6th World Congress on

BIOFUELS AND BIOENERGY

September 05-06, 2017 | London, UK

Posters

Nongyao Sawangjaroen et al., J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Processing of crop residues for heating and CO_2 enrichment in greenhouses

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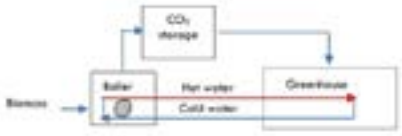
Development of adequate strategies to manage greenhouse crop residues to use it as energy and CO_2 source are presented. Although greenhouse crop residues can potentially be used as fuel in greenhouses, still some difficulties need to be solved to do this technology suitable. Major bottlenecks are related with the high moisture and ash content, in addition to low energetic density of these residues. In this work, three relevant properties for solid fuels have been studied (moisture, ash content and calorific value) for different biomass samples which usually are released at Almeria, Spain. In addition, two different options have been tested in order to enhance the performance of this biomass kind at combustion facilities. One previous drying in order to reduce its moisture content of greenhouse crop residues, whereas the second is related to reduction on ash content. Results allow concluding that both strategies were successful. The gross calorific value (dry basis) of the biomass treated was higher up to 25 MJ/kg, and ash content was lower than untreated, as low as 10% d.w.t. These values are closer to the ones usually presented by standard biomass kinds regularly employed at combustion applications. The biomass obtained was successfully tested on commercial boilers in which thermal efficiencies up to 70% were reached. In conclusion, developed methods allow reusing greenhouse crop residues as fuel in greenhouses, to provide heat and CO_2, thus its utilization can suppose an economic yield and, also, enhance sustainability for this commercial activity.



Biography

José Vicente Reinoso Moreno is a PhD student whose experience is related to the biomass fuel field. He has been collaborating for the RNM-6141 project (Green house crop residues reutilization with energy porpoise). As a result of this research developed for the project, he participated in a study related to combustion properties of different biomass residues usually released at Almería province (south east of Spain) from agriculture. He also collaborated with the testing and development of different strategies to enhance biomass properties quality for combustion applications. He collaborated in the optimization of a pilot scale system designed for heating and supplying heat from biomass. Finally, he collaborated in a study to optimize combustion factor inside a boiler for biomass fuels.

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DOI: 10.4172/2155-6199-C1-009

Application of qNMR and microwave radiation to obtain biofuel precursors from *Opuntia ficus-indica* fruit

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Diminishing fossil fuel reserves and increasingly concern about environmental issues have resulted in the development of sustainable production of biofuels and chemicals. In order to maintain fossil reserves to future generations and to reduce greenhouse gas emissions, biomass has merged as the most abundant and affordable source of new fuels and chemicals. Biomass is composed mainly for carbohydrates, such as glucose, fructose or xylose. The dehydration of these carbohydrates to obtain biofuel precursors has been studied, namely 5-Hydroxymethyl-furfural (5-HMF) and Levulinic Acid (LA). Both 5-HMF and LA are precursors of a wide range of valuable products. Continuing with previous work in our research group in the field of valorization of agro-food waste to obtain biofuel precursors, herein we exposed the catalytic conversion of biomass from *Opuntia ficus-indica* fruit into 5-HMF and LA. Synergy of microwave radiation as a source of environmental friendly energy and Nuclear Magnetic Resonance Spectroscopy (NMR), let us not only carry out carbohydrates dehydration, but also identify and quantify this platform compounds (5-HMF and LA) rapidly and with low use of solvents. For that, NMR plays an important role in the field of agro-food waste valorization, because it can be used firstly to identify what kind of carbohydrates are present in the biomass, and secondly, a special application of NMR called Quantitative Nucleal Magnetic Resonance Spectroscopy (qNMR) allows to quantify the compounds obtained once the dehydration reaction has been carried out.

Figure 1: Dehydration of glucose into 5-HMF and LA

Biography

A J Huertas-Alonso obtained BSc in Chemistry at the Universidad de Castilla-La Mancha (UCLM) and his MSc in Organic Chemistry at the Universidad Complutense de Madrid (UCM) in 2016. His first contact with a research laboratory was during the last year of his Chemistry degree, in the field of sugar dehydration from wine waste to obtain 5-HMF, under the supervision of Dr. Andrés Moreno. After one year stay at the Medicinal Chemistry Institute, in the National Spanish Research Council, he is now doing his PhD at Universidad de Castilla-La Mancha, working in the valorization of agro-food waste to obtain biofuel precursors.

