Gut Check:

The Dietitian Download on Prebiotics and Probiotics

Tuesday, September 22, 2020

PRODUCE FOR® BETTER HEALTH FOUNDATION

PEPSICO

Moderator

Wendy Reinhardt Kapsak, MS, RDN

President & CEO

Produce for Better Health Foundation

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Our Purpose

The Produce for Better Health Foundation (PBH), a 501(c)3, is the only national non-profit organization committed to helping people live happier, healthier lives by eating more fruits and vegetables in all their glorious forms every day.

PRODUCE FOR® BETTER HEALTH FOUNDATION

Our Movement

Research shows, rather than a prescriptive recommendation to eat a certain amount of fruits and vegetables each day, consumers (particularly Gen Z and Millennials) want actionable, realistic and FUN approaches that make eating fruits and vegetables easy, helping them feel confident, happy and healthy.

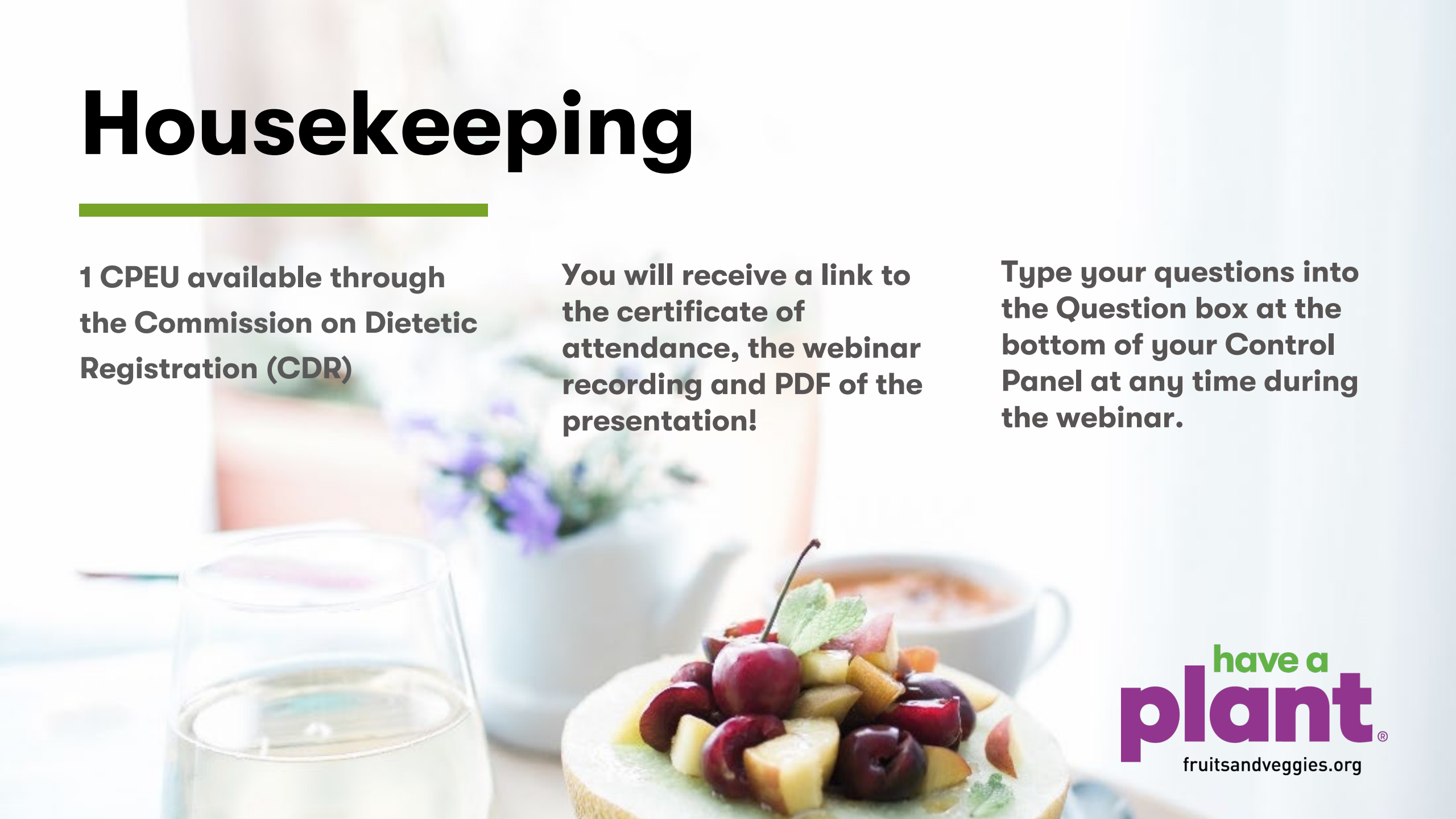
That's where **PBH's Have A Plant® movement** comes in. It's a way to tap into the emotional connection consumers have to the fruit and vegetable eating experience while inspiring long-term, sustainable behavior change. And it does so with a no-nonsense approach that's simple, understandable, and, importantly for this audience, non-prescriptive.

Housekeeping

1 CPEU available through the Commission on Dietetic Registration (CDR)

You will receive a link to the certificate of attendance, the webinar recording and PDF of the presentation!

Type your questions into the Question box at the bottom of your Control Panel at any time during the webinar.



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Presenting Speakers & Disclosures

Elieke Kearns, PhD, RD

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Scientific Advisory Board/Consultant/Board of Directors: Grains Food Foundation

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Other: Kellogg Co., PepsiCo, Tate & Lyle, Nutricia North America

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Defining and Differentiating Probiotics & Prebiotics

Elieke Kearns, PhD, RD
R&D Principal Scientist
PepsiCo Health & Nutrition Sciences

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Learning Objectives

- Definitions:
  - Probiotics
  - Live and Active Cultures
  - Fermentation
  - Prebiotics
- Discuss how probiotics and prebiotics affect the gut microbiota and human health
- Apply knowledge of both probiotics and prebiotics to make informed client and patient recommendations

Kicking Off With a Quick Quiz

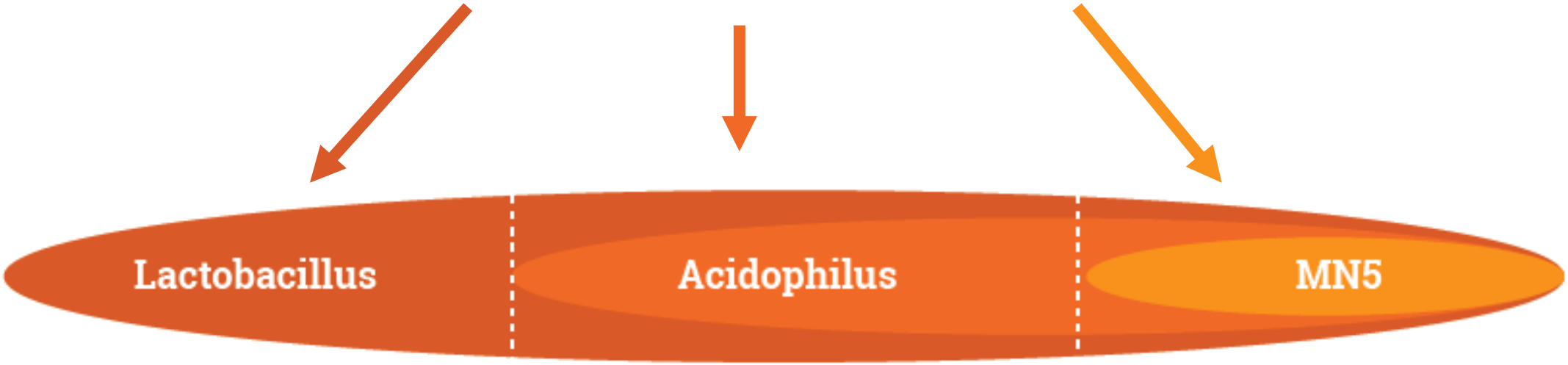
What is a probiotic?

- Bacteria
- Live cultures
- Micro-organisms that have a health benefit
- All of the above

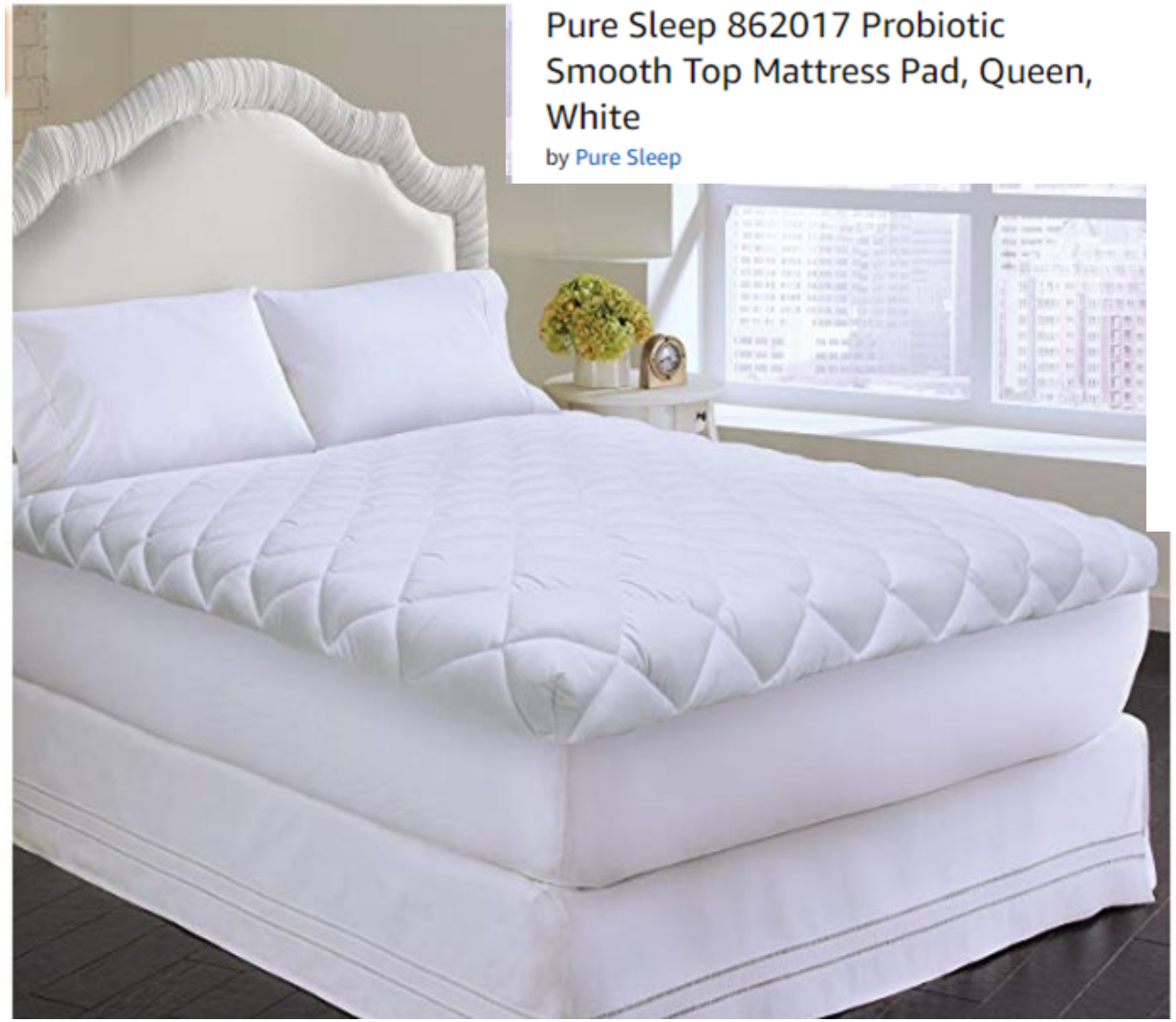
Probiotic nomenclature

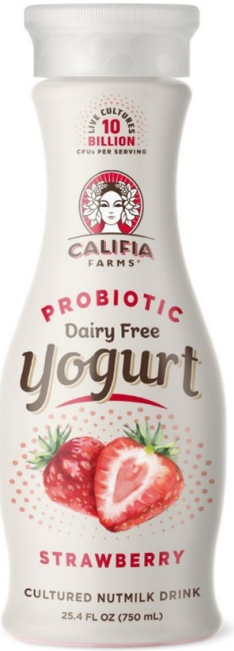
Probiotic names are designated by

GENUS**, **SPECIES**, and **STRAIN



Probiotics:
A Growing (and Sometimes Unusual) Market





Scientific Definition for "Probiotics"

"Live microorganisms that, when administered in adequate amounts, confer a health benefit on the host."

