

PROGRAM 4

PRODUCT AND PROCESS DEVELOPMENT

Program Leader:

Mr David Welch

SunRice (formerly referred to as “Ricegrowers’ Co-operative Limited”)
Sydney

This Program brings researchers and the industry together in strategically directed research that continues to be successful in enabling value adding to rice products. Project outcomes feed directly into improving processing efficiency, product quality and safety, or enabling the design of new products.

Underpinned by CRC research, paddy rice management systems continue to be improved, milling process controls are improved by new methods and instrumentation including near-infrared spectroscopy and image analysis, and the effectiveness of alternative pest management treatments is better understood.

New products underpinned by CRC research now released onto the market include instant hot rice snacks, quick cooking rice side dishes, crisp rice products, and new rice flour-based applications. As we continue to enhance our understanding of the structure and function of the molecular composition and structure of starches, lipids, protein, and other components, we continue to initiate new ideas for products, applications and quality improvement.

The Product and Process Development Program of this CRC contributes to improving the international competitiveness of the Australian rice industry from the development of knowledge and skills in both the commercial and research sectors.

Many CRC outcomes now represent standard industry practice, or have become manifest in new products, whilst some areas of research will need to continue beyond the current CRC to find the answers demanded by the industry and its stakeholders.

Case Study

Sensory science of quick cooking rices

(David Welch)

The technologies used for quick cooking rice products can involve multi-step processes including precooking, other pre-treatment and final re-drying to a shelf stable moisture content. A key measure of success in quick cooking rice technology is achieving an eating quality equal to “standard cooked rice” despite the fundamental differences in the regime of physiochemical change.

In this CRC research, modern sensory science testing and analysis procedures were used to compare quick cook rices and standard cooked rice. Specific research objectives included determining:

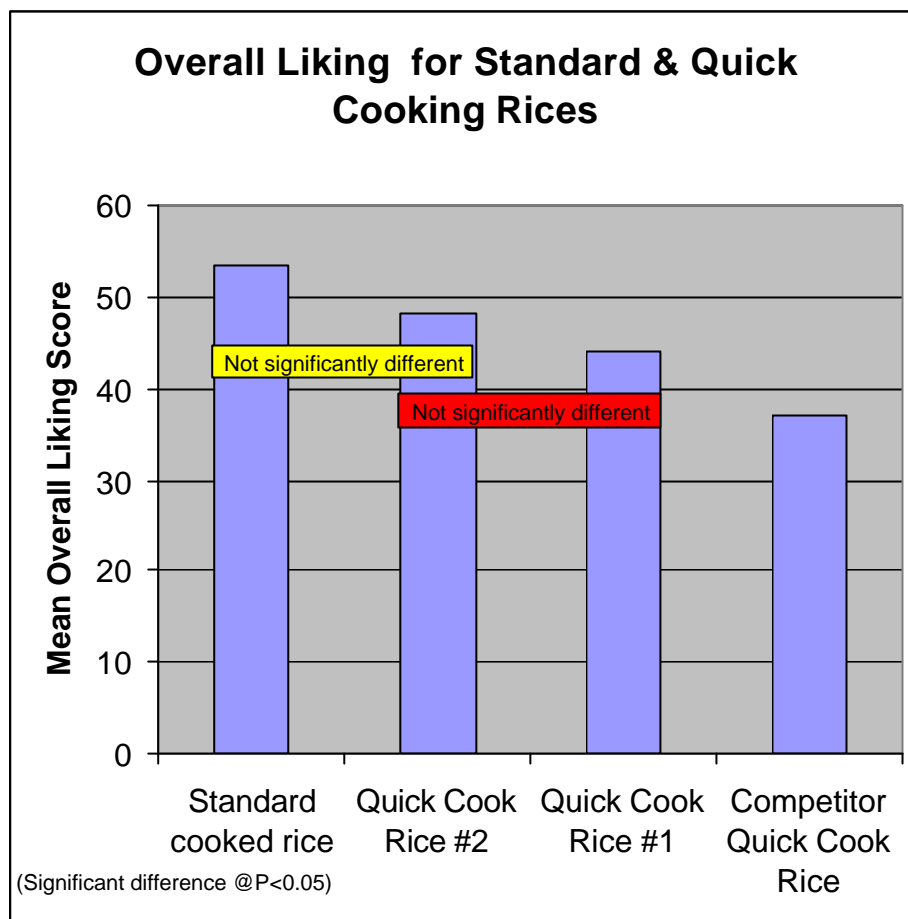
- * the sensory attribute profiles of each product
- * which particular sensory attributes “drive liking”
- * differences in “acceptability/liking”
- * how the products compared to consumer defined ideals for each sensory attribute.

