VALUE ADDED WHEAT CRC
PROJECT REPORT

Review of Program 2:
Products and processing

Convened by:  Di Miskelly

Compiled by: Clare Johnson

Date: November 2001

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VAWCRC Review of Program 2: Products and Processing

7 November 2001

Convened by Di Miskelly

Report compiled by Clare Johnson

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Summary

Overview: Di Miskelly
The Program currently consists of continuing projects, and new projects with elements continued from Quality Wheat CRC (quality assessment of germplasm, blending/breeding, optimisation of baking process, microbiological safety and stability of end products). The project on conditioning efficiency has just been completed, and others (sponge and dough, replacement of chlorination) are candidates for renewal. A draft charter has been prepared for project 2.1.2 (Quality assessment and applications for new and novel germplasm), involving NSW Agriculture and BRI, with a focus on waxy wheats, A/B starch granule ratio and extra strong wheats. Work should commence in the next month. New projects will be proposed in future years to replace those completing.

Blending: Geoff Cornish
This project continues from the work of Ferenc Bekes, developing models to explain why blends have better or poorer qualities than predicted from parent varieties (Quality Wheat CRC reports 35, 40; see also Colin Wrigley’s report #48 on current Australian wheat varieties).

Kukri (with Glu-1 1, 7+8, 5+10 and Glu-3 d,h,b, Rmax 475) and Janz (with Glu-1 1, 7+8, 2+12 and Glu-3 b,b,b, Rmax 225) were parents of 66 lines with Rmax range 140-640BU tested from the 1999 season. There is good potential to change properties by blending varieties with Glu-1 5+10 with 2+12 types. Work is to commence in December 2001, with aims of generating both knowledge and varieties to blend into sub-optimal grades to bring them up to specification. This requires back-crossed inbred lines.

It is important that knowledge from this project is transferred efficiently to breeding programs, e.g. by identifying markers for the quality traits, and we are in touch with Russell Eastwood (VIDA) on this. SA wheat breeders are currently signing IP agreements, after which, existing, more advanced lines will become accessible. Howard Eagles’ (VIDA) New Gene project would also feed in very relevant material, as both VIDA and SARDI are using glutenin alleles in breeding programs. David Martin (DPI Qld) would also interact on use of lines with strong alleles.

Oven technology: Thomas Adamczak
Continuing from work in Quality Wheat CRC, this project involves development of instruments for use as a system or as stand-alone items (humidity probe, on-line colour meter, on-line height sensor, on-line stickiness sensor, velocity probe). It also spans process optimisation, modelling and simulation, and integration via the Bakery Advisory System (BAS), which suggests process changes when required. (See QWCRC report 7 and subsequent annual reports). For current technical detail, see the accompanying slides.

Optimum conditions for proving, baking, and cooling have been established. The benefits include:
- reduced ingredient cost via reduced yeast and weight loss and increased water absorption
- increased process capacity due to shorter proving and cooling times
• maintenance of product quality including colour and texture.

Artificial neural network (ANN), computational fluid dynamics (CFD) and statistical models have been developed to provide efficient control systems with shorter response times, less requirement for experienced operators and more consistent weight loss. They will also enable prediction of the cold spots and heat distribution in the oven, and of weight loss and crumb temperature after cooling, resulting in commercial opportunities through consultancy & software sales. Total benefits to the collaborative partner are estimated at $3 million.

We are leading in 70% of the key areas, with assessment of water absorption and stickiness patentable, and a leading position in CFD. We are behind others in proving, but this was required within the package.

Plans include pilot demonstration of the Bakery Advisory System in a commercial bakery, development of a comprehensive model of oven heat distribution, development and demonstration of the feed-forward oven control model and completion of stickiness meter development. It should be operational by May 2002.

The pilot study could be used to pitch the system to manufacturers such as APV. A commercialisation plan is now required, and should be attended to by the Business Manager in 2002.

**Australian wheats for the sponge and dough process: Ken Quail**

The sponge and dough (S&D) process is widely accepted and used in existing markets (including fast food) in Asia, and North American wheat is favoured for the longer fermentation. The bread produced is considered to have improved flavour and texture, though the process requires additional space and time, management of the sponge and more expensive, high protein flour. Australia faces the risk of displacement of Prime Hard if the US achieve dual purpose wheats suitable for S&D and noodles, but this also represents a potential premium market for Australia if we can supply wheats suited to the S&D process.