Food and Agricultural Organization of the United Nations and World Health Organization. Health & nutritional properties of probiotics in food including powder milk with live lactic acid bacteria. *WHO*, (2001).

Scientific Definition for "Probiotics"

*"**Live** microorganisms that, when administered in adequate amounts, confer a health benefit on the host."*

Survive the journey all the way through your digestive tract

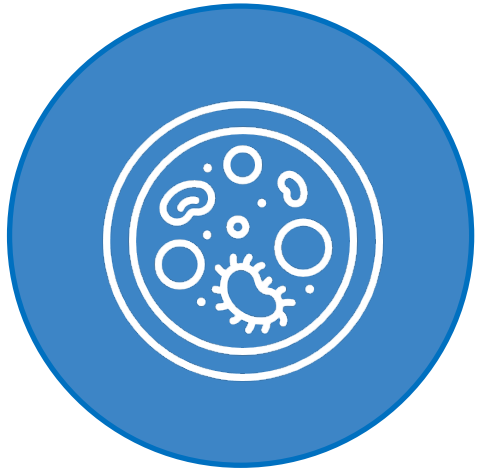
Food and Agricultural Organization of the United Nations and World Health Organization. Health & nutritional properties of probiotics in food including powder milk with live lactic acid bacteria. *WHO*, (2001).

Scientific Definition for "Probiotics"

"Live microorganisms that, when administered in

***adequate amounts**, confer a health benefit on the host."*

- **Probiotic strains are not measured in cups, teaspoons, or grams**
- **Colony Forming Units (CFUs) represent the number of bacteria able to divide**
- **Each probiotic strain has its own CFU amount needed to work effectively**



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Scientific Definition for "Probiotics"

"Live microorganisms that, when administered in adequate amounts, confer a ***health benefit*** *on the host."*

- **Scientific studies prove this probiotic offers a health benefit**
- **Not all strains do the same 'job'**

Food and Agricultural Organization of the United Nations and World Health Organization. Health & nutritional properties of probiotics in food including powder milk with live lactic acid bacteria. *WHO*, (2001).

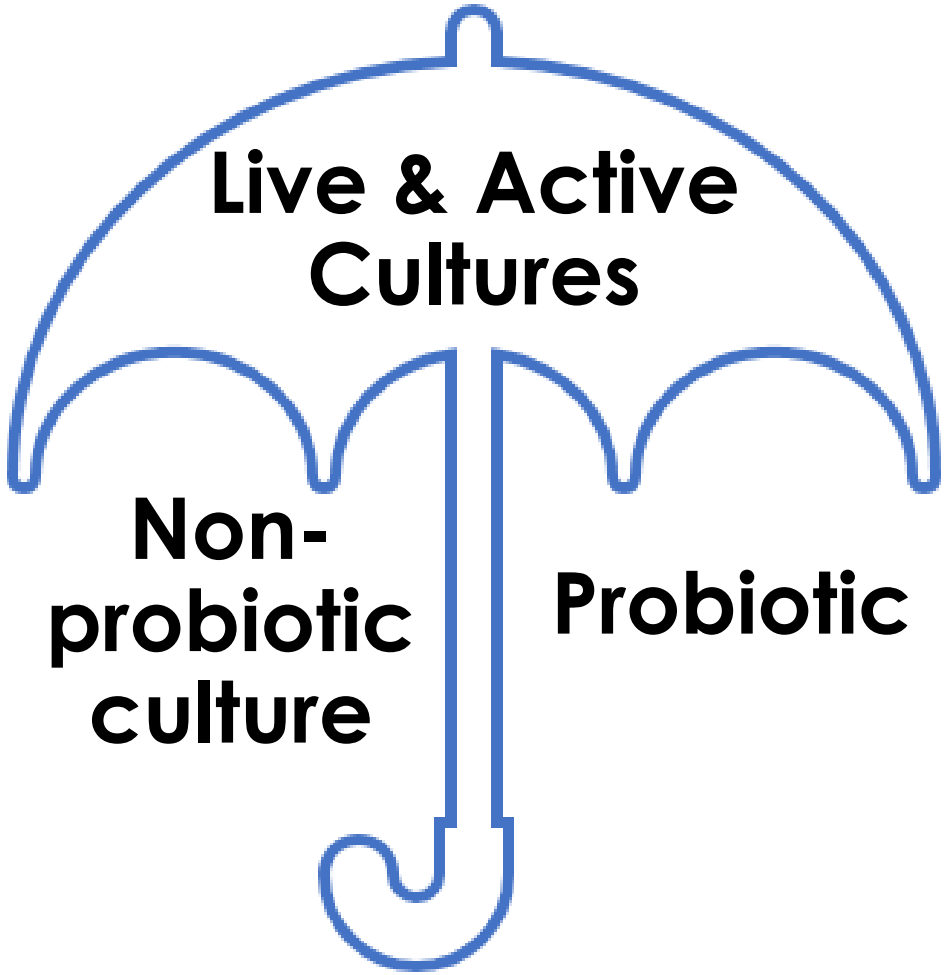
Scientific Definition for "Probiotics"

"Live microorganisms that, when administered in adequate amounts, confer a health benefit on the ***host****."*

This is you (humans)

Food and Agricultural Organization of the United Nations and World Health Organization. Health & nutritional properties of probiotics in food including powder milk with live lactic acid bacteria. *WHO*, (2001).

What is a Culture?



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Fermentation

What is Fermentation?

A metabolic process in which microorganisms break down sugars into other substances

or

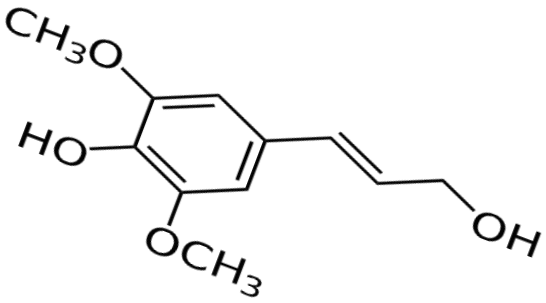
Water

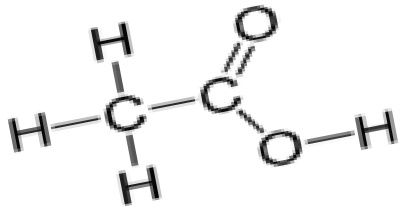
+

+

Micro-organisms/Cultures
(Bacteria and Yeast)

=





Fermentation FYIs

Micro-organisms/Cultures
(Bacteria and Yeast)

Not all cultures are probiotics

Some fermented foods are further processed (pasteurized, baked, filtered)

Can improve taste, texture, digestibility, concentration of certain vitamins

Do Fermented Foods Contain Probiotics?

Yogurt with live cultures

Kimchi

Sauerkraut

Kefir

Kombucha

Maybe! Need scientific evidence that the specific strain can cause a health benefit.

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Prebiotics

Another Quick Quiz

What is a prebiotic?

- A micro-organism
- A different name for ‘probiotic’
- Food for the micro-organisms that confer a health benefit
- All of the above

Scientific Definition for "Prebiotics"

"A substrate that is selectively utilized by the host microorganisms conferring a health benefit."

Gibson, G., Hutkins, R., Sanders, M. et al. Expert consensus document: The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics. Nat Rev Gastroenterol Hepatol 14, 491–502 (2017). https://doi.org/10.1038/nrgastro.2017.75

Scientific Definition for "Prebiotics"

*"A **substrate** that is selectively utilized by the host microorganisms conferring a health benefit."*

Often, prebiotics are types of soluble fiber that the human body cannot digest

Gibson, G., Hutkins, R., Sanders, M. et al. Expert consensus document: The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics. Nat Rev Gastroenterol Hepatol 14, 491–502 (2017). https://doi.org/10.1038/nrgastro.2017.75

Scientific Definition for "Prebiotics"

*"A substrate that is **selectively utilized** by the host microorganisms conferring a health benefit."*

Not all of the micro-organisms in your microbiota can use this substrate

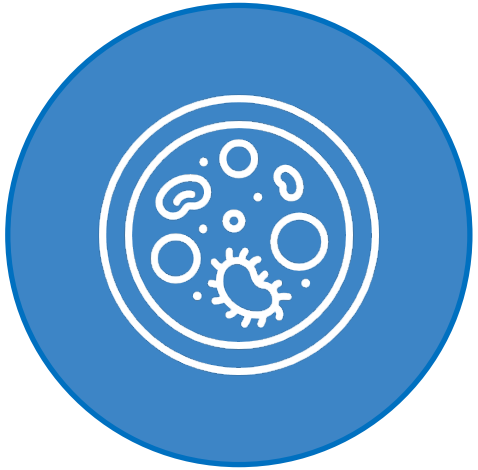
Gibson, G., Hutkins, R., Sanders, M. et al. Expert consensus document: The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics. Nat Rev Gastroenterol Hepatol 14, 491–502 (2017). https://doi.org/10.1038/nrgastro.2017.75

Scientific Definition for "Prebiotics"

"A substrate that is selectively utilized by the

host microorganisms conferring a health benefit."

