Consumers are interested in the period of optimum ripeness for edibility of melons as they continue to ripen even after harvest. However, melons exhibit various degrees of ripeness in a market; thus, making it difficult for consumers to assess the optimum ripeness for eating. To help solve this problem, researchers at Hiroshima University, Higashi-Hiroshima, Japan investigated the period of optimum edibility of melons (Cucumis melo Linn.) using a nondestructive method. The method is based on the fact that melons lose firmness in postharvest ripening. The predetermined period of optimum ripeness helps consumers to choose the timing for optimum edibility. They measured time-course changes in the elasticity index (EI) and sensory test index of melons at the postharvest stage. Using the correlation between the EI and the sensory test index, they determined the period of optimum ripeness for edibility of melons, which serves as an excellent indicator for optimum quality for eating [Taniwaki Mitsuru, Takahashi Masahiro and Sakurai Naoki, Determination of optimum ripeness for edibility of postharvest melons using nondestructive vibration, Food Res Int, 2009, 42 (1), 137-141].

Ethanol from Guayule

Ethanol from guayule (Parthenium argentatum A. Gray) has been obtained after pretreating it with a process known as “organosolv”. This pretreatment makes guayule bagasse quite amenable to being fermented into ethanol. Guayule may be one of the newer additions to the long list of hardwoods suitable for organosolv pretreatment. As with all hardwoods and other green plants, guayule cell walls are made up of cellulose, hemicellulose and lignin. The value of using the organosolv process is that we get not only cellulose that’s readily fermented into ethanol, but also can recover the hemicellulose and the lignin. The hemicellulose can be fermented into other valuable chemicals and the lignin—which is of very high quality—can be burned to generate electricity or made into value-added products.

In other work, a chemical engineer at ARS’s Eastern Regional Research Center in Wyndmoor, Pennsylvania, is looking into converting guayule bagasse into bio-oil using pyrolysis—heating the bagasse in the absence of air. The energy content of the guayule bio-oil is more than 13,000 Btu per pound [Marcia Wood, Guayule: Go Native With This Promising Biofuel—and Biomedical—Crop, Agric Res Mag, 2009, 57(2), 18-19].
Evaluation of hazelnut kernel oil of Turkish origin as alternative fuel in diesel engines

The researchers at Automotive Division, Department of Mechanical Education, Marmara University, Istanbul, Turkey evaluated hazelnut kernel oil of Turkish origin as alternative fuel in a diesel engine. Potential hazelnut production throughout the world and the status of Turkey were examined. Hazelnut (Corylus avellana Linn.) kernel oil was transesterified with methanol using potassium hydroxide as catalyst to obtain hazelnut kernel oil methyl ester (HOME) and a comprehensive experimental investigation was carried out to examine performance and emissions of a direct injection diesel engine running with HOME and its blends with diesel fuel. Experimental parameters included the percentage of HOME in the blend, engine load, injection timing, compression ratio and injector. The cost analysis of HOME production comparing to the price of conventional diesel fuel was performed for last decade was performed. Results showed that HOME and its blends with diesel fuel are generally comparable to diesel fuel and small modifications such as increasing injection timing, compression ratio and injector opening pressure provide significant improvement in performance and emissions. It is also expected that the price of HOME will be lower than the price of conventional diesel fuel in the near future [Gumus M, Evaluation of hazelnut kernel oil of Turkish origin as alternative fuel in diesel engines, Renewable Energy, 2008, 33(11), 2448-2457].

Studies on cottonseed oil biodiesel prepared in non-catalytic SCF conditions

With recent increases in petroleum prices, there is renewed interest in vegetable oil and their derivatives as alternative fuels for diesel engines. As an alternative fuel vegetable oil is one of the renewable fuels. The vegetable oils are all extremely viscous with viscosities ranging from 10 to 20 times greater than petroleum diesel fuel. The purpose of the transesterification process is to lower the viscosity of the oil. Methyl and ethyl esters as biodiesel were prepared from cottonseed oil by researchers at Sila Science, and Energy, Renewable Energy Resources, Trabzon, Turkey through transesterification using non-catalytic supercritical fluids. The transesterification of linseed oil in SCF such as methanol and ethanol has proved to be the most promising process. The biodiesels were characterized for their physical and main fuel properties including viscosity, density, flash point and higher heating value (HHV). The viscosities of biodiesels (3.6-4.0 mm²/s at 311 K) were much less than those of pure oils (33-36 mm²/s at 311 K), and their HHVs of approximately 40.5 MJ/kg were (10% less than those of petroleum fuels ~45 MJ/kg). The flash point values (435-445 K) of methyl and ethyl esters are highly lower than that of cottonseed oil (507-512 K). The most important variables affecting the ester yield during the transesterification reaction are molar ratio of alcohol to vegetable oil and reaction temperature [Demirbas Ayhan, Studies on cottonseed oil biodiesel prepared in non-catalytic SCF conditions, Bioresour Technol, 2008, 99 (5), 1125-1130].