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M Salgado et al., J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Biofuel precursors from almend shell under microwave radiation

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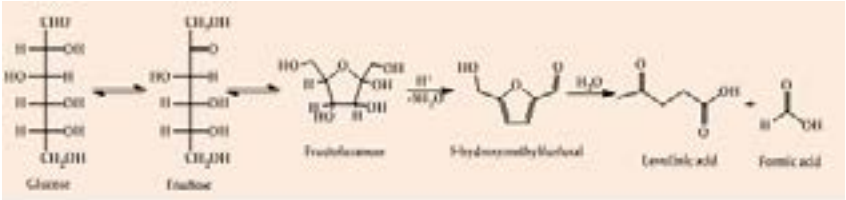
The progressive decrease of fossil fuels and the increase of CO_2 emissions suppose a serious problem for the environment. Moreover, it has been object of study by many research groups for the last years. One of the main renewable source energy in the world is biomass. The agro-industrial wastes also suppose an important source of raw material at the time of reduce these emissions. Among these wastes previously mentioned it can be found melon rind1, beer bagasse or almond shell2. Almond shell is mainly made of cellulose, hemicellulose and lignin. Some simple sugars have been also identified, such as glucose, xylose and fructose. The dehydration of these sugars generates some compounds which have been evaluated as precursors of biofuels due to their calorific capacity are lower than the oils currently used. Among these precursors can be remarked 5-hydroxymehylfurfural (HMF), levulinic acid (LA) and 2,5-dymethilfuran (DMF).3 Microwave radiation is a suitable technique that permits us to carry out the hydrolysis and dehydration of cellulose to obtain the desired products.4 In addition, Nuclear Magnetic Resonance (NMR) allows us to identify and quantify all reactions products.



Biography

M Salgado graduated in Chemistry in 2015 from University of Castilla-la Mancha (UCLM). Later, he completed her Master´s degree in organic chemistry at the Complutense University of Madrid (UCM). He has worked in some groups during his five years as a student. His research career is brief, but he has obtained a publication and participation in several scientific congresses. Actually, he is a PhD at the University of Castilla-La Mancha, in the Organic Chemistry area with the Doctors Andres Moreno Moreno and Maria del Prado Sanchez Verdu.

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Accepted Abstracts

Biofuels Congress 2017

J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Desıgnıng a bıorefinery for the extractıon of hıgh value-added caffeıne from tea waste, and ıts techno-economıc evaluatıon

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Biorefinery is defined as the sustainable refining of biomass into valuable bio-based products. Today there exists an increasing demand for replacing conventional, chemical production methods of high value-added chemicals with biorefinery applications, although the costs are still exceeding the conventional production methods. Turkey is the highest consumer of tea beverage and tea production is almost solely for domestic use. Unfortunately, tea production wastes are not recycled thus giving rise to environmental pollution. Dry tea waste can be estimated to contain 1,75 % caffeine, which is a high value-added chemical used in chemical, pharmaceutical and beverage industries. Decaffeination with hot water was merged with liquid-liquid differential extractions using heptane as a solvent, to construct a process design for caffeine biorefinery in this study. This is the only study to generate a process design that occupies recycles and series configurations with continuous mode of operation utilizing less toxic solvents and recycles them to lower the environmental burden and uses simpler system of leaching extraction followed by liquid-liquid differential extraction with respect to super critical CO_2 extraction, while producing highly favorable techno-economical results. Consequently, the aim of the study was to produce a novel process design for a biomass refinery application utilizing tea wastes to extract high value added chemical, caffeine, while evaluating the process techno-economically. In conclusion, the preliminary cost estimates gave a promising result for such biorefinery application in Turkey with NPV of 17 457 000$, payback time of 4,41 years, profitability up to 50% of the daily treatment capacity, toleration up to 15% interest rate, profitability above 30$/kg product selling price, significant sensitivity to selling price of the product, labor cost, steam price and transportation cost, and total capital investment of 27 338 000$.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

New biomass production, supply chains and markets

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To-date most long distance biomass trade has been white pellets to replace coal in European heat plants and power stations. Black pellets are now being transported across oceans, but markets are tentative due to a cost premium over white pellets. Although pyrolysis oil has been produced since 1989 and is twice as energy dense as wood pellets, it is only now beginning to be recognized as an excellent medium for transporting energy long distances economically. This presentation will examine supply chain enhancements for black pellet supply chains that will open up new production sources and make long distance trade more viable. It will also show the tremendous recent growth in pyrolysis oil capacity worldwide, examine the wide scope of markets both in Europe and Japan, illustrate how supply chains are expanding from road and rail to bulk shipping, and will examine current and future sources of supply, including Australia, Malaysia and Canada.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Options of alternative fuels for electricity generators in Africa using PESTLE analysis tool