Beneficial microbes that already live your colon



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Distinguishing Probiotics From Prebiotics

Probiotic

organism

Prebiotic

energy

Probiotics & Prebiotics: Modulating the Gut Microbiota for Health Benefits

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Department of Food Science and Human Nutrition
Division of Nutritional Sciences
Institute of Genomic Biology
National Center for Supercomputing Applications

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Definitions and Overview

Microbiota – a collection of microorganisms

Microbiome – a collection of microbial genomes

- As many bacteria as host cells in human body[1]
- > 150x more bacterial genes than our human genome[2]

1. Sender, R., et al. (2016). Are we really vastly outnumbered? Revisiting the ratio of bacterial to host cells in humans. *Cell*, 164(3), 337-340.
2. Qin, J., et al. (2010). A human gut microbial gene catalog established by metagenomic sequencing. *Nature*, 464(7285), 59.

Gut Microbiota Overview

Metabolic

- Ferment nondigested substrates
  - Dietary fiber
  - Resistant starch
  - Protein
- Synthesize secondary bile acids
- Synthesize vitamins
  - B vitamins
  - Vitamin K

Immunologic

- Immunoglobulin A
- T-cells

Protective

- Competitive exclusion
  - Nutrient competition
  - Antimicrobials
  - pH reduction
  - Barrier function

Goldszmid, R. S., & Trinchieri, G. (2012). The price of immunity. Nature immunology, 13(10), 932-938.
Sonnenburg, J. L., & Bäckhed, F. (2016). Diet-microbiota interactions as moderators of human metabolism. Nature, 535(7610), 56-64.

Probiotics: Mechanisms of Action

Probiotics, an Expanded Definition

Probiotics are live microorganisms that, when administered in adequate amounts, confer a benefit to the host.[1]

- **Strains** and **dosages** will impact health outcomes
  - **Strains**: taxonomically defined; genome sequence available
  - **Doses** must be adequate; range from 100 million to 450 billion CFUs

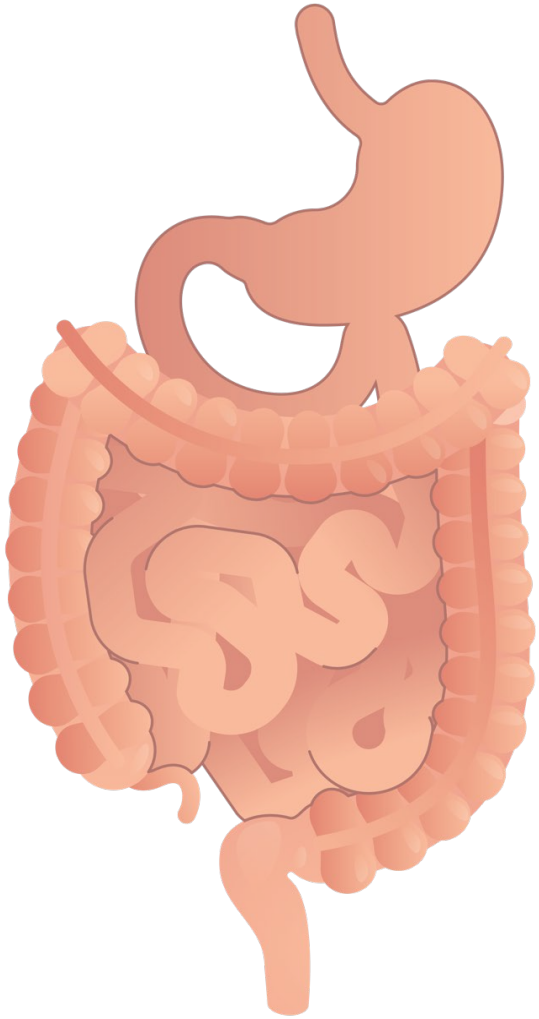
Most commonly studied probiotics

- *Bifidobacterium*
  - *B. lactis*
- *Lactobacilli*
  - *L. acidophilus*
  - *L. casei*
  - *L. plantarum*
  - *L. rhamnosus*
  - *L. reuteri*
- *Saccharomyces boulardii*

1. Hill, C et al. (2014). Expert consensus document: The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the scope and appropriate use of the term probiotic. *Nature Reviews Gastroenterology & Hepatology*.

Probiotic Characteristics

- Safe, nonpathogenic
- Resistant to technological processing, storage & delivery
- Resistant to gastric acidity, lysis by bile, and pancreatic enzymes
- Viable in gut
- Benefit health



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Probiotics: Gut Health Effects

- Oral Health
- Abdominal pain
- Motility
- Constipation
- Diarrhea
  - Antibiotic associated
  - Traveler's
  - *Clostridium difficile* associated
  - Infectious
- *Helicobacter pylori*/ulcers
- Necrotizing enterocolitis
- Inflammatory Bowel Disease
- Irritable Bowel Syndrome

D Skokovic-Sunjic (2020) Clinical Guide to Probiotic Products Available in USA (http://usprobioticguide.com/)

Probiotics: Other Health Effects

- Stress and anxiety
- Colic
- Respiratory tract infections
- LDL and total cholesterol
- Blood glucose
- Urogenital health
- Infections
  - Nosocominal-hospital acquired
  - Community acquired

D Skokovic-Sunjic (2020) Clinical Guide to Probiotic Products Available in USA (http://usprobioticguide.com/)

Probiotic Example: *Bifidobacterium lactis*

Bifidobacterium animalis* subsp. *lactis

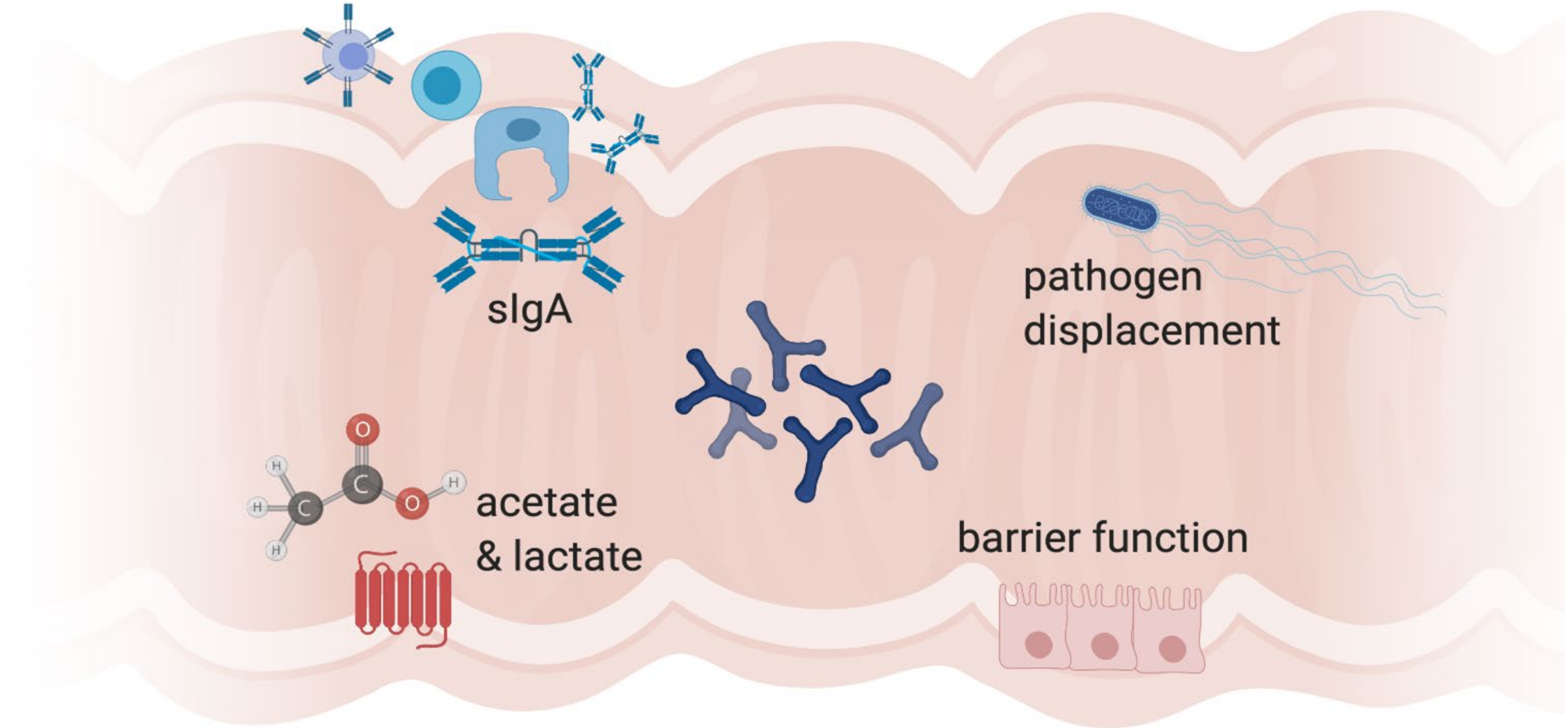
- DSM 15954
- ATCC SD5220, ATCC SD5219
- Bb12
- HN019
- DN-173 010

Health Benefits:

- Prevention of Necrotizing Enterocolitis in preterm infants (DSM 15954)[1]
- Enhanced immunity in infants (Bb12)[2]
- Reduced colonic transit time in women (DN-173 010)[3]
- Enhance immunity in adults and elderly (NH019)[4,5]

1. Su et al. (2020). AGA Clinical Practice Guidelines on the Role of Probiotics in the Management of Gastrointestinal Disorders. *Gastroenterol*.
2. Holscher et al. (2012). Bifidobacterium lactis Bb12 Enhances Intestinal Antibody Response in Formula-Fed Infants: A Randomized, Double-Blind, Controlled Trial. *J Parenteral and Enteral Nutr*.
3. Marteau et al. (2002). *Bifdobacterium animalis* strain DN-173 010 shortens the colonic transit time in healthy women: a double-blind, randomized, controlled study. Aliment Pharmacol Ther
4. Sanders (2006). Summary of Probiotic Activities of Bifidobacterium lactis HN019. *J Clin Gastroenterol*
5. Miller et al (2017). The Effect of Bifidobacterium animalis ssp. Lactis HN019 on Cellular Immune Function in Healthy Elderly Subjects: Systematic Review and Meta-Analysis. *Nutrients*.

B. lactis: Mechanisms of Action



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Key Considerations: Probiotics

Probiotics are no panacea

- **Specificity**
  - Strain specific effects
  - Individual strains vs. combinations; addition of prebiotics
  - Population/Patient specific effect
    - Age
    - Health status

- **Dose**
  - Adequate doses are necessary
  - Acquire from a manufacturer that used Good Manufacturing Practices

- **Duration**
  - Health benefits subside following cessation

A Deeper Dive into Prebiotics

Prebiotics, an Expanded Definition

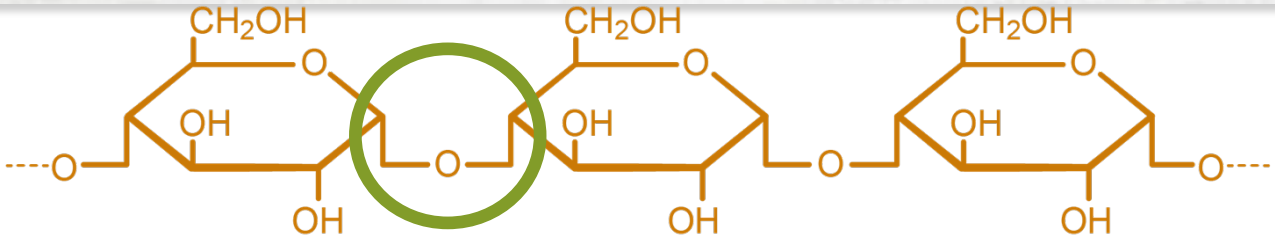
A prebiotic is a substrate that is selectively utilized by host microorganisms conferring a health benefit.

