Dale Bumpers National Rice Research Center
USDA-ARS
Stuttgart, Arkansas

MAY 2023

MONTHLY RESEARCH HIGHLIGHTS

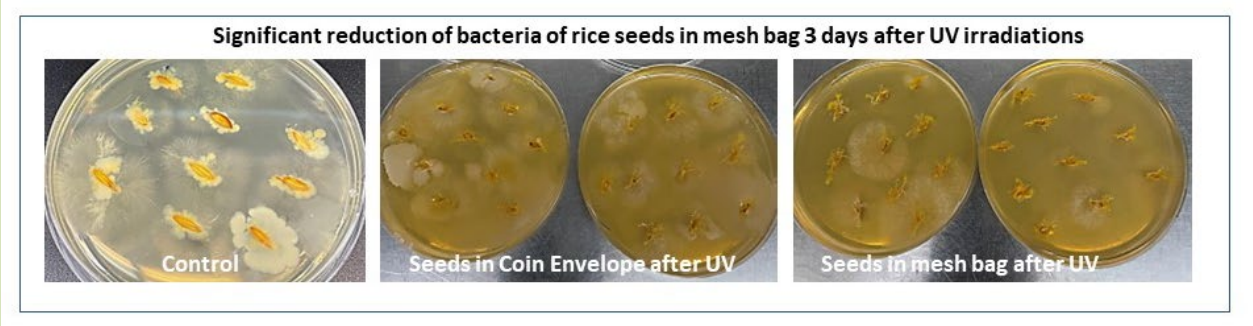
For More Information: Dr. Yulin Jia, Acting Research Leader/Center Director
yulin.jia@usda.gov

- **Recent Scientific Publications**

This addresses USDA-ARS Research Goal: Crops with traits that maintain post-harvest quality and reduce losses.

Yulin Jia and Quentin D. Reed. 2023. Bacteria disinfection of rice seeds by ultraviolet light irradiation in a biosafe flow cabinet. Plant Health Progress Published Online:15 May 2023 https://doi.org/10.1094/PHP-02-23-0017-RS

Field-harvested rice seeds contaminated with bacteria are a concern for rice distribution. User-friendly methods to remove microbes are currently not available. Here we report the effects of 274 nanometer ultraviolet proton treatments for 1-7 days on rice seeds. Seeds were placed without a barrier, in a sterilized mesh bag, or a sterilized coin envelope. Each day for seven days after UV irradiation, 10 seeds were removed and placed in a nutrient agar medium in a dark incubator at 29°C for three days. Bacterial and/or fungal infected seeds were counted. At the same time, 10 seeds were removed and placed onto a moistened filter paper for five days in an incubator at 40 °C for germination assays. The rate of germination was counted at five days after incubation. Across all treatments, bacterial infection rate declined significantly over time. Fungal infection rate also declined significantly over time but at a slower rate. However, the germination rate did not change significantly over time. When comparing the treatments, there was no significant difference between treatments for germination rate or fungal infection rate. Interestingly, the mesh bag UV had the strongest effect on reducing bacterial infection rate over time, even compared to the direct UV treatment. We suggest that UV irradiation of seeds in mesh bag be used to reduce seed bacterial contamination.



This addresses USDA-ARS Research Goal: Enhanced knowledge of food (seed, fruit, tubers etc.) qualities and nutritional value at genetic, molecular, and physiological levels.

Ming-Hsuan Chen (retired), **Shannon Pinson**, **Aaron Jackson**, and **Jeremy Edwards**. 2023. Genetic loci regulating the concentrations of anthocyanins and proanthocyanidins in the pericarps of purple and red rice. Plant Genome 2023; e20338. https://doi.org/10.1002/tpg2.20338

Anthocyanins and proanthocyanidins are the antioxidant pigmented flavonoids that give blueberries, cranberries and red wine their color and health-beneficial attributes. Rice grains with purple colored bran also contain anthocyanins, and red-bran rice contains proanthocyanidins. At the outset of this study, it was known that the biosynthesis of anthocyanins (purple) and proanthocyanidins (red) in rice bran is turned on and off by the *Pb* and *Rc* genes, respectively. This study was conducted to identify genes/QTLs that regulate the concentrations of these pigmented flavonoids after their biosynthesis is activated by *Pb* and *Rc*. When the two compounds were studied individually, we identified two QTLs, one each on chromosomes 3 and 7, that increased anthocyanin content, and identified the same region of chromosome 3 plus a QTL region on chromosome 5 as enhancing proanthocyanidin content. Anthocyanins and proanthocyanidins share a large portion of their biosynthetic pathways. The shared QTL on chromosome 3 appears to enhance activity at one or more of the shared biosynthetic steps, while the other QTLs impact downstream steps that are unique to anthocyanin or proanthocyanidin synthesis. We also evaluated the impact of *Rc*, which activates synthesis of proanthocyanidins, on anthocyanin content, and studied the impact of *Pb*, which activates anthocyanin synthesis, on proanthocyanidin concentrations. If the synthesis of one compound diverted limited precursors from the synthesis of the other compound, one would expect to see a trade-off between the two compounds. What we saw instead was mutual enhancement, indicating that in addition to turning on synthesis of anthocyanins or proanthocyanidins, the *Pb* and *Rc* genes also increase production of pathway precursors.

This addresses USDA-ARS Research Goal: Superior new crops that have value-added traits that improve end-use.