The products tested were:

- * 2 quick cooking rices developed with research support from the CRC and commercialised by SunRice (“Quick Cook Rice #1” and the recently developed “Quick Cook Rice #2”);
- * the major commercial competitor quick cook rice in the domestic market, which is based on imported rice; and
- * Kyeema variety Australian fragrant rice (“Standard Cooked Rice”)

The accompanying chart shows that the mean liking score for the new “Quick Cook Rice #2” was not significantly different to “Standard Cooked Rice”. The results also show the superiority of both “Quick Cook Rice #1” and “Quick Cook Rice#2 over the key commercial competitor.

In addition to validating the success of work on quick cook rice to date, the research also provides direction for further improvements, greater understanding of the consumer basis for rice quality, and will also be used to help “calibrate” instrumental testing methods, such as texture measurement, against consumer perception.



4.1 Grain quality in the pre-milling phase (4101)

Sub-Program/Project Leader:
Mr Nathan Cutter
SunRice, Leeton
Dr Laurie Lewin,
Rice CRC, Yanco

Objectives

- * To monitor and improve quality before milling.
- * To assure the quality of rice delivered to the industry.
- * To evaluate segregation techniques for delivered paddy.

Progress

This project *has developed* techniques for:-

- * evaluating trash levels at receival;
- * measuring moisture on brown rice at receival;
- * providing techniques to assure quality of paddy at receival; and
- * evaluating grain quality at receival to allow segregation of paddy for a particular purpose.

The project was extended in 2003 to fully train all receival staff in the use of the techniques and to apply receival techniques – including automatic data collection, across industry receival sites. This was *successfully achieved* but the small crop in the 2002/2003 season (virtually no rice produced in the Murray Valley) limited opportunities for segregation for the 2003 harvest.

Preliminary analysis of the use of image analysis to evaluate quality in milled rice suggests that this technique could be used at receival to aid segregation by estimating content of broken grain, immature grain, sun-cracked grain and chalky grain in a sample. Preliminary studies have shown that this could well be possible by use of the new generation of image analysis techniques now becoming available.

Outcomes

- * Segregation of rice at receival and feedback to growers *has been improved* by better evaluation techniques and staff training.
- * New expanded evaluation tools may further improve the potential for segregation.

4.3 Quality assurance systems and post-harvest pest management

Sub-Program Leader:
Mr David Welch
SunRice
Sydney

The Australian rice industry must be leaders in the field of quality assurance and food safety. This extends from farmers' fields into the processing sector.

Sustainable fumigation practices (4303)

Project Leader:
Mr Tim Norris
SunRice
Leeton

Objectives

To develop pest control practices that are less reliant on methyl bromide.

Progress

This project aims to reduce reliance on methyl bromide fumigations by:-

- * improving quality of paddy at receipt (Sub-Program 4.1);
- * use of phosphine for pest control in paddy storage where necessary;
- * maintenance of hygiene throughout the milling process (quality assurance); and
- * identification of new insecticides or processes for pest control in milled product.

Trials on bulk fumigation with phosphine at Coleambally indicated the potential of this technique and this is now being used regularly for portions of the product.

Maintenance of hygiene is achieved through implementation of the quality assurance system.

New methods of pest control for milled product are being evaluated. These include new chemical and physical techniques.

Outcomes

- * Improved pest control at receipt and through processing have *reduced reliance* on post-processing chemical control.
- * New chemicals are under evaluation.

Quality assurance for the processing sector (4306)

Project Leader:
Mr Tim Norris
SunRice
Leeton

Objectives

To implement quality assurance systems across all levels of the processing sector.

Progress

Quality assurance using the HACCP system has been applied throughout the processing sector. This has now been extended by gradual implementation of “Six Sigma” implementation. Six Sigma is a process for equipping people with the training, tools and techniques to implement change with critical thinking. The Six Sigma approach has a defined structure but essentially uses the objective criteria developed through other Rice CRC projects to highlight areas in which quality can be assured and continuously improved. Importantly, the focus of this approach is on sustainable change and sustainable benefits.

Implementation within the processing sector is a staged process. Initially the focus will be on areas where objective information is available and improvement will lead to significant benefits. These areas include paddy drying (linked to earlier drying trials in Sub-Program 4.1) and improvements in milling yield (linked to prior developments in Sub-Program 4.2).