- ***Soluble, non-viscous, fermentable fibers:***
  - Galactooligosaccharides (GOS)
  - Fructooligosaccharides (FOS)
  - Inulin

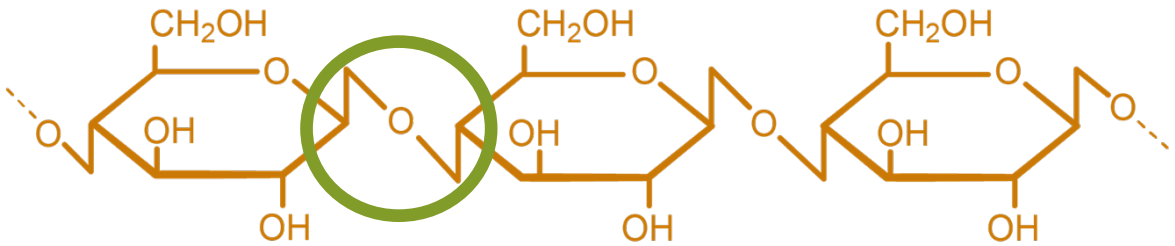
- Doses generally need to be 3.0 g/d or higher

Gibson, G., Hutkins, R., Sanders, M. et al. Expert consensus document: The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics. Nat Rev Gastroenterol Hepatol 14, 491–502 (2017). https://doi.org/10.1038/nrgastro.2017.75

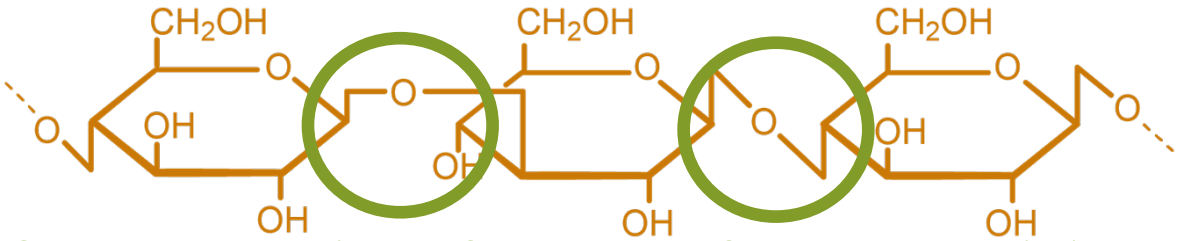
Human vs. Microbial Enzymes



Amylose: α-1,4 glucosidic bonds



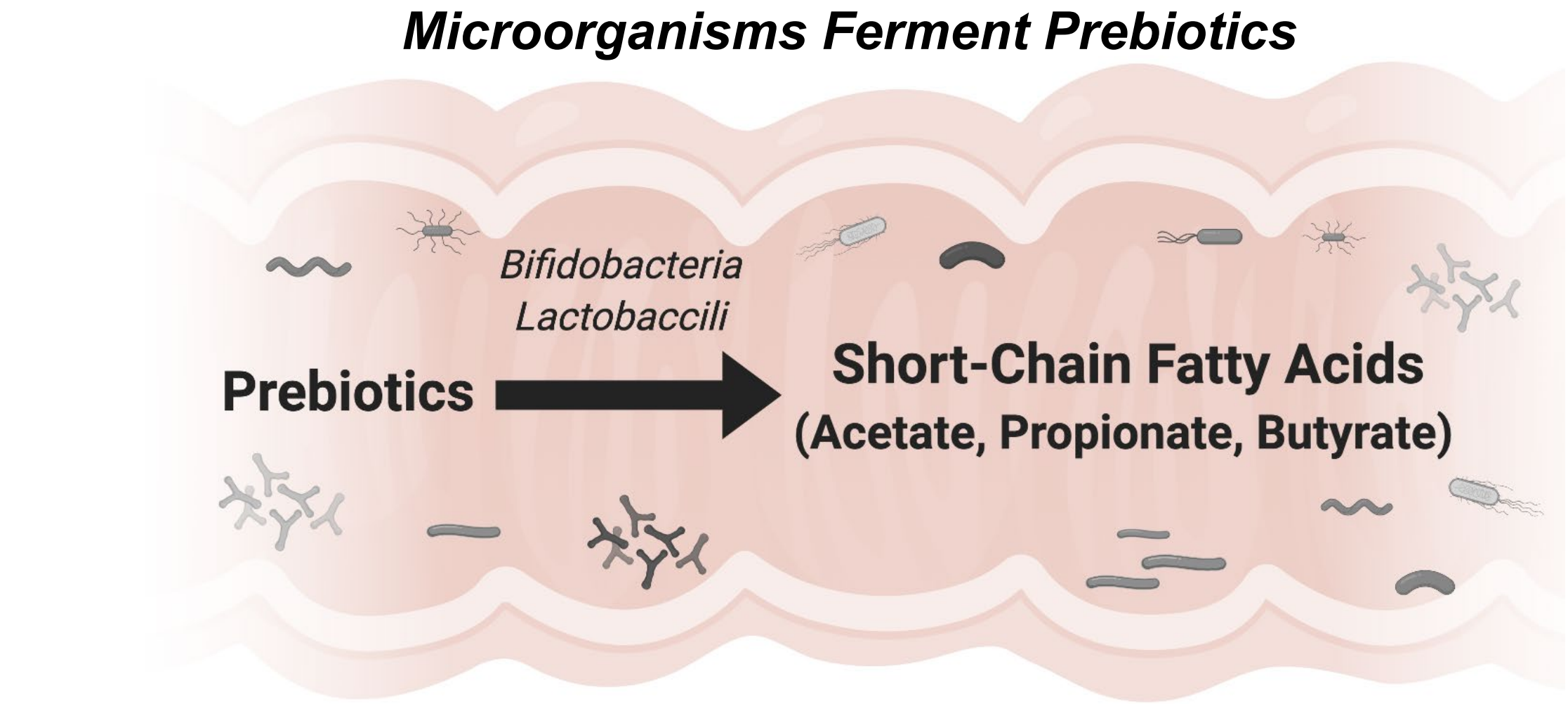
Cellulose: β-1,4 glucosidic bonds



β-Glucan: *mixed β-1,3 and β-1,4 glucosidic bonds*

Image adapted from Linus Pauling Institute, OSU

Prebiotics: Mechanism of Action



Holscher, H. D. (2017). Dietary fiber and prebiotics and the gastrointestinal microbiota. Gut Microbes, 8(2), 172-184.
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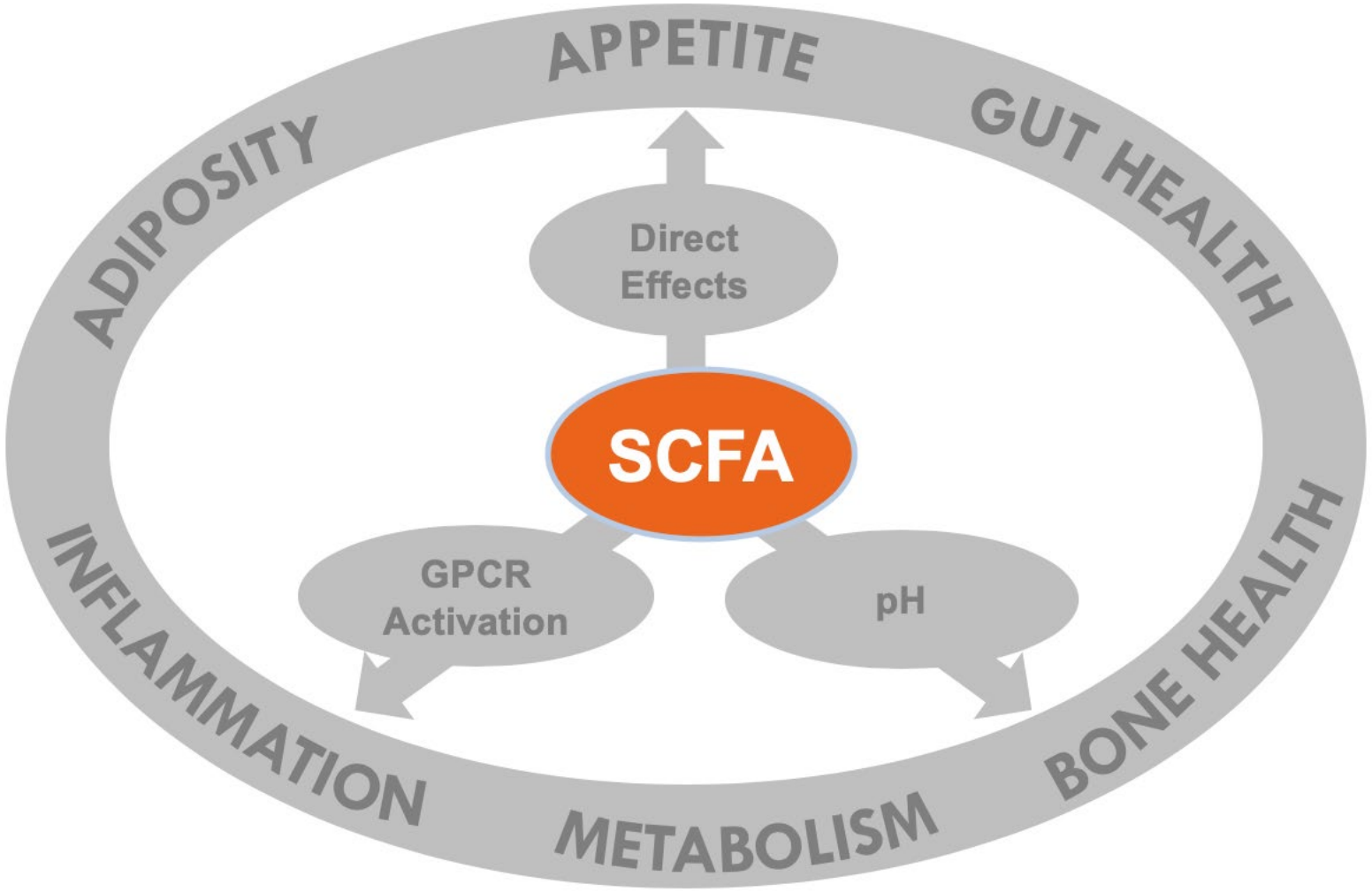
Microbial Metabolism & Health



