Lupin Protein and Dietary Fibre Processes and potential food applications

Dr LiHui Liu, May 2016

FOOD AND NUTRITION UNIT
www.csiro.au
Lupin Production and Utilization

Production:

Contribute to the sustainability of cropping systems

600,000 t/2015, gross value of production at $150 million, mainly in WA

Australia is the largest lupin producer and exporter in the world

Current Utilisation:

Mainly animal feed,

Only 4% for human foods from kernels or kernel flour

(Source from DAF-WA, 2015)
Lupins vs other pulses

• Australian lupins are natural products high in protein and dietary fibre, very low starch, offering potential health benefits

• Lupin has the lowest GI of any commonly consumed grains and pulses

• Lupin gluten free and non GM
## Lupin* – Soy composition (g/100g)

<table>
<thead>
<tr>
<th></th>
<th>Lupin Seed</th>
<th>Lupin Kernel</th>
<th>Soybean Seed</th>
<th>Soybean Kernel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed coat</td>
<td>24-25</td>
<td>25</td>
<td>5-6</td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>33-36</td>
<td>38-45</td>
<td>30-60</td>
<td>↑</td>
</tr>
<tr>
<td>NSP (dietary fibre)</td>
<td>30-32</td>
<td>32-37</td>
<td>17-23</td>
<td>↓</td>
</tr>
<tr>
<td>Fat</td>
<td>5-6</td>
<td>6-7</td>
<td>17-28</td>
<td>↑</td>
</tr>
<tr>
<td>Ash (minerals)</td>
<td>3-5</td>
<td>3-5</td>
<td>4-5</td>
<td>Un-change</td>
</tr>
<tr>
<td>Soluble carbohydrates</td>
<td>8-9</td>
<td>10-12</td>
<td>11-20</td>
<td></td>
</tr>
<tr>
<td>Moisture</td>
<td>7-9</td>
<td>10-12</td>
<td>9-13</td>
<td></td>
</tr>
</tbody>
</table>

* *Lupinus angustifolius (ASL)*
Lupin vs Soy

Soy → Protein and Fat
Lupin → Protein and Dietary Fibre

Soy → Food
Lupin → Feed

Lupin production:
1999 – 1.6 MT
2005 – 0.6 MT

Lupin → Food

value

Feed - lupin seeds $250/T
Lupin for food applications

1. Whole seeds or kernels (mainly Asian foods)

Bean sprouts\textsuperscript{a}
Lupin drinks
Bean curd\textsuperscript{b}
Lupin sauce\textsuperscript{c}
Tempe\textsuperscript{d}

\textsuperscript{a} Yu, Kyle, Hung, Zeckler 1985; \textsuperscript{b} Hung, Kyle, Yu 1986; \textsuperscript{c} Yu, Kyle, Hung, Zeckler 1985; \textsuperscript{d} Hung, Papolais, Nithianandan, Jian, Versteeg 1990
Lupin for food applications

2. Food ingredients
   - Flour
   - Protein, $4k - $10k/T
   - Dietary fibre, $1.5k – 30k/T

3. Products with lupin ingredients:
   - Noodles, Pastas
   - Bakery products
   - Snack foods
   - Drinks
   - Tablets
Lupin kernel protein and dietary fibre fractions

Kernels / Kernel flour
- Wet extraction
- Separation

Lupin proteins
Lupin kernel fibres
Fibre flake

Drum drying
Lupin kernel protein and dietary fibre fractions

Kernels / Kernel flour
- Wet extraction
- Separation
  - Lupin proteins
    - Separation
      - Soluble proteins
      - Protein curd
        - Spray drying
      - Protein concentrate powder
      - Protein isolate powder
  - Lupin kernel fibres
    - Drum drying
    - Fibre flake
Lupin kernel protein and dietary fibre fractions

Kernels / Kernel flour
  - Wet extraction
  - Separation

Lupin proteins
  - Separation
  - Soluble proteins
    - Spray drying
      - Protein concentrate powder
      - Protein isolate powder
  - Protein curd

Lupin kernel fibres
  - Separation
  - Kernel soluble fibres
    - Spray drying
      - Soluble fibre powder
  - Kernel insoluble fibres
    - Drum drying
      - Insoluble fibre flake
        - Grinding
          - Fibre powder
    - Drum drying
      - Fibre flake
Lupin kernel protein and dietary fibre fraction process

Tank
Extraction/Mixing

Decanter
Separation

Clarifier
Separation

Drum dryer
Drying

UF
Concentration

Spray dryer
Drying
Lupin kernel protein and dietary fibre as food ingredients

Spray dried lupin proteins

Drum dried Lupin fibre

Ground Lupin fibre <425 μm
Lupin kernel protein and dietary fibre as food ingredients

Protein concentrate
- Foaming & gelling reagents as egg substitute
- High solubility for beverages

Protein isolate
- Emulsifiers or Protein Additives as high cost dairy protein substitutes for bakery or meat products, even yoghurt or ice-cream product
Lupin kernel protein and dietary fibre as food ingredients

