



The Gut Health Connection: Microbiota Crosstalk and the Role of Prebiotics

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BENEO-Institute/BENEO Asia Pacific Pte Ltd

beneo
institute
connecting nutrition and health



Introduction to the BENEIO-Institute

Three pillars of expertise within the BENEIO-Institute

beneo institute

Connecting nutrition and health

**Nutrition
Science**



**Nutrition
Communication**



**Regulatory
Affairs**



Topics of the BENEIO-Institute

We focus on topics that are important to our customers. This enables us to provide knowledge that is relevant to successfully develop food and beverages for tomorrow's consumers.

The prebiotic
concept

Digestive well-being

Infant and small children
nutrition

Bone health

Dental health

beneo institute



Low glycaemic concept

Dietary fibres

Available carbohydrates
and their metabolism

Sports nutrition

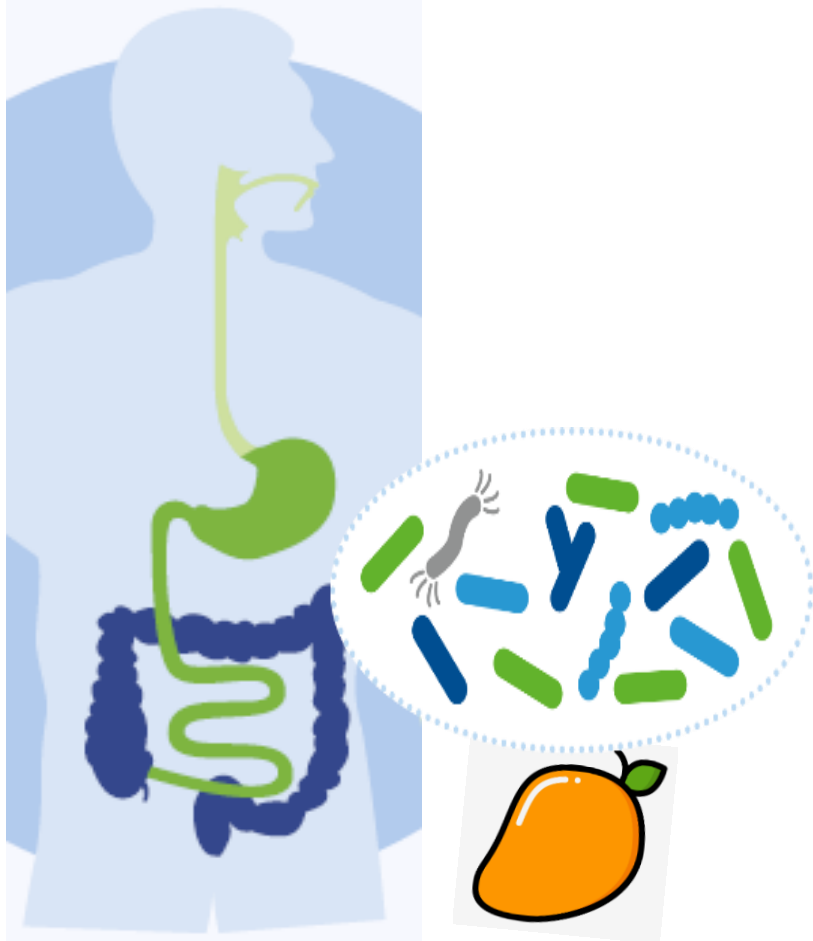
Weight management



Prebiotic chicory root fibres

Superfoods that influence the gut microbiota

Supporting beneficial gut microbiota means supporting human health and well-being



There are trillions of microbiota in the gut; they can weigh about 200g, or the size of a mango

- Trillions of gut microbiota, most are living in the large intestine
- Different types of microorganisms
 - Beneficial microorganisms
 - Neutral microorganisms
 - Potentially harmful microorganisms
- **Supporting beneficial microorganisms, eg. bifidobacteria**
 - **Beneficial for gut environment and human health**
 - **Less favourable living conditions for harmful microorganisms**
- Scientists consider the **gut microbiota an important organ**

The gut microbiota play a vital role in our health

Benefits of health-promoting gut microbiota, especially Bifidobacteria



Digestion and absorption of nutrients, bowel regularity



Supporting and regulating the immune system



Communicating with different parts of our body to influence health



Producing valuable metabolites, eg. vitamins and short-chain fatty acids

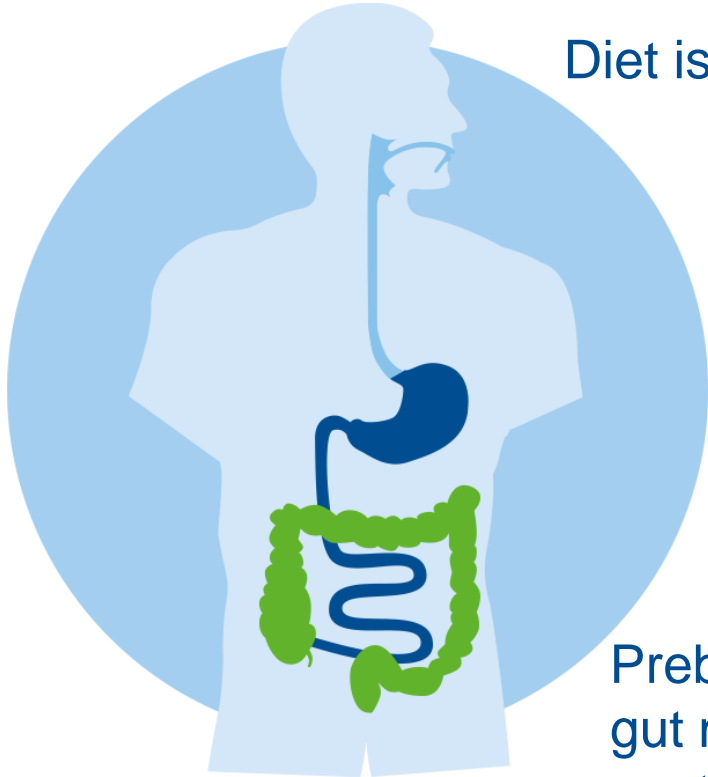


Influencing and regulating hormones



Influencing mood, satiety, metabolism, etc

Natural gut microbiota support with prebiotics in our daily diet



Diet is one of the most important factors that can modify our gut microbiota



Prebiotics are the favourite nutrients of beneficial gut microbiota



Prebiotics selectively increase beneficial gut microbiota, especially Bifidobacteria, thereby supporting human health



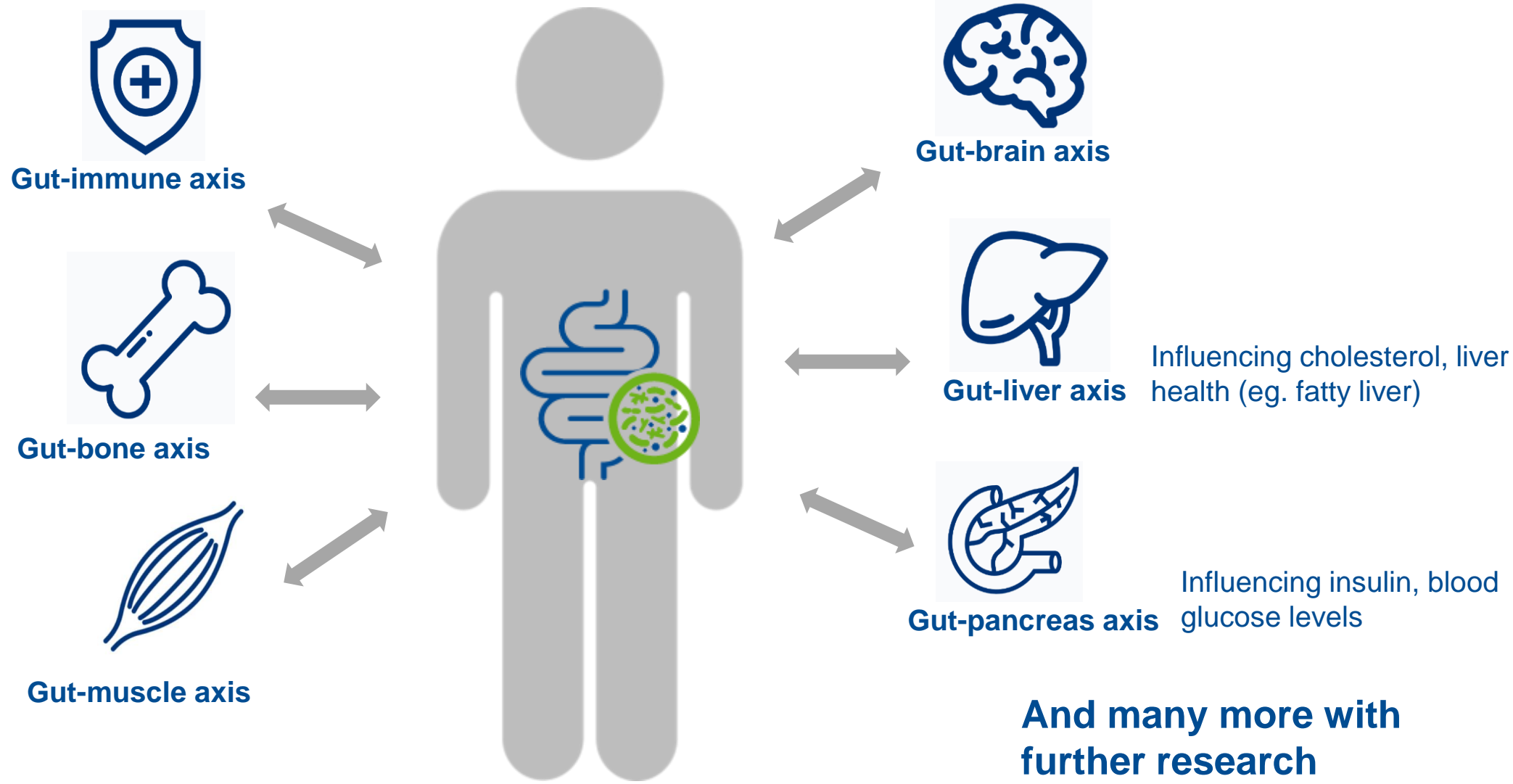
Prebiotic chicory root fibres are SUPERFOODS!

