Quality assessment of Australian oat varieties and their performance in processing Asian oat products

Sabori Mitra, Nabeen Dulal, Mark Tucek

Presented by: Dr Sabori Mitra, Research Scientist, AEGIC
Australian oat industry

• A winter crop grown in Australian grain belt
• Production = 1.1 million tonnes for 2017-18 (ABARES)
• WA is the highest (> 45%) producer
• Highly regarded by international markets:
  ✓ Low moisture
  ✓ Bright colour
  ✓ Clean
  ✓ Plump grains
  ✓ Freedom from pests
China - a growing opportunity

What has been driving growth in China?

• Since mid 2000’s oat consumption has increased dramatically
• Current growth percent = 10%
• Chinese middle-class is continuing to expand
• Increased sophistication in health market and consumer awareness of health benefits

Source: Trade map, International Trade Centre based on HR code 1004-20,000
Asian oat products

Some understanding of oats for oatmeal but limited understanding of functionality or quality requirements for new oat-based food products

Selecting oat variety for purpose
- Oat flakes
- Oat milk
- Oat noodles
- Oat rice
AEGIC oat research project

Aims

To increase the value and consumption of Australian export oats

• Specific aims of the presentation:
  ✓ Understanding variation in quality characteristics between Australian oat varieties
  ✓ Investigating the functionality of Australian oat varieties and their suitability for various oat-based Asian food products
AEGIC oat research project

Outcomes from the project
• Identify quality requirements and preferences by Chinese oat users
• Benchmark Australian oats vs Chinese oats
• Document functionality of Australian and Chinese oats and their suitability for various oat-based Asian products
• Identify improvements required for the development of new oat varieties
• Building national capacity for oat quality research
Collaboration is the key – three partners

Professor Xin-Zhong Hu
College of Food Engineering and Nutritional Science

Dr Glen Fox
Nutrition and Food Science

Dr Pamela Zwer and Mr Peter McCormack
National Oat Breeding Program
Australian oat samples

- **8 Varieties:** Bannister, Dunnart, Mitika, Williams, Wombat, Yallara, Durack and Kowari

- **4 Locations:**
  - Western Australia (Cunderdin, Pingelly)
  - South Australia (Riverton, Turretfield)

- **2 Growing seasons:** 2015 and 2016
Oat and oat product quality

Oat grain

Dehulled oat (Groats)

Heat treated groats

Heat treated wholemeal oat groats flour

Oat-Rice

Oat Flakes

Oat-Milk

Oat-Wheat Noodles
Oat quality

• **Whole oat grain**
  - **Varietal variation** for hectolitre weight (HLW) and groat percentage were noted
  - **HLW**:
    - Durack (60.1 kg·hl⁻¹), Dunnart (54.16 kg·hl⁻¹),
  - **Groat percentage**:
    - Yallara (72.7%), Kowari (72.4%), Durack (71.9%)
    - Williams (68.1%)
  - Groat percentage a better indicator for milling yield than HLW
Oat quality

- **Oat groat**
  - **Varietal variation** significant for β-glucan, TDF, IDF, amylose, ash, protein, lipid, total starch, minerals (except Se)
  - **Seasonal variation**: 2015 had ↑ β-glucan and ↑ amylose ↓ SDF ↓ TDF than 2016

<table>
<thead>
<tr>
<th>Variety</th>
<th>β-Glucan (%)</th>
<th>Protein (%)</th>
<th>Total Starch (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wombat</td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
<tr>
<td>Williams</td>
<td>b</td>
<td>c</td>
<td>b</td>
</tr>
<tr>
<td>Mitika</td>
<td>c</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Yallara</td>
<td>b</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>Dunnart</td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
<tr>
<td>Bannister</td>
<td>c</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>Kowari</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Durack</td>
<td>b</td>
<td>d</td>
<td>c</td>
</tr>
</tbody>
</table>

Graphical representation of oat quality with different varieties showing variations in β-glucan, protein, and total starch.
Other nutritional aspects of oats

- **Minerals:**
  - Higher amount of K, Ca, Fe, Zn, Na and Se than other cereals
  - Kowari had highest of most minerals followed by Durack, Wombat and Mitika