Alexander C. (2019). Perspective: physiologic importance of short-chain fatty acids from nondigestible carbohydrate fermentation.. Adv Nutr, 10(4), 576-589.
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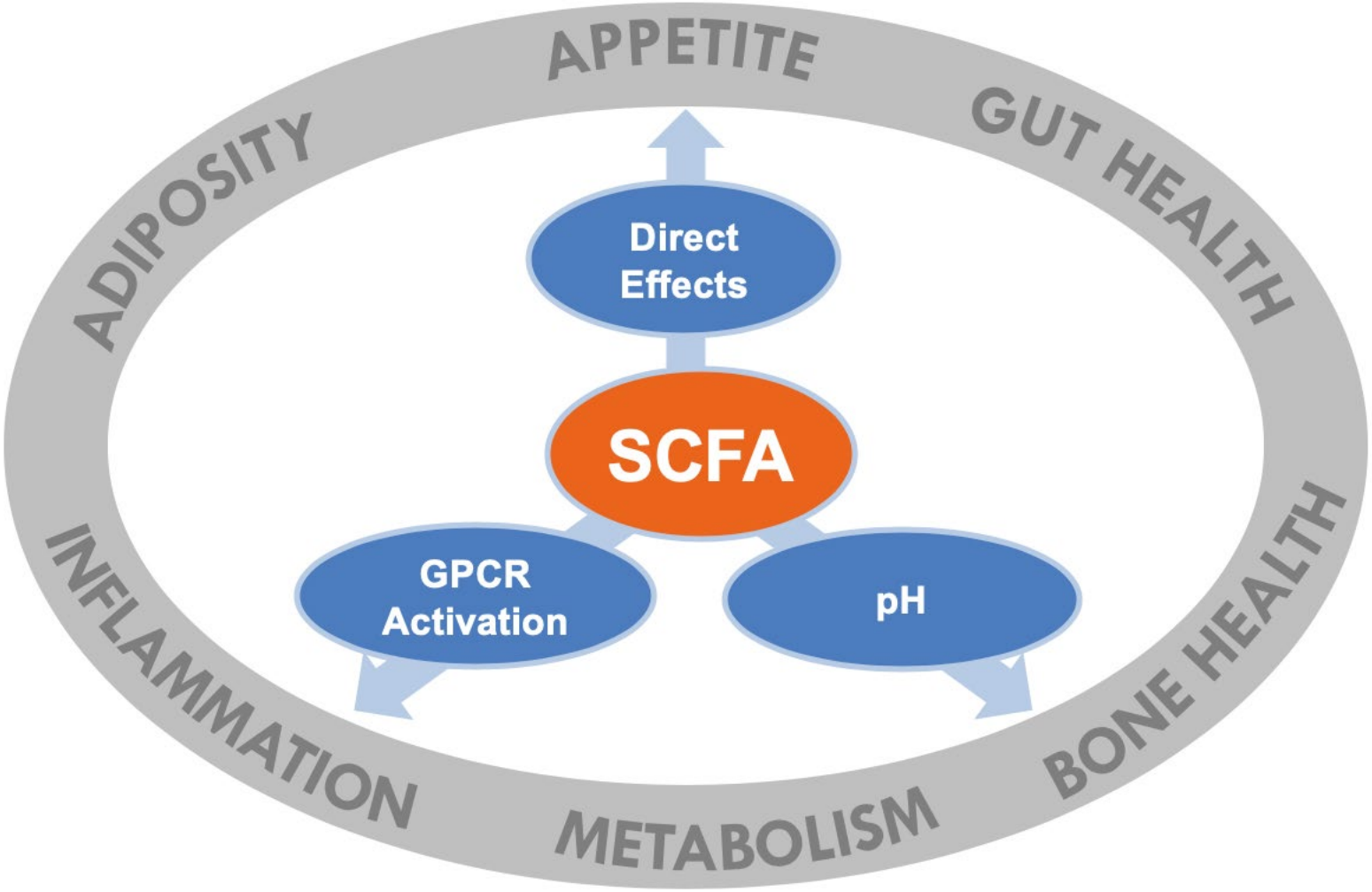
Microbial Metabolism & Health



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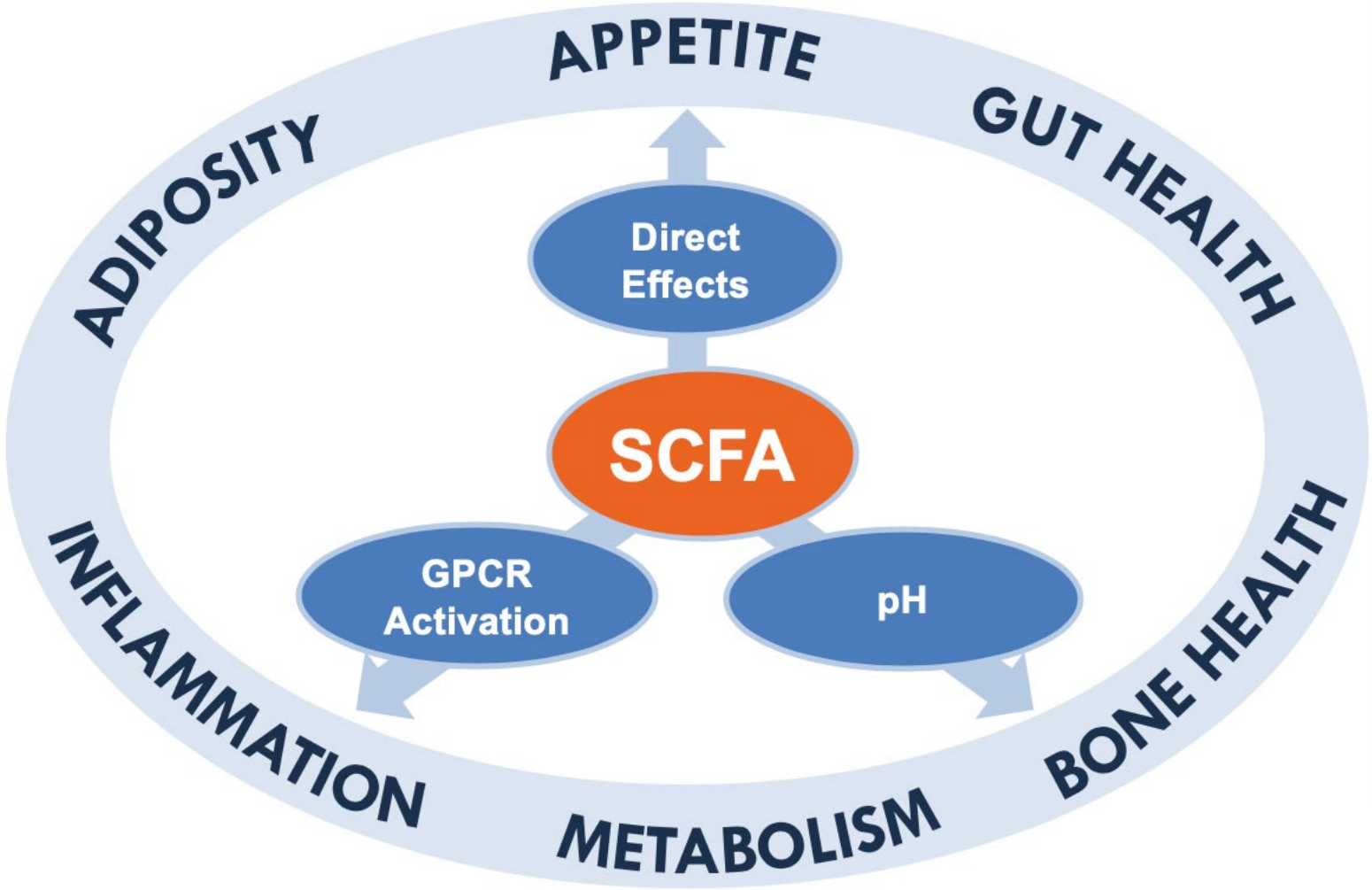
Microbial Metabolism & Health



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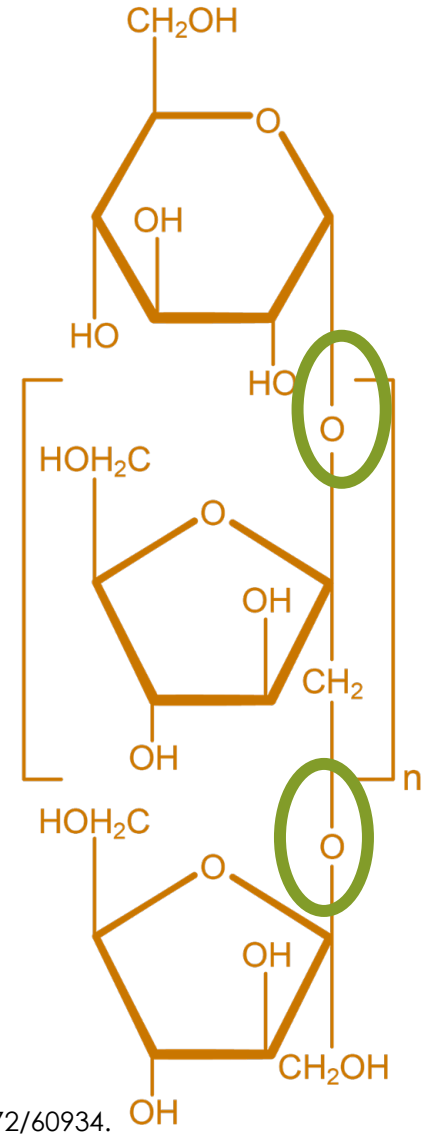
Prebiotic Example: Inulin Type Fibers

Structures

- Fructose polymer linked by ***β-2,1 linkages***
- Varying degrees of polymerization (2-60)
- Fructooligosaccharides (FOS) → Inulin



Meyer TSM (2015). Biotechnological Production of Oligosaccharides — Applications in the Food Industry, Food Production and Industry. DOI: 10.5772/60934.