The aim of this project is to identify the required wheat quality factors, test for them, and develop genetic material. Through a collaboration with a Singapore bakery, a test baking method was worked up, based on their process and specifications. Australian Prime Hard varieties performed poorly, though topped up with commercial gluten (<1%) to achieve similar protein levels to US wheats, but Kennedy performed well in S&D in Australian, and in Singapore and Malay bakeries. Nothing stands out as causal in Extensigraph data, Kennedy, Chara and Kukri are among varieties covering a range of types, currently being harvested in DPI Qld trials, and expected to yield a good range of data. Although it has a late maturity amylase problem, Kennedy has also performed well in the SARDI baking method.

An extension of this project is being negotiated with GRDC, as data from additional seasons would be valuable.
Strategies to replace flour chlorination: Ken Quail
Flour chlorination was banned in the UK in November 2000 and is thus likely to be banned in Australia. It increases stability of sweeter, high ratio cake batters as detailed in the accompanying slides, but consumers, OH&S and the EPO have safety concerns. Chlorinated flour gelatinises and peaks earlier than standard flour, so heat treatment of flour was examined. Treatment at 120°C for 90min contributed to cake volume, but the cake score was still reduced compared with that for chlorinated flour. Addition of wheat starch to optimise texture is producing promising results, and further ingredient trials will be done. Milling for lower ash and starch damage contributed to cake quality, but ozone treatment was ineffective and caused odour problems. Wheat type, and hence starch properties, and milling treatment have emerged as the best leads.
An extension of this project is also being negotiated with GRDC.

Microbiological safety and stability of end-products: Nancy Jensen
A survey of 102 high moisture soft noodle products, made in Australia and Korea from Australian wheat, was conducted. Many of these products are made by small local businesses with limited technical knowledge, and some products have high bacterial counts. Fresh Italian pasta has a lower water activity and can be retorted (a steam/thermal process) in the pack, so is considered a lower risk.

In refrigerated noodles, the risks were mainly from *Bacillus cereus*, the microflora consisting predominantly of spoilage organisms. The pH, water activity, refrigeration and relatively short shelf life were all found to be important for safety.

For shelf-stable noodles, although a pH below 4.6 is required to prevent growth of *Clostridium botulinum*, 5 samples with pH over 4.9 were found. The heat process they undergo is not severe and there is potential for survival of other spore formers and creation of conditions that allow growth of pathogens, if present. In challenge studies on Udon noodles, inoculated spores of *B. coagulans, B. subtilis, B. licheniformis, B. cereus, C. pasteurianum* and *C. butyricum* were unable to grow at pH 4 or 4.5.

Further work planned includes completion of studies on noodles at pH 4.5, inoculation studies to evaluate acids other than acetic acid (HAc) used in marketed products, thermophilic spoilage, breadcrumb and steamed bread studies and dissemination of results/HACCP guidelines to industry.

Investigations on increasing the conditioning efficiency of wheat: Jackie Moawad
On conditioning, there was a large variation in test weight of hard wheats, particularly in the first 2 hours, whereas soft wheats showed little change unless they were first conditioned to 15.5% moisture. A change was then observed in the first half hour. The rate of moisture penetration into the grain could thus be monitored by measuring the hectolitre weight over a selected time interval. While wheat is normally conditioned for 24 hours, these results indicate 4-8 hours would be sufficient, but this is not practical in current flourmill processes. Conversely, growers attempting to increase moisture may find they lower the test weight if they condition for less than 8 hours.

Wheat treated with chemicals (acetic acid, sodium hydroxide, SDS detergent/surfactant, ethanol) and Novozyme enzymes (Shearzyme 500L, Pectinex SMASH, Viscozyme L) displayed a very similar pattern to water-treated controls.
Introduction

Di Miskelly
Potential outcomes

-blending models developed in QWCRC applied in breeding programs

-small scale evaluation of novel genepool processing quality linked to appropriate applications

-automated process control systems used to optimise baking plants

-identification of key wheat parameters and appropriate varieties for sponge and dough breads

-alternative, cost effective strategies developed to replace flour chlorination

-microbiological safety of fresh and long-life noodles determined & used to develop HACCP QA

-identification of potential strategies to increase conditioning efficiency of wheat

2.1.2 Quality assessment and applications for new and novel germplasm

-Drafi AOP prepared

-NSWAg/ BRI

-waxy wheats, A/B granules, extra strong wheats
Blending –
consequences for wheat breeding

