National Science Challenges

HIGH-VALUE NUTRITION

Ko Ngā Kai Whai Painga

Priority Research Programme
Foods for improving gut function and comfort

Unlocking the mysteries of gut comfort

Nicole Roy, Professor

AgResearch and Riddet Institute

Host institution

The University of Auckland – Te Whare Wānanga o Tāmaki Makaurau – New Zealand

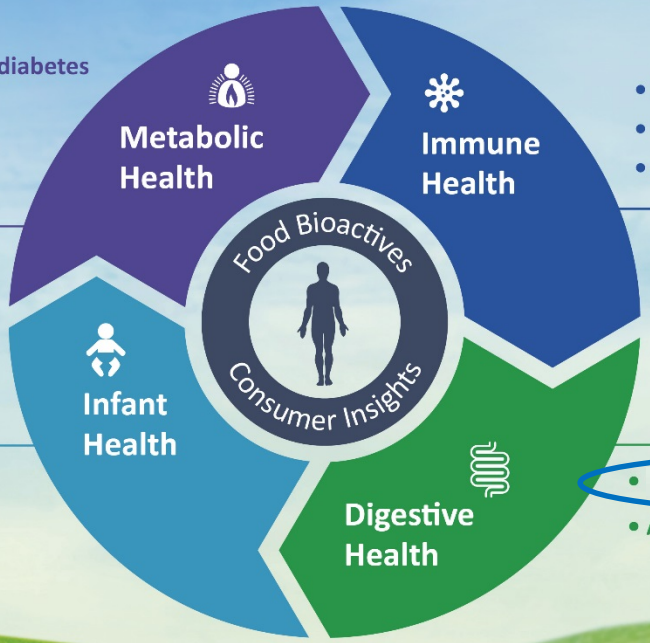
University of Otago – Te Whare Wānanga o Otāgo – New Zealand

Massey University – Te Kunenga ki Pūrehuroa – University of New Zealand

AgResearch

Plant & Food Research – Rangahau Ahumara Kai

High-Value Nutrition National Science Challenge research themes and projects



- TOFI: Thin on the outside, fat inside: preventing diabetes
- Kiwifruit for glucose control
- Combined proteins for lean body mass
- Grass-fed beef for cholesterol control

- Building immune defence
- Natural milk for allergy management
- Greenshell™ mussels to manage inflamed joints

- Complementary feeding for immune protection
- Fibres for sustained energy release

- Foods for gut function and comfort
- A2 Milk for gut comfort

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Irritable Bowel Syndrome is the ideal model for developing future foods with clinical evidence to support claims for healthy people

A translational approach aligned with HVN's mission

Using research excellence to enable the transformation of NZ's food and beverage industry into an exporter of high-value, scientifically-proven foods for health

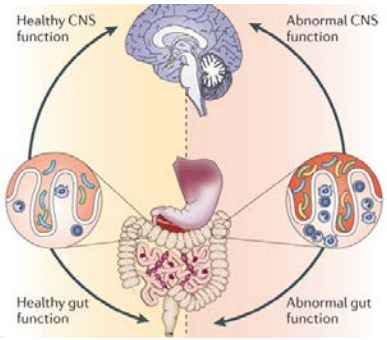
Digestive Health

- Market is large and growing (60% of functional foods)
- A rising concern worldwide for healthy consumers
- Central to broader health and well-being
- Interests from many consumers including lifestyle and technology consumers

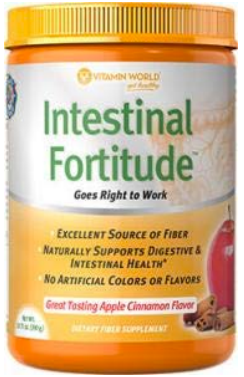
Understanding “healthy” digestion will grow food exports

- A **healthy gut** is critical to:
  - Physical health
  - Mental health
  - Well-being
- Mechanisms underpinning health are poorly-defined
- Food solutions for a healthy gut are sought after by healthy consumers

→ **We need a model for foods with clinical evidence of functionality to do this**



The gut is where the story starts for food



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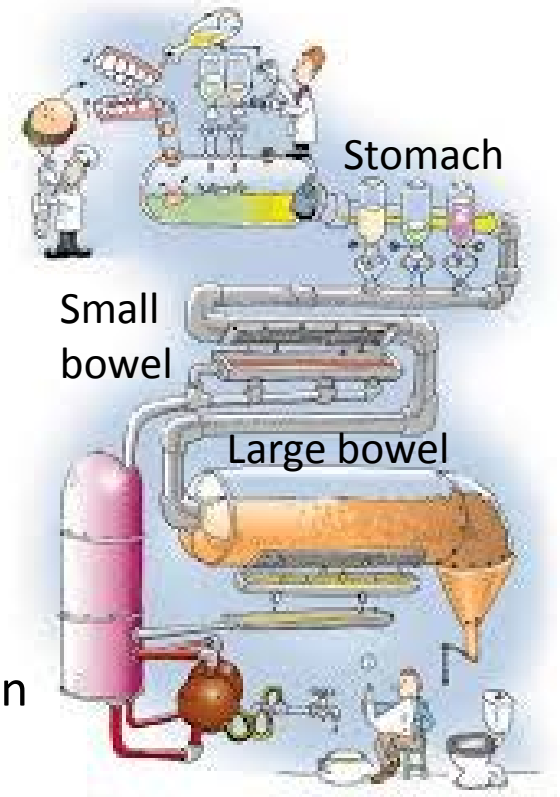
What a healthy gut does for you?