Monitoring biodiesel production (transesterification) using in situ viscometer

Biodiesel, an alternative diesel fuel made from renewable sources, is produced by the transesterification of oil or fat with alcohol. In order to monitor the progress of this reaction, in situ viscosity measurements were taken using an acoustic wave solid state viscometer by scientists at Canada. This novel concept is reported from the proof-of-concept stage to a pilot plant installation. The viscometer was able to monitor the reaction until the end-point was reached, and could therefore be adapted in the future for process control in a batch transesterification reactor for biodiesel production [Ellis Naoko, Guan Feng, Chen Tim and Poon Conrad, Monitoring biodiesel production (transesterification) using in situ viscometer, Chem Eng J, 2008, 138 (1-3), 200-206].
Optimization of the production of biodiesel from soybean oil by ultrasound assisted methanolysis

Researchers at Brazil evaluates and optimizes the production of biodiesel from soybean oil and methanol using sodium hydroxide as catalyst. The study and optimization was carried out at low catalyst concentration (0.2 to 0.6 w/w). The reaction was carried out with application of low-frequency high-intensity ultrasound under atmospheric pressure and ambient temperature in a batch reactor. Response surface methodology (RSM) was used to evaluate the influence of methanol to oil ratio and catalyst concentration on soybean oil conversion into biodiesel. Analysis of the operating conditions by RSM showed that the most important operating condition affecting the reaction was the methanol to oil ratio, while catalyst amount showed little significance in the transesterification reaction. Total consumption of oil was obtained when alcohol to oil ratio of 9:1 and catalyst concentration of 0.2 w/w were applied [Santos Francisco FP, Rodrigues Sueli and Fernandes Fabiano AN, Optimization of the production of biodiesel from soybean oil by ultrasound assisted methanolysis, Fuel Process Technol, 2009, 90 (2), 312-316].

Synthesis of biodiesel from soybean oil by coupling catalysis with subcritical methanol

Biodiesel synthesis from soybean oil and methanol was investigated under supercritical and subcritical conditions by scientists of PR China. Under the supercritical conditions, the maximum methyl ester yield exceeded 98% when the molar ratio of methanol to oil was 42:1 and the reaction temperature ranged from 260 to 350°C. In order to decrease the operational temperature and pressures and to increase the conversion efficiency of methanol, first co-solvent was added to the reaction mixture to improve the reaction process, and then a novel idea was presented in which catalysis and supercritical effect were coupled together. Thus, with 2.5 wt% hexane, temperature of 300°C, methanol to oil ratio of 42, a 85.5% conversion is observed in 30 min, while a 62.2% conversion is observed without hexane in the same condition; with less carbon dioxide, temperature of 300°C, methanol to oil ratio of 42, a 91.6% conversion is observed in 20 min, while a 51.4% conversion is observed without carbon dioxide in the same condition. With only a little amount of potassium hydroxide as the catalyst (KOH/oil=0.1wt%), a 98% yield of methyl esters was obtained in 10 min at a reaction temperature of 160°C and the molar ratio (methanol/oil) of 24:1. In contrast, above 1 wt% of catalyst is required in the conventional alkali-catalyzed method; while only 6% yield of methyl ester was obtained at 260°C (corresponding to subcritical conditions) without the catalyst.

The result demonstrated that by coupling the catalysis and subcritical operation, the amount of catalyst could be largely reduced and the methanol utilization could be significantly enhanced. Thus, this method offers some advantages over both the conventional alkali-catalyst method and the expensive supercritical method [Yin Jian-Zhong, Xiao Min, Wang Ai-Qin and Xiu Zhi-Long, Synthesis of biodiesel from soybean oil by coupling catalysis with subcritical methanol, Energy Conver Manage, 2008, 49 (12), 3512-3516].