Geoff Cornish
Blending - consequences for wheat breeding

Project No. 2.1.1
Project Leader Geoffrey Cornish
Completion date 30 June 2004

Aims

• To extend the blending models previously developed to explain why blends have better or poorer qualities than predicted from parental varieties
• To apply blending models in wheat breeding programs

Glutenins and dough rheology

Genes Glu-1 Glu-3
GLX HMLW
Glutenins LMW
Dough rheology Rimax Extensibility
End products Range High

End Products

Dough strength End product
Low Rice, pasta
Medium Flax bread, white salter & instant noodles, steamed breads
High Pan bread, yellow alkaline noodles

Past research
Non linear interactions Glu-1 alleles

<table>
<thead>
<tr>
<th>Glu-1</th>
<th>Glu-3</th>
<th>Rmax</th>
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<tbody>
<tr>
<td>Kukri</td>
<td>1, 7+8, 5+10</td>
<td>d, h, b</td>
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<tr>
<td>Jant</td>
<td>1, 7+8, 2+12</td>
<td>b, h, b</td>
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</tbody>
</table>

2^3 = 8 biotypes
66 lines tested from 1999 season
Rmax range 140 - 640 BU

Past research
Glu-1 + Glu-3 interactions

Germplasm

A: 2^3, 7+8, 5+10
B: 2^3, 7+8, 2+12

300
250
200
150
100
50
0

Rmax

0 10 20 30 40 50 60 70 80 90 100 % A

0 100 200 300 400 500 600 700 800 900 1000 g/100 mL
### Current material

<table>
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<tr>
<th>Year</th>
<th>Trial site</th>
<th>DH lines</th>
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<tr>
<td>1999</td>
<td>Roseworthy</td>
<td>86 tested</td>
</tr>
<tr>
<td>2000</td>
<td>Roseworthy, Palmer</td>
<td>160 X 2 reps</td>
</tr>
<tr>
<td>2001</td>
<td>Roseworthy, Loxton, 3 Gld</td>
<td>180 X 2 reps</td>
</tr>
</tbody>
</table>

| Chara biotypes | 2001 | Horsham | Seed multiplication |

### Staff

<table>
<thead>
<tr>
<th></th>
<th>SARDI</th>
<th>VIDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr Geoffrey Corinah</td>
<td>10 Dec 2001</td>
<td>Dr Howard Eagles</td>
</tr>
<tr>
<td>Ms Rebecca Tomkin</td>
<td></td>
<td>July 2002</td>
</tr>
<tr>
<td>50% Technical Officer</td>
<td></td>
<td>50% Technical Officer</td>
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Optimization of the Key Stages of the Bakery Processes

VAWCRC Project : 2.1.4

Thomas Adamczak
Glen Pickett
John Kalitsis
Nan Therdthai (PhD-Project)

Objective

• To develop equipment and strategies for the optimization of bakery processes.

• Develop a computer system which will give bakeries the ability to operate consistently in a production environment (Bakery Advisory System).

• Development of Remote Continuous Quality Control System.
Outlines

Research

- Development of Instruments
- Optimization of Processes
- Modeling & Simulation

Application

- Bakery Advisory System (BAS)
- Software for Assisting with Equipment Design

Research

Development of Instruments

- Humidity probe
- On-line Color Meter
- On-line Height Sensor
- On-line Stickiness Sensor
- Velocity Probe

Scalers #1

RS-422
PLC 1
PLC 2
Ethernet Hub
Serial Cable (RS-485)

Thermistor Controllers: Zone 1 Zone 2

Serial Cable (RS-232)

Temperature Data Logger

Division

Internet

Oven

Cooler

Slicer

Bakery Advisory System (BAS)

Software for Assisting with Equipment Design
Summary of Instrument Development

On-line instruments have been developed to evaluate bakery processes including:
- Mixing
- Proving
- Baking
- Cooling

Significant commercial opportunities exist.

Research

2. Optimization of Processes

Water Absorption
Proving Conditions
Oven Conditions
Cooling Conditions
Optimization of Water Absorption & Oven Spring

Objective:
- To determine effects of water absorption on
  - Dough processibility
  - Bread quality.
- To optimize proving conditions.

Achievements
1. Maximum water levels that can be adjusted to obtain good processibility were defined.
2. Optimum proving condition to produce acceptable quality and best financial benefit were defined.