Prebiotic Example: Inulin Type Fibers

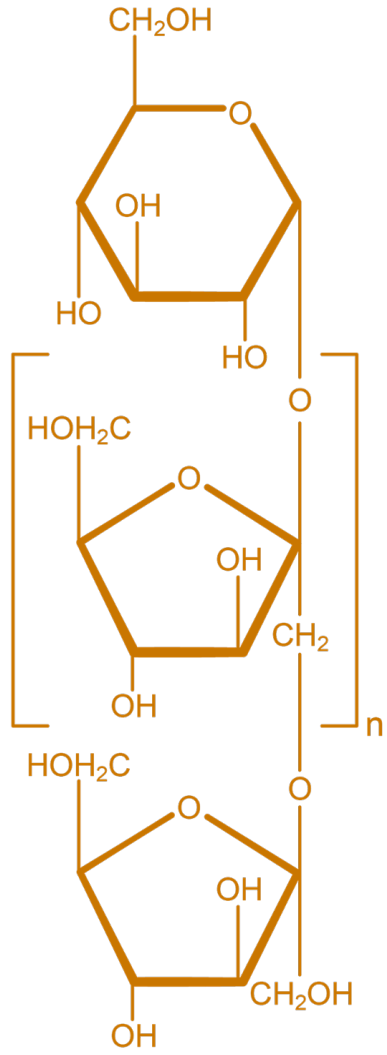
Plant Sources (g/100g)

- Wheat (2.5 g)
- Onion (4.3 g)
- Garlic (12.5 g)
- Leeks (6.5 g)
- Asparagus (2.5 g)
- Bananas (0.5 g)

- Agave
- Chicory root

Food Sources

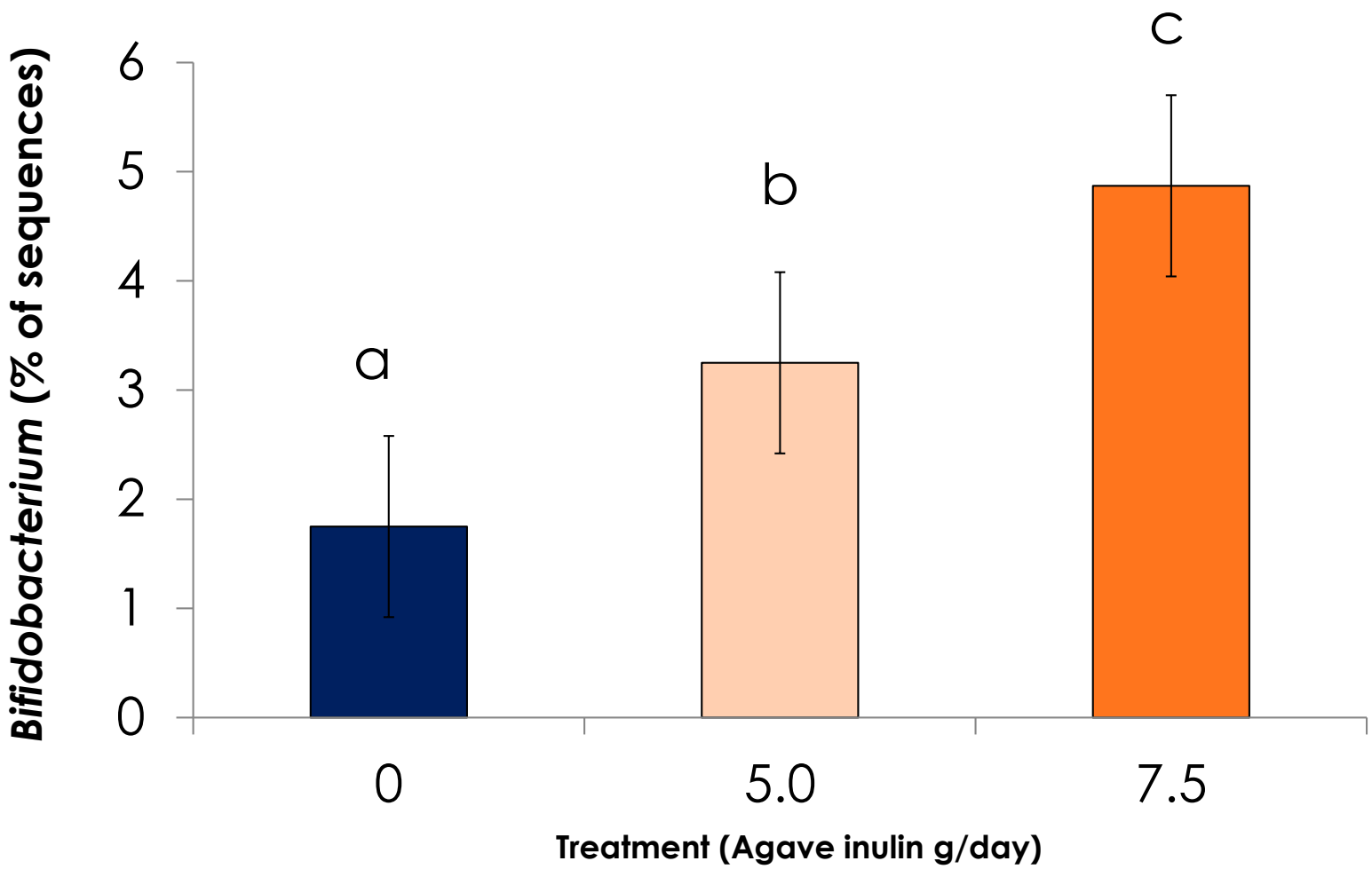
- Bars
- Cereals
- Yogurt
- Ice cream



Moshfegh AJ (1999). Presence of Inulin and Oligofructose in the Diets of Americans. J Nutr. 129, 1407S-1411S.
Meyer TSM (2015). Biotechnological Production of Oligosaccharides — Applications in the Food Industry, Food Production and Industry. DOI: 10.5772/60934.

Agave Inulin: Results

Agave Inulin **dose dependently** increased *Bifidobacterium*

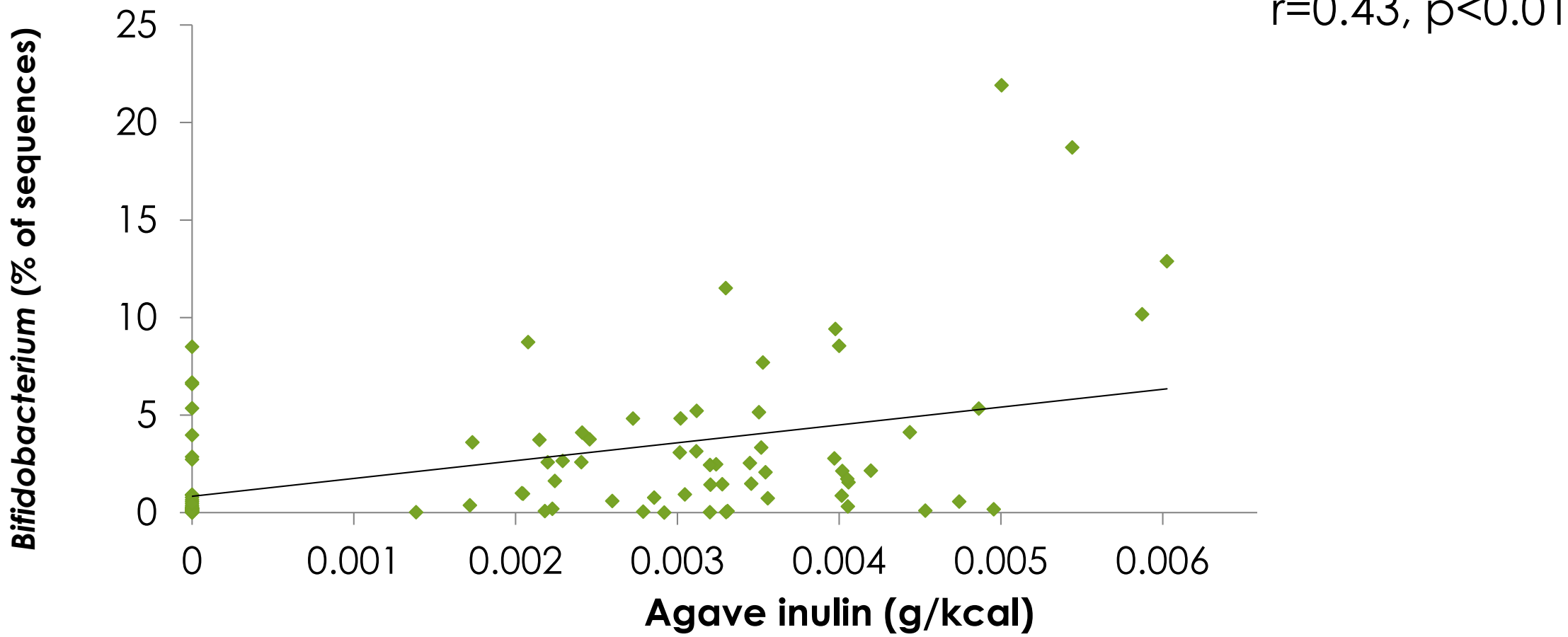


Holscher, HD (2015). Agave inulin supplementation affects the fecal microbiota of healthy adults participating in a randomized, double-blind, placebo-controlled, crossover trial. J Nutri, 145(9), 2025-2032.

Agave Inulin: Results

Positive relationship between **dose** and *Bifidobacterium*

r=0.43, p<0.01



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Microbial & Health Effects: Inulin Type Fibers

- ***Microbial***
  - Increase *Bifidobacterium and Faecalibacterium prausnitzii* and SCFA[1]
- ***Metabolic***
  - 10-21 g/d reduce fat mass and inflammation, improve glycemia.[2-6]
- ***Appetite, food intake, and satiety***
  - 8-21 g/d increase satiety and reduce energy intake.[2,3,6,7]

1. Dewulf EM (2013). Insight into the prebiotic concept: lessons from an exploratory, double-blind intervention study with inulin-type fructans in obese women. Gut; 62: 1112-21.
2. Parnell JA (2009) Weight loss during oligofructose supplementation is associated with decreased ghrelin and increased peptide YY in overweight and obese adults. AJCN; 89:1751–59.
3. Cani PD (2009). Gut microbiota fermentation of prebiotics increases satietogenic and incretin gut peptide production with consequences for appetite sensation & glucose response after a meal. AJCN;90(5),1236-43
4. Dewulf EM (2013). Insight into the prebiotic concept: lessons from an exploratory, double-blind intervention study with inulin-type fructans in obese women. Gut; 62: 1112-21.
5. Dehghan P (2013). Oligofructose-enriched inulin improves some inflammatory markers and metabolic endotoxemia in women with type 2 diabetes mellitus: A randomized controlled clinical trial. Nutrition; 30:418-23.
6. Genta (2009). Yacon syrup: beneficial effects on obesity and insulin resistance in humans. Clin Nutr 28, 182–187.
7. Cani (2006). Oligofructose promotes satiety in healthy human: a pilot study. Eur J of Clin Nutr 60, 567-572.

Prebiotics & Health End Points in Clinical Trials

Health end point	Prebiotic
Satiety	Fructooligosaccharide (FOS)
Calcium and other mineral absorption, bone health	FOS
Stimulation of neurochemical-producing bacteria in the gut	Galactooligosacharide (GOS)
Urogenital health	GOS
Irritable Bowel Syndrome (IBS)	GOS
Skin health, improved water retention and reduced erythema	GOS
Traveler's diarrhea	GOS
Allergy	FOS, GOS
Metabolic health: glycemia, dyslipidemia, inflammation	FOS, GOS
Bowel habit and general gut health in infants	FOS, GOS
Necrotizing enterocolitis	FOS, GOS
Infections and vaccine response	FOS, GOS, and PDX

Gibson, G. R., et al. (2017). Expert consensus document: The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics. Nature Reviews Gastroenterology & Hepatology.