- **Protein concentrate**
  - Foaming & gelling reagents as egg substitute
  - High solubility for beverages

- **Protein isolate**
  - Emulsifiers or Protein Additives as high cost dairy protein substitutes for bakery or meat products, even yoghurt or ice-cream product

- **Lupin kernel fibres**
  - Soluble fibres
  - Gelling & binding reagents for drink or meat products
  - Insoluble fibres
  - Binding reagent for bakery, meat or pasta products

- **Binding reagent for bakery, meat or pasta products**
Functional properties of lupin kernel fibre

Water absorption %

Oil absorption %

<table>
<thead>
<tr>
<th></th>
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<th>Oil absorption %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lupin flour</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lupin fibre</td>
<td>1200</td>
<td>400</td>
</tr>
<tr>
<td>Soy fibre</td>
<td>300</td>
<td>200</td>
</tr>
<tr>
<td>Oat fibre</td>
<td>100</td>
<td>300</td>
</tr>
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Functional properties of lupin kernel fibre

### Swelling power g/g

<table>
<thead>
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<th>Soy fibre</th>
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</thead>
<tbody>
<tr>
<td>60</td>
<td>10</td>
<td>20</td>
<td>10</td>
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<tr>
<td>70</td>
<td>10</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>80</td>
<td>10</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>90</td>
<td>10</td>
<td>20</td>
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### Solubility %

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<tr>
<td>60</td>
<td>30</td>
<td>40</td>
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<td>70</td>
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<td>80</td>
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<td>90</td>
<td>30</td>
<td>40</td>
<td>30</td>
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Lupin kernel dietary fibre as food ingredient
Lupin kernel protein & dietary fibre as food ingredients

Breads with lupin proteins

Lupin dietary fibre tablets
Lupin kernel dietary fibre as food ingredient

Fruit juices with lupin dietary fibre
Lupin kernel dietary fibre as food ingredient

Fruit bars with lupin dietary fibre
Lupin kernel dietary fibre Market Challenging

Australasian Natural Ingredients Ltd, Australia
George Weston Foods Ltd, Australia
KTS Group – Malaysia

(Source: Asia Pacific Food Industry, July 1998)
Lupin kernel dietary fibre market challenging

New range of beverages incorporating Sunbean fibre

Australian Natural Dietary Fibre and Protein Ingredients for the 21st Century

One of the World's Richest Sources of Natural Fibre and Vegetable Protein
WWW.TigerNutritional.com.au

On April 14, Australasian Natural Ingredients (ANI), launched two natural food ingredients which are at the leading edge of food technology. The technology is licensed exclusively to ANI by Australia's premier food research centre, Food Science Australia. Chief executive of ANI, John Sullivan, details the characteristics and commercial relevance of the fibre.
Lupin kernel dietary fibre market challenging
Lupin kernel dietary fibre market challenging
Lupin kernel dietary fibre market challenging
Future opportunities for lupin proteins

According to the FAO, the world’s population projected to reach 9.6 billion and the world demand for animal-derived protein is expected to double by 2050.

The world will need to find alternative protein sources to meet the nutritional demands without overstressing the environment. Lupin can be an economical source of plant proteins for the world demand.
Future opportunities for lupin dietary fibre

The Global Insoluble Dietary Fibres Market was valued at USD 2.18 billion in 2015 and is projected to reach USD 3.2 billion by 2020, at a CAGR of 7.8% during the forecast period from 2015 to 2020.

In terms of value, the Asia-Pacific region is projected to be the fastest-growing market with a CAGR of 15.5% during the forecast period from 2015 to 2020. China is expected to grow at the highest CAGR of 17.9% by 2020.
Conclusions

• An economical process could produce both lupin protein and dietary fibre ingredients

• With good functionality and highly favourable nutritional attributes, the lupin kernel fibre is a new and unique ingredient in a variety of Asian and Western-style food systems. The initial market response to some concept products was positive at Southeast Asia and Australia.

• To capitalize on the encouraging market response, nutrition professionals, food processors, food and ingredient retailers and marketing professionals should join forces to further promote food products from Australian sweet lupin.
Acknowledgements

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Many staff members of F&N involved in the projects

Special thanks to Dr Hung TV - senior research scientist for his work on lupins
Thank you
Lupini beans have a nutritional profile to die for. The problem is, most Americans have never heard of them. But that could change rapidly if the New York based entrepreneur behind BRAMI snacking beans gets his way.

BRAMI Inc founder Aaron Gatti told FoodNavigator-USA: “I put a pack in front of an angel investor and he ate it in two minutes”. “There are chickens and eggs everywhere in this industry: “Retailers won’t take you on unless you’ve got a distributor, and distributors won’t take you on unless you’ve got retail buyers. It’s the same with money. You can’t raise capital until you show investors real numbers, but you can’t show great numbers unless you’ve got capital, and so it goes on”.

Breaking News on Food & Beverage Development - North America
NY start-up unveils the ultimate plant-based protein snack: BRAMI lupini beans. By Elaine Watson+, 04-Apr-2016