Efficient digestion
- Soft bulky stool
- Frequent bowel movement

Controlled inflammation

Intact mucous layer
(gut lining)

Balanced microbiota
Composition/fermentation



Optimal laxation
Optimal transit time
(no constipation/diarrhoea)

Comfort
- No bloating
- No pain
- No excessive flatulence

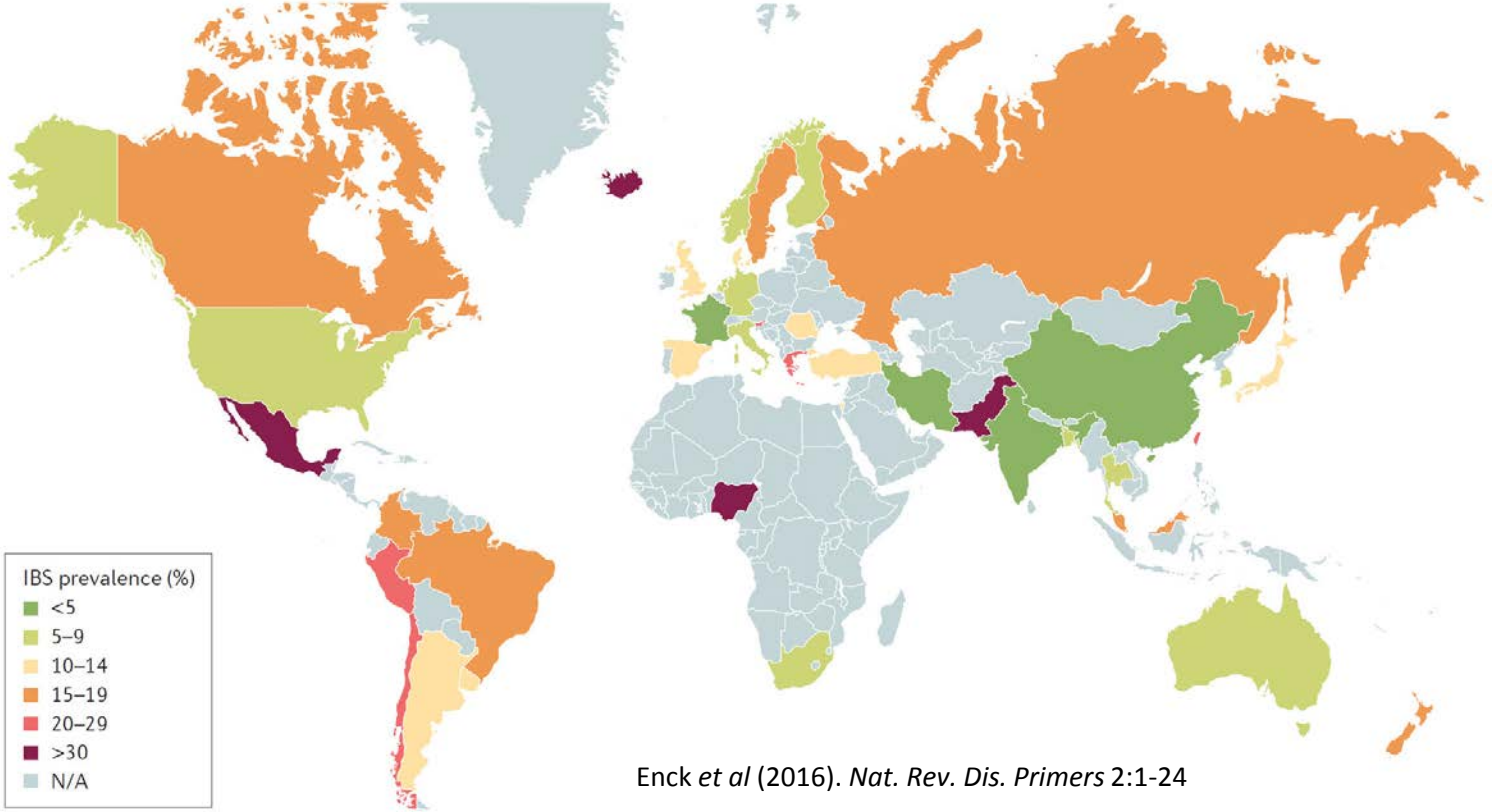
Suboptimal gut function and comfort is common