Orafti[®] oligofructose

Orafti[®] inulin 

The gut health connection and influence of prebiotics

Gut microbiota outreach influencing human health



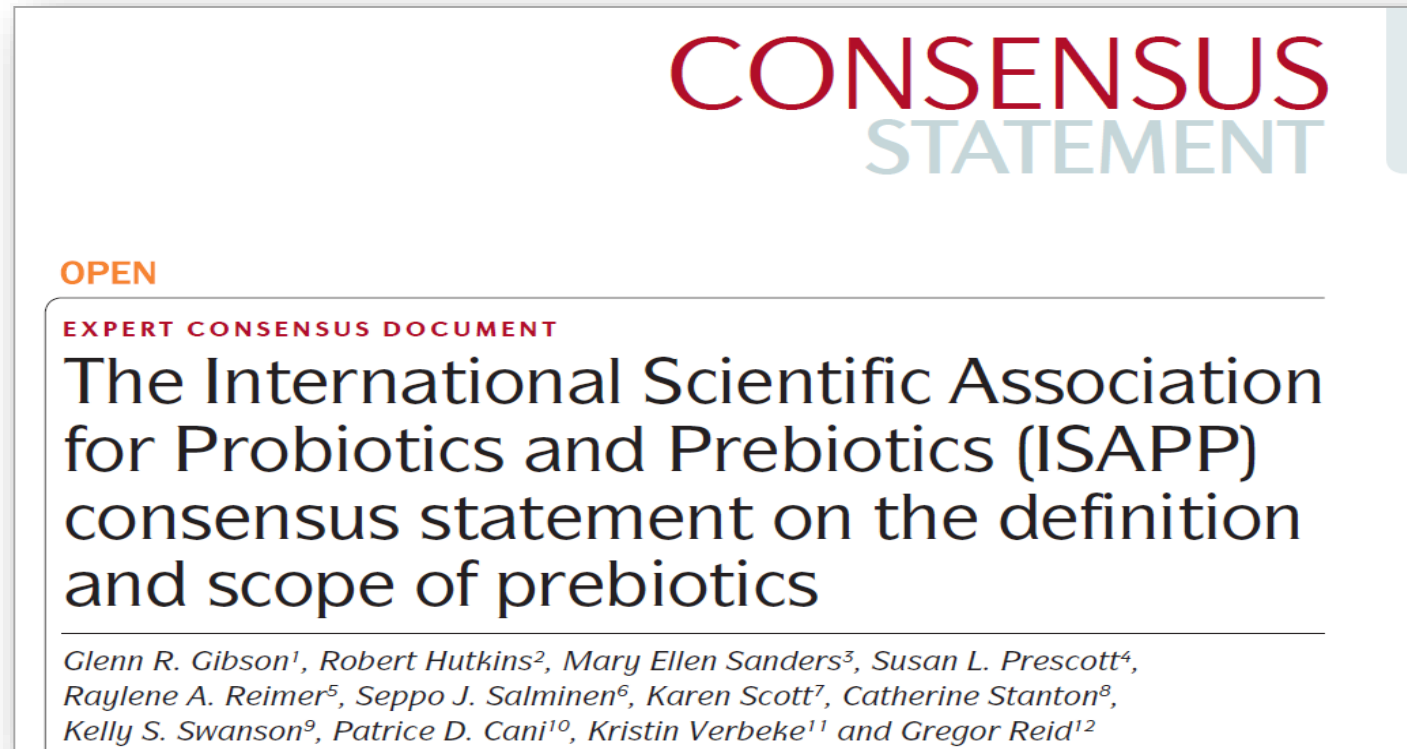
And many more with further research



Prebiotic chicory root fibres

One of the only scientifically proven, plant-based prebiotics

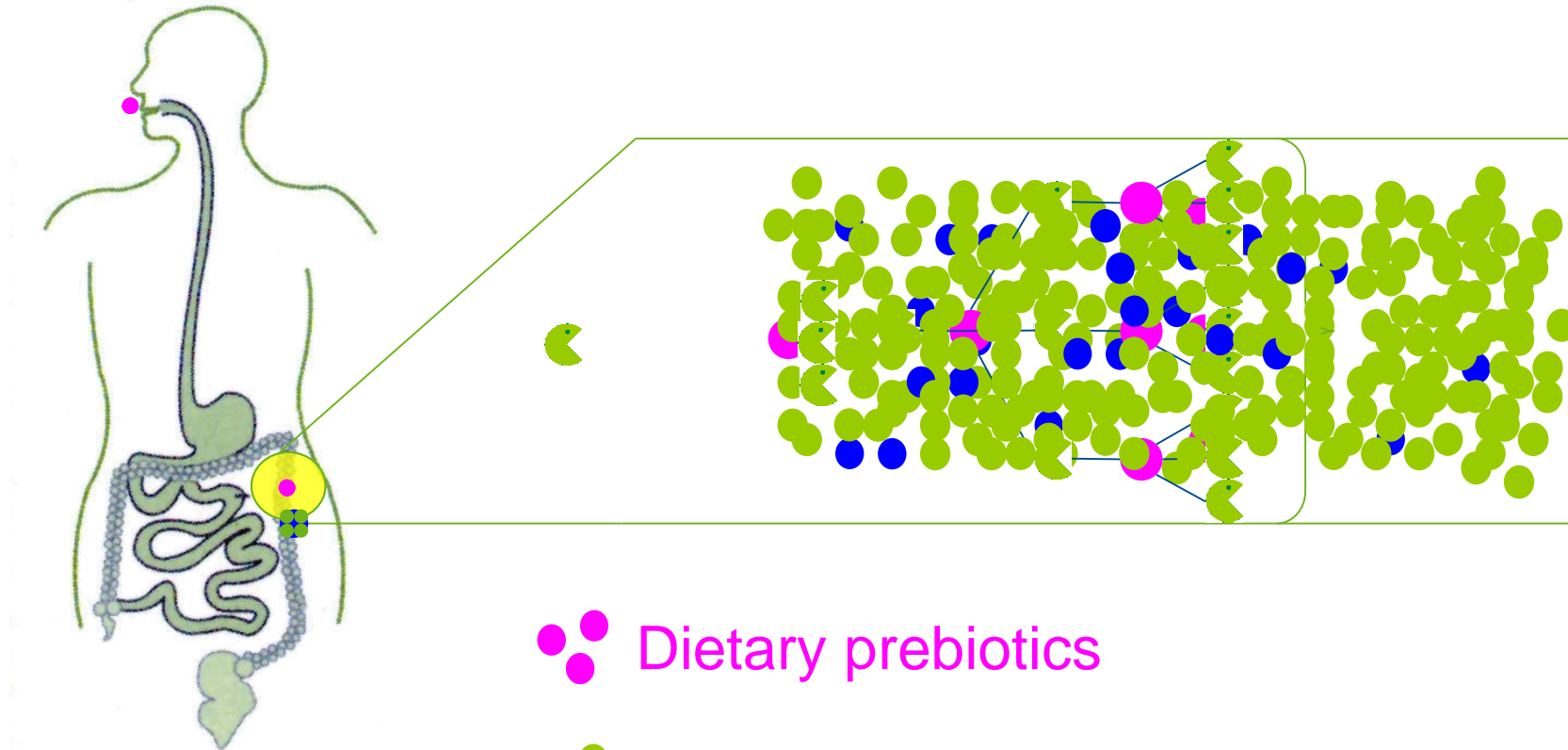
ISAPP expert consensus on latest scientific definition of prebiotics



ISAPP consensus statement on latest definition of prebiotics:

**A substrate that is selectively utilised by host
microorganisms conferring a health benefit**

What does selective fermentation mean?