Microwave assisted transesterification of rapeseed oil

Rapeseed is one of the important vegetable oil sources for biodiesel production due to its high oil content (around 40%). In a study done by scientists at Faculty of Engineering and Architecture, Anadolu University, Eskisehir, Turkey, rapeseed oil was converted to biodiesel by transesterification using microwave heating. Experiments were carried out in the presence of two different alkali catalysts which are sodium hydroxide and potassium hydroxide. Effects of various reaction parameters such as catalyst ratio, reaction temperature and time were investigated. Mono-, di- and
triglyceride content of biodiesel were determined by gas chromatography analysis. Yield and purity (ester content) percentages of biodiesel were specified in weight, which are 88.3-93.7% and 87.1-99.4%, respectively. The results indicated that microwave heating has effectively increased the biodiesel yield and decreased the reaction time [Azcan Nezihe and Danisman Aysegul, Microwave assisted transesterification of rapeseed oil, Fuel, 2008, 87 (10-11), 1781-1788].

Now-a-days, the biomass is an accepted form of renewable energy and is seen as a means of help to reduce global warming by displacing the use of fossil fuels. In this direction, short rotation forestry, which is based on making use of very fast growth rate, may play an important role by providing high production of biomass. *Populus deltoides* Marsh. (Caroline Poplar, Eastern Cottonwood), the most promising short rotation forest tree species under agroforestry programme throughout the northern and eastern India, produces huge biomass per unit area per unit time under irrigated conditions. Therefore, energy content of stems, branches, roots and litter was determined using an oxygen bomb calorimeter, and these data were used to estimate energy storage, net energy fixation and energy transfer within poplar, *P. deltoides* (Clone G-3) plantations of two ages by scientists at the Research Farm of Rajendra Agricultural University, Pusa, Bihar, India. Energy fixation, storage and energy released and exit from the 7-year-old plantation were 1.69, 2.11 and 1.53 times that of the 5-year-old plantation. The net energy fixation was 243.08GJ/ha/year in 5-year-old and 410.57GJ/ha/year in 7-year-old plantation. The energy conservation efficiency in the 7-year-old plantation was higher (1.51%) than that of the 5-year-old plantation (0.89%). The 5-year-old plantation showed lower energy accumulation ratio (2.02) resulting from less energy accumulation in components of poplar tree and greater annual turnover in terms of litter fall. The energy stored in the above-ground tree components from 2131.87ha (5-year-old) and 1002.88ha (7-year-old) or in the above-ground net annual production from 3924.15ha (5-year-old) and 2386.37ha (7-year-old) of poplar plantations is sufficient to operate a 5MW generating station for 1 year. Above-ground biomass and net production from 1ha of 5-year-old and 7-year-old poplar plantations is sufficient to meet the energy need of an average household in eastern India for 8.5 and 18.0 years and 4.6 and 7.6 years, respectively [Das DK and O.P. Chaturvedi OP, Energy dynamics and bioenergy production of *Populus deltoides* G-3 Marsh plantation in eastern India, Biomass Bioenergy, 2009, 33 (1), 144-148].

Conventional and *in situ* transesterification of Sunflower seed oil for the production of biodiesel

The alkaline transesterification of sunflower seed oil with methanol and ethanol, for the production of biodiesel fuel was studied by scientists at Greece. Both conventional and *in situ* transesterification were investigated using low frequency ultrasonication (24 kHz) and mechanical stirring (600rpm). Use of ultrasonication in conventional transesterification with methanol gave high yields of methyl esters (95%) after a short reaction time (20 min) similar to those
Utilization of unattended *Putranjiva roxburghii* Wall. non-edible oil as fuel in diesel engine

The search for alternative sources of energy has been driven by the increased cost and depletion of supply of fossil fuels. The scientists at Department of Chemistry and Department of Mechanical Engineering, Indian Institute of Technology, Kharagpur, West Bengal, explored the possibilities of using wild plant seeds *Putranjiva roxburghii* Wall., a non-edible source of vegetable oil to be used in diesel engine for its fuel properties which are comparable with diesel. Blends (10, 20, 30, and 40\% v/v) of pure *Putranjiva* oil and diesel were used in Ricardo Variable Compression Diesel Engine to study the performance and emission characteristics at various brake power. *Putranjiva* oil blends yield better performance at 45CA bTDC injection timing in comparison to 40CA bTDC timing for diesel. Maximum 30\% blend of *Putranjiva* oil with diesel can be used as an alternative fuel in diesel engine as it differs very little from diesel in performance and is better than diesel with regard to emissions [Haldar SK, Ghosh BB and Nag A, Utilization of unattended *Putranjiva roxburghii* non-edible oil as fuel in diesel engine, Renewable Energy, 2008, 34 (1), 343-347].

