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Co-Production of High-Value Recombinant Biobased Matter in Bioenergy Crops for Expediting the Cellulosic Biofuels Agenda

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At present, food crops such as sugarcane sugar and corn seed starch are used to commercially produce ethanol. The goal of the biofuels industry is to produce biofuels from crop waste matter, that are non-food residues whose cellulosic matter are converted into hydrocarbon liquid fuels (mostly ethanol) after transportation and storage, pretreatment and enzymatic hydrolysis of cellulose via the use of microbial cellulases for production of fermentable sugars, followed by fermentation of sugars. Despite recent improvements in pretreatment technology and modifications of genomes of bioenergy crops via anti-sense methods to lower their lignin contents for an enhanced hydrolysis [1], and improvements made in genomes of cellulase-producing microbes and even considering the synthetic biology [2], the costs associated with cellulosic biofuel production remains to be the inhibitory factor to the non-subsidized commercialization and sustainable economy of cellulosic biofuel industry.

The author proposes the use of the petroleum industry model to expedite biofuels market agenda. Petroleum industry makes its profit not only from petro-fuels (gasoline or petrol, petrodiesel, ethane, kerosene, liquefied petroleum gas and natural gas), but also from over 6,000 petroleum-derivative co-products such as alkenes (olefins), lubricants, wax, sulfuric acid, bulk tar, asphalt, the solid fuel called petroleum coke, paraffin wax, and aromatic petrochemicals that are used for production of hydrocarbon fuels and hydrocarbon chemicals. Using the petro-industry model is not only co-producing of plant-based matters such as for example lactic acid and ascorbic acid, but also pioneering systems on changing the genetic structure of bioenergy crops for production of higher value biobased co-products in crop waste matter. For example, all three microbial cellulases have been produced in maize stover, not in plant seeds, flowers or roots. Such recombinant co-products were accumulated in maize plant sub-cellular compartments such as apoplast (cell wall areas), chloroplast, endoplasmic reticulum and mitochondria [3]. Sub-cellular compartment accumulation of cellulases has the advantage of keeping the heterologous enzyme away from cytoplasm to avid harm to transgenic plant growth and development, and to keep these heterologous cellulases in compartments that can accumulate during the stages of plant growth and development under ideal pH conditions [4,5]. A report indicates that it is possible to co-produce recombinant heterologous cellulases in the cellulosic biomass of maize at over 1 kg/ton of its Stover waste [3].

A few examples of other high-value matter that have been co-produced in recombinant plants either via nuclear of chloroplast transgenesis include, but not limited to silk and silk-like structures [6], Vaccines [7] Therapeutics [8,9], biopharmaceuticals such as interferon [10] and interleukin (Matakas, 2011), A biodegradable plastics [11], and fatty acid commodities [12-15]. Also, advances have also been made to match the glycosylation of plant-produced heterologous proteins to match those of humans when used for human treatments of diseases [16,17].

For example, the global market for cellulases will be enormous. Also, the global market for biotech drugs of 2007 was worth $86.8 billion and is predicted to double by 2013. Co-production of cellulases and high value biopharmaceuticals in bioenergy crops will not only expedite cellulosic biofiels agenda and be lucrative to biotech drugs industry, but will also help to make these drugs available to financially less fortunates at the global level.

After produced, the extraction of the bioenergy crop-produced recombinant high-value co-products fits well in the biofuel industry processes, and would add value to the bioenergy crops allowing the farmers to sell their crop residues at a higher price. Furthermore, the co-production of high-value recombinant commodities in crop waste can boost the cellulosic biofuels industry revenues through the sales of those co-products.

The co-production and use of high-value co-products is a necessary step towards the sustained economy of cellulosic biofuels. The co-production of high-value recombinant molecules in cellulosic wastes of bioenergy crops can revolutionize the economic sustainability and unsubsidized commercialization of cellulosic biofuels including ethanol and butanol.

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