Enzymes from garden compost could favour bioethanol production

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Today, bioethanol is primarily made from glucose. If xylose -- which is found in straw, willow and other fast-growing plant species -- could also be used efficiently, then ethanol production could increase significantly. A researcher in applied microbiology is well on the way to making this a reality.

The researcher in question is Nadia Skorupa Parachin and the secret of her technique is enzymes that she extracted from garden soil. If ethanol can be successfully made from xylose then ethanol production could increase by over 20 per cent – to the benefit of cheaper environmentally friendly fuel.

Ethanol is manufactured by fermenting sugars from plant material. At present, xylose is not used, despite being the second most common type of sugar found in nature. Succeeding with xylose requires good, quick enzymes that can get the yeast to also ferment the less appetising xylose.

Nadia Skorupa Parachin has tested her enzymes and the first results show that her enzymes bind xylose more efficiently than those that have been tested previously.

"In order for carbohydrates in forestry, plant and waste products to be used for ethanol production, enzymes are required in the yeast that 'eat up' the sugar and convert it into ethanol. If we just want to make use of the glucose then normal baker's yeast is sufficient. However, if the xylose is also to be converted to ethanol, then genetic modifications have to be made to the yeast", explains Ms Skorupa Parachin, who has recently patented her newly discovered enzymes.

Nadia Skorupa Parachin began by extracting DNA from a soil sample, then she cut it into small pieces. She was then able to build up a DNA library.

After that she identified the most appropriate genes by coupling enzyme activity to growth on xylose.

Ms Skorupa Parachin's decision to use soil is quite simply due to the fact that soil is considered the most diverse habitat on earth.

"One gram of soil contains ten billion bacteria! Enzymes and other proteins are found in almost unlimited numbers and can have all sorts of unexplored properties. I collected the soil sample from a garden in Höör, but any soil can be used", she points out.

The reason why no researcher has previously identified new enzymes for xylose in this way is because it is not all that easy. Marie Gorwa-Grauslund, who is Nadia Skorupa Parachin's supervisor, was the first person to realise that this genetic technique could work in this specific context. The technique, known as metagenomics, was originally used in environmental studies.

"The most interesting part is really the method itself. We have reasoned along entirely new lines. In fact, it has taken several months to develop the method for use in this area", explains Professor Gorwa-Grauslund.

The Lund researchers will now also take the chance to apply their modified metagenomics technique in other areas, for example, to isolate enzymes that allow microorganisms to cope with difficult industrial conditions, such as high temperatures and high acid levels.

"Robust microorganisms are very important if biological production is to be economically viable", says Marie Gorwa-Grauslund.

Ms Skorupa Parachin has now returned to her home country, Brazil. However, two or three other young researchers will continue to work on the technique. During the spring they will have chance to evaluate the new enzymes better.

"There are still a number of pieces of the jigsaw that must be put in place if ethanol production from xylose is to become financially viable. The process must be speeded up. But we hope that in the long term our method can help to make bioethanol production more efficient", says Marie Gorwa-Grauslund.

Provided by Lund University

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