

Diversification of Sugar Crops for Value Addition

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Sugarcane and sugar crops (sugar beet, sweet sorghum, palms, stevia) are rich source of food (sucrose, jaggery and syrups), fiber (cellulose), fodder (green leaves and tops of cane plant and beet roots, bagasse, molasses, pulp and press mud), fuel and chemicals (bagasse, molasses, syrup and juice and alcohol). It is now an established fact that sweeteners from sugar crops are undoubtedly the most paying proposition for economic sustainability; it is better to produce value-added products by diversification and utilizing the by-products of the sugar crops and sugar industry. Sugarcane and sugar crops are highly efficient in converting solar energy into chemical energy and have unique ability to synthesize a large number of useful compounds and store them. These chemicals include sucrose, glucose, fructose, complex polysaccharides, wax, vitamins, polyphenols, etc., which could be extracted

commercially and may be used in food and wellness industry.

Recent researches in green chemistry has led to transform sugarcane and sugar crops biomass and carbohydrates into the basic chemical ingredients that go into many everyday products. All biomass from sugar crops are potential feedstocks for bio-based industries. The cogeneration of bioelectricity from bagasse and trash is now a reality in many countries and, due to the high carbon content of bagasse and leaves, can also be converted into value-added products such as biochar. Sugar crops are superior feedstocks for the production of chemicals for the manufacture of a range of value-added products which have large-scale application in agriculture and industry. Among sugarcane-based products such as raw sugar, white sugar, refined sugar and sugar with molasses, these sugars are renewable feedstock for the production of platform chemicals for the manufacture of a range of end-products, e.g., bioplastics, industrial solvents, and chemicals. Cellulosic by-products like bagasse is used for the production of bleached pulp, glazed paper, typographic paper, printing paper, corrugated base-stock, copper printing paper, wrapping paper, fiber boards, furfural, binding agent, etc. Molasses-based products are ethyl alcohol, liquid carbon dioxide, dry ice, edible yeast, ribonucleic acid, nucleotides, adenosine triphosphate, cytidine triphosphate, polyinosinate polycytidylate, fuel oil, etc. Other economically important products that can be produced from sugars are succinic acid, sorbitol, xylitol, glutamic acid, itaconic acid, levulinic acid and hydroxymethylfurfural. Commercial production of platform chemicals has received considerable attention in recent years in view of industry sustainability and green chemistry. The diversification in the sugar agro-industry value chain will be an important

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strategy for the competitiveness, profitability and sustainability.

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Dr. Gillian Eggleston was born in Blackburn, Lancashire, UK. She received her B.Sc. in Chemistry and Biochemistry in 1984 from the University of Nottingham, UK, and her PhD in 1989 in Carbohydrate Biophysics from Cranfield Institute of Technology, UK. Dr. Eggleston has worked internationally in the field of carbohydrates and industrial sugar and bioproducts processing. In 2018, Dr. Eggleston became the Director and Full Professor of the Audubon

Sugar Institute, part of Louisiana State University Agricultural Center. Before that, she spent 24 years leading the sugar crop processing at the United States Department of Agriculture's Southern Regional Research Center in New Orleans, USA. During her career, she has had numerous accomplishments with her research having had major commercial and scientific impact in the worldwide sugar and related industries. Accomplishments include elucidation of the biochemical and physical processes leading to sugar crop deterioration, juice clarification, industrial enzyme applications and sugar losses, effects of extraneous sugarcane matter on processing, food authentication, and helping to establish a new, large-scale sweet sorghum processing industry in the USA. Her research has resulted in over 420 publications (six books, 169 peer reviewed journal papers and book chapters, 102 symposia and conference proceedings, 145 abstracts, etc.). Her major scientific and commercial accomplishments are reflected in 35 national and international awards, including five Sugar Industry Technologists (International) Awards, three Federal Laboratory Consortium National Technology Transfer Awards, the International Society of Sugar Cane Technologists' Maurice Paturau Award, and the American Chemical Society (ACS) Melville L. Wolfrom Award. She is also an ACS Fellow. Dr. Eggleston frequently gives international KeyNote, plenary and workshop presentations, and consults extensively worldwide. Dr. Eggleston has organized numerous technical and scientific symposia, international conferences, and delivered short courses. She has mentored young and older scientists as well as visiting scientists and graduates from all over the world, and served as external reviewer for six PhD degrees.



Dr. Manoel Regis Lima Verde Leal is the National Project Director of the SUCRE Project a LNBR–Brazilian Bio-renewables National Laboratory/CNPEN–Brazilian Research Center in Energy and Materials (CNPEN). The SUCRE project is aimed at eliminating the barriers that are inhibiting the increase in sugarcane straw collection and use for surplus power generation by the mills; the project is funded by the Global Environment Facility.

His work in the past three decades has been focused on the study of potential evolution of the technologies applied in the exploiting sugarcane as energy source for the production of ethanol and electricity aiming at the improvement of the Sustainability indicators of bioethanol. He worked at Copersucar Technology Center (CTC) from 1986 to 2004 and Promon Engenharia from 1974 to 1986. Prior to that, he held teaching positions at the Aeronautical Institute of Technology (ITA) and Federal University of Ceará. He is an ISSCT (International Society of Sugar Cane Technologists) Honorary Life Member and he was the National Team Leader representing Brazil in the Task 38 (Greenhouse Gas Balances and Bioenergy Systems) of the IEA (International Energy Agency) Bioenergy, from 2009 to 2015. He graduated in Aeronautic Engineering at the Instituto Tecnológico de Aeronáutica (Brazil) and holds a PhD in Mechanical Engineering from Kansas State University (USA).



Dr. Giovanna M. Aita is a Full Professor at the Audubon Sugar Institute at Louisiana State University Agricultural Center located in St. Gabriel, LA, USA with adjunct appointments in the School of Nutrition and Food Sciences and in the Department of Biological and Agricultural Engineering. She holds a B.Sc. degree in Biological Sciences and a M.Sc. degree in Food Microbiology from Clemson University (Clemson, SC, USA) and a PhD

degree in Food Microbiology from Louisiana State University. Dr. Aita's research focuses on the conversion of renewable biomass to bioproducts with applications in the sugar, food, nutraceutical, and pharmaceutical industries.



Dr. Klanarong Sriroth Director and Head of Innovation and Research Development Institute, Mittr Phol Sugar Corp., Ltd., has involved in sugar and starch industry for more than 35 years after his graduation *Doctor of Engineering in Sugar Technology/Biotechnology* from the Technical University of Berlin in 1986. He was one of the key persons who established the public awareness for the significant roles of Science and Technology to strengthen the

competitiveness of Thai agro industry, in particular carbohydrate crops which are sugar cane and cassava. Consequently, with the collaboration between National Center for Genetic Engineering and

Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA) and Kasetsart University, Cassava and Starch Technology Research Unit, a specialized unit on cassava, starch and sugar technology, was established in 1995, and he has been active as the unit director since then. He is very prominent in starch and sugar processing. His expertise is further extended to bioethanol processing where cassava and sugar cane are preferably used as the promising feedstock. With a great demand of carbohydrate uses in many industries, he has been inquired to conducted many works, granted by the government agencies. He also set up Sugar and Ethanol Technology Program for factory personnel, which promotes academic and industrial networking. Through his long accumulated experience in academic researches and collaborative works with industrial sectors, he currently serves as a technical committee in many National Boards concerning cassava, sugar and bioethanol Ltd. His current interest includes Biotechnology, Food Carbohydrate, Starch and Sugar Technology, Biofuel, Biomass and Ethanol Production.