

FINAL REPORT

Sponge and dough bread quality of Australian germplasm

DAQ00104

Project Details

- **Project Code:** DAQ00104
- **Project Title:** Sponge and dough bread quality of Australian germplasm
- **Start Date:** 01.03.2007 **End Date:** 30.06.2011
- **Supervisor:** Glen Fox (Senior Research Scientist)
- **Organisation:** Department of Employment, Economic Development & Innovation
PO Box 2282 Toowoomba QLD 4350
- **Contact Name:** Glen Fox
Phone: 07 4639 8830
Email: g.fox1@uq.edu.au

Summary

The main grade of wheat targeted for the export sponge and dough (S&D) market is Australian prime hard (APH). By association, protein should be a key parameter relating to S&D quality, specifically loaf volume (LV). Surprisingly, the project revealed a low level of correlation between total protein content and LV. It appears that protein composition may be the key to understanding S&D quality, as the glutenin Glu D1 5+10 subunit contributed to the highest LVs. The current varieties Kennedy^A and Sunzell^A, together with several breeding lines, provided a consistently high quality over a number of seasons. These varieties performed as well as, if not better than, North American S&D varieties.

Report Disclaimer

This document has been prepared in good faith on the basis of information available at the date of publication without any independent verification. Grains Research & Development Corporation (GRDC) does not guarantee or warrant the accuracy, reliability, completeness or currency of the information in this publication nor its usefulness in achieving any purpose. Readers are responsible for assessing the relevance and accuracy of the content of this publication. GRDC will not be liable for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on information in this publication. Products may be identified by proprietary or trade names to help readers identify particular types of products but this is not, and is not intended to be, an endorsement or recommendation of any product or manufacturer referred to. Other products may perform as well or better than those specifically referred to. Check www.apvma.gov.au and select product registrations listed in PUBCRIS for current information relating to product registration.

Copyright

Grains Research and Development Corporation. This publication is copyright. Apart from any use as permitted under the Copyright Act 1968, no part may be reproduced in any form without written permission from the GRDC.

Old or Archival Reports (Projects that concluded in 2005 or earlier)

The information contained in these older reports is now several years old, and may have been wholly or partially superseded or built upon in subsequent work funded by GRDC or others. Readers should be aware that more recent research may be more useful for their needs. Findings related to agricultural chemical use are also potentially out of date and are not to be taken as a recommendation for their use.

Conclusions

The main conclusion to be drawn from this project was that a range of Australian wheat genotypes were equal to the North American varieties that currently dominate the S&D market. Kennedy^A and Sunzell^A were of equal quality to the hard red spring wheat AC Barrie and other North American varieties. Ten unreleased breeding lines demonstrated high standards of S&D quality, and have the potential to improve the Australian S&D suitable wheat stocks through either direct release or use as parents by the breeding companies. In addition, it was confirmed that a very high portion of the varieties and breeding lines tested had the important Glu D1 subunit (5+10) which is related to the key S&D quality factor of improved LV. This is the same subunit contained by AC Barrie.

Australian breeding programs have readily adopted the S&D product evaluation method in screening their breeding material. This will assist them in selecting new breeding lines, targeted for the northern region, with suitable quality for the high value S&D export markets.

Recommendations

The data from this project will be sent to the breeding companies and other project collaborators. This will provide the basis for selection of breeding lines with improved S&D quality.

The other major market for APH wheat is the yellow alkaline noodle (YAN) market and this project did not include resources to cover any YAN analysis. The inclusion of this analysis would have positioned all the breeding programs, targeting APH varieties, to fully understand the quality required for the main two export markets for APH wheat varieties. It is strongly recommended that consideration be given to testing current and potential breeding lines for both S&D and YAN quality. The YAN quality testing of subset of lines and varieties based in usual rheological and noodle tests should undergo sensory evaluation in collaboration with Grain Growers Limited (Sydney) or another organisation qualified in consumer and sensory science. This would facilitate a market driven value chain approach likely to improve the market reach and attractiveness of Australian wheat.

We also recommend that wheat marketers focus on exporting customised bulks of varieties with S&D quality containing the 5+10 Glu D1 subunit. This will ensure more consistent end-product quality, rather than blending varieties with different subunit combinations. Consistency is critical to creating end-user demand. As part of this process, grower variety declaration is very important and as a consequence, variety testing should be increased to ensure correct declarations.

Improved promotion of specific S&D varieties rather than just any APH variety, by the breeding companies and wheat exporters, would help in the communication pathway to export markets.

Outcomes

Economic outcomes:

The results show there are a number of Australian APH varieties (Kennedy^A and Sunzell^A) which match Northern American varieties, such as AC Barrie, for S&D quality. Appropriate communication to growers to increase tonnage of such varieties at APH grade would ensure an increase in S&D suitable wheat available for export. In addition, the provision of data from this project for use by export traders would also increase the potential to regain some of the S&D market lost to North American varieties. Increased tonnage of a number of S&D quality varieties will also create the potential to develop export markets for individual varieties, rather than bulk cargoes.

The results from testing a section of Australian breeding lines show that all of the wheat breeding programs have material equal to, or better than, the North American varieties tested in the project. This information is critical for breeders to consider the potential to advance these lines for release or use as parents. The continued development of varieties suited to the S&D market will support long term export opportunities into this premium market.

Environmental outcomes:

Wheat remains the most important winter cereal in Australia, but particularly in northern region cropping systems. The APH grade remains the most desirable quality standard for northern wheat growers to target export markets

such as S&D. APH grade product requires a minimum protein of 13%; S&D ideally requires protein between 13% and 14%. It is critical that northern growers manage soil nutrition through rotations, double cropping with summer legume crops, or fallows, to preserve moisture and control diseases.

