Is beer made with microwave-dried rice any different than air-dried rice?

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Kaushik Luthra, post-doctoral research associate, and Griffiths Atungulu, associate professor and director of the Arkansas Rice Processing Program, set up a microwave dryer to dry a load of rough rice. Credit: U of A System Division of Agriculture photo by Fred Miller

Using an industrial microwave can shorten the time needed to dry rice bound for beer making from days to hours and may lend itself to other food uses of the staple grain, Arkansas Agricultural Experiment Station researchers found.

Since Arkansas rice is a key ingredient in beer production—about 18 million bushels of Arkansas rice went into beer made by Anheuser-Busch in 2021—researchers conducted a brewing experiment to find out if rice dried with this emerging technology had any negative impacts on the "sweet water" called wort that is made into beer after hops and yeast are added.

While microwave oven technology has been around since the late 1940s, they have not become mainstream for commercial rice dryers. The Arkansas Rice Processing Program's research of microwave rice dryers has shown potential for the technology to decrease drying time and increase throughput during the busy harvest season.

"It is important to establish if the new microwave drying approach produces a product consistent with the traditional method," said Griffiths Atungulu, director of the Arkansas Rice Processing Program and associate professor of grain processing and post-harvest system engineering. "Microwaves offer fast drying and may offer other advantages over traditional drying approaches."

Better than hot air

Rice is typically harvested with a moisture content of about 20% and stored in bins to begin the air-drying process to an optimum storage level of 12.5%. This level of moisture wards off mold growth and helps maintain the rice's structural quality, Atungulu said.

While new technologies have increased rice harvesting and delivery

speed, the rice drying infrastructure has not grown at the same rate. The Rice Processing Program is pioneering research with microwave drying rice to meet the demands of higher delivery rates to commercial drying facilities, he said. Arkansas ranks first among rice-producing states, accounting for nearly 50% of U.S. rice production in 2022.

Normally, rice is dried using either heated air or unheated air, which is called "natural air." The Rice Processing Program's research shows that wort made with microwave-dried rice is more comparable to wort made with natural air-dried rice than hot-air dried rice.

Atungulu's previous research with graduate research assistant Deandrae Smith, presented in the American Society of Agricultural and Biological Engineers' *Resource Magazine*, showed that microwave drying can increase rice drying capacity, overall rice quality, and "head yield," or the percentage of rice kernels that are at least three-quarters of their original length after milling.

Their research was supported by industry partner AMTeK Microwaves and a Small Business Innovation Research grant administered by the U.S. Department of Agriculture's National Institute of Food and Agriculture.

Not your mom's microwave

For a visual cue, these are not the kind of microwave ovens found in most home kitchens, which pump out about 1 kilowatt of power. The industrial 75-kilowatt microwave used by the Rice Processing Program includes a box 4 feet long, 2 feet wide and 2 feet high with a conveyor belt running through it. It can drop the moisture content of rice from about 20% to 13% in a single pass over the course of about eight minutes.

By comparison, with air at 140°F, the hot-air drying requires two to three passes under the dryers, with each pass taking 20 to 30 minutes depending on moisture content. Natural air drying at about 77°F takes five to seven days but doesn't required a tempering step.

Once the rice is dried in the microwave, it must be tempered—held at the drying temperature for four hours after drying to reduce fissuring and improve head yield. Tempering is also required after hot-air drying but due to two passes, with tempering between, microwave drying rice took less than half the time than hot-air drying, according to Kaushik Luthra, post-doctoral research associate with the Rice Processing Program.

The experiment station's study of brewing with microwave-dried rice was conducted by Luthra, Atungulu, and food science undergraduate honors student Christopher Stuckey. The study, "Impact of Drying Techniques on Physicochemical Properties of Dried Rice and Its Influences on Rice Beer Brewing Process," was published in the *Journal of the ASABE.*

The study compared wort made with microwave-dried rice to wort made with rice dried using natural air and rice dried with hot air at both 125 and 140 degrees. The purpose of the study was to understand the effects of different rice drying treatments on the content of protein and amylose—one of the two components of starch—in wort because those two components have an impact on the brewing process and resulting nutrient content.

Compare and contrast

The benefit of using rice in beer is that it provides abundant sugar for yeast to turn into alcohol without the syrupy mouthfeel resulting from the additional sugar that comes from malted barley, Atungulu said. For

the experiment, Stuckey and Luthra brewed each batch with 15% Arkansas-grown long grain rice and 85% two-row malted barley.

Results from the study showed that wort made with the hot-air dried rice had a lower protein content and higher amounts of amylose, a long-chain sugar. This was likely due to the longer milling time required for hot-air dried rice to achieve the standard 0.4% surface lipid—or fat—content used in the brewing experiment. The longer milling time removes a greater portion of the protein content in bran, resulting in a higher percentage of amylose, the study noted.

The initial gravity, or sugar content, was similar for all three batches made from each drying methods—natural air, hot air and microwave. For comparison, the sugar content of the all-malt control batch was slightly lower.

Atungulu foresees microwave rice dryers being used in cylindrical conveyers to take up less space in processing facilities, and a gentle finishing air dryer to complete the drying process after fast evaporation from microwaves. He said the application also has potential for use in drying rice that has been parboiled for nutrient additions and drying partially cooked "instant rice."

More information: Christopher Stuckey et al, Impact of Drying Techniques on Physicochemical Properties of Dried Rice and Its Influences on Rice Beer Brewing Process, *Journal of the ASABE* (2023). DOI: 10.13031/ja.15236

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