- Up to 60% of population reports gut symptoms
- ~30% of the population has at least one of the functional gut disorders
  - **“Everything looks normal”, no detectable disease**
  - Irritable bowel syndrome (IBS) – most common
    - IBS constipation (IBS-C)
    - IBS diarrhoea (IBS-D)
    - IBS mixed (IBS-M)
  - Functional constipation (FC) – most common
  - Functional diarrhoea (FD)

Thompson *et al* (2002). *Dig Dis Sci.* 47(1):225-35; Drossman (2016). *Gastroenterol.* 130:1377-90

World prevalence of IBS is high

11.2% (Range 1.1-45%)



Enck *et al* (2016). *Nat. Rev. Dis. Primers* 2:1-24

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Whai Painga

IBS has significant impact on quality of life

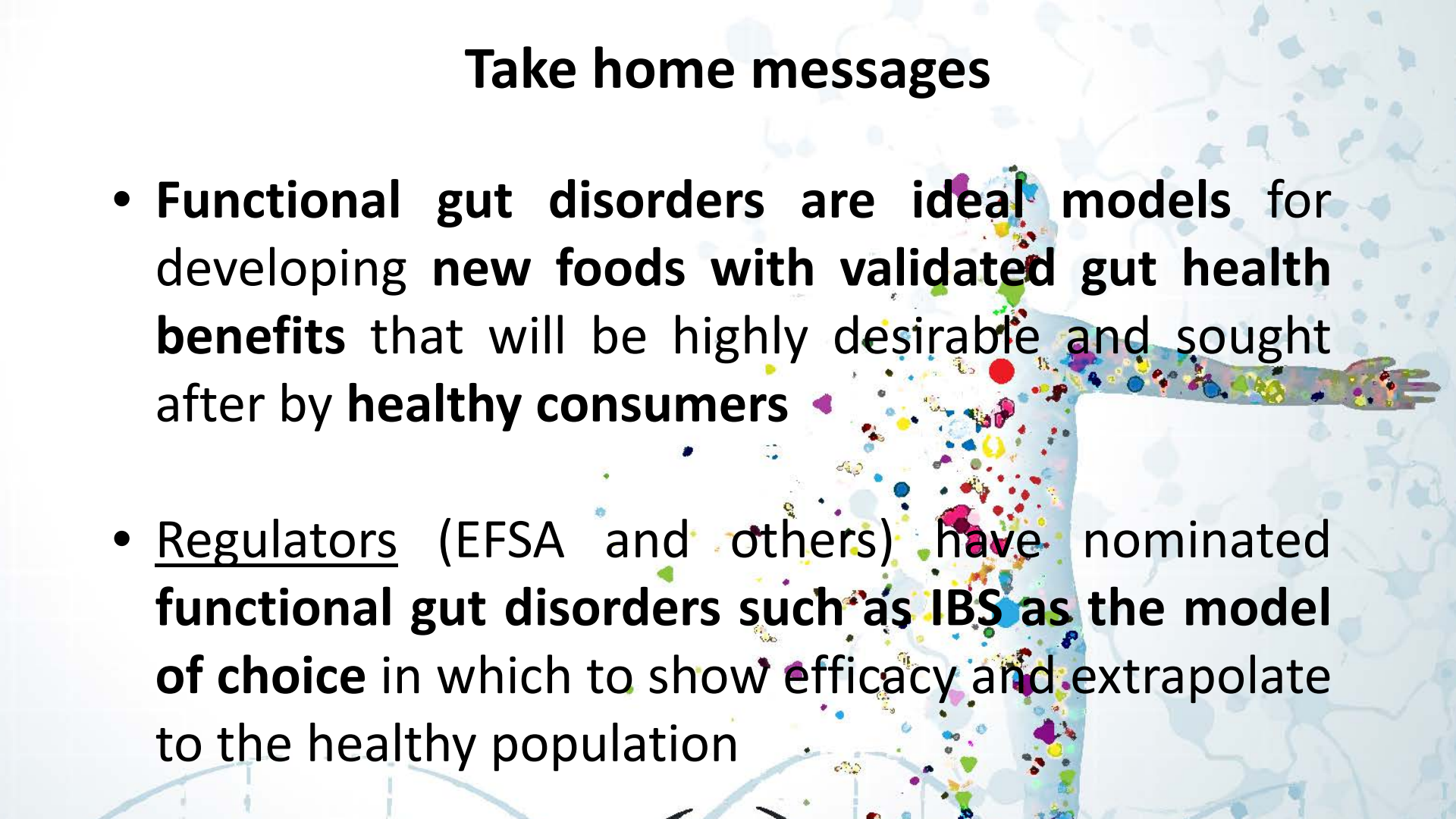
- Common; 1/6 women, 1/9 men
- 12% of visits to general practice
- Three-fold increase in:
  - School and work absenteeism
  - GP visits
- Association with depression and anxiety