 Dietary prebiotics

 Beneficial bacteria

 other bacteria (neutral, harmful)

Chicory root fibres are scientifically proven prebiotics

Well-established prebiotics with nearly 30 years of science

	Reported Prebiotics	Scientifically proven Prebiotics?
Proven Prebiotics	Inulin	Yes ✓
	Oligofructose	Yes ✓
	Galacto-oligosaccharides	Yes ✓
Potential Candidates	Resistant dextrins (soluble corn fibre)	No
	Resistant starch	No
	Polydextrose	No
	Isomalto-oligosaccharides	No
	Xylo-oligosaccharides	No
	Lactulose	No
	Lactosucrose	No
	Soybean oligosaccharides	No
	Gentio-oligosaccharides	No

Orafti® inulin 

Orafti® oligofructose

There are
just 3
proven
Prebiotics

Effect of chicory-derived inulin-type fructans on abundance of *Bifidobacterium* and on bowel function: a systematic review with meta-analyses

Published in *Critical Reviews in Food Science and Nutrition*, 2023

By Dávid U Nagy ^{1,2}, Kinga Amália Sándor-Bajusz ¹, Blanka Bódy ¹, Tamás Decsi ¹, Jessica Van Harsseelaar ³, Stephan Theis ³, Szimonetta Lohner ⁴

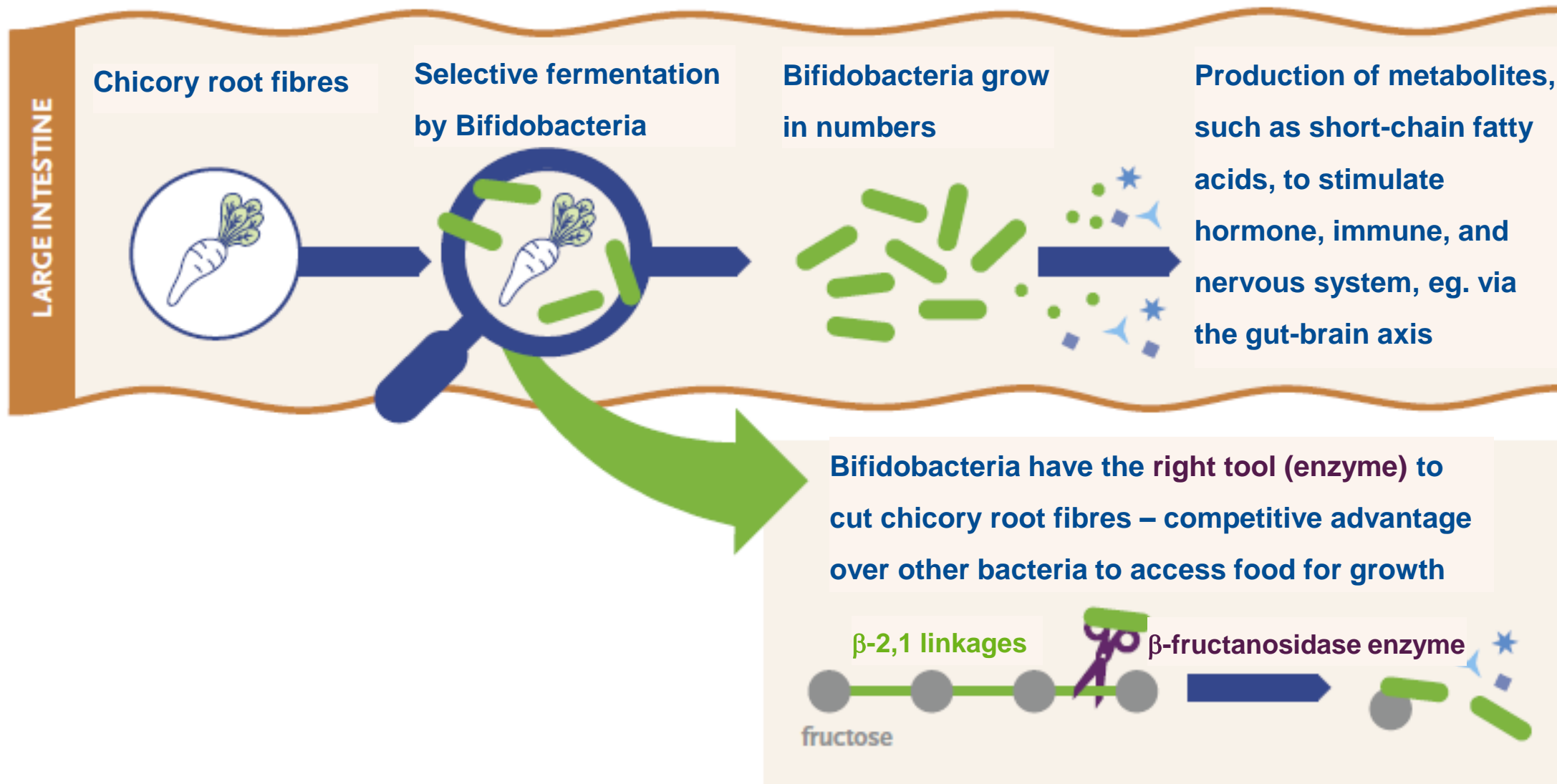
Affiliations

1. Department of Paediatrics, Clinical Centre of the University of Pécs, Medical School, University of Pécs, Pécs, Hungary.
2. Institute of Geobotany/Plant Ecology, Martin-Luther-University, Halle (Saale), Germany.
3. BENE0-Institute, c/o BENE0 GmbH, Obrigheim, (Germany).
4. Department of Public Health Medicine, Medical School, University of Pécs, Pécs, Hungary.

- Chicory-derived Orafti® prebiotics are scientifically proven
- These prebiotics selectively **increase beneficial bifidobacteria** (from 3g/day) and **improve bowel function**
- Highest level of strong scientific evidence of **50 high quality, randomised controlled clinical trials** in infants, children and adults



Chicory root fibre supports selectively the growth of bifidobacteria



The gut health connection

Beneficial shift in gut microbiota with prebiotic chicory root fibres

The many benefits of prebiotic chicory root fibres (inulin, oligofructose):



**Increase beneficial
Bifidobacteria**

**Digestive health and
well-being**

Improving mood

**Supporting immune
health**

**Blood glucose
management**

**Calcium absorption
for bone health**

Weight management

**and more,
Eg. reducing cholesterol,
reducing frailty**



Chicory root fibres (inulin, oligofructose) are extracted using hot water from the roots of chicory plants



Chicory plants

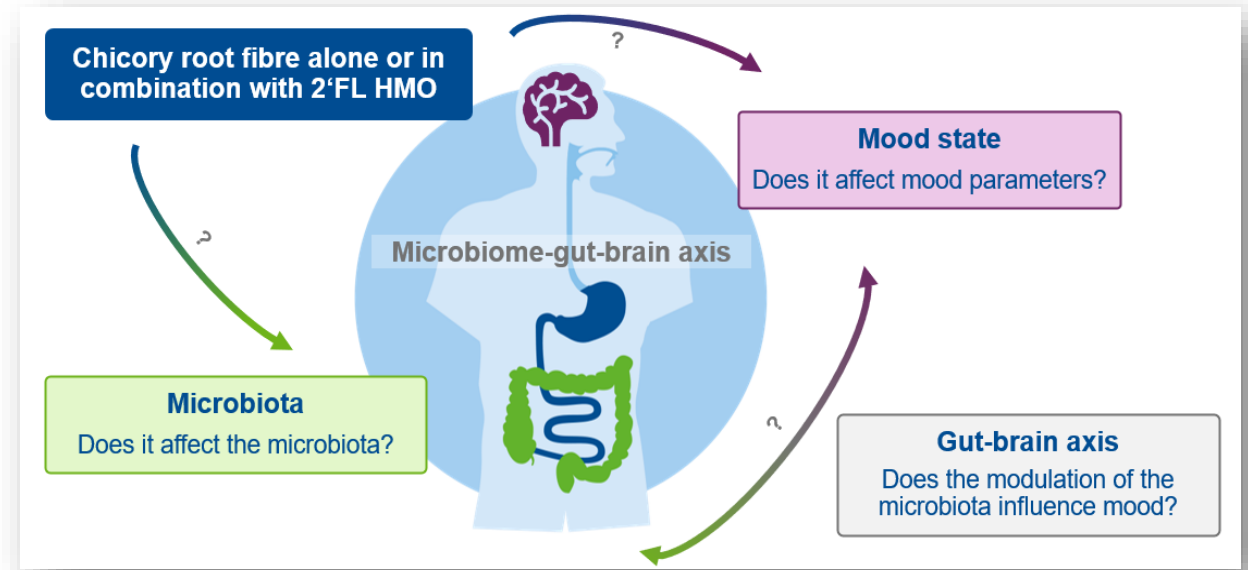
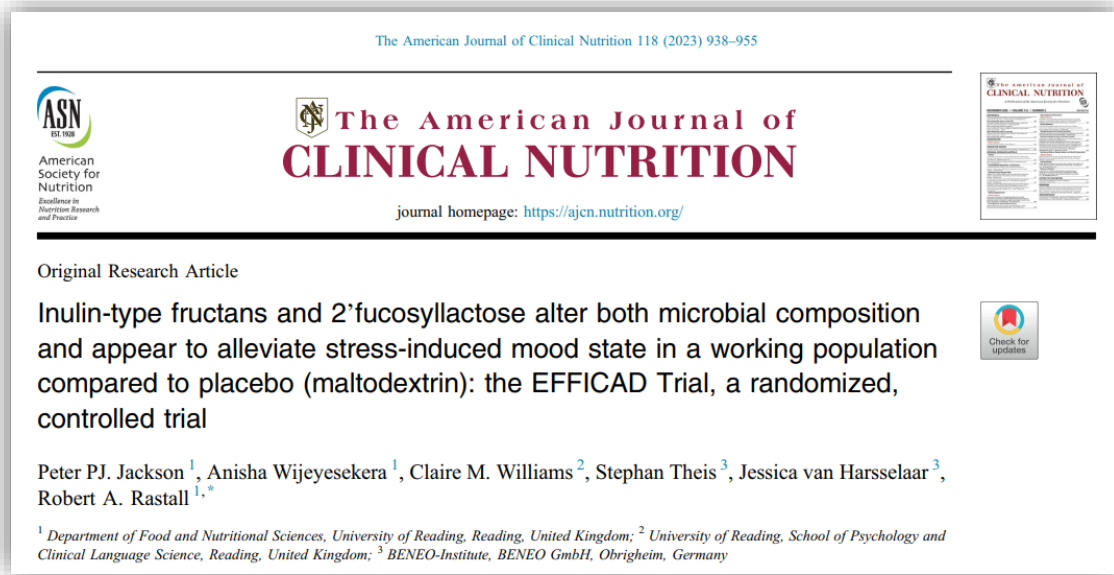


