FUEL (incl. Biogas, Biodiesel, Biomass energy, Ethanol etc.)

NPARR 3(1), 2012-045, **Thin-layer drying kinetics and quality changes of sweet sorghum stalk for ethanol production as affected by drying temperature**

The chopped sweet sorghum stalk was thin-layer-dried for long-term storage and ethanol production. The drying kinetics and the effects of drying temperature on the qualities of sweet sorghum stalk were investigated in this work. The results showed that the drying process could be simulated well by Wang and Singh's model. The diffusivity constant (D0) and active energy (Ea) were estimated as 4.4 × 10-5m2/s and 21.4 kJ/(mol K) for drying the chopped fresh stalk. According to the sugar composition, browning degree, and fermentability of the dried stalk obtained at various temperatures, the approximate drying temperature could be suggested as 50-60◦C for application. In this range, the moisture of the chopped fresh stalk could drop below the safe moisture for storage in 7-5.5 h with 12.1-9.7% total sugar loss during the drying process [Fei Shen, Lin Peng, Yanzong Zhang, Jun Wu, Xiaohong Zhang, Gang Yang, Hong Peng, Hui Qi, Shihuai Deng (Provincial Key Laboratory of Agricultural Environmental Engineering, College of Resource and Environment, Sichuan Agricultural University-Chengdu Campus, Chengdu, Sichuan-611130 PR China), *Industrial Crops and Products*, 2011, **34**, 1588-1594].

NPARR 3(1), 2012-046, **High quality biodiesel from yellow oleander (*Thevetia peruviana*) seed oil**

Yellow oleander (*Thevetia peruviana* Schum.) seed oil has been investigated to produce biodiesel. Transesterification of the oil to biodiesel was carried out in methanol by batch reaction using a heterogeneous catalyst derived from the trunk of *Musa balbisiana* Colla (one variety of banana plant). 96 wt % of the oil is converted to biodiesel at 32°C in 3 h. The wt % composition of the biodiesel is methyl oleate 43.72, methyl palmitate 23.28, methyl linoleate 19.85, methyl stearate 10.71 and methyl arachidate 2.41. Fuel properties conform to standards set for ASTM D6751, EN 14214, BS II and BS III, and in certain aspects better. The biodiesel is free from sulfur and has exhibited a high cetane number of 61.5 [Deka, D.C.* and Basumatary S. (Department of Chemistry, Gauhati University, Guwahati 781 014, Assam, India), *Biomass and Bioenergy,* 2011, **35**(5), 1797-1803].

NPARR 3(1), 2012-047, **Ethanol production from banana peels using statistically optimized simultaneous saccharification and fermentation process**

Dried and ground banana peel biomass (BP) after hydrothermal sterilization pretreatment was used for ethanol production using simultaneous saccharification and fermentation (SSF). Central composite design (CCD) was used to optimize concentrations of cellulase and pectinase, temperature and time for ethanol production from BP using SSF. Analysis of variance showed a high coefficient of determination (R^2) value of 0.92 for ethanol production. On the basis of model graphs and numerical optimization, the validation was done in a laboratory batch fermenter with cellulase, pectinase, temperature and time of nine cellulase filter paper unit/gram cellulose (FPU/g-cellulose), 72 international units/gram pectin (IU/g-pectin), 37°C and 15h, respectively. The experiment using optimized parameters in batch fermenter not only resulted in higher ethanol concentration than the one predicted by the model equation, but also saved fermentation time. This study demonstrated that both hydrothermal pretreatment and SSF could be successfully carried out in a single vessel, and use of optimized process parameters helped achieve significant ethanol productivity, indicating commercial potential for the process. To the best of our knowledge, ethanol concentration and ethanol productivity of 28.2g/l and 2.3g/l/h, respectively from banana peels have not been reported to date [Oberoi, H.S.*, Vadlani, P.V., Saida, L., Basal, S., Hughes, J.D. (Department of Grain Science and Industry, Kansas State University, Manhattan, KS 66506, United States), *Waste Management*, 2011, **31**(7), 1576-1584].

