Optimizing the large-scale production of ethanol from culled watermelon

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Research

4 billion pounds of watermelon were produced in the U.S. in 2007 and 800 million pounds were abandoned as culled crop. Given the increasing demands for fuel ethanol in the U.S. as a result of several recent government mandates, the culled watermelon has significant potential for use as a sugar source to produce ethanol. We investigated the feasibility of producing ethanol from culled watermelon at a small scale where numerous parameters could be easily investigated and found that 1,000 pounds of watermelon can produce 4.74 gallons of ethanol when the sugar extraction process is optimized. Thus, the 800 million pounds of culled watermelon crop from 2007 could have been used to produce about 3.8 million gallons of ethanol. This may represent a significant opportunity for the watermelon industry.

All crops must be processed and liquefied before they can be fermented to ethanol, and each crop has its own peculiarities that must be dealt with during processing. Unlike berries and other fruits, watermelon has a significant rind that poses problems. The rind of watermelon must be solubilized during processing in order to prevent it from interfering with the fermentation of the released sugars. Because watermelon rind is composed of cellulose and hemicellulose which are intricate polymers of sugars, the rind represents a significant additional source of sugar. We investigated various protocols that can be used to ferment watermelon-derived sugars into ethanol. Surprisingly, the use of enzymes that can liberate sugars from cellulose and hemicellulose increased the sugar yields from watermelon by 49%.

We plan to continue this research with emphasis on developing a process to produce ethanol from watermelon that can be implemented on a large-scale. Numerous parameters must be investigated. In any crop-ethanol fermentation process the ability to produce value-added products must be considered since this greatly influences the overall economics. Lycopene and citrulline are valuable products that can be extracted from the meat and rind of the watermelon, respectively. Any large-scale process that is developed must allow the flexibility to extract these valuable chemicals. There is also the potential of producing a dried distillers' grain (DDG) coproduct after the fermentation process is completed and the ethanol has been recovered. Two main strategies will be considered. The first involves the processing and fermentation of the entire watermelon while the second involves the extraction and fermentation of only the watermelon juice via crushing or pressing.

Timeline

Research development	05/01 – 06/30	07/01 – 08/31	09/01 – 10/31
Evaluating processing protocols	+++		
Whole watermelon process		+++	+++
Watermelon juice process		+++	+++
DDG preparation and analysis			+++

A final report detailing the optimized protocols for both strategies will be delivered to the National Watermelon Association when the research is completed.

Budget

Elliot Altman and Mark A. Eiteman will oversee all aspects of this research. Fringe benefits for the technician and institutional indirect costs are calculated as per University of Georgia guidelines. The supplies are required to ferment and analyze ethanol from watermelon.

Salaries

Technician	$3,395
Fringe Benefits (38%)	$1,290
Supplies	$750
(Growth media, chemicals, plastic disposables, analytical reagents, and HPLC supplies)	
Direct Total	$5,435
Indirect Costs (38%)	$2,065
TOTAL	**$7,500**