Gut-brain axis and prebiotic chicory root fibres

Improvement in mood

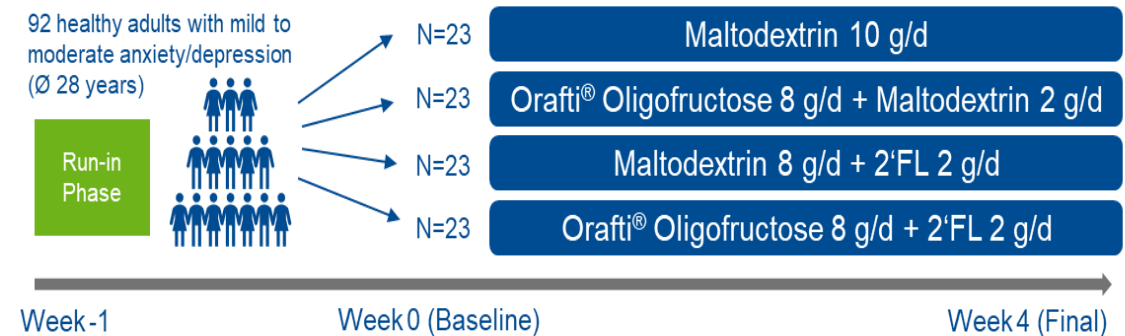
Benefits for gut microbiota and mood with prebiotics

Gut-brain axis as the link behind



Background and study aim:

- Ability of the adult gut microbiota to utilise HMOs and to improve mood state is unclear
- To investigate the effects of **prebiotic oligofructose** and prebiotic candidate **HMO 2'FL** alone and in combination on the microbiota and whether they could improve mood state parameters

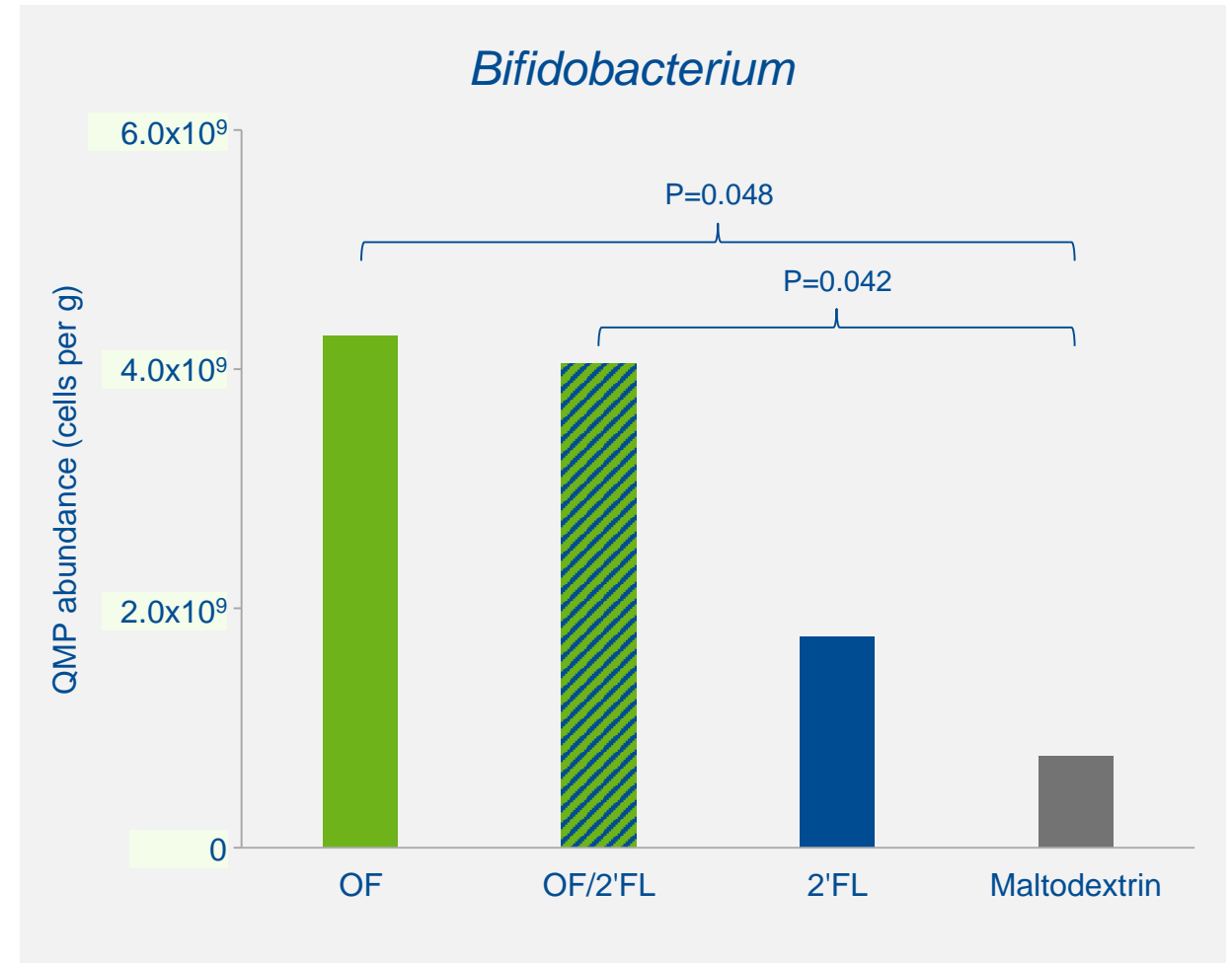


Selective growth of *Bifidobacterium*

With oligofructose alone and in combination with 2'FL

- Significantly higher bifidobacteria with oligofructose alone and the combination of oligofructose and 2'FL compared to control.

The high level of selectivity of oligofructose towards *Bifidobacterium* is demonstrated



Oligofructose alone and in combination with 2'FL improves mood

Correlation also with higher bifidobacteria numbers

Changes in mood state parameters and cortisol

	Oligofructose	Oligofructose and 2'FL	2'FL	Placebo
Depression ¹	++	++	+	-
Anxiety ²	++	++	+	-
Positive feelings ³	++	+	++	-
Negative feelings ³	++	++	++	-
Cortisol ⁴	++	++	+	-

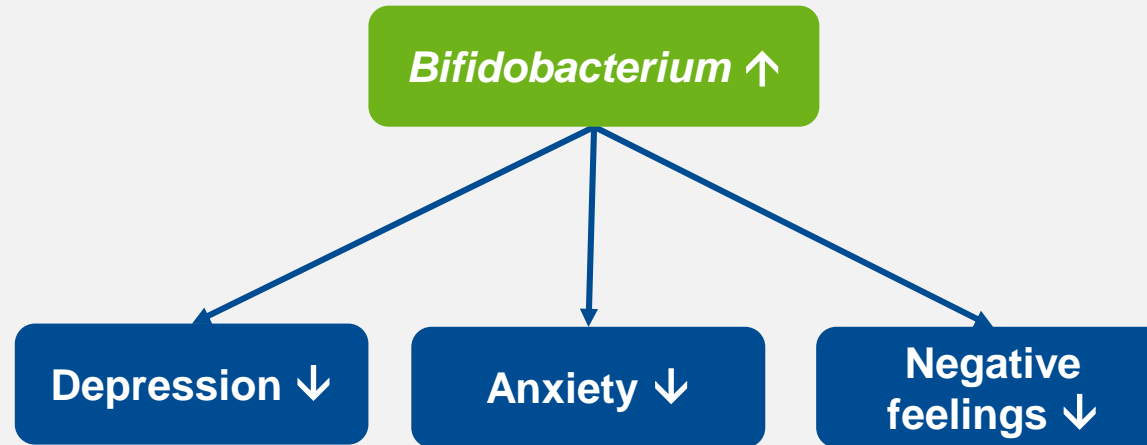
++ Significantly improved vs baseline and placebo
+ Significantly improved vs baseline
- No significant change

- Oligofructose alone and in combination with 2'FL improves mood state parameters and cortisol responses

