technology gap and take advantage of this potential, research is still needed. Particularly critical is our understanding of lignocellulosic biomolecules and the respective mechanisms regulating their bioconversion to liquid fuels. This BioEnergy Special Issue presents a range of experimental advancements including theoretical and experimental data on the production of biologically derived energy products, primarily cellulosic ethanol and biodiesel. Authors here report on variables including feedstock types, bioprocess engineering considerations, plant and microbial genetics and the overall process economics.

Critical to the overall environmental impact of biofuels is the type of feedstock used and its method of production. Of particular interest in this regard is the use of agricultural waste as feedstock and the reduction in the use of nitrogenous fertilizer in the growth of dedicated bioenergy crops. Venkatesh et al. present data on fungal conditioning of rice straw followed by AFEX treatment and enzymatic hydrolysis, noting the potential yield of additional fungal-derived products. Thomsen and Haugaard-Nielson report a decreased need for fertilizer and increased ethanol yield from clover-grass supplementation of a wheat straw crop. Wang et al. further expand upon the possibilities inherent in sorghum while reporting in detail the extractability and digestibility of its proteins, amount of phenolic compounds, amylase and amylopection and other factors relating to sorghum's utility. Bocher et al. present data on the operation of a secondary digester for brewery wastewater and the subsequent increase in the generation of biogas compared to conventional high-rate digestion of brewery wastewater alone. Kadam et al. examine the enzymatic digestibility of corn stover as correlated with the efficiency of lignin removal.

The efficient bioconversion of lignocellulosics is also explored as Sarath et al. discuss the potential advantages and disadvantages of switchgrass, sorghum and wheat as feedstocks for the production of cellulosic ethanol, and make a particular point regarding the great extent of exploitable genetic diversity in switchgrass. Anderson and Akin review the structural and chemical properties of grasses as they related to biofuels conversion and note that carbohydrate bioconversion is limited by associated lignins and low MW phenolic acids. Zhang discusses the potential to reduce cellulosic ethanol production costs through the economic utilization of nonfuel byproducts. Kumar et al. examine the biochemical and molecular aspects of lignocellulosic bioconversion.

Apart from the production of biofuel, other value-added products such as fermentable sugars, organic acids, enzymes and drink softeners were also considered as coproducts that can greatly improve the economics of the process. Hronich et al. explored the utilization of *Eichhornia*

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Crassipes, commonly known as water hyacinth, as a competitive source of biomass for conversion to fuel.

Towards novel approaches, Kalia and Purohit discuss the potential to improve the efficiency of energy production through the exploitation of microbial diversity and genomics, while Vasudevan and Briggs compare various sources of oil for biodiesel, including edible and nonedible plants, as well as algae, and Canakci and Sanli present data on the properties of the fuel derived from such various biodiesel sources. In addition, Rudnitskaya and Legin review electronic tongues and electronic noses for online liquid and gas analysis, and discuss their potential application to biofuels processing.

These reports, elucidating several broad-ranging areas of progress and challenges, come just at a time when government and industry are ramping up their investment in biofuels, with the expectation of a long-term need for alternatives to petroleum-based liquid fuels. Several demonstration-scale and full-scale facilities are in use, under construction or were recently awarded funding, and the United States government has set a goal to reduce gasoline usage by 20% in the next 10 years.

We hope readers will find these articles interesting and helpful to their research pursuits. It has been our pleasure to put together this special issue in Journal of Industrial Microbiology and Biotechnology. We would like to thank Dr. Allen Laskin, Editor-in-Chief, for providing researchers a unique forum in which to report ongoing BioEnergy research activities. We would also like to thank all of the contributing authors for sharing their quality research and ideas through this special issue.