Optimization of Baking Conditions

Objective: To optimize baking conditions
- to minimize weight loss
- to complete starch gelatinization
- to maintain crust color.

Achievements:
Based on quadratic models, tin temperature and baking time were optimized to reduce weight loss to 7.0-7.5% (see Fig. 1).
Optimization of Cooling Conditions

**Objective:**

To optimize cooling conditions to reduce weight loss

- without reducing quality
- without processing difficulties.
Summary of Optimization

Established optimum conditions for proving, baking, and cooling.

The benefits include:

☆ Reducing ingredient cost due to
  - reduced yeast
  - reduced weight loss
  - increased water absorption

☆ Increasing process capacity due to
  - shorter proving time
  - shorter cooling time

☆ Maintaining the product quality including color and texture.

Research

Oven Modeling (ANN&CFD)
Cooler Simulation
Artificial Neural Network Modeling

Objective

: To evaluate influence of oven conditions on weight loss.
: To design feed-forward control system.

Progress

1) Temperature and humidity sensors installed.
2) Preliminary ANN model established.

ANN Model & Control System

Y1, Y2 = f (x1, x2, x3, x4, x5, x6, x7, x8)

Disturbances
- oven load (no. of loaves * weight) - x1
- gap between products - x2
- air humidity - x3
- initial dough temperature - x4
- conveyor speed - x5
- product variety - x6

Controller

set point (temperature)

heating rate (Y1, Y2)

Process

oven temperature - x7

weight loss - x8
Objective: To explain heat transfer and airflow patterns in the oven.

Progress
1) Sensors have been installed.
2) Data has been recorded to use for verification.
3) A preliminary model including conduction and convection has been developed.

Application:
1. Investigate fluctuation in weight loss and crust colour due to heat transfer patterns.
2. Re-design oven configuration to obtain uniform distribution and baking efficiency.
3. Design control systems.
Cooler Simulation

Objective:
To predict consequent cooling loss and final bread temperature from different cooling conditions including:
- Cooling temperature
- Relative humidity
- Airflow velocity
- Cooling time

Summary of Modeling & Simulation

ANN, CFD and statistical models have been developed.

The applications are:
- Efficient control systems with
  - shorter response times.
  - less requirement for experienced operators.
  - decreased fluctuation of weight loss.
- Prediction of the cold spots and heat distribution in the oven
- Predicted weight loss and crumb temperature after cooling.
- Commercial opportunities through consultancy & software sales.
Application

Bakery Advisory System (BAS)

- Water Absorption Control
- Divider Control
- Intermediate Control
- Volume Control
- Oven Temperature Control
- Oven Set Point Optimization
- Cooling Control

Objective:

- To provide industry with the tool to improve profitability and quality.
- with expertise to maintain long term benefits
- with the tools to reduce production losses.

To keep management levels aware of production statistics

To generate Maintenance Schedules
BAS

Bakery Advisory System 05_09_2001

Summary of BAS

BAS has potential to bring a benefit of approximately $3 million p.a. to the collaborative partner by installation in all bakeries. Pilot demonstration of the system is planned in the local bakery and should achieve:

- Reduced fluctuation of weight.
- On-line optimization of %yeast.
- On-line optimization of water absorption.
- Daily optimization of set point baking temperature.
- Reduced process loss.
**Application**

Software for Assisting with Equipment Design

Oven

Cooler
Software to Assist Oven Design

Items
1. CFD model.
2. Chart for optimum temperature profile.
3. Modification of oven configuration.

Benefits
1. Improved baking efficiency.
2. Increased the uniformity of crust colour.
3. Reduced the fluctuation of baking losses.

Software for Assisting with Cooler Design

Items
1. Cooler simulation software.
2. Chart for optimum cooling condition.
3. Modification of cooler configuration.

Benefits
- Improved cooling rate.
- Reduced cooling loss.
Summary of Software Assisting with Equipment Design

Software for assisting with oven and cooler design has potential to:
- modify the oven to overcome the non-uniformity of products due to heat distribution.
- modify existing oven and cooler to obtain higher efficiency.
- design new ovens and coolers to minimize capital cost.

Conclusion

- This research has contributed to the development of new instruments and software packages.
- The work in application areas demonstrates opportunities for reduction of waste and significant improvement in quality & production costs.

Total benefits to collaborative partner are anticipated at about $3 million.
Future Plan

- Pilot demonstration of Bakery Advisory System (BAS) in a commercial bakery.
- Development of a comprehensive model of oven heat distribution.
- Development and demonstration of the feed-forward oven control model.
- Complete the development of stickiness meter.

