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7. Title

Biomaterials from Sugarcane

12. Investigator Name(s) (Last Name and Initials)

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Outputs:

The goal of this research was to synthesize non-toxic, biodegradable polyesters from molasses and bagasse, both byproducts from the sugarcane industry. Eighteen non-toxic biodegradable polyesters with varying stoichiometry and functionalization were prepared. Findings resulting from thermochemical characteristic and cell growth studies were disseminated in presentations at national conferences, local and regional symposia, and private sector meetings.

Outcomes/Impacts:

Formulations in the original proposal were synthesized from aconitic acid (isolated from molasses), glycerol and cinnamic acid (isolated from pretreatment wastes associated with the production of ethanol from sugarcane bagasse using Audubon Sugar Institute's pretreatment technology). Ethyl acetate was the extracting solvent for aconitic acid from molasses by liquid-liquid extraction. Yields varied from 20-68% with purity of the extracted acid ~99.9%. Molasses was fermented before extraction to generate ethanol as an additional stream. Fermented molasses gave aconitic acid yields of up to 62% and purities that reached 99.9%. The ethanol concentration reached a maximum of 13.93% and the yield was 73.5% of the theoretical projection. The thermally cured polymer is an optically-clear, colorless and brittle material which exhibits a glass transition (Tg) between 90-100C. SAXS and WAXS analysis was performed on polymers that were swelled in the presence of a dye (fluorescein, rose Bengal and the chelate dye ferroin (tris-o-phenanthroline-Fe2+)) and then dried. Early attempts to intercalate contraceptive compounds, ethynylestradiol and norethindrone, were hampered by extremely low aqueous solubility. Promising results with co-solvent systems and carriers (such as cyclodextrins) were produced. The polyesters containing cinnamic acid exhibited an intensity of emission similar to samples that did not, but the intensity of emission was significantly less (2-fold). Radiation-less energy transfer may be taking place with cinnamic acid, and that effect is proportional to the amount of acid in the formulation. It is also possible, yet unconfirmed, that the dye may be activating the [2+2] photocyclo addition of cinnamic acid, which is of interest because a) this transition is usually limited to 272 nm (and we are exciting at 435 nm), and b) it is the patterning mechanism for the polyester tissue scaffold concept. Polymers were tested for their toxicity towards human adipose-derived stem cells (hASC). The cellular viability of "on-scaffold" cultures was determined using cytotoxicity assays. The polymeric scaffolds were toxic to hASC at an incubation time of 1 week. The degradation of the polymeric structure in aqueous environment reduced the pH (2-3) which was attributed to an incomplete reaction and poor mixing. Modifying the mixing efficiency improved the polymeric structure. This new mixed polymeric mixture was cured for 24h and then cross linked using a UV transilluminator. These polymers passed the "cell viability" test and were non- toxic to cells. Stem cells survived on the polymers for up to 14 days.

Publications:

Aita G. (2012) Research Studies at the Renewable Fuels and Byproducts Laboratory. Audubon Sugar Institute Biennial Report LSU AgCenter, pages 5-6.

Aita, G., Madsen, L. (2011) Added Value Through Bio-Plastics from Sugarcane. Factory Operations Seminar LSU AgCenter, page 13.

Aita, G. (2011) Biotechnological Potential of Energy Crops in Louisiana. Biofuel Symposium at Southern University, Baton Rouge, LA, October 20, 2011.

Aita, G., Salvi, D. (2009) Lignocellulose As a Source for Fuels and Chemicals. Louisiana Agriculture (Special Issue on

Biofuels), 53 (4): 12-13.

Participants:

Giovanna Aita (PI), Lee Madsen (Co-PI), Michelle Walker (research associate), Chardcie Verret , Akanksha Kanitkar, Shuo Cao, Zenghui Qiu and Derek Dorman, LSU AgCenter. Other partner organizations and/or collaborators in this project include: the 11 Louisiana sugar factories along with their plant managers, the American Sugar Cane League (Louisiana sugarcane commodity group domiciled in Thibodaux, LA) and the Louisiana sugarcane growers.

Target Audiences:

Target audiences include personnel in the biofuels, bioenergy and biochemicals industries as well as sugar industry personnel who are interested in conversion of their raw sugar factories into biorefineries. Other target audiences include: researchers in food science, biotechnology, biochemistry, engineering and medicine who could benefit from the findings of this project; and, the domestic sugar industry to include managers of all sugar factories in Florida, Hawaii, Louisiana and Texas and the commodity groups in these states.

Project Modifications:

Nothing significant to report during this reporting period.

Approved (Signature)	Title	Date