Oligofructose alone and in combination with 2'FL improves mood

Correlation also with bifidobacteria numbers

Correlation between bifidobacteria and mood state

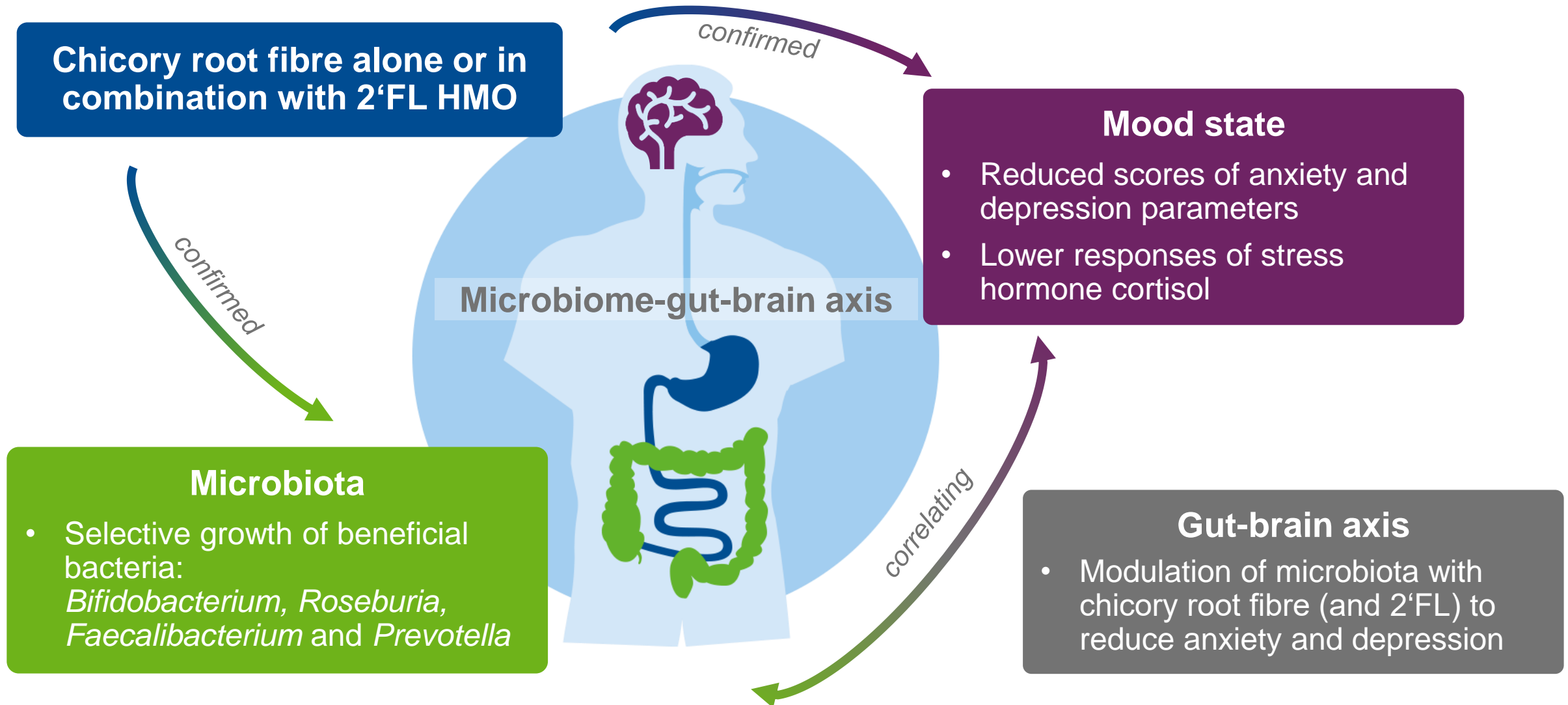


Significant negative correlations between *Bifidobacterium* and mood state parameters

- Higher bifidobacteria correlated with the positive effects on mood state (depression, anxiety and negative feelings)

Benefits for gut microbiota and mood with prebiotics

Gut-brain axis as the link behind



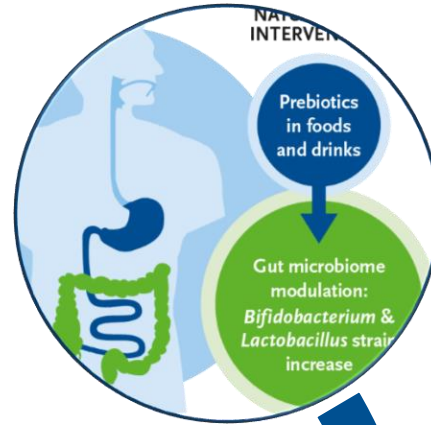


Gut-brain axis and prebiotic chicory root fibres

Weight management

Chicory root fibre helps you to eat less, naturally and helps you to stay healthy

Chicory root fibre as part of the daily diet



Gut microbiota:
Prebiotic fermentation →
positive shift in gut microbiota

Increase in the gut hormones
regulating satiety, including GLP-1
and

Effects on satiety regulation in
the brain (via the gut-brain axis)



Positive changes
in body weight and
body composition



Metabolic
improvements



Less energy (calories)
intake over time

Meta-analysis reveals prebiotic inulin-type fructans improve satiety

Review > Br J Nutr. 2014 Apr 14;111(7):1147-61. doi: 10.1017/S0007114513003607

Epub 2013 Nov 13.

Metabolic benefits of dietary prebiotics in human subjects: a systematic review of randomised controlled trials

Nicole J Kellow ¹, Melinda T Coughlan ², Christopher M Reid ¹

Affiliations – collapse

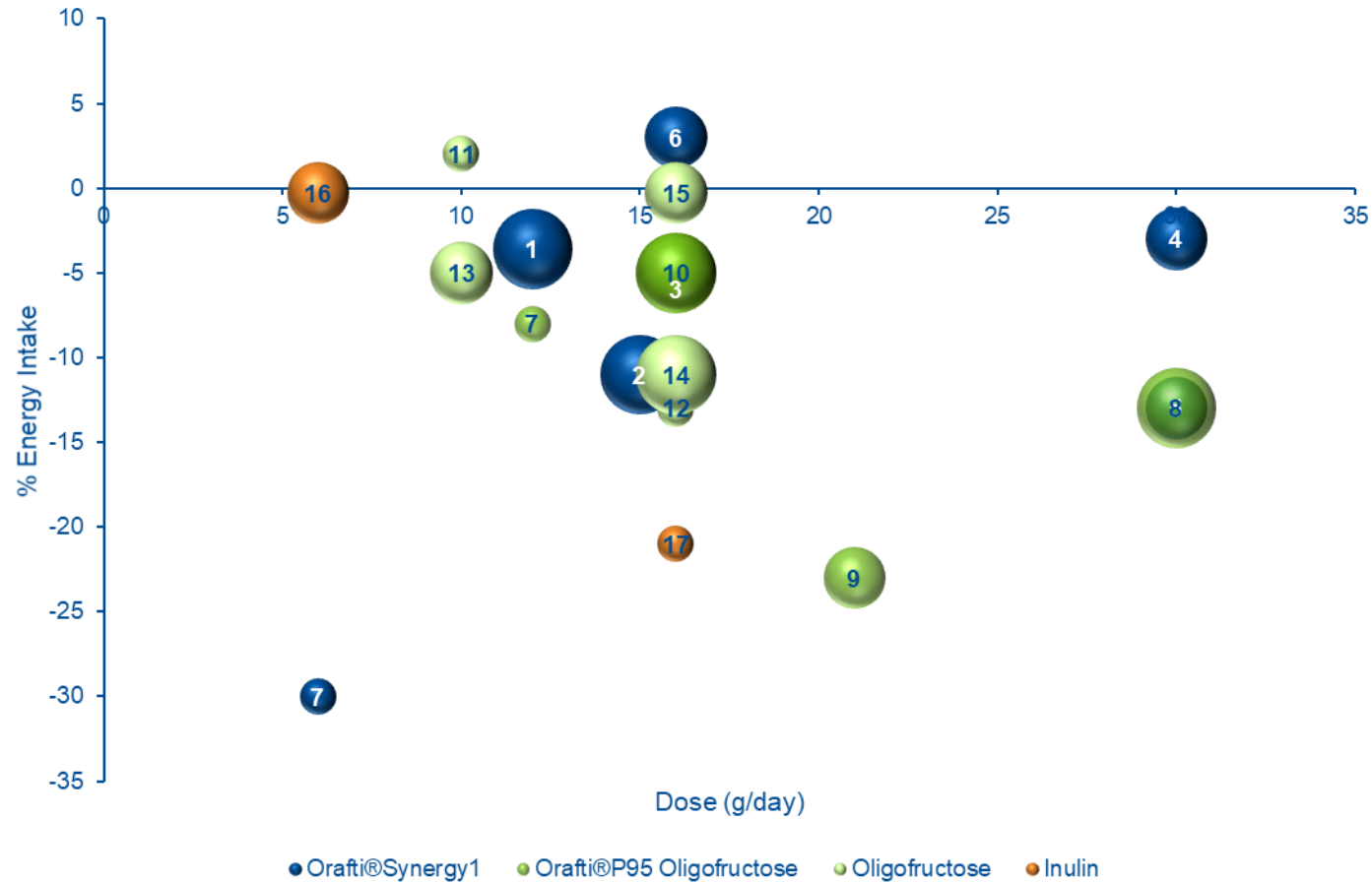
Affiliations

- 1 Department of Epidemiology and Preventive Medicine, School of Public Health and Preventive Medicine, Monash University, Alfred Medical Research and Education Precinct, Melbourne, Victoria 3004, Australia.
- 2 Glycation, Nutrition and Metabolism Laboratory, Baker IDI Heart and Diabetes Institute, Melbourne, Victoria 8008, Australia.