End.
Australian wheat for the sponge and dough breadmaking process

Ken Quail
Australian Wheat for the Sponge and Dough Process

Ken Quall
Chuck Walker
Bill Hogan
David Martin
Tessa Lever
John Shepherd

Sponge and Dough Process

Mix  →  Mix

Sponge  →  Divide 2hrs

Remix  →  Mould

Divide  →  Proof

Mould  →  Bake

6hrs  ↓  The sponge stage adds about 4 hours to the process
**Preparation of Sponge**

- 70% of flour
- 52% water
- no salt
- low FDT
- short mix

---

**Benefits of S & D**

- Wide market acceptance within existing markets.
- Considered to have improved flavour.
- Considered to have improved texture.
- Fast food requirements
Disadvantages of S&D

- Additional space
- Additional time
- Management of sponge
- High flour protein (more expensive flour)

Issue

- North American wheat is favoured in Asia for S&D
- Potential displacement of PH if US crack dual purpose
  - ie. S&D and noodles
- Potential premium market for Australia
Objective

- To determine if Australia has the potential to supply wheat of adequate quality for S&D.

- To identify the requirements to supply this market.
  - Wheat quality factors
  - Test for them
  - Genetic material

Test method

- Work with Malaysian and Singaporean flour millers and bakers.
  - Establish requirements
  - Flour specifications
**Method**

---

**Flour Performance**

![Flour Performance Graph](image-url)
Ingredient Effects

- Yeast level
- Amylase
- Fat
- Sugar
- Water
- Ascorbic Acid
- SSL
- Others

Processing Variables

- Finished dough temperature
- Sponge fermentation time
- Remix
- Proving
Effect of Sugar

Effect of Sponge Time
Leslie Institute

- Sowing trial 2000/01
  - 100 samples being tested
- Test baking method to match BRI results on smaller scale.
- Sowing trial 2001/02 currently being harvested.

Work in Progress

- Extra strong flour
- How critical is protein content?
- Milling extraction
- Flour age
Extension

- Results from the project are promising.
- Need additional seasons to be able to study flour quality parameters and gain further expertise in S&D technology.

Thanks

- GRDC
- CRC
- Leslie Institute
Strategies
to replace flour chlorination
as a treatment for cake flours

Ken Quail
Project 2.1.6:
Strategies to Replace Flour Chlorination

Ken Quail
Chuck Walker
Kirsty Germaine
Frank Bekes

GRDC
Quality/Value Added Wheat CRC
NZ Flour Millers
CSIRO Plant Industry
BRI Australia Ltd

Why replace chlorine?

- Chlorine is extremely reactive
- Environmental Protection Agency
- Occupational Health and Safety
- Consumer concerns
  - by-products
Legal status

- Europe
- Ban in the UK
- ANZFA
  - no current position

Application of chlorine

- Lighter and sweeter cakes
  - increased liquid
  - increased sugar
  - high ratio cakes
- increases in liquid and sugar level decrease batter stability
- sugar also raised the starch paste temperature
Effect of chlorine

- First recognised in the 1930's.
- Allowed sugar levels up to 140% by flour weight.
- Increased batter viscosity
  - greater foam strength
  - better batter stability
- Increased cake volume
- Increased crumb strength and resilience
Action of chlorine

- Bleach
- Lowers pH
- Protein
- Starch
- Lipids

Published strategies

- Heat treatment
  - wheat
  - flour
- Acetylation
  - ketene
  - acetic anhydride
- Recipe modification
Project aim

- Develop alternative strategies for chlorine treatments currently used for high ratio cake flours.
  - must be “clean”
  - cost effective
  - effective for cake manufacturers in Australia & NZ

Strategy

- Evaluate chlorinated flours to establish key features and provide a benchmark
  - use as a guide for modifications
- Apply published methods
  - seek to improve
- Develop new methods if required
Flours

- 24 commercial flours
- before and after chlorination
- Consistent pH

Bleaching
Ash and Starch damage

RVA Peak height
RVA time to peak

Extensograph
Cakes

Flour properties

- Changes
  - pH
  - bleach
  - starch gelatinisation
  - proteins

- Targets
  - low ash
  - low starch damage
  - low particle size
Higher temperature (Score)