Implementation in these areas will lead to *significant savings* for the industry and *improved products* to meet specific markets.

Outcomes

First stage implementation of the quality assurance has *already achieved significant results* for the processing sector.

4.5 New rice-based foods

Sub-Program Leader:
Mr Phillip Williams
SunRice
Leeton

This Sub-Program is evaluating new technologies that will promote the development of new rice-based food products.

Quick cooking rices (4501)/New applications for rice flour (4503)

Project Leader:
Mr Michael Bayles/Mr Phillip Williams
SunRice
Leeton

Objectives

- * To scale up and commercialise a process for making quick cooking and puffed rices using existing rice varieties.
- * To investigate new applications for rice flour. This includes work with the existing rice varieties and work with rice varieties currently not used commercially for rice flour production.

Progress

* *Quick cooking rices*

A number of new quick cooking rices ***have been developed*** over the last 12 month period. These include an Instant Medium Grain rice suited for use in hot snacks and cold/hot desserts. Nutrition and convenience were drivers in the development of a quick cooking brown rice that does not suffer from oxidation of oils in the bran layer induced by heat in the quick cook process. A new range of quick cooking rices was developed to deliver ***superior quality*** and ***cost efficiency*** in certain applications. This latter range has been derived from an entirely different technology platform to the pre-existing range.

Scientific Sensory Research work was undertaken through an external service provider with international best practice capability to identify the key consumer based sensory properties of rice, and how various quick cooking rices compared to "scratch cooked" rice. This work has been used to validate the success of quick cooking rice developments and identify directions for improvement. A key driver of sensory acceptability, and one which is impacted significantly by quick cooking technology, is texture.

Other research undertaken by SunRice and staff at the Yanco Agricultural Institute has been to develop methods for objective instrumental analysis of rice texture. This texture analysis work is on-going.

The quick cooking rice technology has also been extended to develop new puffed or crisp rice ingredients suited to breakfast cereal, bakery, snack and other applications. New processes were developed that enabled the inclusion of ingredients such as malt, sugar and salt to deliver highly acceptable colour and flavour. Crisp brown rices without these ingredients ***have also been developed***, relying on the natural flavours generated from the bran layer to deliver a highly acceptable flavoursome product.

Outcomes

Many of the new products arising from this Program in the last year are either in the market or in the process of being commercialised, and with the range developed over recent years, are ***winning business for the Australian rice industry*** in local and international markets, both as an ingredient for other food manufacturers and as retail products marketed by SunRice.

* *Rice noodles*

Further evaluations on the suitability of NSW rice varieties for rice noodles has been undertaken in cooperation with Charles Sturt University (CSU). Dr Chris Blanchard has had two students work on the rice noodle project in 2003. The first student developed a method for the preparation of rice noodles using NSW rice flour. The second student has used this method to evaluate various rice flours. The flours under evaluation include commercially produced rice flours from the SunRice Leeton flour mill and rice flours produced by Dr Michael Southan as part of the RIRDC Rice Flour project at the Bread Research Institute (Project BRE-3A). Rice varieties include Doongara, Langi, Illabong, Amaroo and Kyeema.

Outcomes

The rice noodle method developed in the first part of the work with CSU is being refined and will be provided to SunRice Marketing and Consumer Relations Departments for use by customers. The work with the different rice varieties has not been completed but texture analysis method for use with rice noodles has been developed and is indicating measurable differences between the varieties.

* *Rice cakes*

* *New products*

Research to produce rice cakes with a superior texture has been undertaken. Successful progress has been made and the new product is in the final stages of development. Research to develop flavoured rice cakes has also been undertaken. Development work with formulations, processing, flavour adhesion systems and packaging is being continued. These new products are ***currently being commercialised***.

* *Objective texture measurement*

One challenge to improving rice cake texture is the issue of texture measurement. Current assessment of texture is based on taste panel responses. The availability and maintenance of panellists for use in ongoing taste panels is a difficulty. This is time consuming and personal preferences distort the assessment. To help overcome this, another student under the supervision of Dr Blanchard is working at CSU to develop an objective method for texture measurement based on the Stable Micro Systems Texture Analyser. This instrument has been used in other food industries for texture measurement, eg - snack foods, and shows potential for use with rice cakes. Results to date indicate a large variation within the same treatment resulting in the need to assess a large number of replicate samples. Initial work required for assessment of a number of different probes and attachments for the Texture Analyser to measure rice cake crispness has been undertaken.

