MAFES

Researchers Make "Elusieve" Dreams Happen

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Photos by Jim Lytle

Bioenergy scientist Radhakrishnan Srinivasan conducts research to ensure that all the byproducts from the manufacture of ethanol can be put to use.

What comes first from the processing of corn—the ethanol in the car, the egg in the refrigerator or the enhancements in plastic lumber?

Mississippi Agricultural and Forestry Experiment Station scientists are working with a manufacturing process that can generate materials for all three products at the same time. Commanding the most attention is ethanol, which is made from the starch in corn. The manufacturing process to make the fuel also yields a byproduct known as "distillers dried grains with solubles" (DDGS). This byproduct—a mix of protein, fat and fiber—is used primarily as a nutritional supplement in cattle feed.

Radhakrishnan Srinivasan, a MAFES bioenergy scientist, is developing a technique to separate the protein, fat and fiber in DDGS. Meanwhile, poultry scientist Alex Corzo and wood composites scientist Sheldon Shi are investigating potential markets for these materials in the poultry and forest industries. If their work is successful, rural economies that have benefitted from ethanol manufacturing may see more profits from sales of other valuable materials.

"Ethanol production in the United States has increased fivefold within the last few years and continues to climb," Srinivasan said. "For every pound of ethanol produced, nearly 1 pound of DDGS is produced, but its market has not expanded."

Government mandates for ethanol use have strengthened domestic demand for corn and tightened the supply. To secure corn needed for feed, poultry mills are paying higher prices. They are scrambling to find alternative sources of the protein and energy that corn provides.

DDGS could be an alternative ingredient, but chickens cannot digest its fiber well and feed manufacturers cannot easily shape it into the pellets that chickens prefer. DDGS without fiber would serve as a plentiful, affordable source of protein and energy

in poultry feed. The enhanced DDGS would also help mills contain their production costs.

Forest products manufacturers also want to control costs and would welcome alternative, inexpensive materials that add strength, durability, beauty and lightness to wood composites. The fiber yielded from the separation of DDGS could be used in wood composites, but it would have to be free of protein and fat. Any protein and fat residues could cause decay.

Technology to separate the protein, fat and fiber in DDGS must be developed before new markets will open. Srinivasan has taken on this quest.

"Most corn-to-ethanol plants are farmer cooperatives, and their financial resources are limited," said Srinivasan, an assistant research professor in the Department of Agricultural and Biological Engineering. "If the plants are going to modify their current operations, they need technology with low capital investment to minimize financial risk and uncertainty."

With support from MAFES and his department, Srinivasan built a pilot plant at MSU to test his separation technique, the "elusieve process," on commercially produced DDGS.

The technique is performed by sifting the DDGS particles into different sizes and then blowing air over them to remove fiber. The name is a combination of the words "sieve" and "elutriation," which means application of upward airflow. Srinivsan's Web site, www.abe.msstate.edu/~radha/Elusieve.html, contains videos and documentation on the technique.

The pilot plant can separate the DDGS at a rate of 1 ton per hour into enhanced DDGS and fiber. According to Srinivasan, results have been promising.

"Sieving the DDGS minimized the influence of particle size on separation," he said. "The technique also met the criteria of low investment and simplicity because it utilizes standard sifters and aspirators."

Obtaining good separation of DDGS meant that poultry scientist Corzo could begin measuring the performance of the separated protein and fat in poultry feed. In the first phase of his study, Corzo compared broiler performance using three feed treatments: conventional feed, feed made with unaltered DDGS and feed made with the separated DDGS protein and fat.

"We wanted to know how much of the nutrients in enhanced DDGS was available to the birds, how much of it they retained and how much quality improved," said Corzo, an assistant research professor in the Department of Poultry Science.

Performance of chickens fed both forms of DDGS compared favorably with performance of those fed conventional feed. However, enhanced DDGS offers the advantage of helping eliminate digestive and manufacturing problems the fiber causes.

Corzo has been working with poultry feed mills to test the effect of enhanced DDGS on the manufacturing process. He is assessing the research data.

"After we look at the nutrition and handling issues, we will be able to determine what the next stage of enhanced DDGS research should be," Corzo said. "We want to test within a setting that has the management and nutritional characteristics of a typical broiler operation."

The availability of fiber from the elusieve process also has moved the research effort with wood composites one step forward. It allowed forest products researcher Shi to begin comparing the separated fiber with traditional materials used in wood composites.

Shi is planning to investigate how DDGS fiber can be used with wood powders in polymer composites to improve water and weather resistance. If processed appropriately, the fiber also has potential to improve the bonding interface between natural fibers and polymers, as well as to provide pliability for molding and shaping.

"The use of plastics already minimizes decay in wood products," said Shi, an assistant professor in the Department of Forest Products. "The addition of fiber could contribute to the stiffness of polymer composites without adding needless weight."

Shi said he also wants to investigate what other effects DDGS fiber may have on the bonding process. One of the problems Shi identified in his preliminary work is the possibility of minuscule amounts of protein still on the fiber after separation. Protein can affect the ability of the fiber to resist the high temperatures of composite fabrication.

"We want to try different polymer matrixes and protein treatments, and perhaps discover another technique to purify the DDGS fiber," he said.

Shi said he thinks DDGS fiber also could be used in particleboard for furniture and polymer composites. He wants to study the effect on particleboard of replacing some of the wood and other natural fibers with 10 to 20 percent DDGS fiber.

"The market for plastic lumber is growing, and the demand for wood composite products also is growing," Shi said. "Our goal is to help the forest products industry find materials that are equal to or an improvement over the ones now being used."