Japanese heat treated
Ozone treatment

- Ozone generator
- Wide range of treatments with several flour samples
- No improvement
- Odour
- Mechanism for modification

Starch modification
- Added different starch types to modify the RVA traces to match the chlorinated flour.
Balancing starch

- Guar gum
- Egg
- Water
- RSM design to optimise

Optimised cake
Ingredient trials

- Amylase
- Emulsifiers
- CMC
- Xanthan and Arabic gums
- Egg white products
- Milk products ex CSIRO Food Science
- Flours ex CSIRO Plant Industry

Continuing work

- Flour treatment agents (new and novel) aiming to modify starch behaviour
- Wheat type, starch properties
- Milling treatment: is there a means to affect starch pasting?
- Further formulation balance
- Commercial trials.
Microbiological safety and stability of noodles, breadcrumbs and steamed breads

Nancy Jensen
Microbiological safety and stability of noodles, breadcrumbs and steamed breads made from Australian flour VAWCRC project 2.1.7

Nancy Jensen1,2, Yong Huang1,2, Allau Hocking1,2, Di Miskelly1,3
1 Food Science Australia
2 Value Added Wheat CRC
3 Goodman Fielder Milling & Baking

Summary
- Project overview
- Noodles
  - Market place survey
  - Results
  - Challenge studies
  - Dissemination of results
- Other products

QWCRC to VAWCRC
- Microbiology of milling processes (QWCRC)
- End products of Australian flour (VAWCRC)
  - Noodles, breadcrumbs, steamed breads
  - Sharing results with industry

Noodles
- Increased availability and consumption
- Limited data
- Risks
  - Small businesses, limited technical knowledge
  - High bacterial counts in some products
  - Some shelf stable
  - Re-heating inadequate?

Breadcrumbs
- Potential hazards from mould growth
  - Mycotoxins?
  - Heat stable mycotoxins?

Steamed breads
- Have caused food borne illness
- Consumption probably increasing
- Need to identify (and minimise) the risks.
Noodles:

- Refrigerated
  - locally manufactured
  - 'short' shelf life
  - may be cooked
  - wide pH range

- Shelf stable
  - imported
  - 6-12 months shelf life
  - heat processed
  - generally pH < 4.6 (acid washed)

102 samples:

- Sydney, Brisbane, Adelaide, Korea
- Brand duplication avoided
- Tested within shelf life
- 70 refrigerated (including 12 Asian pastry samples)
- 32 shelf stable

Analyses:

- Standard plate count
- Coliforms
- E. coli
- Bacillus cereus
- Staphylococcus aureus
- Salmonella spp.
- Listeria monocytogenes
- Lactic acid bacteria
- Aerobic spores
- Clostridia (42 samples only)
- Yeasts and moulds
- pH, aw

Shell stable noodles:

- 32 samples
- No pathogens detected, commercially sterile
- pH < 4.6 mostly
- Aw 0.90-0.99

Refrigerated noodles:

- 70 samples
- Salmonellae, S. aureus, L. monocytogenes not detected
- E. coli detected in 2 pastry samples only (240, >1100 MPN/g)
- Clostridia detected in 6/17 samples
- B. cereus detected generally in low numbers
- Aw 0.93-0.99

<table>
<thead>
<tr>
<th>Bacillus cereus</th>
<th>Noodle type</th>
<th>No. tested</th>
<th>No. +/-</th>
<th>No./g</th>
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<tr>
<td>Fresh white</td>
<td>12</td>
<td>1</td>
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<td>Hokkien</td>
<td>20</td>
<td>6</td>
<td>1</td>
<td></td>
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<tr>
<td>Udon</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Fresh yellow alkaline</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>Fresh yellow alkaline egg</td>
<td>3</td>
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<tr>
<td>Fresh egg</td>
<td>9</td>
<td>7</td>
<td>1.5</td>
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<tr>
<td>Pastry</td>
<td>12</td>
<td>6</td>
<td>1-&gt;100</td>
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Refrigerated noodles

What did we learn?
- Refrigerated noodles
  - Risks mainly from *B. cereus*
  - Microflora predominantly spoilage organisms
  - pH, a_w, refrigeration, relatively short shelf life all important for safety

Shelf stable noodles
- Seemingly low risk, but:
  - pH < 4.6 (5 samples pH > 4.9)
  - Heat process - not severe
    - Survival of other spore formers?
    - Create conditions which allow growth of pathogens, if present?
- Challenge studies

Challenge studies
- Growth of acid tolerant spore forming bacteria?
- Spores of spoilage and pathogenic bacteria during manufacture?
- Likelihood of thermophilic spoilage?