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Alternative fuels are being sought to replace fossil fuels in a wide range of applications. Alternative fuels can be derived from renewable or non-renewable resources. This paper looks at the potential use of replacing diesel with alternative fuels in diesel engines used for electricity generation in the African developing countries which has low electrification rates. Fuels for consideration for partial or whole replacement of fossil diesel were: Biofuels (ethanol and biodiesel), gas to liquid (GTL), coal to liquid (CTL), coal water slurries (CWS), hydrotreated vegetable oil (HVO), straight vegetable oil (SVO), animal fats and biogas from anaerobic digestion. The potential feasibility of each alternative fuel was assessed using PESTLE analysis whilst considering a number of factors such as are political, economic, social, technical, legal and environmental. PESTLE (Political, Economic, Social, Technological, Legal and Environmental) analysis revealed that GTL, CTL, HVO, CWS and Biodiesel are not currently suitable as diesel fuel replacements for this application. This was due to a combination of reasons including limited supply of feedstock, economics, poor transport infrastructure, lack of arable land for growing edible crops for biofuels. Arable land is limited and using this to grow edible crops for biofuels competes with food production. The study showed that bioethanol, animal fats, SVO from non-edible crops and biogas from anaerobic digestions were viable alternatives for this application. Further work is required to identify which of these fuels is the best alternative by conducting a life cycle assessment, a cost analysis exercise and further emissions testing. This data then needs to be compared with one another and against fossildiesel.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

The reconstruction of metabolic pathways in selected bacterial and yeast strains for production of bioethylene from crude glycerol

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Crude glycerol, a major by-product from the transesterification of Sunflower oil with alcohol to biodiesel, can pose danger to the environment in large quantities. Studies have shown that utilization of the glycerol to afford commercial products is one of the promising options for lowering its pollution effects and biodiesel production costs. For example, its bioconversion can offer a wide range of chemicals including alcohols, organic acids, hydrogen, solvents and precursors for bioplastics. In Pseudomonas *syringae* species of bacteria, the 2-oxoglutarate dioxygenase (2-OGD) are widely known to be among the enzymes with an emerging importance in ethylene formation. However, the optimization and industrial applications of enzyme as recombinant systems for crude glycerol conversion to ethylene is still not been reported. The present study investigated the production of ethylene from crude glycerol using engineered *Pichia pastoris, E. coli* MG1655 and JM109 strains. Ethylene production with a codon-optimized expression system for 2-OGD in *E.coli* using a codon optimized construct of the ethylene-forming gene was studied. The effect of codon optimization resulted in a 20-fold increase of protein production and thus an enhanced production of the ethylene gas. For a reliable bioreactor performance, the effect of temperature, fermentation time, pH, substrate concentration, concentration of methanol, concentration of potassium hydroxide and media supplements on ethylene yield was investigated. The results demonstrate that the recombinant enzyme can be used for future studies to exploit the conversion of low-priced crude glycerol into advanced value products like light olefins, and tools including recombineering techniques for DNA, molecular biology and bioengineering can be used to allowing unlimited the production of ethylene directly from fermentation of crude glycerol. It can be concluded that recombinant E.coli production systems represent significantly secure, renewable and environmentally safe alternative to thermochemical approach to ethyleneproduction.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Targetted engineering of brassica seed biochemistry to produce plant oil for direct use as biodiesel

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Energy crises along with environmental concerns are driving researchers to develop viable alternative fuels from renewable resources. The use of *Brassica juncea* oil as an alternative fuel suffers from problems such as high viscosity, low volatility and poor cold temperature properties. The seed of *Euonymus alatus* produces low viscosity oil having unusual triacylglycerol (TAGs) called acetyl triacylglycerol (acTAGs) where the sn-3 position is esterified with acetate instead of a long chain fatty acid. The enzyme *Euonymous alatus* diacylglycerol acetyltransfrase (EaDacT) present in these plants is an acetyltransferase that catalyzes the transfer of an acetyl group from acetyl-CoA to diacylglycerol (DAG) to produce acTAG. In order to reduce the viscosity of *Brassica juncea* oil by synthesizing acTAG, we have developed an efficient and simple agrobacterium mediated floral dip transformation method to generate transgenic *Brassica juncea* plants. A binary vector containing the EaDacT gene under the transcriptional control of a glycinin promoter and with a basta selection marker was transformed into *Agrobacterium tumefaciens* strain GV-3101 through electroporation. Basta is a herbicide which is used as a selection marker to allow us to conveniently screen very young transgenic plants from a large number of untransformed plants. The basta resistant putative transgenic plants were further confirmed by PCR. Biochemical analyses of the transgenic B. *juncea* seed revealed modified fatty acids profile having no acetyl TAGs. Alternative strategy is in process to silence genes encoding enzymes DGAT/PDAT along with overexpression of *EaDAcT*, that will hopefully produce acetyl TAGs.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Dual purpose of microalgae as hexavalent chromium accumulator and biodiesel producer