- Significant improvements in subjective satiety measurements

Chicory root fibres cause a reduction in energy intake

Reduction in Energy Intake by various chicory root fibres



Study ID

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18

References

- McCann et al. 2011 (total)
- Reimer 2011 (savory food)
- Cani et al. 2009
- Guess et al. 2015
- Guess et al. 2016
- Healey et al. 2018
- Alptekin et al. 2021
- Sheth & Gupta 2014
- Daud et al. 2014
- Parnell & Reimer 2009
- Cani et al. 2006
- Verhoef et al. 2011
- Verhoef et al. 2011
- De Luis et al. 2013
- Reimer et al. 2017
- Pol et al. 2017
- Heap et al. 2016
- Salmean 2017

Prebiotic chicory oligofructose-enriched inulin as a proven tool for weight management in overweight and obese children



Prebiotic supplementation improves appetite control in children with overweight and obesity: a randomized controlled trial¹⁻³

Megan P Hume,⁴ Alissa C Nicolucci,⁴ and Raylene A Reimer^{4,5*}

⁴Faculty of Kinesiology and ⁵Department of Biochemistry and Molecular Biology, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada

Gastroenterology 2017;153:711-722

Prebiotics Reduce Body Fat and Alter Intestinal Microbiota in Children Who Are Overweight or With Obesity

Alissa C. Nicolucci,¹ Megan P. Hume,¹ Inés Martínez,² Shyamchand Mayengbam,¹ Jens Walter,^{2,3} and Raylene A. Reimer^{1,4}

¹Faculty of Kinesiology, University of Calgary, Calgary, Alberta, Canada; ²Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Alberta, Canada; ³Department of Biological Sciences, University of Alberta, Edmonton, Alberta, Canada; ⁴Department of Biochemistry and Molecular Biology, University of Calgary, Calgary, Alberta, Canada



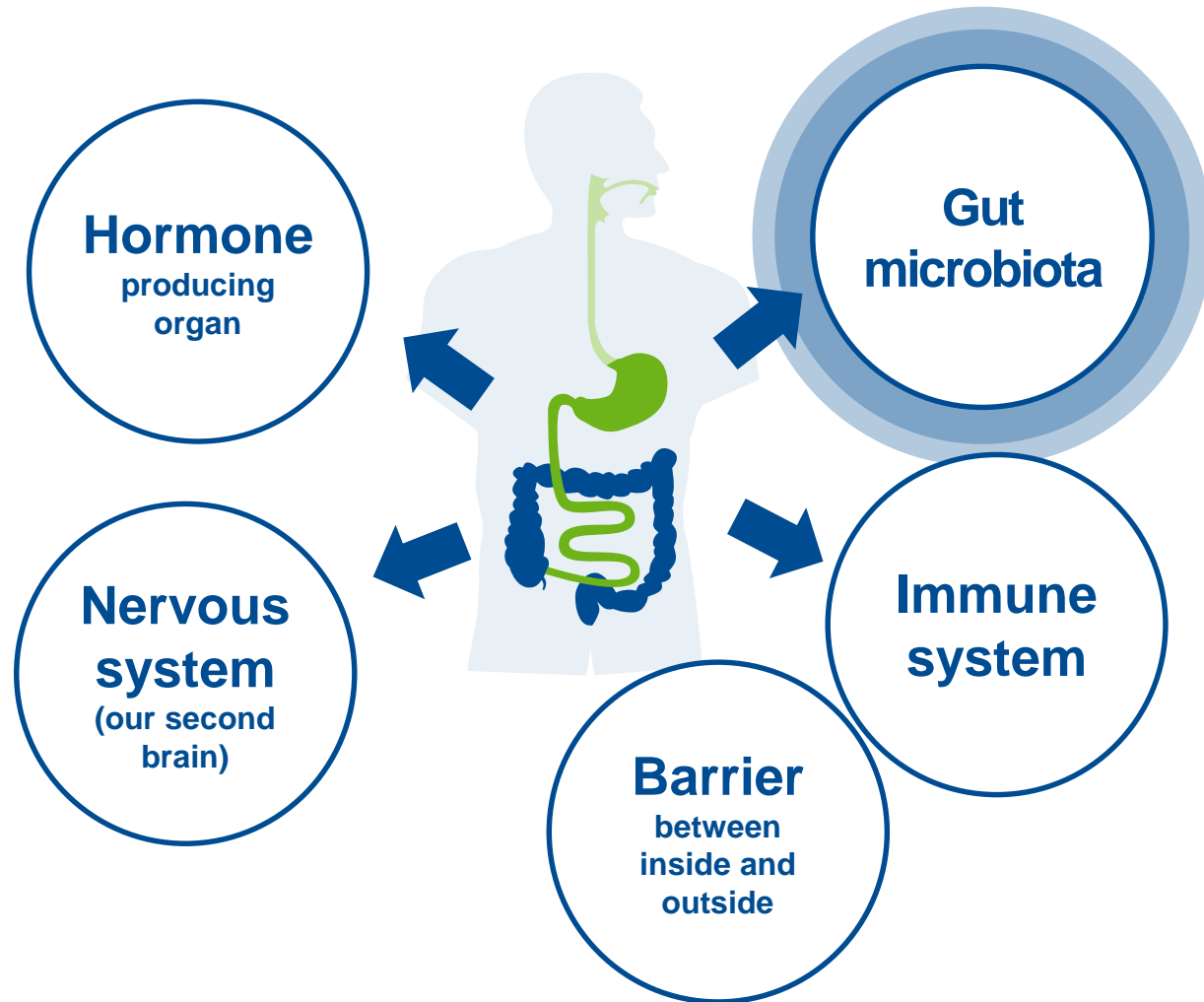
- In the prebiotic Orafti®Synergy1 (chicory oligofructose-enriched inulin) group:
 - **Increased satiety hormones and feelings of satiety**
 - **Reduced energy intake**
 - **Lower body fat, lower trunk body fat, reduced BMI z-scores**
- Mechanism of action: prebiotic effect, **shift in gut microorganisms** (significant increases in Bifidobacteria, decreases in *Bacteroides vulgatus*)



Gut-immune axis and prebiotic chicory root fibres

Influence on immune health

Unlocking the secret of good health, well-being, and a strong inner defence with prebiotic chicory root fibres



- The **gut and gut microbiota** are key players of **immune health**
- The **gut is the centre of immunity**, containing about **70% of the body's immune cells**
- The gut microbiota interacts closely with the gut, and influences many aspects of health, from **immune health**, mood, bowel regularity, bone health, blood glucose levels, weight, and more

**Strengthening
inner defence in
infants and
children**

**Reducing
negative effects
antibiotics**

**Strengthening the
gut barrier**

**Nourishing the
gut mucosa**

**Autoimmune
disorders
(type 1 diabetes,
inflammatory
bowel disease)**

**Reducing
infections of
pathogens**

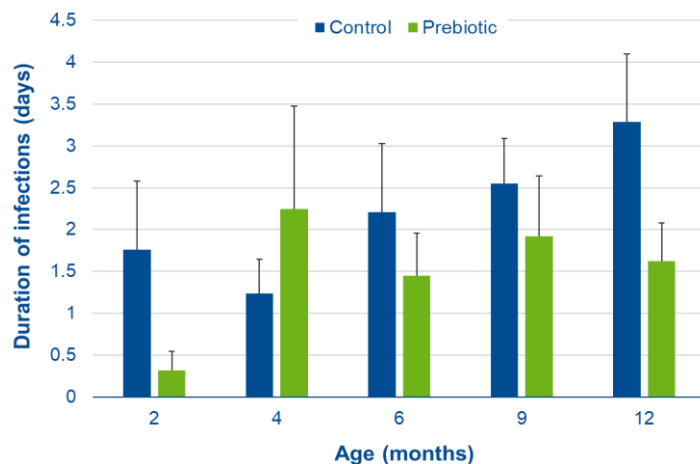
**Reducing
inflammation**

**Greater antibody
response during
vaccination**

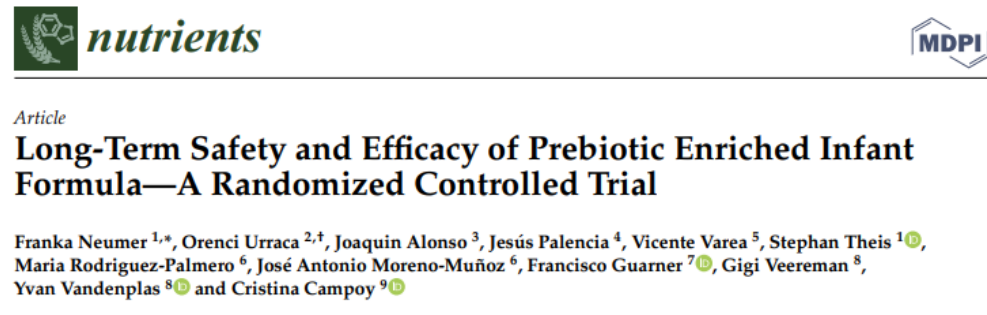
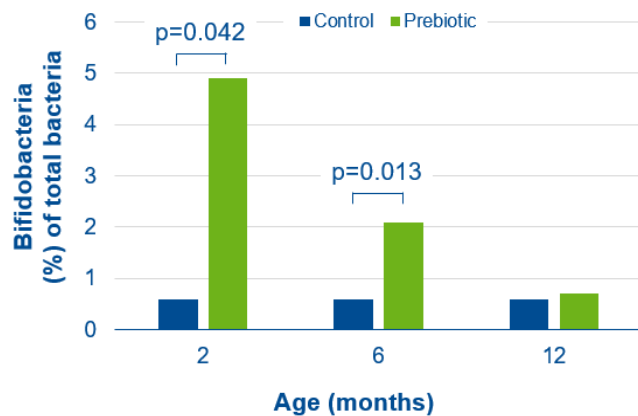
Long-term study proves supports well-being and inner defence

Orafti®Synergy1-enriched formula for infants in the first year of life

Significantly lower mean duration of infections



Significantly higher Bifidobacteria versus Control during first 6 months when formula intake was still higher



