Microbiome analysis for personalised nutrition

This webinar is supported by Microba
Conflict of interest

Dr Alena Pribyl is employed as a Senior Scientist at Microba

Dr Paula-Smith Brown is employed as the Lead Dietitian and Microbiome Coach at Microba
Part 1:
The Science

PRESENTED BY:
Dr Alena Pribyl
Senior Scientist, Microba
A change in perception

Then:

Pathogen
“the only good bug, is a dead bug...”

Now:

Microbiome
Microbes are an essential part of us
Accessing our microbiome

Technological breakthroughs

Can access the gut microbiome without culturing using high throughput sequencing

Almost exclusively 16S rRNA-based to date
16s rRNA amplicon sequencing

Only “sees” known bacteria groups

No detection of un-characterised bacteria, viruses, fungi, protists

Low resolution

Poor reproducibility across labs

Limited functional insight
Solution: use the *whole genome*
Get *clearer* results with metagenomics

Species/strain level detection of microorganisms

Ability to identify bacteria, archaea, fungi, protists, DNA viruses

Functional potential
The gut microbiome and disease
Gut microbiota produce metabolites
Metabolites from fibre
Metabolites from protein
# Key metabolites influenced by diet

<table>
<thead>
<tr>
<th>Butyrate</th>
<th>Indolepropionic acid</th>
<th>Lipopolysaccharides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role: Main fuel source for intestinal cells, anti-inflammatory</td>
<td>Role: Strong antioxidant, protects nerve cells from damage</td>
<td>Role: Pro-inflammatory, linked to metabolic diseases</td>
</tr>
<tr>
<td>Resistant starch</td>
<td>Fibre, especially rye</td>
<td>High fat foods</td>
</tr>
<tr>
<td><img src="image1.png" alt="Resistant starch" /></td>
<td><img src="image2.png" alt="Fibre, especially rye" /></td>
<td><img src="image3.png" alt="High fat foods" /></td>
</tr>
</tbody>
</table>
Summary

Metagenomics provides a high resolution picture of the gut microbiome
  • Species level detection and functional potential

Microbial metabolites interact with the body and influence health
  • Fibre = metabolites associated with health
  • Protein = metabolites associated with both health and disease
  • Source of protein is important
Part 2:
Using the Microba *Insight* test

PRESENTED BY:
Dr Paula Smith-Brown
Lead Dietitian, Microba
(Accredited Practicing Dietitian)
Process overview

Consumer sample → Analysis & Bioinformatics → Digital interactive reports
Customer questionnaires

Questionnaires
This survey is an important part of understanding how your microbiome and health are connected. If you have agreed to be part of our Future Insights Project, it will also help our future research and give us the possibility of making new breakthroughs to help you and others.

Mar 2018
- Kit ID
  - Intervention
  - Overall progress
  - Day of Sampling: 12/12/2018
  - Food: 12/12/2018
  - Medical History: 12/12/2018
  - Exercise: 12/12/2018
  - Mental Health: 12/12/2018
  - View

Apr 2018
- Kit ID
  - Insight
  - Overall progress
  - Day of Sampling: 12/12/2018
  - Food: 12/12/2018
  - Medical History: 12/12/2018
  - Exercise: 12/12/2018
  - Mental Health: 12/12/2018
  - View

You now have access to your Microbiome Coach
- I acknowledge I have received my report for this Kit
- Make appointment

Complete your questionnaires to receive your report and gain access to your Microbiome Coach
- View report
- Continue
- View report
Microbial diversity is a general measure of microbiome health.
Microbiome Profile comparison

**Microbiome Profile comparison**

**Report overview**
- Microbial Diversity
- Your Microbiome Profile
- Important Species
- Microbial Eukaryotes
- Sample Composition

**Dig deeper into the detail**
- Microbial Metabolites
- Microbiome Digestion Potential
- Food Questionnaire
- Physical Activity Questionnaire
- Mental Health Questionnaire

**Faecalibacterium prausnitzii, A 3.80%**

The abundance of this species is about the same as than the comparison group.

*Faecalibacterium prausnitzii* (aka strains SL3/3 and M21/72) is an inhabitant of the human gut microbiome.

Fuel sources used: It can use fibre, resistant starch, simple sugars and acetate for energy.

Key metabolites produced: It can produce lactate, ethanol, and the short chain fatty acids acetate and butyrate.

Emerging research: Low levels of *F. prausnitzii* have been linked to Crohn’s disease, ulcerative colitis, colon cancer, type II diabetes and chronic fatigue syndrome. This species produces lower levels of butyrate than *F. prausnitzii, C.*

Microbiome Profile comparison

Example more diverse profile

Example less diverse profile
Top 5 species

Microbial diversity is a general measure of microbiome health.

The diversity of your gut microbiome is important. Microbial diversity is a measure of both the different types and the amount of bacterial species in your sample.

A varied diet rich in plant-based foods such as fruits, vegetables, whole grains and nuts is associated with increased microbial diversity. Low microbial diversity is often associated with poor health.