Barbara *et al* (2015). *FISMAD*; Bahn *et al* (1999). *Digestion* 60:77-81

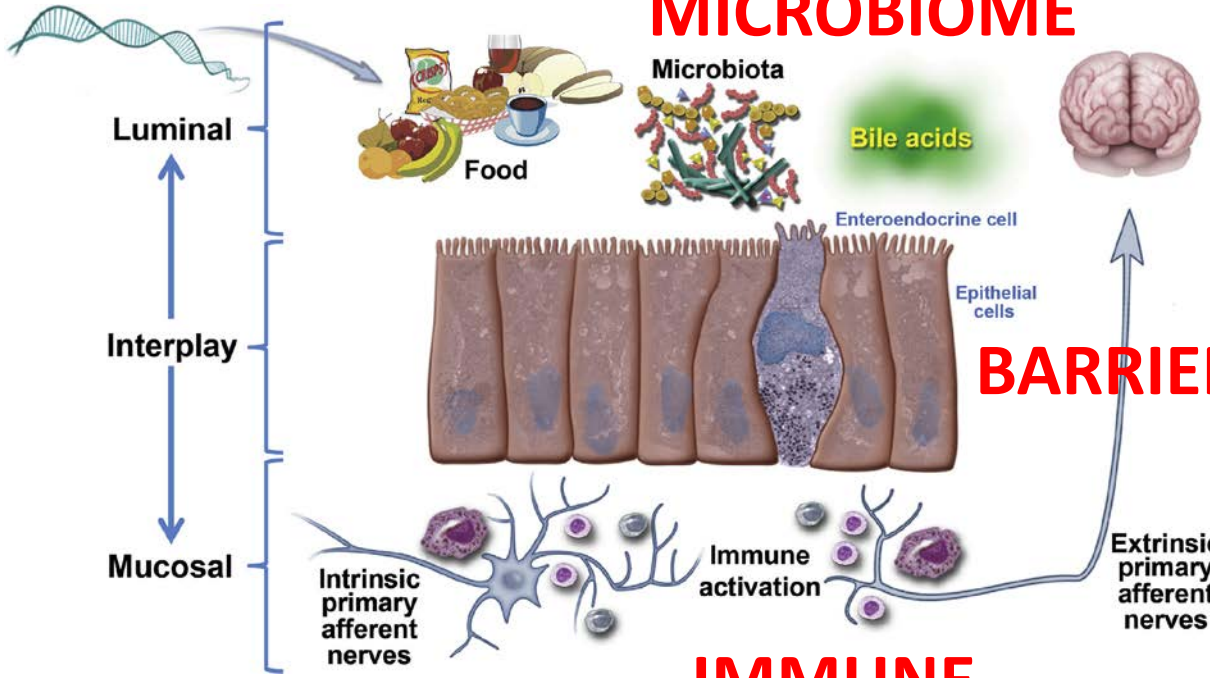
Take home messages

- **Functional gut disorders are ideal models** for developing **new foods with validated gut health benefits** that will be highly desirable and sought after by **healthy consumers**

- Regulators (EFSA and others) have nominated **functional gut disorders such as IBS as the model of choice** in which to show efficacy and extrapolate to the healthy population



What underlies functional gut disorders?



