CFW Plexus

Spotlight on Rice: An Update from the Rice Division

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CURRENT RICE QUALITY ISSUES

The meaning of the term "rice quality" depends on the requirements of the end user, so there are varying definitions. Rice is consumed largely as intact kernels—usually as white rice, where most of the bran has been removed by milling—rather than as a ground product. Thus, size, shape, color, appearance, functionality, and cooking properties are important quality characteristics that must be addressed. Two of the most challenging quality issues facing the rice industry today are fissuring and chalkiness of kernels.

Fissuring

Fissures are fine cracks that develop in rice kernels as a result of rapid moisture transfer, which produces intra-kernel stress imbalances within individual kernels. Kernels that have fissures are susceptible to breakage during milling, resulting in a high percentage of "brokens" and thereby reducing quality and milling yield. Although brokens are used in various products and applications, they have a much lower value than intact, milled rice.

Drying methods that include appropriate tempering to equalize the moisture content and minimize mechanical stress inside rice kernels are being developed to address fissuring. Fissuring can occur in the field and some cultivars are more susceptible to in-field fissuring than others. Thus, some causes of fissuring might be controlled through rice genetics and breeding. Studies are underway to find the genes responsible for fissure susceptibility in rice kernels.

Chalkiness

Chalky sections are visible white areas in individual rice kernels. The white appearance is due to the presence of air between starch granules in the endosperm, which leads to differential refraction of light in kernels. The air spaces are the result of the interruption of starch formation during the critical grain-filling stage in rice, usually because of high nighttime air temperatures.

Chalkiness may result in decreased milling yield. This is because the air spaces interrupt the continuity of the endosperm in chalky kernels, which weakens the kernels and makes them susceptible to breakage when exposed to the abrasive and frictional forces of milling. Chalky kernels are also undesirable because they negatively impact functional performance; e.g., chalky rice doesn't puff uniformly and results in products with an inferior finish. Detection and measurement methods are currently being developed for chalkiness. Some cultivars are more resistant to chalk formation than others, underscoring the role genetics may play in the development of less susceptible cultivars.

FUTURE CHALLENGES IN RICE QUALITY

Chalkiness and Fissuring

Both chalky rice and fissuring will continue to present tremendous challenges for research and industry personnel. Chalk formation is particularly challenging because all cultivars tend to show some susceptibility when exposed to high nighttime temperatures. This makes it difficult to develop completely chalk-resistant varieties. Since temperatures are speculated to increase around the globe over time, chalk formation will continue to be an important research issue. Fissure formation might be addressed with the development of improved drying/tempering techniques and genetically resistant cultivars.

Heavy Metals

Another challenge is the presence of toxic heavy metals in rice and its products. The recent investigation of arsenic in rice products has received much attention in the press and could have huge repercussions for the rice industry. Arsenic occurs naturally in the environment and is taken up more efficiently by some plants than others. To reduce intake of arsenic, health professionals advise consumers to reduce the quantity of rice in their diet and/or to wash rice before cooking. However, roughly half of the world's population relies on rice as their major source of calories and washing removes essential nutrients from fortified rice.

Arsenic in rice might be an issue that will go away on its own; however, the rice industry needs to be prepared for this and other events that jeopardize the industry and this important food supply for the world. We need to establish safe exposure levels of toxic metals in our foods.

Rice Straw and Hulls

Although not directly related to cereal grain research, it is imperative that we find a value-added use for rice straw and hulls. This is increasingly important as rice straw accumulates in fields in California where it can no longer be burned due to air quality regulations. A value-added use might also reduce both the need for petrochemicals and the environmental impact of waste accumulation. Bioproducts and biofuels are being developed to take advantage of agricultural residues and waste materials. This is an important aspect of the entire picture of growing crops to feed the planet.

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http://dx.doi.org/10.1094/CPLEX-2013-0221-01S

MEMBER FOCUS

Alejandra Billiris is a Ph.D. student in the Food Science Department of the University of Arkansas, and is also a member of the university's Rice Processing Program (RPP). She has worked at the Technological Laboratory of Uruguay (LATU) since April 2005 as a food analyst and is now on leave to pursue her Ph.D. degree. The projects on which she is working are intended to improve rice processing operations and support the rice industry. Her goals at LATU and the Ph.D. program are similar, as the Rice Processing Program of the University of Arkansas works very closely with the rice industry, including producers, processors, and end-users of rice.