* *Storage changes and aroma in milled rice*

Changes in rice aroma during storage are known to occur and can cause problems during further processing in some products. Traditional methods for aroma measurement have generally involved either trained assessment panels or gas chromatography methods. There are limitations in both methods. Trained panels as mentioned previously are difficult to maintain and time consuming. Gas chromatography has long been used but requires specialised laboratory analysis, usually requiring considerable time for analysis. A student working under the supervision of Dr Blanchard at CSU is evaluating an instrument recently acquired by the University which can potentially provide aroma assessment of a sample with minimal sample preparation and analysis within a few minutes. This assessment is automated and the result can be compared electronically with a reference sample stored in the computer software.

* *Project 4501a – New rice based food products*

Miss Jennifer Dang (PhD student) submitted her thesis in late July 2003 for examination.

Starch-lipid interactions and their role in ageing processes in rice (4504)

**Project Leader:
Prof Kevin Robards
Charles Sturt University
Wagga Wagga**

The project commenced in January 2000. Team members are Assoc Prof Kevin Robards, Dr Stuart Helliwell, Dr Chris Blanchard and Mr Zhongkai Zhou.

Objectives

Specific aims identified for 2002/2003 were to complete:-

- * pasting analysis of stored rice samples;
- * assessment of lipid distribution in the aged rice samples;
- * thesis writing; and
- * preparation of journal papers to facilitate transfer of information to Australian rice growers and processors.

Progress

The research program of Mr Zhongkai Zhou has been completed. Chemical and physical testing of stored rice samples was carried out to complete the experimental section of this project. Many of the changes observed in the stored rice samples appeared to be due to a change in the functional properties of the rice proteins. The change in lipid composition observed after storage may have also contributed to the change in physical properties.

All major findings have been documented by Mr Zhou in his PhD thesis which has been accepted with favourable comments from the examiners, subject to minor typographical changes. It is expected that he will graduate in the April 2004 ceremonies. Mr Zhou's supervisors believe that this has been a very successful appointment, with five refereed publications (plus at least three to come), several conference presentations and doctoral completion within the time limit. The work was also presented at various conferences and Zhou has commenced a postdoctoral appointment in Honk Kong working on rice proteins.

MILESTONES

	Milestone	Year 4	Year 5	Year 6 - 2002/2003	Yr 7
4.1	Grain quality in the pre-milling phase				
	Appointment of scientific officer				
	Sampling procedures optimised				
	Individual grain moisture distribution monitored				
	Optimum grain drying strategies developed	X ✓	X ✓		
	Training programs developed	X ✓			
	Training programs implemented	X ✓	X ✓	X ✓	X
4.2	Development of rice handling in-line process control				
	Software development				
	Closed loop control developed for degree of milling/whitening				
	Moisture meter interface developed				
	Packer weigher interface developed				
	Process weigher interface developed				
	Closed loop system for broken grain content developed	X ✓	X ✓		
	Closed loop system to maximise hulling efficiency developed		X Deferred	X Deferred	X
	System implementation		X Deferred	X In process	X
4.3	Quality assurance systems and post-harvest pest management				
	IPM strategies evaluated				
	- Ethyl formate				
	- CO ₂ fumigation				
	- Cool temperature treatment				
	- Phosphine fumigation	X ✓	X ✓		
	- Carbonyl sulphide	X Discontinued	X Discontinued		
	- Designing out pests				
	HACCP systems				
	- rice-based foods plant				
	- mills and stock food plants				
	- rice receival sheds and on-farm	X RCL	X RCL implementation	X ✓ Six Sigma implementation	X
4.4	Rice hull use				
	Potential for energy conversion determined				
	Potential for hull-based alternatives determined	X RCL			
	Other uses for hulls investigated	X RCL	X RCL implementation	X RCL implemented	X
4.5	New rice-based foods				
	Quick cook rices developed	X ✓	X ✓	✓	
	Feasibility for pouch-packed cooked & frozen rice			✓	
	Frozen rice products developed & test marketed			In process	
	Development of pouch packed products	X ✓	X ✓	✓	
	Evaluation of waxy rice flour	X ✓		Other flours	
	Potential to produce and market rice noodles evaluated			✓	
	Other rice-based products evaluated	X ✓	X ✓	X ✓	X

X = To be completed (in some cases this exercise is spread over several years).

✓ = Achieved (if not achieved, status provided.)

NB: After obtaining approval from the CRC Secretariat, comments on milestones for Years 1 to 3 inclusive have been removed from this table. Please refer to previous Rice CRC Annual Reports if you wish to view this information or contact the Rice CRC for additional information.