MICROBIOME

STRESS

ANXIETY

BARRIER

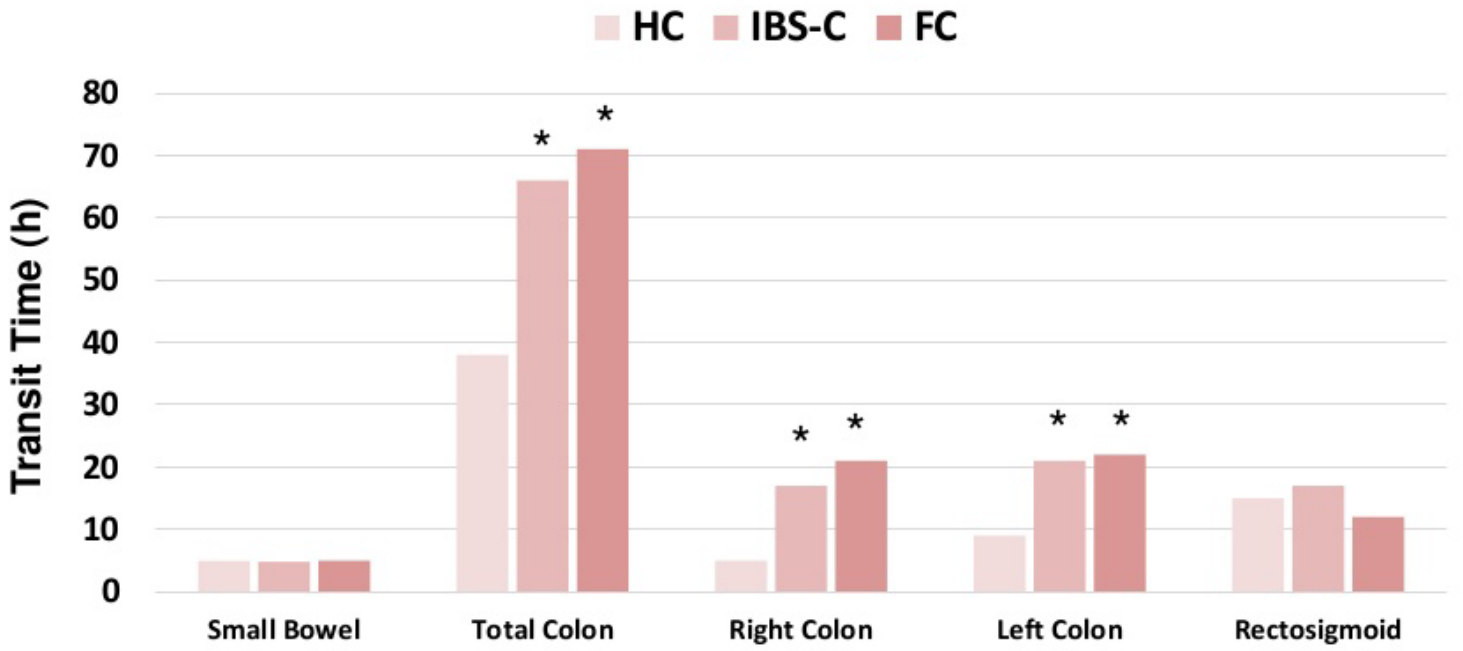
PAIN

IMMUNE

TRANSIT

Barbara *et al.* 2016. *FISMAD*

Longer colon transit time in IBS-C and FC

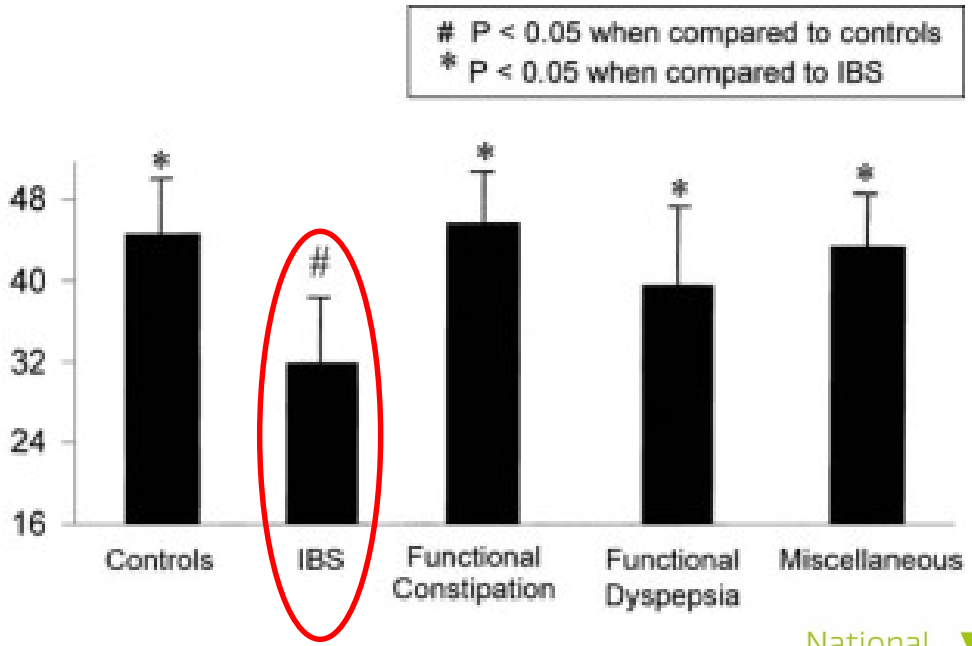


Rao *et al* (2011). *Neurogastroenterol Motil.* 23:8–23