Jannasch, A., Wang, Y.J., Lee, S.O., **McClung, A.M.** and Brownmiller, C., 2023. Effects of Bran Pigmentation and Parboiling on Rheological Properties of Waxy Rice in Neutral and Acidic Environments. *Cereal Chemistry*. **https://doi.org/10.1002/cche.10678**

There is increasing interest in developing enhanced nutritional food products and because of the increase in global diabetes and obesity, there has been concern in how to keep rice as part of a healthy diet. Although most commercialized rice has a brown bran layer, there are rice varieties with purple and red brans. Research has shown that relative to brown rice these pigmented brans are rich in natural antioxidant compounds that have been linked with health beneficial effects. These pigmented rices are being marketed directly but little research has been conducted on the impact of processing methods like parboiling on these pigmented compounds and their subsequent rheological properties in cooked rice. In addition, most commercial rice has 15-25 percent amylose content, a starch component that affects cooked rice texture and processing quality. However, waxy rice varieties have essentially 0 percent amylose causing the cooked rice to have an extremely viscous texture and a slower gut digestion resulting in greater satiety. This research was conducted to explore the combination of pigmented bran and parboiling on viscosity of waxy rice with the goal of developing a food product that is nutritionally enhanced and satisfying. Brown bran and purple bran waxy rices were compared for starch viscosity properties after using two parboiling treatments. One set of treatments resulted in increased viscosity likely due to crosslinking between the polyphenols and proteins in the pigmented bran and, when exposed to an acidic environment like the stomach, was observed to have increased starch swelling. These findings indicate protein-polyphenol interactions of pigmented rice may help develop functional foods with improved rheological properties for enhanced satiety that may reduce dietary caloric intake.

- **Technology Transfer**

  ✓ **<u>Interactions with the Research Community</u>**

  On May 24, 2023, Drs. Yulin Jia and Shannon Pinson visited with Mr. Jerry Martin and Ms. Kelsey Anderson in the USDA-ARS Poultry Production and Product Safety Soil Science laboratory in Fayetteville, AR to learn about their methods and equipment for measuring concentrations of inorganic arsenic in food and plant samples.

  ✓ **<u>Rice Germplasm Distributed</u>**

  During the month of May, 31 rice genetic stocks were shipped to researchers in Canada and the United States.

  Dr. Anna McClung and the rice breeding staff provided seed to the following research groups: May 1, University of Arkansas, 5 varieties for looking at phytochemicals produced during seed sprouting; May 2, 10 early maturing varieties to test for adaptation at USDA-ARS/St. Paul, MN; and 1 variety for isotope studies to the Center for Climate Change Impacts and Adaptation- Scripps Institution of Oceanography, CA.

- **Stakeholder Interactions**

  On May 15, 2023, Dr. Anna McClung provided information to an Arkansas grower on jasmine and basmati style rice varieties developed by USDA/ARS. These were derived through traditional breeding methods from genetic resources originating in Thailand and India, respectively, and possess the same unique culinary properties of these varieties that are not adapted for production in the US climate.

Drs. Yulin Jia and Shannon Pinson attended the annual Rice Industry Meeting, held in Fayetteville, AR, May 23-24, 2023. Nearly 100 attendees representing all aspects of the US Rice Industry, including farmers, millers, food processors such as Kellogg's and Anheuser Busch, and international marketers, as well as public and private breeders and researchers came together to share methodology and ideas for enhancing the quality of rice and rice-based foods.

On May 25, 2023, Dr. Anna McClung participated in a virtual board meeting of the Carolina Gold Rice Foundation, based in Charleston, SC, along with 10 other members and guests. Currently South Carolina has some 8000 ac in rice production with most of this being used as waterfowl habitat for hunting. One thousand acres are grown for commercial grain which is milled in the state. Topics discussed included new grants with Clemson University to support rice production with tidal/saline water, preservation of seeds of other heirloom crops from the Southeast area, opportunities for grants to help support further development of the rice industry in the state, and the need to secure a means for pure seed production of specialty rice varieties like Carolina Gold Select, Santee Gold, and Charleston Gold – all of which were produced with USDA/ARS involvement.

- **Education and Outreach**

Dr. Anna McClung participated in an event to provide landscaping around a sculpture in Lonoke, AR on May 17, 2023. The sculpture is an abstract representation of a school of fish made from recycled agricultural iron. The sculpture celebrates the aquaculture industry of Lonoke County which is known as the "minnow (bait fish) capital of the world".

Dr. McClung provided purple foliage rice plants to include as an ornamental in the landscaping to recognize the contribution that the county has also made to rice culture. Historical records indicate that the first rice commercially grown in Arkansas began in Lonoke County around 1900.
https://501lifemag.com/lonoke-is-home-to-the-worlds-largest-supplier-of-bait-fish/

Left to right: Valena Washington, Graham Biles, Alice Bridges, and Anna McClung.

- **New Research Grants**

  Dr. Yulin Jia received funds to support the project titled "Identification and Characterization of Novel Resistance Genes to Rice Blast Disease," through the 1890 Faculty Research Sabbatical Program. Dr. Jia will use the submitted proposal and budget to execute a Non-Assistance Cooperative Agreement (NACA) with the University of Arkansas at Pine Bluff (UAPB) for the project to start in 2024.

See the web version of all DBNRRC research highlights at: https://www.ars.usda.gov/southeast-area/stuttgart-ar/dale-bumpers-national-rice-research-center/docs/monthly-research-highlights/