Social outcomes:

Most northern region grain growers prefer to double crops between winter and summer seasons. Information on farm management to optimise high value crops, such as APH wheat, enables growers to build a cropping system for maximum profitability driven by supplying premium quality grain. Increased and sustainable farm profitability builds regional economies, and adds to the national economy by aiding the Australian wheat industry to remain globally competitive through increased shares of premium export markets.

Achievement/Benefit

This project was undertaken to characterise quality traits required for the high value S&D export market for wheat. The most significant market for S&D wheat is Japan. The project focused on the assessment of S&D quality through detailed testing of grain from eight sites over four years. The project collaborators were the wheat breeding companies, industry (George Weston Technologies (GWT)), CSIRO, the Department of Agriculture and Food Western Australia (DAFWA) and the Department of Employment, Economic Development and Innovation (DEEDI). There was an open and shared focus among the parties to understand S&D quality and identify the top ten performers for both of the main bread baking processes. A positive feature of this project has been the enthusiastic support it has received from breeders, as demonstrated by the increasing number of entries contributed for evaluation each year. CSIRO have delivered molecular marker results (diversity arrays technology (DART) and single nucleotide polymorphisms (SNPs)) while GWT supplied rapid baking data. The project also worked closely with the GRDC National Statistics Program (Statistics for the Australian Grains Industry (SAGI)) to ensure appropriate field designs were followed up with second phase design for the laboratory testing, so as to extract the best possible interpretation of the data.

The overall results demonstrated a high genetic variance for key traits such as LV and protein. High protein is currently the primary grain quality attribute used to grade APH wheat for the S&D market. However, the study showed there was a very low genetic correlation between LV and protein over most of the sites. This suggests there may not be a genetic link between S&D quality and protein content. However, this was not the case when it came to protein composition. The key protein components in overall wheat protein are the glutenins. The important individual subunits of these b-units were 5+10 and 2+12, with the 5+10 subunit providing the highest LV across all the varieties and breeding lines tested. This result is highly important as it highlights the need to consider protein composition and structure in conjunction with overall protein content when it comes to establishing the needs for optimal end product quality. Another piece of evidence came from a single site assessment and used a gluten extraction in a rapid visco analysis (RVA) pasting test. While peak height can be related to LV in a starch RVA test, the protein RVA test showed a much better relationship between peak height and LV.

At the gene level, sequences for the key glutenin subunits are available. In this project, we found site variation linked to the specific chromosome regions associated with glutenin genes. However, the Glu D1 locus had the highest associations across more sites, supporting the positive relationship between this particular subunit and baking quality. The marker analysis included SNPs based on the CSIRO multiparent advanced generation intercross (MAGIC) population, which allowed more accurate identification of important chromosome regions and confirmed the results.

While protein is one important aspect in achieving APH quality classification, hardness is also important for baking quality. Interestingly, while hardness was related to S&D quality, the region on 5DS known to be associated with grain hardness was not linked to any LV results. This supports data from barley studies where allelic variation at the matching hardness locus on 5HS was not related to variation in end-use quality. Another genetic region of interest is located on 5H and is linked to endosperm cell wall structure which is, in turn, associated with endosperm hardness. These associations require further study as little is currently known in regard to wheat product quality and cell wall structure, although it is known that the cell wall components contribute to dietary fibre.

The development of a standard method to assess wheat grain qualities for S&D production has inspired keen interest from Australian wheat breeding companies, with each of the companies now using the method either in-house or through arrangements contracted with external quality testing laboratories. However, one limitation to effective adop-

tion of the methods by breeding programs is the recommendation to include second phase designs. This is because the costs of milling, rheology and baking are high and the second phase design requirement for extra laboratory duplicate samples could increase costs significantly. The SAGI project is investigating this issue.

The current commercial varieties Kennedy^A and Sunzell^A consistently performed well over all eight sites; being within the top ten across site entries. In addition, a number of other named varieties demonstrated high S&D LV- for example, Gascoigne was in the top 10 performers across all eight sites. New Australian varieties, Spitfire^A and King Rock^A, also performed well in the testing, demonstrating high LV.

Evaluation of the unreleased lines provided by the breeding companies revealed several genotypes with excellent S&D attributes. Six unreleased lines (B1301F, Ken89B1, SUN397H, SUN397I, VR1128 and VQ2791) were in the top 10 highest LV achieving lines, and another four unreleased lines (96-536-190, SUN397J, SUN405B and SUN401D) were in the top 20 entries for LV across all sites.

Intellectual Property Summary

All data are made available to collaborators under a specific contract.

Additional Information

Martin D, Cavanagh C, Banks P, Morell M, Taylor T, Tredwell L and Sheppard J (2007). Sponge and dough bread quality of Australian wheat germplasm. 57th Australian Cereal Chemistry Conference, Melbourne.

Martin D, Kelly A, Cavanagh C, Newberry M and Taylor T (2008). Sponge and dough bread research update. UQ Symposium on Cereal and Nutrition Sciences, Brisbane.

Martin D, Kelly A, Taylor T, Newberry M and Cavanagh C (2009). Trait correlations with sponge and dough bread loaf volume. 42nd Annual Australian Institute of Food Science and Technology Convention, Brisbane.

Taylor T, Kelly A, Newberry M, Cavanagh C, Martin D & Fox G (2011). Sponge & dough quality testing using RVA. 61th Australian Cereal Chemistry Conference, Tweed Heads.