Pain develops at a lower threshold in IBS subjects

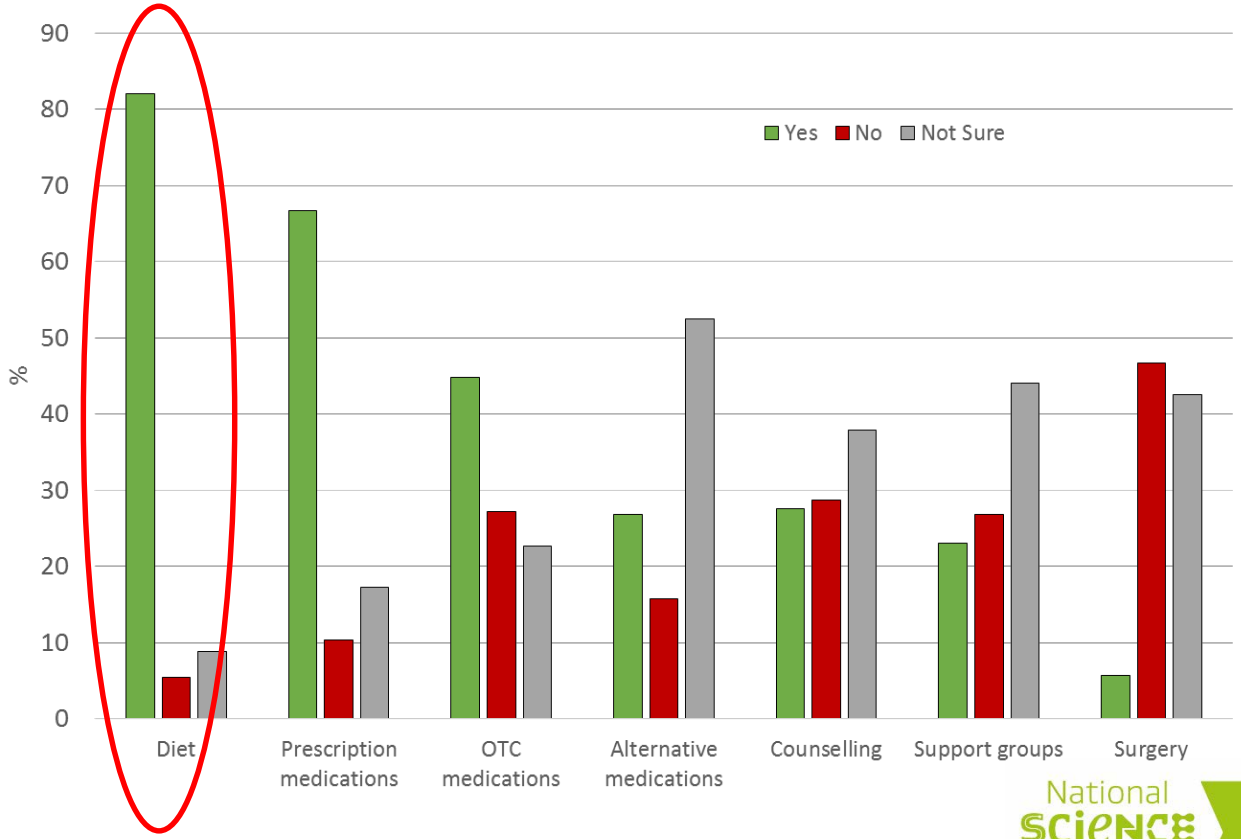
→ Hypersensitive gut

Rectal pain threshold (mmHg) in response to rectal balloon inflation



Bouin *et al* (2002). *Gastroenterol.* 122(7):1771–77

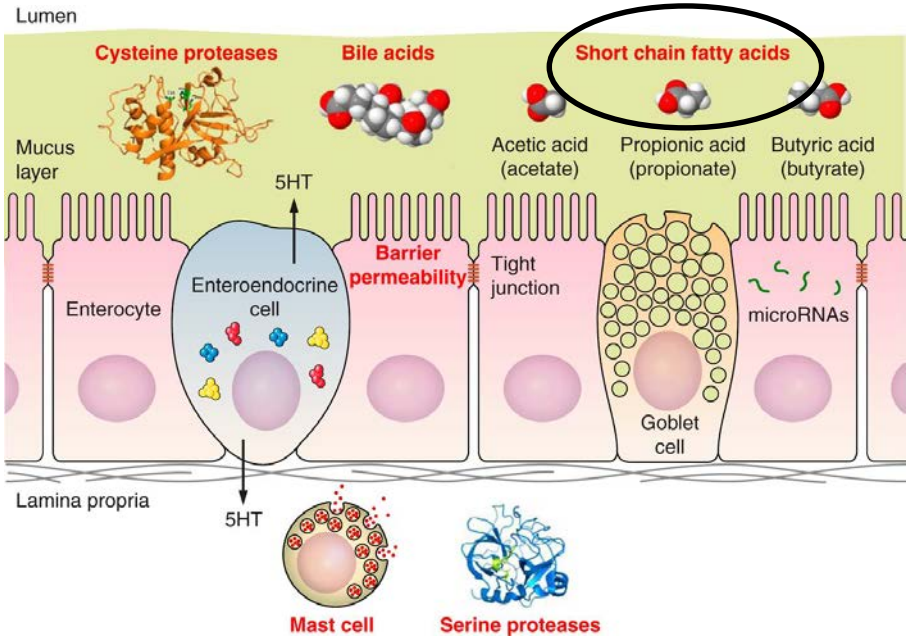
People's beliefs: food is effective for IBS