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Microalgae are single cellular photosynthetic organisms having potential of very high oil content and growth rate. Moreover, the cultivation of these algae do not require diversion of agricultural land, as they can grow in both fresh water, marine or brackish water environments, and additionally fix substantial amount of CO_2 emitted from combustion. With all this promise, intense effort is now on all over the world to devise suitable systems to make large scale cultivation and harvesting of these microscopic organisms, extraction and conversion of their oil content to bio-diesel and other high value byproducts, in a cost-effective approach. Photochemical reduction of hexavalent chromium is a practical interest for detoxification waste water. Several efforts have been made to reduce Cr(VI) into less toxic Cr(III) by algae as it is available conveniently and low expense. Biomass of algae species *Chlorella vulgaris* has shown efficiency toward Cr(VI) reduction in photochemical mechanism gained lot of interest in employing algal community. Other algae like *Sargassum cymosum and Pelvetia canaliculata* have been experimented for the reduction of chromium. So in a single route dual application of Cr(VI) reduction during cultivation followed by biodiesel production post harvesting of microalgae can be projected for multiple utilization. The harvested biomass can undergo a desorption process to separate pure biomass and reduced components of chromium. For this dual purpose development of mass cultivation protocol and necessary systems required for high productivity of the microalgae with Cr(VI) reduction and biodiesel production will gain much interest in the environmental biotechnologist communities. To qualify the dual objectives in a single microalgae track a tentative flow sheet is shown in Fig 1, which is started with algae cultivation and ended with two products such as pure chromite and biodiesel.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Phototrophic culture of *Chlorella sp*. using charcoal ash as an inorganic nutrient source

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Although several studies have recognized the suitability of employing ashes as a component of a culture medium or fertilizer, the number of these studies remains limited. The use of biomass ash as a nutrient source for algal culture is an unexplored research topic that should be investigated to analyse the possibility of reducing the costs associated with commercial microalgae culture.In this study, biomass ash from charcoal was used as a source of nutrients for the cultivation of Chlorella sp., and two alternative processes for nutrient supply were studied. First, various culture media containing the leachate stock solution from solid ash at different concentrations were prepared. Second, different amounts of solid ash were added directly to the culture media. The results indicated that the direct use of biomass ash mixed in water enables the formation of a more suitable medium compared with Guillard's f/2 medium because it promotes faster cell growth and higher biomass productivity. The higher biomass productivities were reached over the same period compared with those achieved with the culture media based on biomass ash leachates. Moreover, the nutrients in the media containing ash leachates are sufficient to maintain cell growth rates and biomass productivities that are comparable to those achieve with Guillard's f/2 medium.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Implementation of circular economy concept in the world's second largest refugee camp: Zaatari biogas plant

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Refugee camps are taken as temporary solution to existing circumstances. And their temporariness usually prevents the implementation of numerous vital concepts like sustainability, environmental impact, and circular economy among many other. But temporariness is not always the case some refugee camps exceed several years while some eventually turn to permanent living conditions, Jordan's fourth biggest city "Zaatari" as an example. The lack of sustainability in running refugee camps impacts the quality of life in the camps and the cost to run them amid many other aspects. Furthermore, Zaatari being located in Jordan where the gap between the landfill capacity and the total volume of waste produced on a daily basis was found to be 1,698 tons per day (indicating that 19 per cent of solid waste will not be landfilled due to lack of landfill capacity) further stresses out the need reconsider the running scheme at the camp. The main scope of this paper is to study the potential benefits of the application of circular economy in terms of biomass at Zaatari camp. A representative MSW sample was provided by the camps representatives. also, sludge samples from Zaatari wastewater treatment plant. Then MSW samples and sludge were mixed in different ratios and analyzed for potential biogas yield. For the next step analysis of digestate will be performed to determine its adequacy as fertilizer. While carrying out numerous calorific tests for an improved assessment of the best track to harness the full potential biomass produced in the camp. The 80,000 inhabitants of Zaatari consume over 500,000 $ worth of electricity each month, that accompanied by the growing deficit in landfill capacity and Jordan's high dependency on foreign energy sources all contribute to the necessity in implementing circular economy concept for the refugee camp, and for Jordan in general.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Microalgae of Northeast India for bio-energy and other products of commercial potential based on the biorefinery approaches

