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VALUE PROPOSITION:

Conversion of galactose containing hemicellulose substrate to bioethanol.

KEY FEATURES AND BENEFITS:

Bioconversion of plant derived hemicellulose to bioethanol by a fungal derived NDPSE enzyme.

MARKET

Biofuel industry, enzyme industry.

STATUS

European Patent application filed 30/11/16 (Application Number EP16201554.9)

OPPORTUNITY

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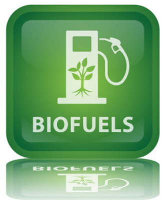
Producing Bioethanol from Plants using a Fungal Derived Enzyme



Globally there is a need to obtain a secure, renewable, environmentally-benign and cheap supply of energy to reduce dependency on fossil fuels. Lignocellulose or plant biomass is commonly used as a low-cost raw material in the production of biofuels such as ethanol. Although commercial-scale lignocellulosic ethanol production has become a reality in recent times, the complex disentangling process associated with lignocelullosic bioconversion to bioethanol lacks the efficiency and commercial profitability to make it cost-competitive when compared to fossil fuels.

Conventional methods to convert lignocellulose involve thermo-chemical hydrolysis of hemicellulose followed by enzymatic conversion of cellulose and yeast based fermentation of the resulting sugars. Alternatively a low cost, eco-friendly method referred to as "consolidated bioprocessing" (CBP) can be used whereby microbes can enzymatically hydrolyse cellulose and hemicellulose to sugars and then convert the released hexose and pentose sugars.

The research team within UCD and Teagasc have identified a nucleotide diphopho sugar-epimerase (NDPSE) enzyme within *Fusarium oxysporum* which enhances the production of bioethanol from lignocellulose during fungal-mediated CBP, thus providing a cost effective means to produce bioethanol.

Technology Description

The main components of lignocellulose are lignin, cellulose and hemicellulose, the latter accounting for 20-40% of plant biomass and representing the biggest polysaccharide fraction waste in most cellulosic bioethanol plants around the world.
Whilst a number of microorganisms have been identified for use as an effective CBP agent , they are inept at effectively co-fermenting the variety of sugars found in plant biomass, particularly the hemicellulosic sugars.

Fusarium oxysporum is a plant pathogen which has the ability to infiltrate the plant's lignin barrier and degrade complex carbohydrates to value-added chemicals which has made it a leading microbial agent in the emerging CBP industry. Nevertheless drawbacks such as low level ethanol production and accumulation of acetic acid by-product have prevented it's wide spread exploitation.

Researchers within UCD and Teagasc have discovered an enzyme (NDPSE) derived from a specific Fusarium strain whose expression level is highly correlated to bioethanol productivity. Overexpression of the gene encoding NDPSE within *F. oxysporum* increases bioethanol yield from a straw/bran mix via CBP by 18% compared with the wild type fungal strain. Overexpression of the NDPSE enzyme improved the maximum theoretical yield of bioethanol from a key component of hemicellulose, galactose from 38% to 89% . This yield is higher than other maximum theoretical yields that have been reported for various mutants of the most widely used microorganisms for industrial bioethanol production.

As most industrial microbial strains are already adept at fermenting the cellulosic fraction of plant substrates, the identification of NDPSE involved in the microbial conversion of the under-utilised hemicellulosic fraction will be the defining factor in increasing bioethanol yield and making commercial scale CBP a reality.

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About Us

The mission of UCD Research & Innovation is to enhance the value and quality of UCD's research and innovation activities in order to achieve the maximum impact for the University, its partners, and for social and economic life in Ireland in the wider world.

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