

Taking the next step forward in biofuel technology

New research is looking at the potential to turn bagasse into biofuel, and then take a step further by transforming it into products such as jet fuel. By Brad Pfeffer

The production of ethanol from sugarcane juice and molasses is well understood.

But it is the potential to create advanced biofuels – such as aviation fuel – from bagasse that could be the next step forward for the Australian cane industry.

This is the focus of a major research project that is looking at adding value to the sugar industry by providing the research foundation to create biorefineries alongside the existing sugar industry.

The project is funded by the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit program, along with SRA and the Queensland University of Technology (QUT).

One aspect of the project is looking at the conversion of bagasse into products called microbial oils, which can then be used as a feedstock to create advanced biofuels.

Dr Jan Zhang and his team have studied different ways of converting bagasse into microbial oils and ensuring maximum yield.

“These oils created from bagasse have very similar properties to algae oil and vegetable oil, and can be used to create biodiesel,” Dr Zhang said. “However, we know that we can generate greater value by targeting the production of advanced fuels.”

Why aviation fuel?

Fuel for aviation, whether it be consumed by major commercial airlines or other users such as defence departments, has much higher quality requirements than traditional fuel.

It needs to be able to withstand the risks of icing and explosion and comply with other safety and regulatory requirements.

This means it is a higher value product than traditional fuel.

In addition, there is a growing appetite for the production of sustainable aviation biofuels. Australian airlines have previously signalled their intent to increasingly use biofuels in their fleets.

Defence forces have also expressed their desire to increase their consumption of biofuel. The US Navy has made a commitment to source 50 percent of its fuel from renewable sources by 2020.

Bagasse



What is needed

End-users are looking for biofuels to be drop-in products to replace fossil fuels, so they can avoid any changes or redesign to aircraft and systems.

They also need these fuels continue to meet the high safety standards already in place, while looking for a solution that reduces carbon emissions.

The cane industry

Biofuel – and high value biofuel – can potentially be produced from a wide range of sources and feedstocks. But this research is helping the Australian sugarcane industry into a position to assess the viability of this fuel production, prove the concept, and then be ready to capitalise on future opportunities.



Fermentation

Micro bio oil

**Hydrothermal
liquefaction**

**High grade
biofuel**

“Currently we can achieve more than 20 grams (gm) per litre of microbial oils from fermentation of molasses. When we started the project in 2016, the concentration was less than 5 gm per litre, and we are still working on improving the concentration further, and replacing molasses with lower-cost substrate—bagasse,” Dr Zhang said.

The second process, using yeast, does not present the same control problems as the fungi, meaning it may produce more biomass. However, the oil content may be lower. One current strain of yeast accumulated up to 45 percent of its biomass as oil, based on preliminary screenings.

The research

The first part of the process is converting molasses and bagasse into microbial oils, with the research teams using micro-organisms for this process. They have worked on two different approaches: one using a type of fungi and another using yeast.

To be successful, a process would need to deliver a high oil content (50 percent to 70 percent), as well as a high biomass. This means ensuring a high yield of oil from the bagasse.

Dr Zhang said that there were challenges with both, as well as opportunities. Using the fungi creates a risk of quality control because it can grow in various morphological forms, as well as posing cultivation problems that mean not enough biomass is created.

However, he said that they had developed a morphological control method and used one strain of the fungi that could accumulate up to 70 percent of its dry biomass as oil, which is very high.

The next step

A process called hydrothermal liquefaction (HTL) is used to convert the oleaginous microbial biomass into bio-oils, from which advanced fuel is produced through catalytic cracking processes. QUT researchers are working on the HTL process and will collaborate with Southern Oil Refining to test and demonstrate the oil-upgrading process for advanced biofuels.

The Biorefineries for Profit project is funded by SRA and QUT and the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit program. It is also supported by funding from the Queensland Department of Agriculture and Fisheries.



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