The prebiotic potential of Australian honeys

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Introduction

- Gut bacteria significantly impacts host health & disease
- Prebiotics alter bacterial composition of gut
- Honey has prebiotic potential
Gut bacteria

$10^{14}$ bacteria (100,000 billion!!)

> 500 different types

<table>
<thead>
<tr>
<th>Location</th>
<th>Bacteria Types</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach</td>
<td>Lactobacilli</td>
<td>$10^2$ to $10^3$</td>
</tr>
<tr>
<td>Duodenum</td>
<td>Streptococci Lactobacilli</td>
<td>&lt; $10^{4.5}$</td>
</tr>
<tr>
<td>Jejunum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ileum</td>
<td>Enterobacteria Enterococcus faecalis</td>
<td>$10^3$ to $10^7$</td>
</tr>
<tr>
<td>Colon</td>
<td>Bacteroides Bifidobacteria Peptococcus Peptostreptococcus Ruminococcus Clostridia Lactobacilli</td>
<td>$10^9$ to $10^{12}$</td>
</tr>
</tbody>
</table>

and...
Gut bacteria

10^{14} bacteria

> 500 different types

- Stomach: 10^2 to 10^3
- Duodenum: < 10^{4-5}
- Jejunum
- Ileum: 10^3 to 10^7

- Colon: 10^9 to 10^{12}

- Lactobacilli
- Streptococci
- Lactobacilli
- Enterobacteria
- *Enterococcus faecalis*
- Bacteroides
- Bifidobacteria
- Peptococcus
- Peptostreptococcus
- Ruminococcus
- Clostridia
- Lactobacilli

and...
Why are gut bacteria important?

- Help modulate immune system
- Contribute to metabolism of the host
- Contribute to energy harvest from food
- Some gut bacteria associated with bowel diseases, allergy & obesity
- Need a balance of ‘good’ and ‘bad’ bacteria
### ‘Good’ vs. ‘Bad’ bacteria

<table>
<thead>
<tr>
<th>‘Good’</th>
<th>‘Bad’</th>
</tr>
</thead>
</table>
| **Health promoting:**  
Eg Bifidobacteria and Lactobacilli | **Exert harmful effects:**  
Eg Clostridia and Bacteroides |

<table>
<thead>
<tr>
<th>‘Good’</th>
<th>‘Bad’</th>
</tr>
</thead>
</table>
| Inhibit growth of harmful bacteria  
Stimulate immune functions  
Improve digestion and absorption of essential nutrients  
Synthesise vitamins | Involved in diarrhoea, infections and liver damage  
Can produce carcinogens  
Cause intestinal putrefaction |
Changes in gut bacteria

The gut system

- Food digested and absorbed in *small intestine*
- Simple sugars absorbed in *small intestine*  
  → i.e. fructose, glucose, sucrose
- Good bowel bacteria get left-overs  
  → need complex sugars

Honey contains simple AND complex sugars
What is a prebiotic?

- Complex sugars that:
  - are **not digested** in upper gut → reach colon intact
  - used as a food source by good gut bacteria

- Sources of prebiotics:
  - breast milk
  - some root crops (e.g. chicory)

- Differ from **pro**biotics - live bacteria
Probiotics vs. prebiotics

Live bacteria

Food for gut bacteria
Honey

- Super saturated sugar solution
  - Mainly fructose (36-50%) and glucose (28-36%) (simple sugars)
  - Oligosaccharide (~1-4%) (complex sugars)

- Exact composition: highly variable dependant on floral source

- Australian floral honeys unique

- Therapeutic properties
  - Antioxidant, immunostimulatory, wound healing, antimicrobial, prebiotic

- Not all honeys are the same
Is Australian honey a good prebiotic?

- Can good bacteria use honey to grow?
- Can honey help good bacteria out-compete bad bacteria?
Stage 1

- Can good bacteria use honey to grow?
  (tested 17 honeys)

Bacterial counts

Chemical analysis
Prebiotic effect of Australian honeys on the growth of good bacteria
Prebiotic effect of Australian honeys on the growth of good bacteria
Prebiotic effect of Australian honeys on the growth of good bacteria
Stage 2

- Can honey help good bacteria out-compete bad bacteria? 
  (17 + 22 honeys)

Phase 1: Simulate gut conditions
Phase 2: Use complex sugars in tests
Prebiotic Index (PI)

- Measures prebiotic capacity
- Generates ‘score’ of prebiotic effect

Bifidobacteria & Lactobacilli: (+)ve value

Bacteroides & Clostridia: (-)ve value
Prebiotic index values for Australian honeys

![Graph showing prebiotic index values for different substances and honeys. The x-axis represents substances and honeys, while the y-axis represents the PI index values. Inulin, Sucrose, No sugar, Honey 2, Honey 5, Honey 7, Honey 9, and Honey 14 are listed along the x-axis. The graph indicates varying PI index values for these substances and honeys.](image-url)
All Australian honeys support growth of good bacteria (lactobacilli)
All Australian honeys suppress growth of bad bacteria (clostridia)
Prebiotic index values for Australian honeys
Prebiotic index and oligosaccharides
Chemical analysis of beneficial end products

![Graph showing the concentration of Butyrate (mM) in different honeys.](image)
What do these results mean?

- **Australian honeys:**
  - have prebiotic activity
    - oligosaccharides
  - deliver health benefits
  - could be an effective functional food ingredient

- **Each honey could provide different health benefits**
  - Prebiotic, nutritional, therapeutic
Acknowledgements

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