NPARR 3(1), 2012-048, **Weedy lignocellulosic feedstock and microbial metabolic engineering: Advancing the generation of 'Biofuel'**

Lignocellulosic materials are the most abundant renewable organic resources (~200 billion tons annually) on earth that are readily available for conversion to ethanol and other value-added products, but they have not yet been tapped for the commercial production of fuel ethanol. The lignocellulosic substrates include woody substrates such as hardwood (birch and aspen, etc.) and softwood (spruce and pine, etc.), agro residues (wheat straw, sugarcane bagasse, corn stover, etc.), dedicated energy crops (switch grass, and Miscanthus etc.), weedy materials (*Eicchornia crassipes*, *Lantana camara* etc.), and municipal solid waste (food and kitchen waste, etc.). Despite the success achieved in the laboratory, there are limitations to success with lignocellulosic substrates on a commercial scale. The future of lignocellulosics is expected to lie in improvements of plant biomass, metabolic engineering of ethanol, and cellulolytic enzyme-producing microorganisms, fullest exploitation of weed materials, and process integration of the individual steps involved in bioethanol production. Issues related to the chemical composition of various weedy raw substrates for bioethanol formation, including chemical composition-based structural hydrolysis of the substrate, need special attention. This area could be opened up further by exploring genetically modified metabolic engineering routes in weedy materials and in biocatalysts that would make the production of bioethanol more efficient [Chandel A.K* and Singh O.V. (Centre for Biotechnology, Jawaharlal Nehru Technological University, Hyderabad 500 085, India), *Applied Microbiology and Biotechnology*, 2011, **89**(5), 1289-1303**]**

NPARR 3(1), 2012-049, **Biofuels from algae for sustainable development**

Microalgae are photosynthetic microorganisms that can produce lipids, proteins and carbohydrates in large amounts over short periods of time. These products can be processed into both biofuels and useful chemicals. Two algae samples (*Cladophora fracta* and *Chlorella protothecoid*) were studied for biofuel production. Microalgae appear to be the only source of renewable biodiesel that is capable of meeting the global demand for transport fuels. Microalgae can be converted to biodiesel, bioethanol, bio-oil, biohydrogen and biomethane via thermochemical and biochemical methods. Industrial reactors for algal culture are open ponds, photobioreactors and closed systems. Algae can be grown almost anywhere, even on sewage or salt water, and does not require fertile land or food crops, and processing requires less energy than the algae provides. Microalgae have much faster growth-rates than terrestrial crops. the per unit area yield of oil from algae is estimated to be from 20,000 to 80,000 liters per acre, per year; this is 7-31 times greater than the next best crop, palm oil. Algal oil can be used to make biodiesel for cars, trucks, and airplanes. The lipid and fatty acid contents of microalgae vary in accordance with culture conditions. The effect of temperature on the yield of hydrogen from two algae (*C. fracta* and *C. protothecoid*) by pyrolysis and steam gasification was investigated in this study. In each run, the main components of the gas phase were CO_2, CO, H_2, and CH_4.The yields of hydrogen by pyrolysis and steam gasification processes of the samples increased with temperature. The yields of gaseous products from the samples of C. fracta and C. protothecoides increased from 8.2% to 39.2% and 9.5% to 40.6% by volume, respectively, while the final pyrolysis temperature was increased from 575 to 925K. The percent of hydrogen in gaseous products from the samples of *C. fracta* and *C. protothecoides* increased from 25.8% to 44.4% and 27.6% to 48.7% by volume, respectively, while the final pyrolysis temperature was increased from 650 to 925K. The percent of hydrogen in gaseous products from the samples of *C. fracta* and *C. protothecoides* increased from 26.3% to 54.7% and 28.1% to 57.6% by volume, respectively, while the final gasification temperature was increased from 825 to 1225K. In general, algae gaseous products are higher quality than gaseous products from mosses [Demirbas, M.F. (Sila Science, University Mahallesi, Mekan Sokak No. 24, Trabzon, Turkey), *Applied Energy*, 2011, **88**(10), 3473-3480**]**