Does your sample have an overly high abundance of any single organism? No

Top 5 most abundant species

- Alistipes putredinis: 5.13% High READ MORE ABOUT THIS
- Bacteroides uniformis: 2.89% Average READ MORE ABOUT THIS
- Faecalibacterium prausnitzii_A: 2.80% Average READ MORE ABOUT THIS
- Ruminococcus_E bromii: 2.62% High READ MORE ABOUT THIS
- Agathobacter faecis: 2.46% High READ MORE ABOUT THIS

Food ideas to promote the health of your microbiome:

- Strawberries
- Apples
- Bread, pumpernickel
- Bran, wheat
- Almonds
- Carrots, raw

References: [1] [2] [3]
Proportion of species that can break down fibre

Investigate whether a microbiome is receiving adequate fibre intake is to look at the proportion of species that can break down fibre.
**Important species**

**Eggerthella lenta**

The abundance of this species is about the same as the comparison group. This is an inhabitant of the gut microbiota, but has also been associated with gastrointestinal infections. Fuel sources used: It can use the simple sugar glucose, protein and some sterolids for energy. Key metabolites produced: It can produce the short chain fatty acid acetate.

Disease associations: Elevated levels of *E. lenta* have been associated with frailty, atherosclerosis, chronic fatigue syndrome and type II diabetes. Emerging research: This species can inactivate the cardiac drug digoxin by breaking it down. Interestingly, this species prefers the amino acid arginine for growth. When arginine is present, this inhibits *E. lenta* from breaking down digoxin.

**Important species**

- **Biophila wadsworthia**

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The abundance of this species is about the same as in the comparison group. This is a common inhabitant of the human gut, but can become problematic at high levels.

**Fuel sources used:** This bacterium can use protein for energy and reduces sulphur.

**Key metabolites produced:** It produces the short chain fatty acid acetate and the gas hydrogen sulphide.

**Disease associations:** High levels of this species can promote increased inflammation in the gut and has been observed at high levels in patients with colon cancer.

**Emerging research:** High levels of *B. wadsworthia* is associated with a diet high in saturated fats.

**Functional potential**

Microbial Metabolites

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The abundance of this metabolite is about the same as the comparison group. Butyrate is a short chain fatty acid that is very important for gut health. It is the main fuel source for gut cells, helps keep the gut cell barrier intact, can reduce inflammation, and helps control appetite. Low levels of butyrate production have been observed in individuals with inflammatory bowel diseases. Consuming foods high in resistant starch (e.g. lentils, peas, beans, rolled oats) has been shown to increase butyrate levels. Although butyrate is very beneficial in most circumstances, animal models have suggested that when inflammation is already present, excessively high butyrate levels may delay the repair of gut cells.

Functional potential

Microbial Metabolites

<table>
<thead>
<tr>
<th>Microbial Metabolites</th>
<th>HEALTH INDICATOR</th>
<th>NEUROENDOCRINE</th>
<th>SHORT CHAIN FATTY ACIDS</th>
<th>ESSENTIAL VITAMINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimethylamine</td>
<td>ND</td>
<td>LOW</td>
<td>AVERAGE</td>
<td>HIGH</td>
</tr>
<tr>
<td>Ammonia (urease)</td>
<td>ND</td>
<td>LOW</td>
<td>AVERAGE</td>
<td>HIGH</td>
</tr>
<tr>
<td>B. fragilis toxin</td>
<td>ND</td>
<td>LOW</td>
<td>AVERAGE</td>
<td>HIGH</td>
</tr>
<tr>
<td>Beta-glucuronidase</td>
<td>ND</td>
<td>LOW</td>
<td>AVERAGE</td>
<td>HIGH</td>
</tr>
<tr>
<td>Hydrogen sulphide</td>
<td>ND</td>
<td>LOW</td>
<td>AVERAGE</td>
<td>HIGH</td>
</tr>
<tr>
<td>Lipopolysaccharide</td>
<td>ND</td>
<td>LOW</td>
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</table>

Most people’s gut microbiome contain a species of bacteria called Bacteroides fragilis. A small proportion of B. fragilis strains have the ability to secrete a toxin. In some people this toxin can cause symptoms such as diarrhea while other people can remain symptom free. There are concerns that this toxin can cause intestinal inflammation which could increase the risk of developing colon cancer. If you are experiencing diarrhea symptoms and have this toxin, consider seeing a healthcare practitioner.

References: [1] [2]
B Fragilis toxin
Trimethylamine

Choline

L-Carnitine

TMA (Gut) → TMAO → CKD ↑ TMAO Levels → Atherosclerosis

FMO
**FFQ Results**

No grains, low fibre
Proportion of species that can break down fibre

Investigate whether a microbiome is receiving adequate fibre intake by looking at the proportion of species that can break down fibre.
Proportion of species that can break down fibre

Investigate whether a microbiome is receiving adequate fibre intake is to look at the proportion of species that can break down fibre.
A healthy microbiome is a diverse fibre consuming microbiome.

Signs that a microbiome is not receiving enough fibre include:

- Low diversity
- Microbiome geared towards protein or mucus degradation
- High levels of protein degrading microbes, such as *Eggerthella lenta* or *Bilophila wadsworthia*.
- Low potential for producing SCFAs
- High potential for producing protein metabolites *e.g.* ammonia, trimethylamine, BCAAs or hydrogen sulphide.

This is further confirmation of the strong evidence base that a diet rich in plant foods is optimal for health.

Dietitians play an important role, particularly in those who may have gut disease or food allergy and intolerance and require specialist support to meet their fibre requirements.
Online training course for accredited practitioners

- Provides an introduction to the gut microbiome
- Overview of the latest research
- Descriptions of key species and microbial
- Metabolites linked to health and disease
- Learn how to interpret and integrate our
- Report into your clinic

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Microbiome analysis for personalised nutrition

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