Survival of acid tolerant spore formers
- Udon, Hokklen noodles
- pH 4.5
- *B. coagulans, B. subtilis, B. licheniformis, C. pasteurianum, C. butyricum, B. cereus*

Udon noodles, pH 4.0
- Aerobic, 2°C
- Anaerobic, 2°C
- Aerobic, 37°C
- Anaerobic, 37°C
Next phases:
- Complete studies on noodles pH 4.5
- Inoculation studies of manufacturing process
  - Have evaluated one process (with MAC) against B. cereus spores
  - Other acids used in marketed products
- Thermophilic spoilage
  - Incubation by participant company
  - Identify isolates
  - Assess risks
- Dissemination of results
  - Industry keen to have feedback and improve processes
  - HACCP, industry guidelines?
- Breadcrumbs
- Steamed breads
Investigations on increasing the conditioning efficiency of wheat

Jackie Moawad
INVESTIGATIONS ON INCREASING THE CONDITIONING EFFICIENCY OF WHEAT

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Introduction

- Conditioning is an important step in the preparation of wheat for milling
- Wheat is usually conditioned to a moisture content of 13.5 - 17.5%
- It is at this moisture content that maximum flour yield is obtained with minimal bran contamination during milling

Introduction

Two steps to the conditioning process
- amount of water to be added
- time taken for wheat to reach equilibrium

Aim

1) To monitor the rate of water penetration into the grain
2) To investigate methods both chemical and biological which may reduce the conditioning time and therefore increase the efficiency of milling

Aim

3) To investigate ways of increasing flour yield by enhancing bran separation from adhering endosperm
4) To investigate the effect of the new conditioning processes on flour quality, by-product quality and milling

Monitoring the Rate of Water Penetration Into Grain
Chemical Approach

Aim
To see whether the use of chemicals will have an effect on the rate of penetration into wheat and hence the efficiency of the conditioning process.

Method
1) Four chemicals are to be used: acetic acid, sodium hydroxide, sodium dodecyl sulphate & ethanol
2) Sample is to be conditioned and the test weight to be measured.

Moisture Penetration for Hard & Soft Wheat

Moisture Penetration Using 1.0M Acetic Acid

Moisture Penetration Using 0.1M NaOH Solution
**Flour Data & Analysis**

**Biological Approach**

**Aim**
To see whether the use of enzymes will have an effect on the rate of penetration into wheat & hence the efficiency of the conditioning process.

**Method**
1) Three enzymes to be used:
   - Shearzyme 500L
   - Pectinex SMASH
   - Viscozyme L.

2) Wheat sample is to be conditioned using the above enzymes & test weight is to be measured at the following time intervals: 10, 11, 12, 13, 14, 16, 18, and 24.
3) Sample is to be test milled using the above time interval.
4) Flour obtained will undergo both analytical & end product testing with our main concern being bran content.

Flour Data & Analysis

Bran Scan Average % and Average Bran Speck Count for Shearzyme
Bran Scan Average % & Average Bran Speck Count for Viscozyme

End Product Testing

Rapid Dough Loaf and Total Score

Rapid Dough Loaf Volume & Total Score

Conclusion

- Rate of moisture penetration into the grain could be monitored by measuring the hectolitre weight over a selected time interval
- Use of chemicals & enzymes displayed a very similar pattern to water, so very little effect is seen in the rate of moisture penetration & hence the time.

<table>
<thead>
<tr>
<th></th>
<th>Shearzyme 500L</th>
<th>Pectinex SMASH</th>
<th>Viscozyme L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of moisture penetration into grain</td>
<td>similar to control</td>
<td>&gt; control</td>
<td>similar to control</td>
</tr>
<tr>
<td>Flour yield</td>
<td>similar to control</td>
<td>similar to control</td>
<td>&gt; control</td>
</tr>
<tr>
<td>Bran content</td>
<td>similar to control</td>
<td>similar to control</td>
<td>&gt; control</td>
</tr>
<tr>
<td>Raking quality</td>
<td>&gt; control</td>
<td>similar to control</td>
<td>similar to control</td>
</tr>
</tbody>
</table>
Conclusion

- Each enzyme had a different effect on quality and further studies need to be carried out such as looking at the most active ingredients present in the enzyme and the effect of varying concentration on the final product.