- Both formulas were well-tolerated and safe
- Compared to control, the prebiotic formula group showed:
 - **Significantly lower mean duration of infections**
 - Tendency for lower total daily time of crying
 - Significantly softer stools
 - Significantly **increased bifidobacteria** during the first 6 months
- This is the first study with Orafti®Synergy1 covering the first year of life
- It adds to the growing evidence for the **beneficial development of the gut microbiota and the immune system** in infancy

Healthier children with prebiotic chicory root fibres

Improved digestive and immune health

The Journal of Nutrition
Nutrition and Disease



Inulin-Type Fructan Supplementation of 3 to 6 Year-Old Children Is Associated with Higher Fecal *Bifidobacterium* Concentrations and Fewer Febrile Episodes Requiring Medical Attention

Szimonetta Lohner,¹ Viktória Jakobik,¹ Krisztina Mihályi,¹ Sara Soldi,³ Sotirios Vasileiadis,⁴ Stephan Theis,⁵ Manuela Sailer,⁵ Carolin Sieland,⁵ Károly Berényi,² Günther Boehm,⁶ and Tamás Decsi¹

¹Department of Paediatrics, Clinical Center of the University of Pécs; ²Department of Public Health Medicine, Medical School, University of Pécs, Pécs, Hungary; ³Advanced Analytical Technologies Srl, Fiorenzuola d'Arda (Pc), Italy; ⁴Department of Biochemistry & Biotechnology, University of Thessaly, Larissa, Greece; ⁵Beneo-Institute, Obrigheim, Germany; and ⁶Nutritional Science Consulting, Leipzig, Germany

Beneficial Microbes, 2019; 10(3): 253-263



Prebiotic supplementation over a cold season and during antibiotic treatment specifically modulates the gut microbiota composition of 3-6 year-old children

S. Soldi¹, S. Vasileiadis², S. Lohner³, F. Uggeri¹, E. Puglisi⁴, P. Molinari⁴, E. Donner⁵, C. Sieland⁶, T. Decsi³, M. Sailer⁶ and S. Theis^{6*}

¹AAT – Advanced Analytical Technologies Srl, Via P. Majavacca 12, 29017 Fiorenzuola d'Arda, Italy; ²Department of Biochemistry & Biotechnology, University of Thessaly, Viopolis, 41500 Larissa, Greece; ³Department of Paediatrics, Clinical Center of the University of Pécs, Medical School, University of Pécs, József Attila u. 7, 7623 Pécs, Hungary; ⁴Microbiology Institute, Università Cattolica del Sacro Cuore in Piacenza, Via Emilia Parmense 84, 29122 Piacenza, Italy; ⁵Future Industries Institute (FII), Mawson Lakes Campus, University of South Australia, 5095 Mawson Lakes, Australia; ⁶Beneo-Institute, c/o Beneo GmbH, Wormser Straße 11, 67283 Obrigheim, Germany; stephan.theis@beneo.com

- Prebiotic chicory root fibres are well tolerated and show positive effects on:

Gut microbiota

Significantly higher levels of *Bifidobacteria* and *Lactobacilli*

Stool consistency

Significantly softer stools in the normal range

Immune system

Significantly fewer infections with fever and sinusitis

Higher *Bifidobacteria* even with antibiotics

Significantly higher *Bifidobacteria* even during antibiotic treatment

Reduced diarrhoea caused by pathogenic bacteria with prebiotic oligofructose

CLINICAL GASTROENTEROLOGY AND HEPATOLOGY 2005;3:442-448

Effect of the Prebiotic Oligofructose on Relapse of *Clostridium difficile*-Associated Diarrhea: A Randomized, Controlled Study

STEPHEN LEWIS,* STEPHEN BURMEISTER,† and JON BRAZIER‡

*Department of Medicine, Derriford Hospital, Plymouth; †Department of Medicine, Addenbrooke's Hospital, Hills Rd, Cambridge; and ‡Department of Microbiology, University Hospital of Wales, Cardiff, United Kingdom

- As compared to the placebo group, the Oligofructose group had **fewer relapses of diarrhoea** ($p < 0.001$), a **shorter hospital stay** ($p < 0.05$), and it took a **shorter time for their diarrhoea to settle** after taking antibiotic medication (3 days versus 6 days; $p = 0.007$)

Aliment Pharmacol Ther 2001; 15: 1139-1145.

A study of fructo oligosaccharides in the prevention of travellers' diarrhoea

J. H. CUMMINGS*, S. CHRISTIE† & T. J. COLE‡

*Ninewells Hospital and Medical School, Dundee, UK; †Department of Food Science and Technology, University of Reading, UK; and ‡Institute of Child Health, London, UK

Accepted for publication 11 April 2001

- There was a trend towards **fewer reported events of traveller's diarrhoea** in the prebiotic Orafti®P95 oligofructose group as compared to the control group (11% vs. 20%, $p = 0.08$)
- The prebiotic group also reported a **better sense of well-being** ($p = 0.04$)

Immunomodulating properties of prebiotic chicory root fibres

Via selective increase in beneficial gut microorganisms

> Crit Rev Food Sci Nutr. 2015;55(3):414-36. doi: 10.1080/10408398.2012.656772.

Immunological Properties of Inulin-Type Fructans

Leonie Vogt ¹, Diederick Meyer, Gerdie Pullens, Marijke Faas, Maaïke Smelt, Koen Venema, Uttara Ramasamy, Henk A Schols, Paul De Vos

Affiliations + expand

PMID: 24915372 DOI: 10.1080/10408398.2012.656772



- Inulin-type fructans from the chicory root has immunomodulating properties:
 - Through selectively **increasing beneficial gut microorganisms**, while **reducing potential pathogens**
 - **Influencing the activity of certain immune-related cells**
 - **Influencing gut barrier function**



Gut-pancreas axis and prebiotic chicory root fibres

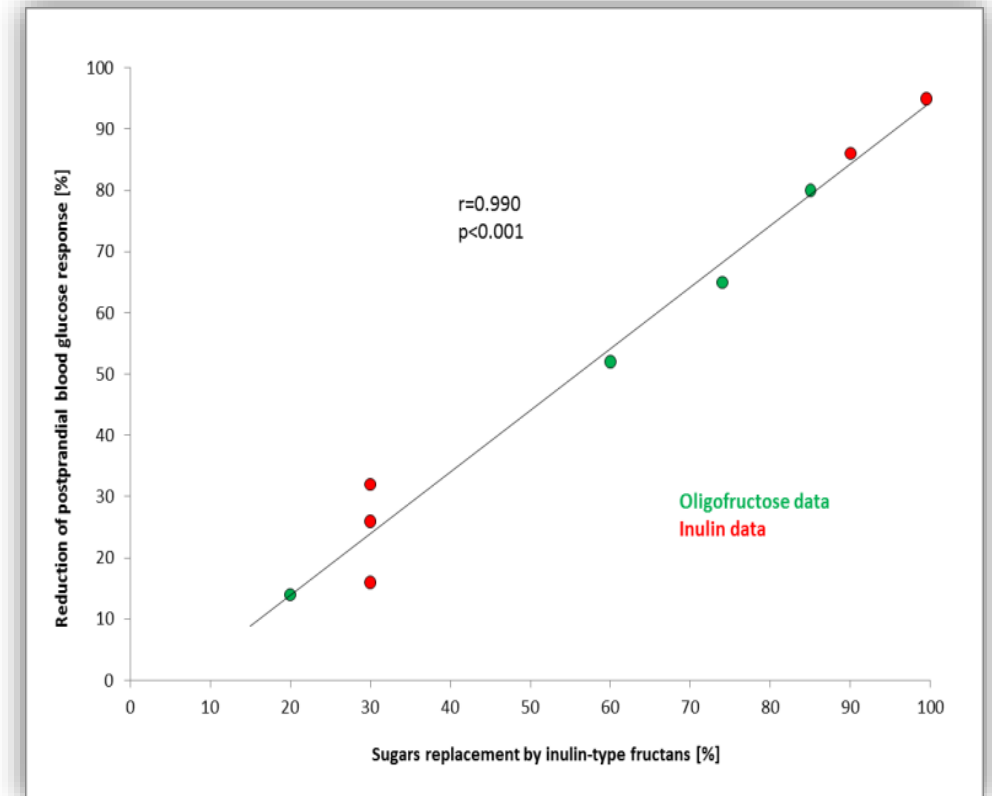
Blood glucose management

Review continues to confirm the low blood glucose response of chicory root fibres

- Sugar reduction with chicory root fibres on blood glucose and insulin response has been investigated in:
 - **9 human trials**
 - In both normal and overweight subjects
 - In different product applications
 - Results show that the more sugar is replaced with chicory root fibres, the lower the blood glucose response
 - **20% sugar replacement already shows a significant effect**



All studies show a reduced blood glucose response with chicory fibres



Improved glycaemic control with Orafti®Synergy1 in children with type 1 diabetes

ENDOCRINE
SOCIETY

Effect of prebiotic on microbiota, intestinal permeability and glycaemic control in children with type 1 diabetes

Josephine Ho, Alissa C. Nicolucci, Heidi Virtanen, Alana Schick, Jon Meddings, Raylene A. Reimer, and Carol Huang

The Journal of Clinical Endocrinology & Metabolism
Endocrine Society

Submitted: February 27, 2019
Accepted: June 06, 2019
First Online: June 12, 2019

OXFORD
ACADEMIC

JCEM THE JOURNAL
OF CLINICAL
ENDOCRINOLOGY
& METABOLISM

Background on type 1 diabetes:

- Linked to an imbalanced gut microbiota, which is associated with “leaky gut” (intestinal permeability)
- “Leaky gut” has been shown to pre-date the development of type 1 diabetes

Gut microbiota

Increase in
Bifidobacteria

Higher C-peptide

Indicating pancreatic
beta-cell function to
produce insulin

Lower intestinal permeability (IP)

Correlation analysis
found link between
microbiota and IP



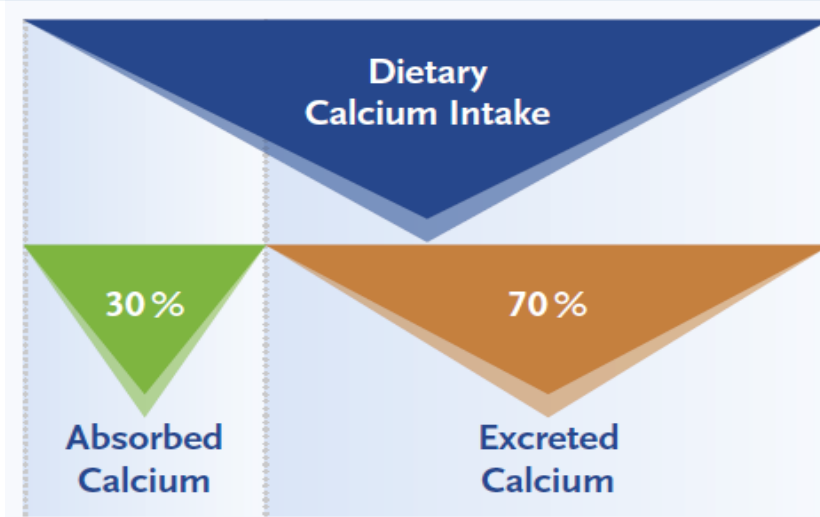
Gut-bone axis and prebiotic chicory root fibres

Bone health

The large intestine: additional place for calcium absorption

Stronger bones with prebiotic chicory root fibres

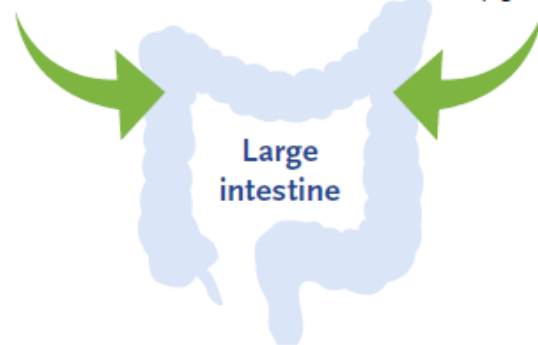
The bioavailability of calcium in the diet is low
(about 30% calcium is absorbed)



About 70% escapes absorption in the small intestine, reaches the large intestine and is excreted

Rapid fermentation of shorter-chain oligofructose by gut microbes

Slower fermentation of longer-chain inulin by gut microbes



- With **Orafti®Synergy1**, the **large intestine** becomes a **new place of calcium absorption** due to prebiotic fermentation
- This calcium reaches the bones, as demonstrated in a one-year long human intervention study.



Prebiotic chicory root fibres, especially Orafiti® Synergy1

Improved calcium absorption from adolescents to older adults

Non-digestible oligosaccharides and calcium absorption in girls with adequate calcium intakes

By Griffin et al 2002. Published in the British Journal of Nutrition

Effects of oligofructose-enriched inulin on intestinal absorption of calcium and magnesium and bone turnover markers in postmenopausal women

By Holloway et al 2007. Published in the British Journal of Nutrition

Enriched chicory inulin increases calcium absorption mainly in girls with lower calcium absorption

By Griffin et al 2003. Published in Nutrition Research

Effects of inulin on calcium metabolism and bone health

By Bakirhan and Karabudak 2021. Published in the International Journal for Vitamin and Nutrition Research

A combination of prebiotic short- and long-chain inulin-type fructans enhances calcium absorption and bone mineralisation in young adolescents

By Abrams et al 2005. Published in the American Journal of Clinical Nutrition

An Inulin-Type Fructan Enhances Calcium Absorption Primarily via an Effect on Colonic Absorption in Humans

By Abrams et al 2007. Published in the Journal of Nutrition

One-year long study shows that absorbed calcium reaches the bones and increases bone mineral density

Long-term effects of Orafti®Synergy1

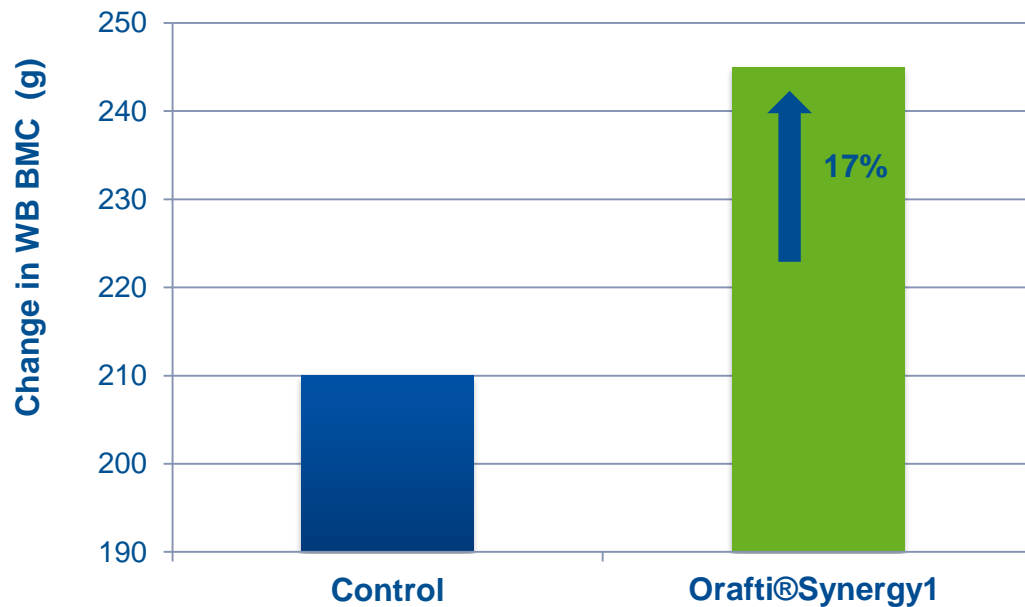
One-year study shows that absorbed calcium is reaching the bones

A combination of prebiotic short- and long-chain inulin-type fructans enhances calcium absorption and bone mineralization in young adolescents¹⁻⁴

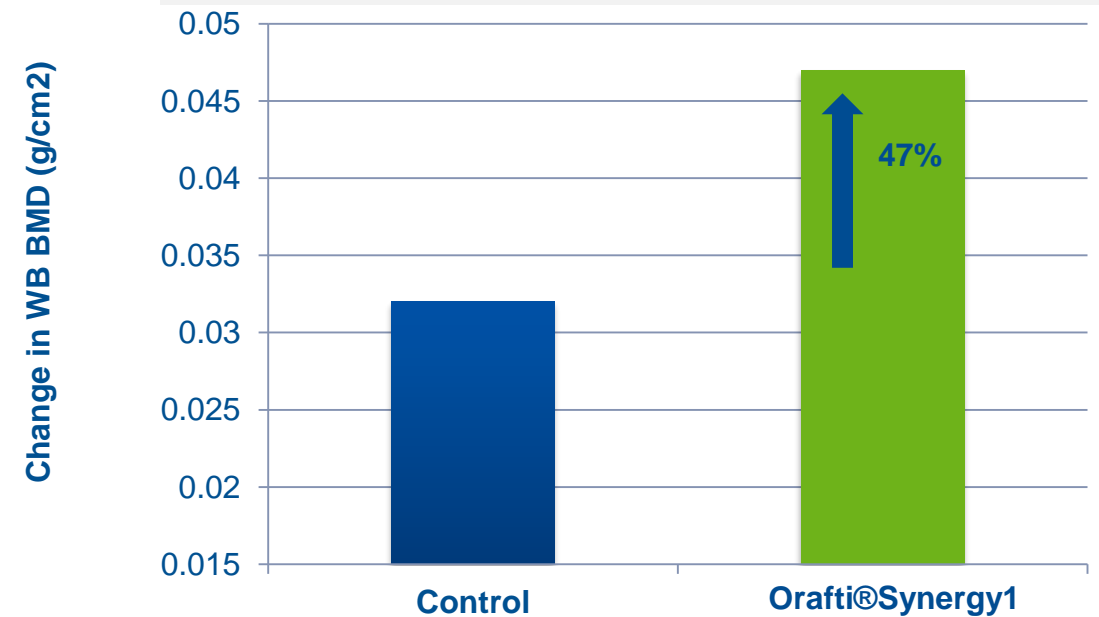
Steven A Abrams, Ian J Griffin, Keli M Hawthorne, Lily Liang, Sheila K Gunn, Gretchen Darlington, and Kenneth J Ellis

Am J Clin Nutr 2005;82:471-6.

Significantly higher increase in Bone Mineral Content (BMC) with Orafti®Synergy1 after 1y



Significantly higher increase in Bone Mineral Density (BMD) with Orafti®Synergy1 after 1y



p<0.05 versus control

Find out more about prebiotic chicory root fibres



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www.dietaryfiber.org