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In the recent times, microalgae have been the immense source of attraction as a highly potential and promising renewable biomass source of energy, biomittigation and sustainable valuable products. Biotechnological explorations of the underutilized bountiful indigenous algae diversity of NE India, have potentially opened up a new avenue for sustainable product development including biofuel production. Several microalgae species have been marked as potential source of naturally occurring high valued products such as lipids, vitamins, proteins, carbohydrates, antioxidants, colorants, food supplements and other bioactive molecules. The North East India, apart from being one of the mega biodiversity hotspots in the world, has bestowed upon with vivid freshwater microalgal resources. These diverse bio-resources of the region are yet to be explored to the extent for their potential biotechnological applications. Recent studies carried out are envisaged with the isolation and screening of freshwater biodiesel potential microalgae of the region yielding with the isolation of 24 indigenous freshwater microalgae species, which require further works for possible commercial utilizations and biotechnological applications. Among the isolated microalgae, *Chlorella* sp, *Botryococcus braunii, Ankistrodesmus* sp., *Scenedesmus* sp., *Euglena* sp., *Haematococcus* sp., *Navicula* sp., and *Nitzchia* sp. are known to be a few oleaginous microalgae noteworthy for biofuel production. Oil (lipid) contents were quantitatively evaluated in laboratory cultures of isolated *Ankistrodesmus* sp., *B.braunii*, *Scenedesmus* sp., *Chlorella* sp. and *Chlorococcum* species. The lipid content of some of the isolated microalgae species grown in normal BG11 medium were found to be in the range between 11.3–42.0% of dry weight. Analysis of the carotenoid contents of the selected native microalgae species also revealed higher content of lutein, lycopene and astaxanthin, which can be produced as other high valued products for additional fund generation in the course of liquid biofuel production. The liquid hydrocarbon producing green microalgae B. *braunii* is found to be significant among the isolated microalgae, which exhibited hydrocarbon in the range between 21.9-60.7% of dry weight. Some of these isolated microalgae e.g. *Scenedesmus* sp. (8-56% Protein; 10-52% Carbohydrate), Chlorella sp. (51-58% Protein; 12-26% Carbohydrate), Euglena sp. (39-61% Protein; 14-18% Carbohydrate & 14-20% Lipid) are also reported to contain high percentage of carbohydrate and protein in addition to its moderate to high lipid content, which justify the enough scope for utilization of these species in developing a technology for potential biofuel production and other value added products of commercial potential based on biorefinery approaches.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Algononics: Integrating nanodots to enhance algal biofuels development

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Algal systems have the potential to alter the landscape of biofuels by enabling the direct capture of the sun and its conversion to valuable biofuels and other co-products. However, there are a number of bottlenecks that limit algal capabilities and have slowed the development and large scale application of microalgae. One of these is their limited light capture bandwidth that can be restrictive and is based on natural photosynthetic capture mechanism. The improvements in light capture with microalgae has potential to get the best of life sciences capability in conversion of light to chemical entities. The capabilities of nanomaterials devices to capture the light available across a wider spectrum is emerging field. To study the impact of enhancing light capture in microalgae was studied by supplementing Chlamydomonas reinhardtii cc503 with Green Graphene Quantum Dots (GGQD). Intake of GGQDs within the microalgae was determined by TEM. Biological compatibility was observed by non-toxic nature of GGQDs. There were not any morphological or chemical changes except for photo-quenching of GGQDs. Despite of photo-quenching cells showed growth and increase in lipid production. Furthermore, investigation was done for lipid and Fatty Acid Methyl Ester (FAME) upsurge and we found that increase in concentration of H2O2 might have caused the enrichment of lipids and FAME. The results indicate specific relation between GGQDs intake and impact on electron gain or loss for florescence quenching activity whereas improving bio-compounds production.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Microalgae biorefinery high-value chemicals: Polysaccharides

