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Cracking and breakage in rice grains: implications for the rice industry

Dr Mark Talbot, Dr Prakash Oli and Dr Peter Snell (NSW DPI, Yanco)

Key findings

- Cracked rice grain can break when milled, reducing post-milling quality and affecting the rice industry as a whole.
- Collaborative research between NSW DPI Yanco and SunRice aims to standardise crack measurement to support quality analysis throughout the supply chain.
- Research will focus on understanding why grain cracks to mitigate cracking and breakage and improve the crack-resistance of future varieties.

Introduction

Rice is primarily consumed and processed as a whole grain. Maintaining the structural integrity of the grain throughout maturation in the field, harvesting, transport, drying, storage, milling and post-milling handling, is critical. Cracked rice significantly affects breakage during milling and subsequently reduces the value of the rice throughout the supply chain; every 1% increase in whole grain yield is equivalent to $2.5 million in revenue to SunRice.

Rice grains are hygroscopic, and will readily equilibrate with environmental moisture levels, especially when milled. Grains can potentially crack under adverse conditions (e.g. rapid changes in relative humidity and temperature), either before or after milling. While the significant contribution of cracked grain to the amount of breakage during milling is well known, very little is known about post-milling cracking and breakage. Research at NSW DPI Yanco, in collaboration with SunRice, aims to understand post-milling cracking and develop imaging methods to incorporate into quality tests performed at different stages in the rice processing industry.

Measuring and monitoring cracks

There is currently no standard method for measuring cracks or monitoring their formation over time, either in a research or industrial capacity. Aligning procedures to measure/monitor cracking will support breeding varieties with crack-resistance traits through the Quality Evaluation Program (QEP) at Yanco, and will benefit industry, e.g. as a quality test at receivals, monitoring cracking and breakage during milling, handling and transport, and as a quality test for rice-based food production. Standardised testing will ensure consistent delivery of premium quality Australian rice varieties to consumers.

Cracks in milled grains can either form internally or on the surface (Figure 1), depending on whether the grain absorbs or loses moisture, respectively. There is little knowledge on how the different types of cracks affect grain breakage during milling and/or processing.

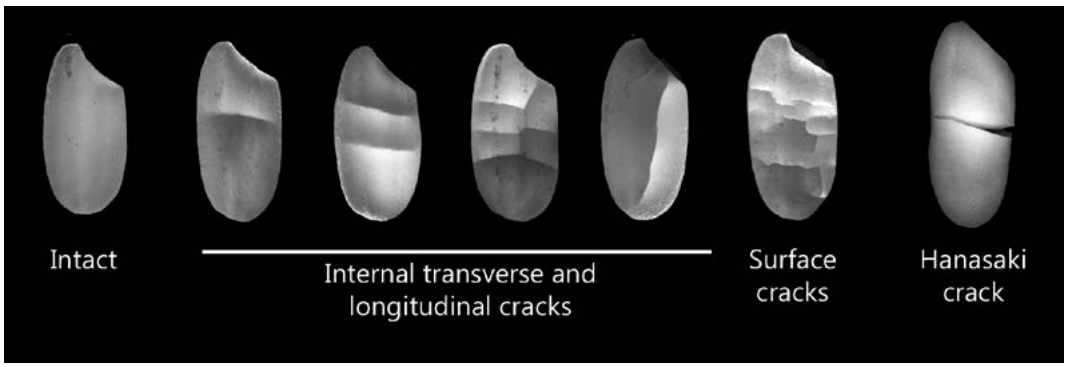

Figure 1. Cracks formed in dry, milled grains (transverse, longitudinal and surface cracks), and soaked milled grains (Hanasaki cracks) of Sherpa(t). Similar crack patterns can appear in other varieties.

Soaking-induced crack formation

A procedure to semi-automatically determine the percentage of cracked grain in a soaked rice sample has been implemented and further developed at DPI. The Hanasaki test, used by SunRice and DPI, measures the formation of large cracks (see Figure 1), which can occur when rice is soaked in water before cooking, e.g. in sushi production. The Hanasaki test gives a better indicator of cooking quality for sushi than measuring cracks in dry, milled grains. DPI has automated measurement by developing an image analysis algorithm (Figure 2), and the improved test has been incorporated into the QEP for certain varieties.

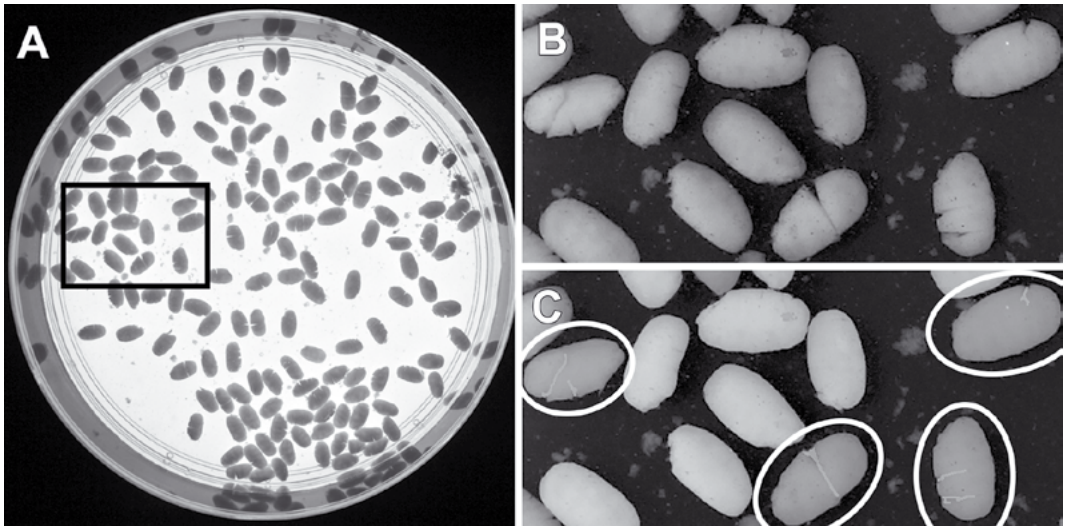

Figure 2. Detecting cracks in grains soaked in water (Hanasaki cracks). A – original Petri dish with 100 grains soaked for 1 hour in water. B – enlarged portion of dish from boxed area in A. C – cracked grains are circled with cracks showing as lighter marks.

Future research

The focus for future research into cracking will be on:

- understanding the biological and physical causes of cracking, leading to varieties with enhanced crack resistance
- standardising methods for measuring and monitoring cracking, and incorporating these into the QEP and industry quality assessment
- determining the contribution of grains with different crack types on milling and post-milling breakage, and processing
- investigating conditions in rice handling, milling and processing that contribute to cracking and breakage, allowing industry to maximise whole grain yield and returns to growers and processors.

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