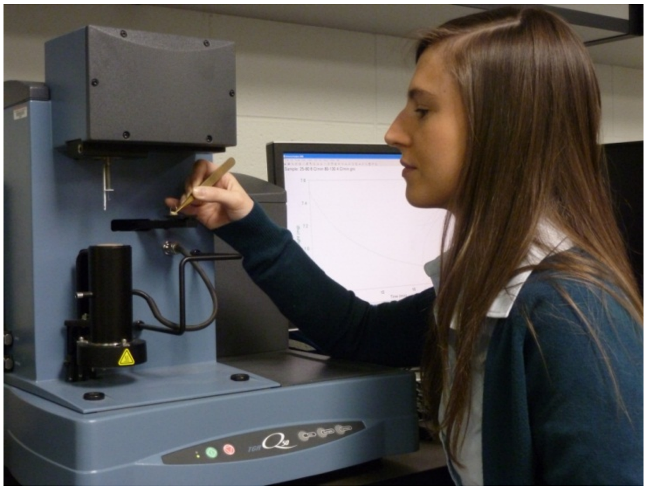

Figure 1. Alejandra Billiris setting up a rice kernel for analysis in a thermogravimetric analyzer. The instrument is being used in this research to accurately measure mass loss during drying of the kernel, from which Alejandra can calculate the drying rate.

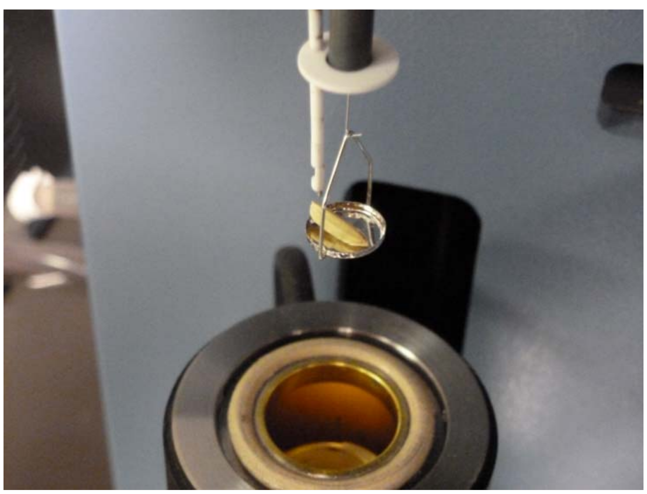

Figure 2. A single kernel of rough rice in the weighing pan of the thermogravimetric analyzer before it is inserted into the drying chamber.

Research

The focus of Alejandra's research has been to quantify energy use during rice postharvest processing in order to improve energy efficiency. Initially, she developed equations to theoretically predict the amount of energy required to dry rice compared to actual energy requirements. In this way, the energy efficiency of any given drying process may be determined. Secondly, she measured the energy requirements to dry rice at the individual kernel level using a thermogravimetric analyzer and a differential scanning calorimeter to confirm the theoretical equations developed (Fig. 1–3). Finally, she collected data on energy requirements to dry rice at on-farm and commercial dryers to quantify the energy efficiency of these dryers operating across a range of ambient conditions.

She is also studying the effects of several fundamental factors such as kernel dimensions, drying air temperature, relative humidity, and flow rate on drying rates.

In addition, she has participated in several projects on topics that involve other operations of rice postharvest processing. For instance, she has worked on assessing the effect of degree of milling on cooked rice's hydration, texture, and sensory response, as well as the duration of energy required for cooking. Upon completing her Ph.D., Alejandra will continue her work at LATU on projects that will improve the efficiency and profitability of rice producers and millers.

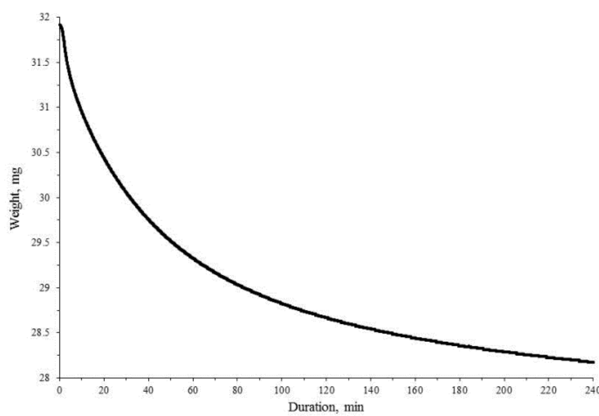

Figure 3. Drying curve for a single kernel of rice collected from the thermogravimetric analyzer.