- **Fatty Acid:**
  - Good balance of MUFA and PUFA
  - Oleic acid (MUFA) and linoleic acid-Omega 6 (PUFA) promote heart health
  - Yallara, Dunnart, Williams had highest Omega-6.
Oats in noodles

• Popularity and simplicity in processing make it an ideal base
• Lack of gluten in oats limits its utilisation in wheat based food products
• Addition of additives increase the incorporation of non-traditional ingredients in noodles
• Our target was
  ✓ To increase the oat incorporation to >50% by use of additives acceptable in Chinese industry
  ✓ Produce dried oat noodles with longer shelf life
Oat-wheat noodles processing
Oat-wheat noodle quality (colour)

CIE L* of Cooked Noodles (15 min after boiling) - Brightness

CIE a* of Cooked Noodles (15 min after boiling) - Redness

CIE b* of Cooked Noodles (15 min after boiling) - Yellowness

Oat-wheat noodle

Wheat noodle
Oat-wheat noodle quality (texture)

- Firmness was not significantly different between varieties
- Oat-wheat noodles had lower firmness and higher cooking loss than 100% wheat noodles
- REC and Resiliency: (+) correlation with protein; (-) correlation with fat
- Peak viscosity and Final viscosity: (+) correlation with firmness and resiliency
Oat-wheat noodle quality

**Oat-wheat noodle market in China:**
- Prefer oat noodles reflecting oat colour
- Prefer brighter oat noodles

**Varieties scoring highest for sensory:**
- Wombat, Mitika, Yallara and Kowari were selected as most preferred oat varieties for a location and year
Oat rice

• Processed to remove the bran layer (pearling)
• Oat rice is cooked and consumed with white rice in China
• Commercially available oat rice in Asian markets are generally
  ✓ Excessively pearled
  ✓ Not/inadequately heat-treated
Effect of pearling on oat groats

- Reduce the cooking time
- Increase the brightness
- Improve the eating quality
- β-glucan content did not change significantly
Groats colour vs oat-rice colour

CIE L*: Brightness

CIE a*: Redness

CIE b*: Yellowness

HT- Groats (heat treated)
OR- Oat-rice (heat treated)
Quality of oat rice

Oat rice market in China:
- Prefer golden yellow and bright coloured oat rice

Instrumental analysis of texture
- Varietal variations: hardness, adhesiveness, springiness, cohesiveness, gumminess, chewiness and resilience
  - Kowari, Yallara, Dunnart, Durack and Mitika had higher hardness

Sensory evaluation of texture
- Durack, Yallara, Dunnart, Wombat most preferred oat varieties for a location and year
Impact of groat quality on oat rice processing

![Graph showing the impact of groat quality on oat rice processing. The graph displays the roundness and pearling time for different groats. The categories are Wombat, Williams, Mitika, Yallara, Dunnart, Bannister, Kowari, and Durack. The roundness values are shown on the y-axis, ranging from 0.560 to 0.610, while the pearling time (s) is shown on the x-axis, ranging from 0 to 80. The groats are labeled with letters indicating different quality levels. For example, Dunnart is marked with 'a', and Kowari is marked with 'd'.]
Other work done/being done in this project?

6 Chinese naked oat varieties X 2 years X 2 locations: Quality analysis + performance in oat products

Oat flake and oat milk processing

Sensory evaluation of oat products
Conclusions

• The quality of Australian oat varieties were affected by genotype and growing season
• Oat quality information will be of great value for markets becoming technically sophisticated
• Oats have β-glucan and other high value nutrient components which can enhance its health image
• It was possible to use >50% oat flour for processing high quality dried oat-wheat noodles
• Mitika, Yallara, Wombat and Kowari selected for oat noodles by sensory panel
• Pearling improved the cooking and eating quality without compromising its β-glucan content
• Durack, Yallara, Dunnart and Wombat selected for oat rice by sensory panel
• Oat has the potential to increasingly become a staple of daily diets
Focus for future work

• Developing new and innovative healthy oat food products

• Other nutritional aspects in addition to β-glucan
Acknowledgements

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