Prebiotics: Meta-Analysis

- 14 of 29 *prebiotic* studies reported a ***decrease in ≥ 1 marker of systemic inflammation***.
  - Meta-analyses indicated that *prebiotics* ***reduce CRP***[1]
- Prebiotics[2], inulin-type fructans[3], and inulin[4] ***reduced total and LDL cholesterol.***
- Prebiotic treatments ***reduced postprandial glucose and insulin***.[5]

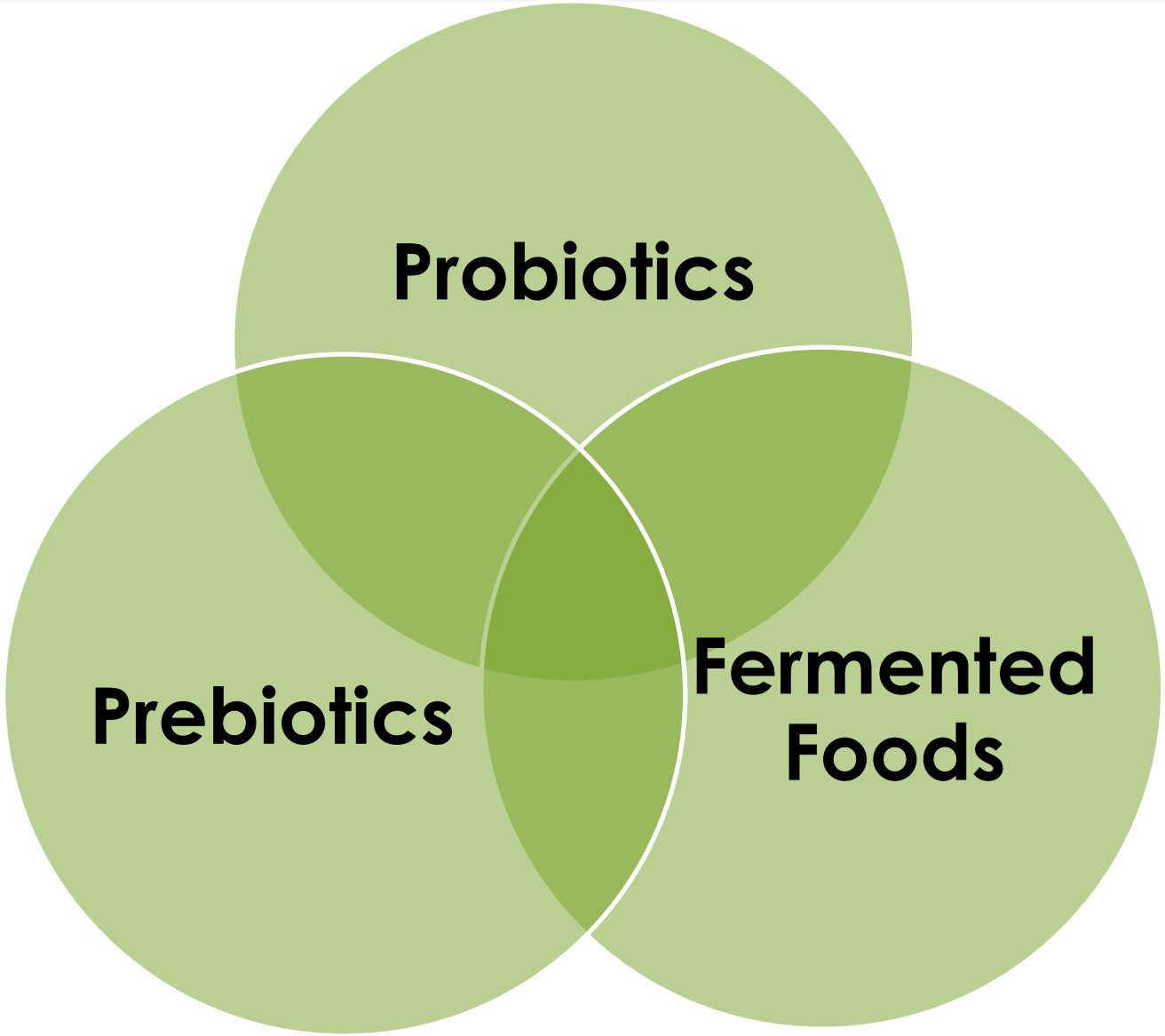
1. RF McLoughlin, *et al. Short-chain fatty acids, prebiotics, synbiotics, and systemic inflammation: a systematic review and meta-analysis. AJCN. 2017*
2. Beserra BT, et al. (2015). A systematic review and meta-analysis of the prebiotics and synbiotics effects on glycaemia, insulin concentrations and lipid parameters in adult patients with overweight or obesity. *Clinical Nutrition*, 34(5), 845-858.
3. Liu F (2016). Effect of inulin-type fructans on blood lipid profile and glucose level: a systematic review and meta-analysis of randomized controlled trials. Euro J Clin Nutr, 71, 9-20
4. Guo Z (2017). Effect of inulin on the plasma lipid profile of normolipidemic and hyperlipidemic subjects: a meta-analysis of randomized controlled trials.
5. Kellow NJ. Metabolic benefits of dietary prebiotics in human subjects: a systematic review of randomised controlled trials. Br J Nutr. 2014;111:1147–61.

Key Considerations: Prebiotics

- **Specificity**
  - Substrate specific effects
  - Population/Patient specific effect
    - Age
    - Health status
- **Dose**
  - Adequate doses are necessary
- **Duration**
  - Health benefits subside following cessation

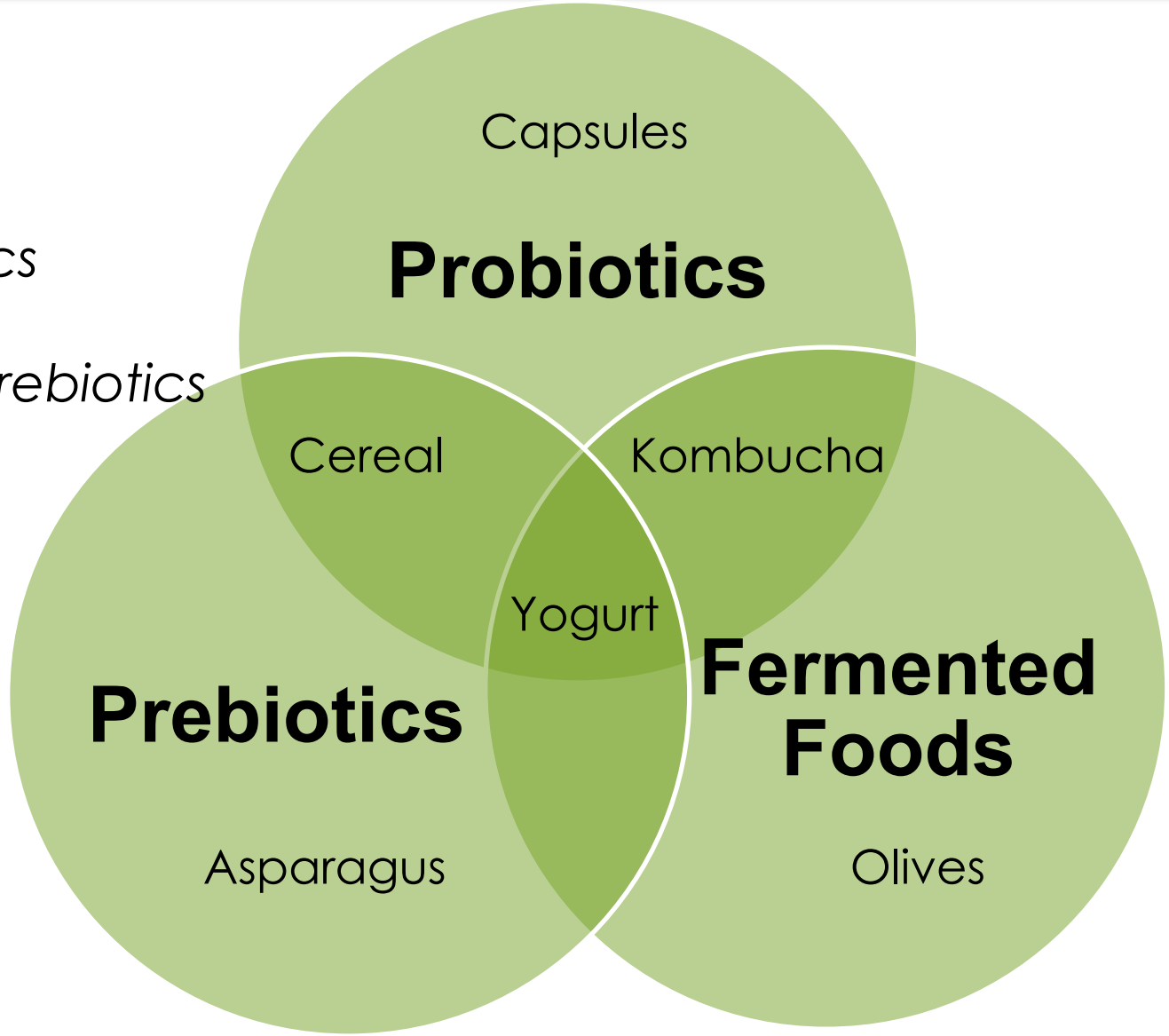
Sorting out the Differences

Asparagus
Capsules
Cereal
Kombucha
Olives
Yogurt



Sorting out the Difference: Answers

Asparagus: Prebiotic
Capsules: Probiotics
Cereal: Prebiotics & *Probiotics*
Kombucha: Fermented Food & *Probiotics*
Olives: Fermented Food
Yogurt: Fermented Food, *Probiotics*, & *Prebiotics*



Check the Label

Ingredients

Whole Grain Wheat, Cane Sugar, Inulin, Natural Flavor, Brown Rice Syrup, *Bifidobacterium Lactis* HN019, Contains 2% Or Less Of Coconut and Sunflower Oil, Natural Flavor, Salt, Mixed Tocopherols (Vitamin E) For Freshness

Check the Label: Answers

Ingredients

Whole Grain Wheat, Cane Sugar, **Inulin**, Natural Flavor, Brown Rice Syrup, ***Bifidobacterium Lactis* HN019**, Contains 2% Or Less Of Coconut and Sunflower Oil, Natural Flavor, Salt, Mixed Tocopherols (Vitamin E) For Freshness