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Many renewable energy technologies had been developed such as Aeolian wind and solar (1). However, there is a need to develop renewable fuels for transportation without compromising food security. Land crop is currently the main source of food and biofuels (2,3), and it will not be able to respond to all the fuel and food demand in the future. Microalgae could be a potential biomass alternative. Microalgae is a micro-crop that produce oleaginous biomass where no land crop can grow, can use seawater instead of fresh water, and use sun light to convert CO_2 into high-value chemicals (4). The microalgae biorefinery could then establish a positive association between bioenergy and food security leading to a significant positive impact on the socio-economic development. A viable microalgae biorefinery should be designed in a way to improve high-value chemicals yield such as polysaccharides (Figure1). Methodology and Results: Polysaccharides were extracted from *Botryococcus braunii* by alkaline hydrothermal treatment solution for 10 h. Ethanol (2 volumes) was used to precipitate water-soluble polysaccharides for characterization. The glycosyl-linkage analysis showed that polysaccharides polymers are less branched and dominated by (1-4) linkage. The viscosity behavior was measured at 25°C (5), at the concentration 10% (w/v), the profile of viscosity versus shear rate showed a non-Newtonian pseudoelastic viscosity. It is a shear thinning behavior in the shear rate range of 0.01 to 1000 1/s. This property indicated the alignment of the less branched polysaccharide polymer in the direction of the flow under increasing shear rate. The polysaccharides solution (10%) viscosity test was also performed with a temperature range from 25°C to 100°C and showed also a decreasing viscosity.

Conclusion: The low viscosity, shear thinning and water solubility properties of extracted polysaccharides demonstrated potential applications in supplements, cosmetics, food, and beverages industry to improve commercial microalgae biorefinery feasibility.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Emissions of jatropha oil biodiesel blend fuels during combustion using swirl burner with different swirl angle

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Experimental works on combustion of jatropha oil biodiesel blends of fuel with high swirling flow in swirl burner have been studied in various blends percentage. Jatropha oil biodiesel was produced using a two-step of transesterification process. Firstly, jatropha oil was esterified using methanol with 1% of H_2SO_4 catalyst to diminish their free fatty acid level. Then, the oil ester was taken through the transesterification process with methanol and the catalyst of KOH. The paper focuses on the emissions of biodiesel blends fuel using jatropha oil biodiesel blends of fuel in lean through to rich air/fuel mixture combustion. The 4 different blends of jatropha oil biodiesel included B10, B15, B20 and B25 are evaluated in this swirl burner with 3 various angles of swirler. The results show that the B25 has good emissions even though it has a higher emission of NO_x than diesel fuel, while it emits as low as 42% of CO, 33% of SO_2 and 50% of UHC emissions. These are due to the different density and viscosity of the blends.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Biomethane, variables and wastes conversion: Optimal process conditions for enhanced biomethanation of animal and fruit wastes

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Biomethanation of animal and fruit wastes is an environmental benign and cheap source of energy. However, biomethanation has the problem of large hydraulic retention time and low gas production which has led to its underutilization. Therefore, research is focused on biomethanation enhancement for efficient and high yield biomethane production. Laboratory scale batch anaerobic digester was used to investigate the effects of operating variables [Total Solid Content (TSC), Temperature (TEMP), Agitation (AGT) and Feed/Inoculum Ratio (FIR)] on biomethane generation from mixture of animal wastes (cattle dung, pig dung and poultry droppings), co-substrates (orange, mango and pineapple wastes) and (chicken rumen). 5 different slurries [Animal and Orange wastes with Inoculum (AOI); Animal and Mango wastes with Inoculum (AMI); Animal and Pineapple wastes with Inoculum (API); Animal and the three fruits wastes with Inoculum (AOMPI) and Animal wastes (A)] were charged into the digester. The process were carried out for 70 days at these conditions TSC (2- 10%), TEMP (25 -60°C), AGT (35- 70 rpm) and FIR (1:1, 1:2, 1:3, 2:1 and 3:1). Biomethane produced was collected continuously into a gas bag and analysed using Gas Chromatography. One-Factor-at-A-Time was used to select TEMP, TSC and FIR for Central Composite Design of experiment to obtain optimal conditions that maximise the yield of biogas (Y1), biomethane content (Y2) and minimise the hydraulic retention time (Y3). Kinetic parameters of the process were estimated. Maximum yield (%) were obtained in API having the range 43.5 - 65.5; 65.5 - 69.5 and 50.1- 66.8 for TSC, FIR and TEMP, respectively. Maximum of 7.2 kg (Y1), 71.54 % (Y2) and 8 days (Y3) were obtained at optimum conditions TEMP (55.2°C), TSC (6.25 %) and FIR (1:2). MG model best fitted the experimental data. Use of pineapple waste as a co-substrate is more productive in biomethanation. Operating variables enhanced biomethanation.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

A hanging sword over bioenergy. Analysis on Brexit policy and regulatory impacts on advanced biofuels industry.

