

A Sweet Idea Converting Sweet Sorghum into Ethanol

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Between dependence on foreign oil and the need to become more environmentally conscious, the United States is looking at domestic agriculture products for energy alternatives.

The production of ethanol as an additive to petroleum-based fuel is a popular solution, and sweet sorghum is a crop that is currently under research as a source of ethanol at the Food & Agricultural Products Center located on the Oklahoma State University campus in Stillwater, Okla.

“Sweet sorghum has the potential to be used as a renewable energy crop and has become a viable candidate for ethanol production,” said Dr. Danielle Bellmer, FAPC food processing engineer.

Ethanol is an alcohol-based alternative fuel produced by fermenting and distilling simple sugars, mostly derived from starch crops, such as corn, according to the U.S. Department of Energy.

Unfortunately, an issue with using starch crops is the requirement to use heat processing to convert the starch into simple sugars. Sweet sorghum, however, is exempt from complex processing because the simple sugars are directly “juiced” from the stalks, thus eliminating the starch conversion step.

The idea of using sweet sorghum for commercial ethanol production is not new; in fact Brazil is cultivating a similar crop, sugar cane, for the same purpose, said Bellmer.

The benefits of using sweet sorghum are numerous. Advantageous properties of this crop are that it is a low input, high carbohydrate producer and can be cultivated in nearly all temperate climates.

Past Concerns

The reason sweet sorghum is not as popular as corn as a source of ethanol is due to the high costs associated with constructing and operating a central processing plant.

While starch can be stored for long periods of time, the simple sugars directly derived from sweet sorghum have to be fermented immediately.

The harvest season for sweet sorghum is only a few months, Bellmer said.

“Since the sorghum juice cannot be easily stored, the processing plant would only be in production for a few months out of the year, making it economically unfeasible,” Bellmer said.

Lee McClune, president of Sorganol Production Co. Inc. in Knoxville, Iowa, initially approached the FAPC for assistance with studying a solution to this problem.

Bellmer, the principal investigator of the project, is investigating the process of in-field ethanol production in which sweet sorghum juice will be collected, fermented and distilled in the field. Her goal is to determine the validity and efficacy of this hypothetical solution.

Harvesting Sweet Sorghum

McClune built and tested a piece of equipment to harvest and press sweet sorghum. It uses a standard forage chopper/header and feed rollers to both harvest and “juice” in a single pass through the field.

With this harvester a potential 4,000 to 6,000 gallons of juice can be harvested per acre, McClune said.

Fermentation

Immediately after harvesting, the fermentation process must begin.

The FAPC is researching the hypothesis that fermentation can take place in large storage containers in the environment without temperature control.

Most yeast used for fermentation operates within a finite optimum temperature range, thus posing a problem for the large temperature range of the open environment, Bellmer said.

“Fortunately, many new yeast strains have recently been developed with high temperature tolerance,” Bellmer said.

Initial experiments investigated the use of temperature-tolerant yeast strains with results indicating that fermentation is possible and that little or no pretreatment of the “juice” is necessary, Bellmer said. More research is being performed for validation on fermentation efficiency.

Distillation

After fermenting, concentration of the ethanol through distillation is the next step. Fasttech, a company located in Ferris, Okla., has developed a small-scale distillation unit. David McDowell, owner of the company, started designing the unit nearly seven years ago.

Currently, the distillation unit uses diluted blackstrap molasses, combined with yeast and enzymes, to produce 21 percent ethanol, which is then distilled to about 99 percent ethanol. This same distillation unit can be used for the ethanol produced from sorghum.

Fasttech is presently taking the necessary steps to make the distillation unit mobile.

Both Bellmer and McDowell agree that a cooperative group of farmers could potentially own one distillation unit.

The Future of Sorganol

By obtaining university data through research by the FAPC, McClune hopes the entire process of converting sweet sorghum into ethanol will become more marketable.

“[Bellmer] has been very helpful, very encouraging, and I certainly appreciate all the efforts and everything she’s done,” McClune said.

The FAPC is dedicated to helping Oklahoma agriculturalists develop value-added enterprises in order to keep the products, jobs and dollars in Oklahoma.

Through research and combining the efforts of agricultural entrepreneurs, like McClune and McDowell, it is hoped a system will be developed that can allow farmers to produce their own alternative fuel, Bellmer said.

“Rural agricultural producers will then have the ability to fuel their own machinery, as well as a means of generating additional income,” Bellmer said.

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