Eat the Rainbow: Probiotics, Prebiotics, & Fermented Foods

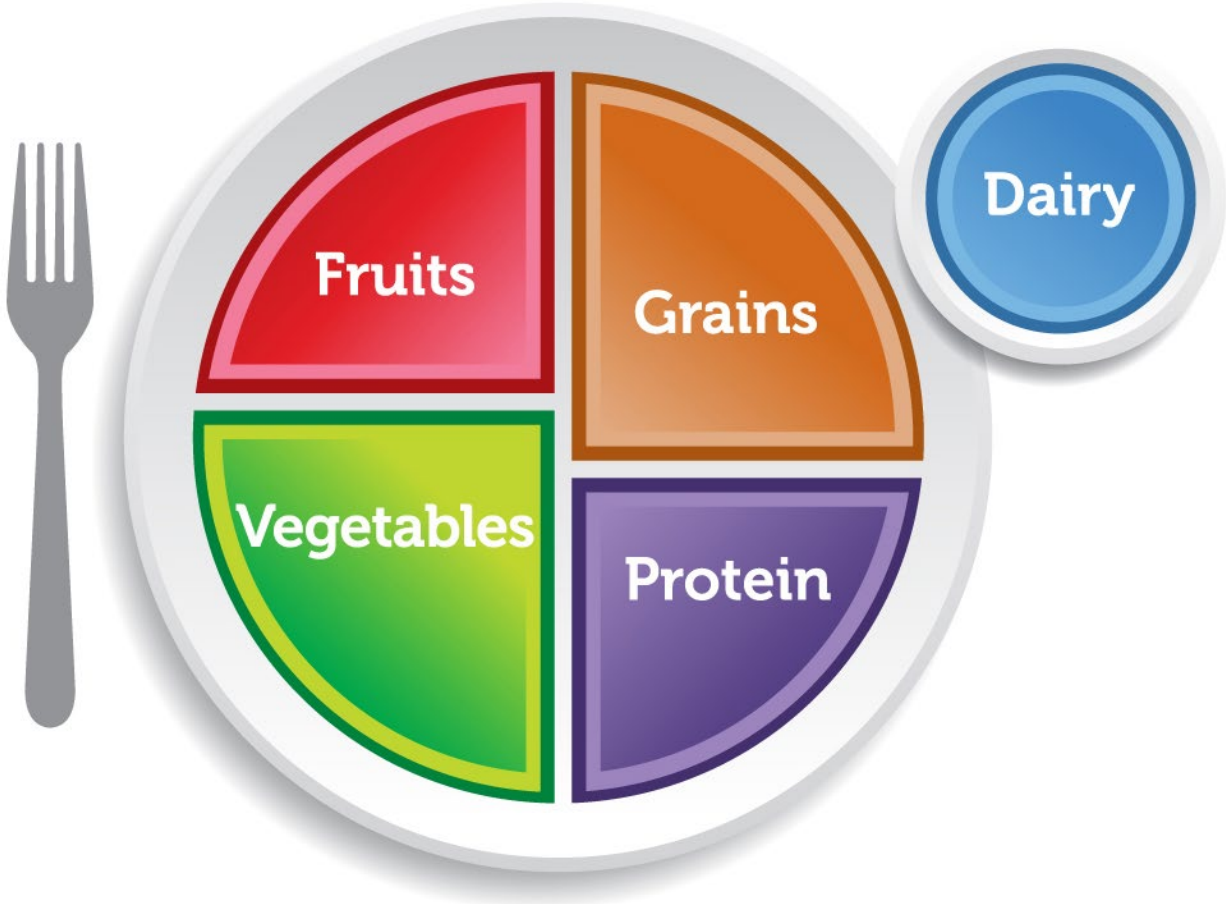
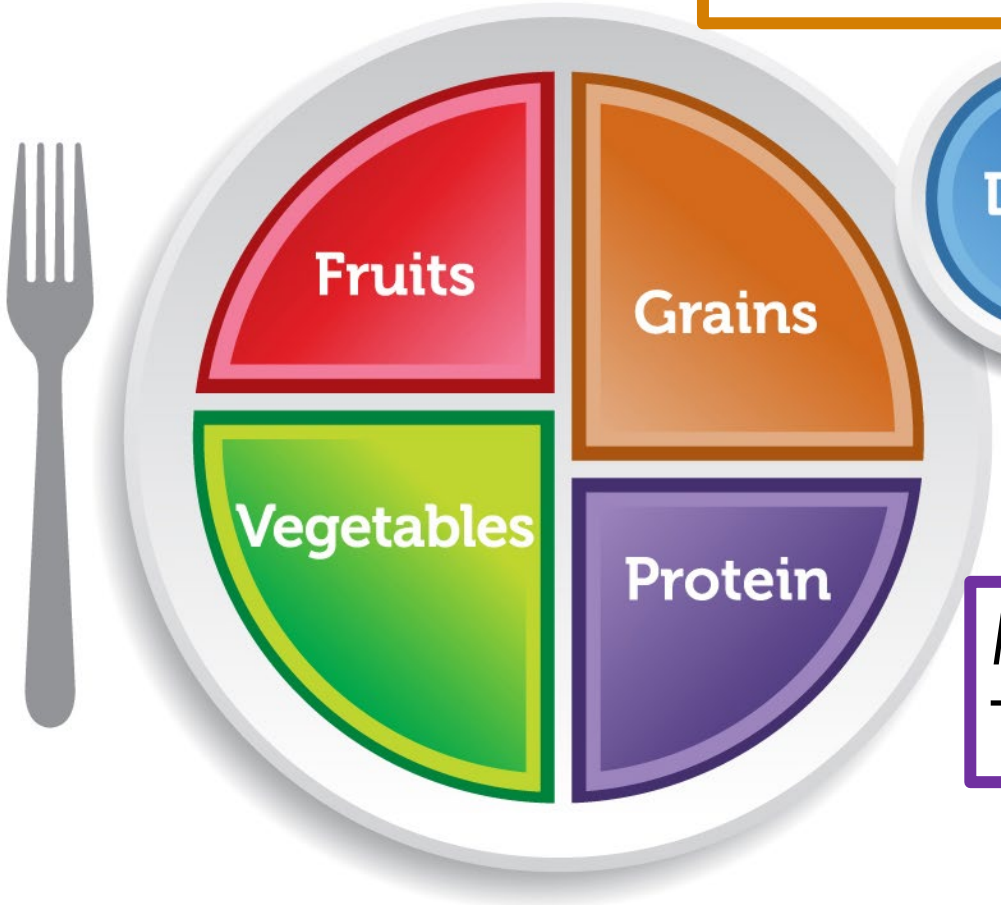


Image: U.S. Department of Agriculture myPlate

Eat the Rainbow: Probiotics, Prebiotics, & Fermented Foods

Bread: wheat, barley, rye
Bushera

Banana



Cheese
Kefir

Onions
Kimchi

Miso
Tempeh

Image: U.S. Department of Agriculture myPlate

Practical Applications

- **Probiotics & Prebiotics**
  - Specificity
  - Dose
  - Duration

- **Guiding Questions:**
  - *What is the indication?*
  - *Which probiotic strain(s) or prebiotic substrate(s)?*
  - *What is the evidence?*
  - *Where can I find additional information?*
    - American Gastroenterological Association (AGA)
    - World Gastroenterology Organisation (WGO)
    - European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN)
    - International Scientific Association for Probiotics and Prebiotics (ISAPP)
    - US Probiotic Guide

Key Takeaways

1

Probiotics & prebiotics affect health

2

Strain and ***substrate*** specificity

3

Adequate ***doses*** and ***duration***

Thank You!

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Join the Movement

Show your support by taking and sharing the Have A Plant® pledge at fruitsandveggies.org. While you're there, check out the useful resources to equip you with the tools you need to enhance your nutrition knowledge and empower consumers to enjoy more fruits and vegetables every day.

Follow PBH's social channels to keep up to date on all the insights and inspiration. #haveaplant

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@fruits_veggies

@fruitsandveggies

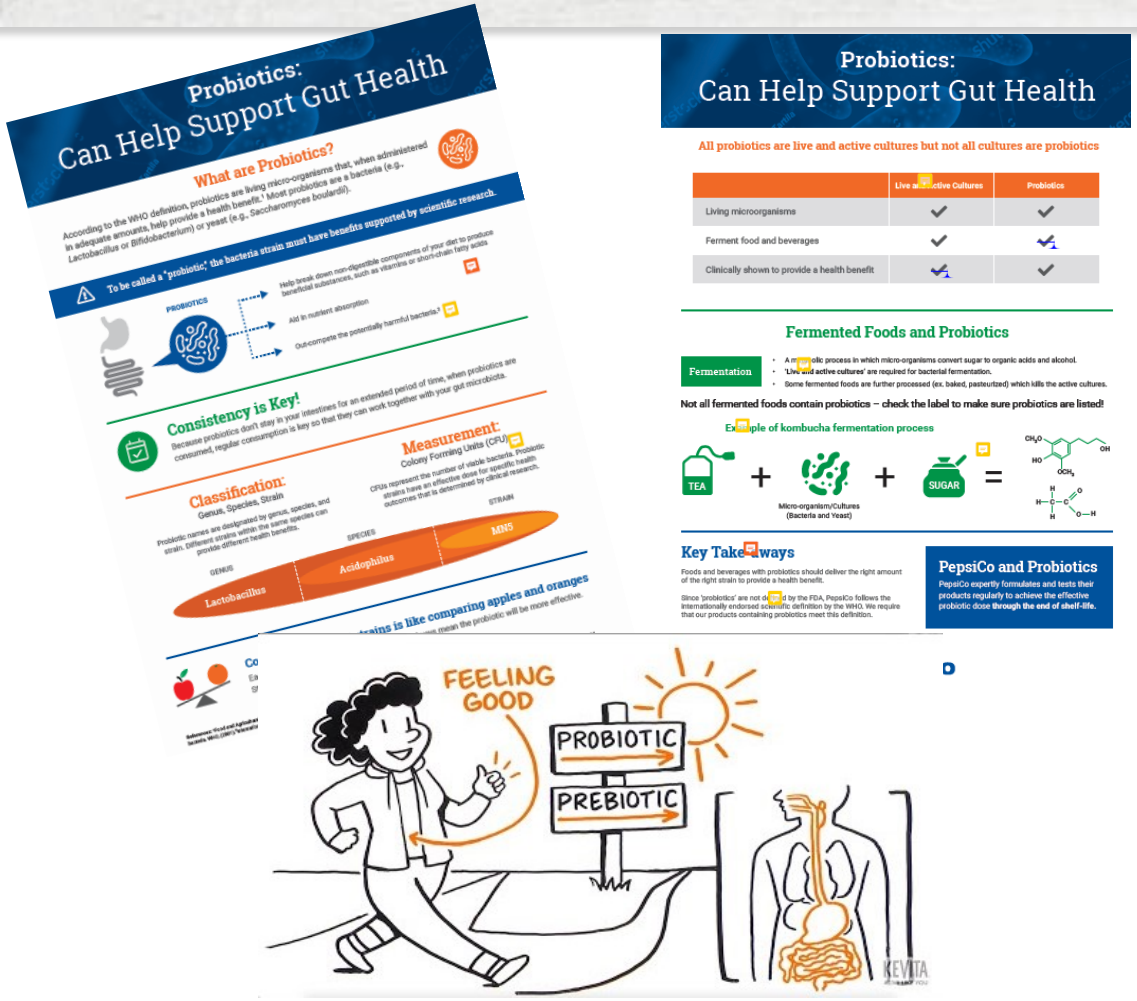
Produce for Better Health Foundation

September is National Fruits & Veggies Month and this year we're celebrating Have A Plant® Nation alongside National Family Meals Month™! Take a moment to celebrate how we can enjoy more fruits and vegetables during the month of September and beyond to support your health and happiness! https://fruitsandveggies.org/nfvm-toolkit/

A catalog of PBH's past webinars is available at fruitsandveggies.org/expert-professionals/webinars.

Continuing professional education units (CPEU) are available for live and pre-recorded webinars.

PepsiCo Resources and Products



Additional Educational Whiteboard Videos:
https://www.kevita.com/whiteboard-video-page/

Probiotics:

Prebiotics:

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