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Statement of the problem: EU´s Art. 50 was invoked and the UK has a two-year negotiating period. Like others, UK´s biofuel industry wonder what lies ahead. Will Brexit usher an era of more independence in policymaking for EU countries? Despite UK´s decision to leave, there is a good chance that EU policies will remain intact. Some have reminded the Norwegian precedent, raising hope for the UK to obtain "associate" status granting access to the single market on condition of implementing relevant EU Law. The study delves into UK´s paradox of parting… to keep on applying EU rules, seeking to answer whether UK´s biofuels policy will have to abide by EU´s RED and biofuels policy anyway or will there be regulatory leeway for bioenergy policymaking. Methodology & theoretical approach: A comparative-analytic study based on UK´s need of access to the single market as theoretical framework examining the EU regulatory framework on bioenergy, focused on the interaction with the UK´s and the analysis of Norway case as to domestic scope for policymaking. Findings: Supranational versus domestic energy policies will be items for Brexit negotiation, but upon the theoretical framework conventional biofuels scenario should not vary much, as opposed to advanced biofuels policy framework already impacted by cuts on EU R+D funds making –in the long run – that EU countries´ freedom to decide their own preferred energy-mix becomes a "sword of Damocles" or impending peril to UK´s bioenergy industry. Conclusions & significance: Along with entry to the market and free-trade, RED, sustainability criteria, targets on green fuels share, ILU, CAP, tax issues are all at stake. Brexit brought uncertainty, but it is for the Law to mitigate it and thus appropriate to look at what offers to secure bioenergy industry´s rights and sustainable delivery to citizens, either in or out the EU.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Pyro-gasification of agri-crop residue for Hydrogen production: A pilot process demonstration

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Statement of the Problem: The demand for hydrogen is likely to increase in future, which is driven by stringent product specification in oil refineries in the near term and hydrogen becoming an energy carrier in the long term. With rising prices of fossil fuels and depleting natural gas reserves, gasification route is believed to gain more ground as an alternative process to conventional hydrogen production technologies. Here, a total steam gasification process has been developed and demonstrated at pilot scale (0.5- 1 kg/h biomass processing capacity).

Methodology: Any ligno-cellulosic biomass is understood as a polymeric structure containing C, H, N, O and few metals in different proportions. Typically, a conventional gasification process yields CO, CO_2 and H2; where a major portion of the carbon in the biomass is lost as CO_2. Here, a novel process was conceptualized on the basis of superheated steam aided enhanced-elemental extraction from biomass at high temperature. The biomass is treated purely by high temperature steam (~300-400oC) at elevated temperature (700- 750oC). The elemental analysis of biomass suggests a nearly equi-molar composition of C and O in biomass. More than 90% convertible portion of the biomass turns majorly into CO and H_2. CO_2 is formed marginally as there was no additional O2 or air supply. CO was then converted into H2 and CO2 by Water-Gas-Shift reaction in a fixed bed reactor.

Findings: The process was established at pilot scale (1 kg biomass/h) to achieve 90% conversion of ash free basis. Parametric optimization for hydrogen production from steam gasification of biomass has been done for operating parameters i.e. steam to biomass ratio, temperature and residence time. Salient feature in the process is control of biomass residence time and gas residence time in the reactor by adjusting rotating drive rpm and vacuum levels respectively.

Conclusion & Significance: This process exemplifies a robust approach for clean production of hydrogen from agri-residues and provides a potential and alternate way to produce hydrogen for petroleum refineries.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Enzymatic degradation of sugarcane bagasse: Biotechnology route to renewable biofuels

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Cellulosic ethanol has gain the attention as a potential option of renewable fuel. One of the most favorable routes for the conversion of cellulosic materials into ethanol is the enzymatic hydrolysis followed by fermentation. Hydrolysis of lingo-cellulosic materials by cellulases and hemi-cellulases are the efficient method for the release of fermentable sugars. Xylanases are valuable enzymes that degrade xylan, the most abundant hemicellulose present in both hardwoods and Pulp. Most industrial enzymes are produced by bacteria, yeasts and fungi that are able to ferment specific substrates. A number of fungi from the genus *Penicillium* are effective decomposers of lingo-cellulosic biomass and efficient producers of xylanases. The present study deals with the evaluation of xylanase production using different agro biomasses. Three extracellular xylanase was observed to be the major protein in the culture filtrate of Penicillium chrysogenum when grown in 1% agriculture biomass (sugarcane bagasse, straw, orange peel). One xylanase of 38kDa completely and another (20kDa) was partially purified after three steps of Purification: Ultrafiltration, molecular exclusion, anion-exchange chromatography. Physical characteristics of purified enzyme represent its optimal pH.5.0 ad 40oC temperature best suited conditions for the fermentation. The enzyme retained 85%activity in the presence of Tannic acid and Gallic acid two main phenolic compounds mainly produced during lignin degradation, making it desirable for application of second generation bioethanol industries. With its low temperature activity the enzyme can also be used in baking industry. The study assesses the route could enhance performance on inexpensive biomass like bagasse and reduce the cost of enzyme production using cellulolytic strains, *Penicillium chrysogenum*.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Exergoeconomic study of gas turbine combined power cycle with biofuel