Direct preparation of biodiesel from rapeseed oil leached by two-phase solvent extraction

A new method which coupled the two-phase solvent extraction (TSE) with the synthesis of biodiesel was studied by scientists at China. Investigations were carried out on transesterification of methanol with oil-hexane solution coming from TSE process in the presence of sodium hydroxide as the catalyst. Biodiesel (fatty acid methyl esters) were the products of transesterification. The influential factors of transesterification, such as reaction time, catalyst concentration, mole ratio of methanol to oil and reaction temperature were optimized. The results showed that the optimal reaction parameters were sodium hydroxide concentration 1.1\% by weight of rapeseed oil, mole ratio of methanol to oil 9:1, reaction time 120 min, and reaction temperature 55-60°C. Under these conditions, the TG conversion would rise up to 98.2\%. Based on the new method, biodiesel production process could be simplified and the biodiesel cost could be reduced [Shi Haixian and Bao Zonghong, Direct preparation of biodiesel from rapeseed oil leached by two-phase solvent extraction, Bioresour Technol, 2008, 99 (18), 9025-9028].
Pumpkin (Cucurbita pepo Linn.) seed oil as an alternative feedstock for the production of biodiesel in Greece

In recent years, the acceptance of fatty acid methyl esters (biodiesel) as a substitute to petroleum diesel has rapidly grown in Greece. The raw materials for biodiesel production in this country mainly include traditional seed oils (cotton seed oil, sunflower oil, soybean oil and rapeseed oil) and used frying oils. In the search for new low-cost alternative feedstocks for biodiesel production, a study done by researchers at National Technical University of Athens, Athens, Greece emphasizes the evaluation of pumpkin (Cucurbita pepo Linn.) seed oil. The experimental results showed that the oil content of pumpkin seeds was remarkably high (45%). The fatty acid profile of the oil showed that it is composed primarily of linoleic, oleic, palmitic and stearic acids. The oil was chemically converted via an alkaline transesterification reaction with methanol to methylesters, with a yield nearly 97.5 wt%. All of the measured properties of the produced biodiesel met the current quality requirements according to EN 14214. Although the study showed that pumpkin oil could be a promising feedstock for biodiesel production within the EU, it is rather difficult for this production to be achieved on a large scale [Schinas P, Karavalakis G, Davaris C, Anastopoulos G, Karonis D, Zannikos F, Stournas S and Lois E, Pumpkin (Cucurbita pepo L.) seed oil as an alternative feedstock for the production of biodiesel in Greece, Biomass Bioenergy, 2009, 33 (1), 44-49].

Gum/Rubber

Blends of PVC and epoxidized liquid natural rubber: Studies on impact modification

Liquid natural rubber of different molecular masses L-LNR and H-LNR were subjected to varying degree of epoxidation (L-ELNR-10, L-ELNR-20, L-ELNR-30, L-ELNR-40, L-ELNR-50, H-LNR-20 and H-LNR-50) and the products were incorporated into PVC at various compositions by the solution blending method. The scientists at Kottayam, Kerala subjected these blend systems to tensile testing, tensile impact measurements and SEM studies. It was observed that blends with L-ELNR-20 showed highest impact strength modification, followed by L-ELNR-10 and L-ELNR-30. High impact properties shown by these blends are attributed to the optimum level of compatibility existing between the blend components. Tensile impact fracture studies revealed that the failure pattern for this blend system is intermediate between the brittle fracture of rigid PVC and ductile fracture of PVC/L-ELNR-50 samples. Blends up to 30 mol% of epoxidation showed partially compatible heterogeneous nature exhibiting domain morphology. Blends of liquid rubber with higher degree of epoxidation showed deterioration in tensile strength, modulus, yield strength and tensile impact strength due to plasticization of PVC caused by the higher polar interaction between PVC chains and the oxirane rings. Effect of ELNR molecular weight was studied and found that the impact modification is higher for the L-ELNR blends compared to the H-ELNR blends [Nair Radhakrishnan MN, Biju PK, Thomas George V and Nair Gopinathan MR, Blends of PVC and epoxidized liquid natural rubber: Studies on impact modification, J Appl Polym Sci, 2009, 111(1), 48-56].