OTC: Over the counter

Lacy *et al* (2007). *Aliment Pharmacol Ther.* 25(11):1329-41

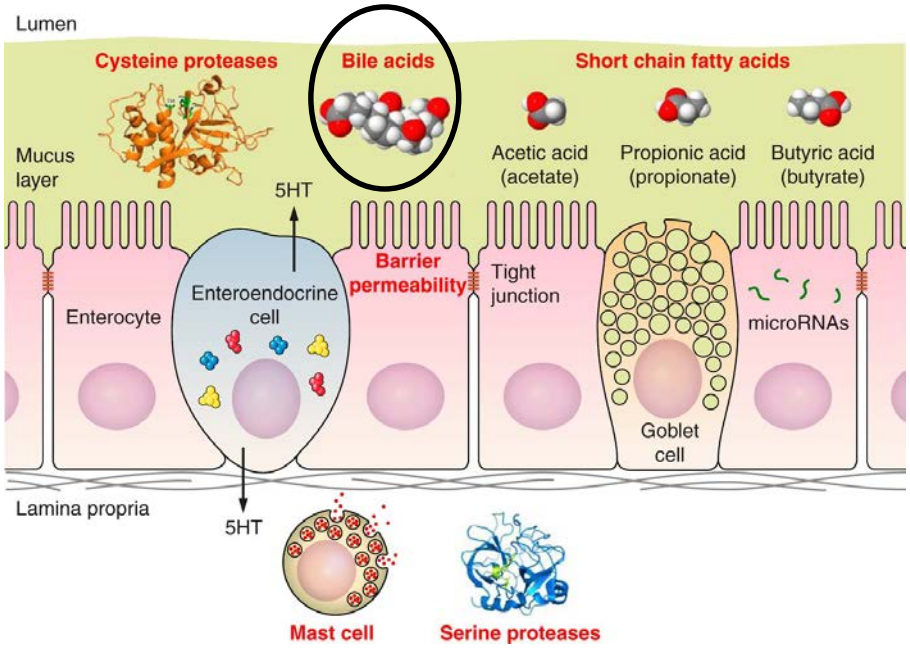
Host-microbe interactions: Short-chain fatty acids



- Products of bacterial fermentation in the colon
- Main energy source for colonocytes
- Altered faecal concentrations or composition with IBS
- Cause or consequence of altered gut transit?

Camilleri *et al* (2016). *Am J Physiol Gastrointest Liver Physiol.* 311(5):G777-84

Host-microbe interactions: Bile acids



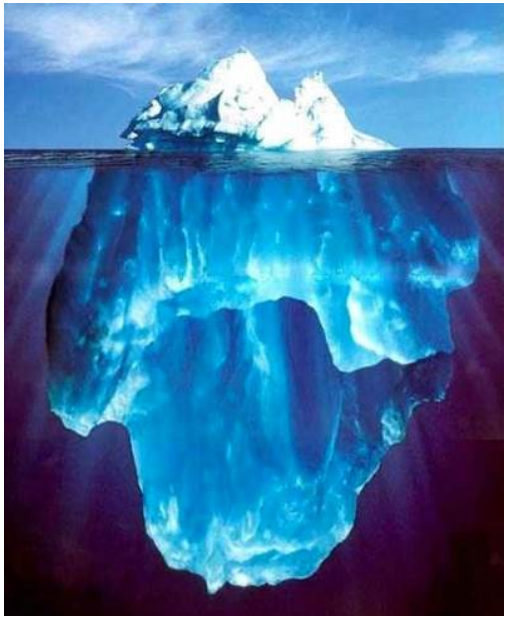
- **Primary forms** are synthesised by the liver
- **Secondary forms** result from bacterial actions in the colon
- Digestion of dietary lipids
- Altered faecal and plasma levels in IBS individuals
- How microbiota transform them?
- Role in gut motility and secretion?

Camilleri *et al* (2016). *Am J Physiol Gastrointest Liver Physiol.* 311(5):G777-84

What we understand

Newfoundland, Canada

What we do not know



Our whole systems approach to High-Value Nutrition science

Our biology
Organ networks
Cellular networks
Molecular networks
Genetic interaction

Our environment
Where we live
Cultural backgrounds
Social networks
Food choices

Our research focuses on understanding biological processes as complex integrated systems.
Nutrition to keep us healthy and well requires an holistic approach.

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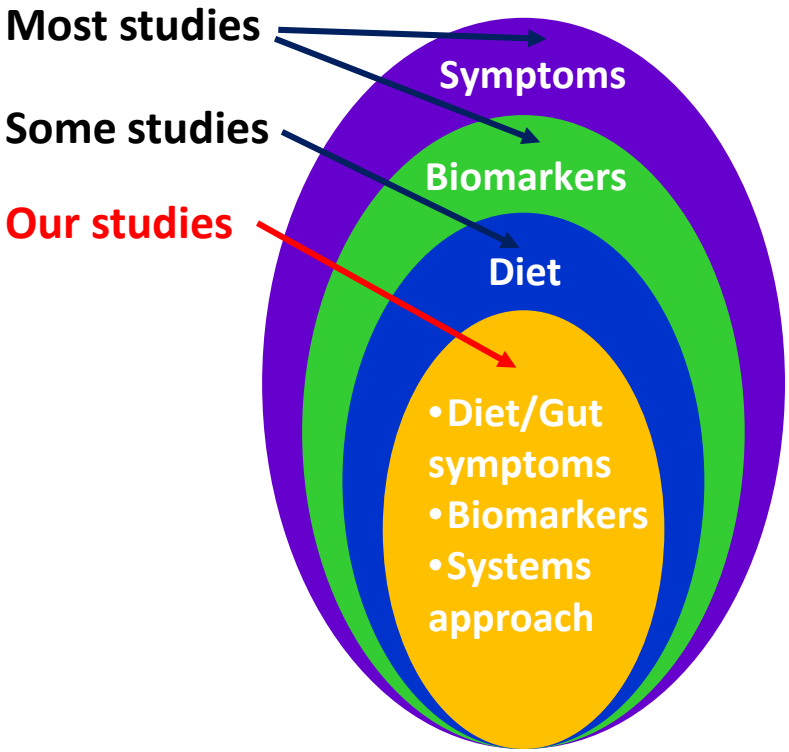
Systems biology of COMFORT cohort