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Biomass energy has the potential to replace fossil fuels despite its lower heat value. Fog cooling and steam injection, as well as adding steam turbine cycles to gas turbine cycles, can enhance the performance of power generation systems. Here, the results are reported of energy, exergy and exergoeconomic analyses of two proposed biomass (wood) integrated steam injection cycles and combined power cycles. Their performances are assessed for similar sets of conditions. The thermodynamic analyses demonstrate that at lower values of compressor pressure ratio the combined cycle has a higher efficiency but at higher values of pressure ratio the steam injection plant is advantageous. For the same conditions, the steam injection plant exhibits a higher net power output. The exergoeconomic analyses show that electricity and component costs for the combined cycle are higher than for the steam injection plant. The exergy destruction rate and its cost are higher at lower compressor pressure ratios for the steam injection cycle, and at higher pressure ratios for the combined cycle. The exergy loss rate and its cost are higher for the combined cycle at all pressure ratios. Also the steam injection cycle is more cost effective due to its lower relative cost difference.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Synthesis of highly hydrothermally stable catalysts for the conversion of castor oil into bio-aviation fuel

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Fossil fuels are becoming exhausted and new alternative fuels need to be found to meet the increasing energy demand. Biofuels have emerged as one of the most strategically important sustainable fuel sources and an increasing number of developed and developing countries found biofuels as a key to reducing reliance on foreign oil, lowering GHG emissions and meeting rural development goals. Therefore, raw materials such as animal fats, waste greases, edible oil and inedible oil have been studied for preparing aviation fuel through hydrodeoxygenation (HDO) technology [1-5]. In this study, Highly hydrothermally stable HDO catalysts Ni–Mo/MCM-41–TiO_2 have been investigated for overcoming the detrimental effect of water on the catalyst in the process of hydrotreating castor oil with high oxygen content (15 wt%). Characterization by XRD, XPS, FT-IR and activity test results showed that modified MCM-41 (Ti–O–Si) improved the water resistance of the catalyst and prevented loss of the active component as given in Fig. 1. With increasing reaction time, the water that is produced by the HDO reaction can gradually impact on MCM-41, as shown in Fig. 1(c). It can be seen that the conversion begins to decrease at 40 h and the XRD characterization also proved that the crystallization peaks of NiO and Ni have disappeared after 40 h on NiMo/MCM-41, while the NiO and Ni peaks still exist for NiMo/MCM-41–TiO_2 (10 wt%) after 200 h (see Fig. 1(d)). This phenomenon suggests the loss of the active component in the dehydration process over a long time. Therefore, NiMo/MCM-41–TiO_2 was synthesized for enhanced water resistance and weak interaction between metal and carrier.

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J Bioremediat Biodegrad 2017, 8:5(Suppl)
DOI: 10.4172/2155-6199-C1-009

Influence of ultrasound-assisted extraction on volatiles and residues in wood pyrolysis

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Eucalyptus was used as the raw material for treatment with ultrasound-assisted extraction (UAE) to study the ultrasonic effects on volatiles emitted and residues produced during pyrolysis. A swept ultrasonic cleaner with a frequency of 40 kHz and an intensity of 360 W was applied to samples at 60°C for 30 minutes. The characteristics of the ultrasound-treated samples were then compared with those of Soxhlet-extracted and untreated biomass by TG-FTIR and SEM. The results showed both mechanical and chemical effects of ultrasound played a significant role in efficiently altering biomass characteristics. In thermogravimetric analysis, UAE samples showed the highest maximum mass loss rate (-52.1%/min) with the lowest temperature (378.4 °C), while the other two samples presented similar trends to each other with lower maximum mass loss rate. Volatile profiles obtained by TG-FTIR indicated that CO and methanol components were mainly influenced by extraction, while CO_2, CH_4, and formic acid responded more strongly to the effects of ultrasound. After UAE, an increase in CO, CH_4 and decreases in CO_2 and formic acid were produced during pyrolysis. From SEM images, the fracture of pit membranes clearly showed the mechanical effects of ultrasound, which accounted for the significant enhancement of extraction of valuable ingredients.

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