The ageing gut microbiota and the impact of prebiotics

Dr. Gemma Walton
Overview

- The transition of age
- Ageing and disease risk
- Ageing – the microbiota – from birth to old age
- Prebiotics – what can they do
- Immunosenescence and inflammageing??
How are we ageing?

- Population pyramid EU-28, 1994 and 2014
- (Eurostat)

Source: Eurostat (online data code: demo_pjangroup)
What does the future hold (2080)?

- Increased longevity
- Reduced fertility

(*) 2080 projections (EUROPOP2013). Source: Eurostat (online data codes: demo_pjangroup and proj_13noms)
Ageing

- A major risk factor underpinning chronic diseases.
- Longevity has increased – but a healthy life expectancy has not increased at the same rate, therefore age-related diseases increase
Age associated illness

- Diabetes
- Cardiovascular disease
- Cancers
- Depression
- Neurodegenerative diseases
- Mobility
- Vision
- Arthritis
- Hypertension
Gut microbiota changes – coincidence?

- The gut microbiota
  - Birth
  - Breast v Formula
  - Adulthood
  - Ageing
The ageing microbiota

- Bifidobacterial decline?
  - Mitsuoka, 1992; Hopkins et al., 2002; Woodmansey et al., 2004; Mueller et al., 2006

- Culturing

- Reduced bifidobacteria diversity (Zwielehner et al., 2009)
- Centenarian bifidobacterial reductions (Biagi et al., 2010)
The ageing microbiota

Other observations

- *Bacteroides* – higher proportion
- More *Clostridium* cluster IV
- Less *Clostridium* cluster XIV
- Claesson *et al.*, 2009
- Less short chain fatty acids
Ageing

- Is there a magic bullet to help healthy ageing?
Prebiotics

- Foods for the health promoting bacteria
- Not be broken down by our own enzymes
- Selective
**In vivo**


A randomised crossover study investigating the effects of galacto-oligosaccharides on the faecal microbiota in men and women over 50 years of age.

Walton GE, van den Heuvel EG, Kosters MH, Rastall RA, Tuohy KM, Gibson GR.

Not an elderly population
Target before changes occur
Interval Plot of Bifidobacteria
Bars are One Standard Error from the Mean

<table>
<thead>
<tr>
<th>Placebo</th>
<th>Prebiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>8.9</td>
<td></td>
</tr>
<tr>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>8.7</td>
<td></td>
</tr>
<tr>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>8.4</td>
<td></td>
</tr>
</tbody>
</table>

Panel variable: Treatment

*p = 0.006, t-test, p = 0.014 – Friedman
Gut model

- Three stage continuous culture system
- pH and volume
- RT
- Faeces from volunteers
- Steady state
- Increased butyrate
Re-addressing the balance

- Impact on health??

- Immunosenescence - loosely defined as decline in immune system brought on by ageing

- However - immune system is complex and multifaceted
Immunosenescence signs

- Decline of T-cell function
- Reduced progenitor B-cells
- Lower anti-body titre (humoural response)
- Reduce natural killer cell activities
- Inflammageing
B-GOS intervention

10 week intervention
Blood and faeces collected
• Positive shift in microbiota
• Increased natural killer cell activity
• Increased anti-inflammatory cytokine (IL-10)
• Reduced inflammatory mediator IL1-β

**Influence of galacto-oligosaccharide mixture (B-GOS) on gut microbiota, immune parameters and metabonomics in elderly persons.**

Vulevic J¹, Juric A², Walton GE², Claus SP², Tzortzis G¹, Toward RE², Gibson GR².

**Modulation of the fecal microflora profile and immune function by a novel trans-galactooligosaccharide mixture (B-GOS) in healthy elderly volunteers.**

Vulevic J¹, Drakoularakou A, Yaqoob P, Tzortzis G, Gibson GR.
Summarise

- Ageing concerns are increasing
- Prebiotic intervention
- Potentially positive microbial balance
- Increased SCFA
- Reduced signs of immunosenescence and inflammageing
- Potential strategies for healthy ageing
Acknowledgements

- Prof. Glenn Gibson
- Dr. Ellen van den Heuvel
- Dr. Jelena Vulevic
- Prof. Bob Rastall
Thank you!

- It’s all about the right balance