- Gut disorders (IBS): a model to deliver new foods for healthy consumers
- Systems biology: relevant biomarkers and mechanisms
- Sensitive, quicker, cost-effective biomarkers: industry can predict food-gut health relationship
- Validated evidence for new foods that deliver a healthy gut to consumers

This programme is internationally unique



- Systems biology approach to define:
  - What the microbes do?
  - What metabolite signatures are in breath, plasma, faeces and urine?
  - What interactions are relevant to gut comfort?
- Integration of clinical and biological data to better characterise a healthy gut

More on the mysteries of gut comfort…

"a2 Milk™ for gut comfort"

COMFORT Cohort
PI Richard Gearry

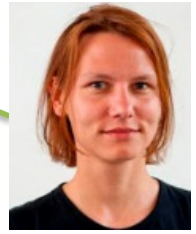
Karl Fraser
Plasma metabolites

Shriya Sharma
Macronutrients

Phoebe Heenan
Anxiety

Hedley Stirrat
Breath metabolites

AI Wayne Young
Faecal microbiome



Heike Schwendel
Plasma bile acids

Capability

AI Karl Fraser
Metabolomics

AI Janine Cooney
Proteomics

Aligned funding

AgR Strategic Science Investment Fund

Riddet Institute
FOOD | INNOVATION | HEALTH

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‘The whole is greater than the sum of its parts’

Aristotle

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

Digestive Health programme

apc Alimentary Pharmabiotic Centre Interfacing Food & Medicine

INRA SCIENCE & IMPACT

BIOMET

New Zealand Food Industry and beyond

NZ inc and beyond

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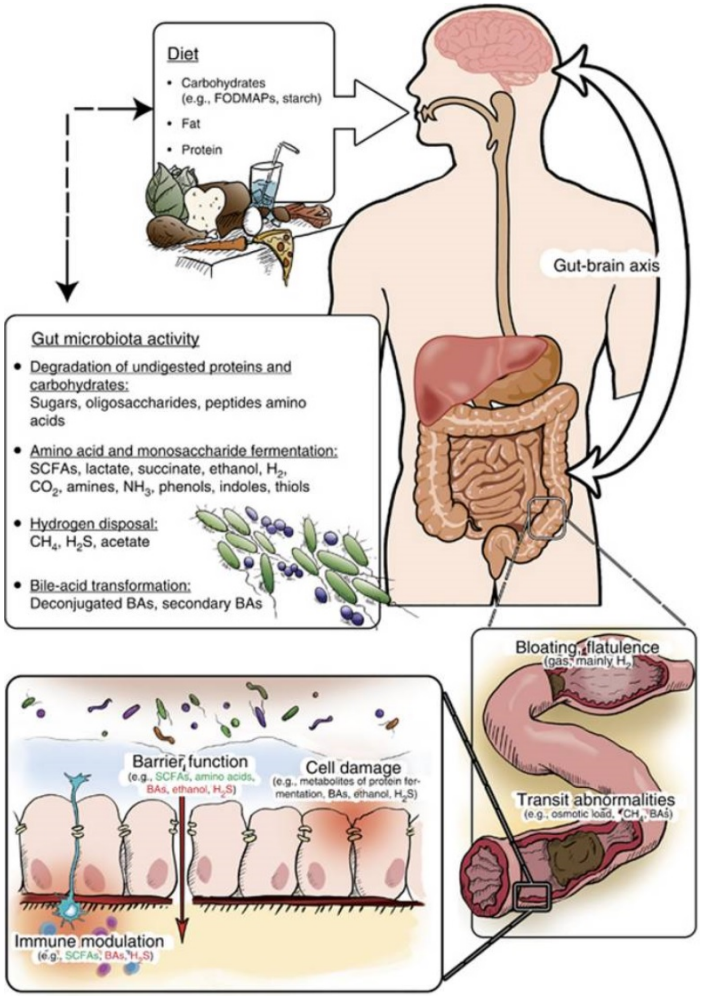

Rajilić-Stojanović *et al* (2015). *Am J Gastroenterol* 110:278-87

Take home message

Clinical and systems approach will de-risk ***developing new foods*** *with* ***validated gut health benefits*** *that will be highly desirable and sought after by* ***healthy consumers***

Healthier Digestion and Mind

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