

# Feed Your Flora: How to Promote Healthy Gut Bacteria

Steven Lalevich, RD



healthy.iu.edu

---

---

---

---

---

---

---

---

## Overview of today's presentation

- We'll take a close look at the relationship between gut bacteria and health
- We'll discuss general recommendations for promoting a healthy gut
  - We won't be discussing specific medical problems
  - If you have any medical problems related to gut health, consult your physician
- One-on-one nutrition counseling
  - Email [askanrd@indiana.edu](mailto:askanrd@indiana.edu) to schedule an appointment
- Please save questions until the end of the presentation
- Presentation slides will be available at:
  - <https://healthy.iu.edu/wellness-information/workshop-handouts.html>



healthy.iu.edu

---

---

---

---

---

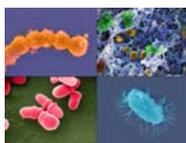
---

---

---

## What is the gut flora?

- Gut flora: the microorganisms that live in the digestive tract
  - Also known as: Gut microbiome/microbiota/microflora
- Gut flora includes:
  - Bacteria, archaea, fungi, and viruses



<http://rpi.nih.gov/catalyst/v2116/the-human-microbiome-project>



healthy.iu.edu

---

---

---

---

---

---

---

---

## The amount of bacteria in the human body

- **Number**
  - 100 trillion bacteria in and on your body (90% in large intestine)
  - Bacterial cells outnumber human cells 10 to 1 (You are 90% bacteria!)
- **Species**
  - 10,000 species of bacteria in your body
  - 1,000 species of bacteria in your gut
- **Weight**
  - All the bacteria in your body weigh a total of 2-6 pounds



healthy.iu.edu

---

---

---

---

---

---

---

---

There are 300 times more bacteria in your gut than there are stars in the Milky Way galaxy.



<http://spod.nasa.gov/spod/sp050104.html>  
healthy.iu.edu




---

---

---

---

---

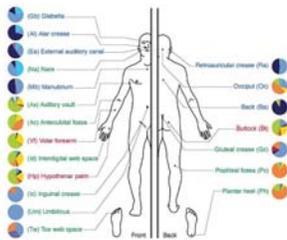
---

---

---

## Beyond the gut...

- Digestive tract
- Skin
- Mouth
- Nose
- Ears
- Eyes
- Genitals
- Respiratory tract



<http://www.genome.gov/dmd/img.ctm?mode=Photos/Graphics&id=85320>



healthy.iu.edu

---

---

---

---

---

---

---

---

## Microbiome as Ecosystem

- Variety of species interacting with each other
  - Species may compete with each other for same food source
  - One species' waste is another species' dinner
  - Increasing/decreasing population of one species may affect many others
- Different ecosystem in different locations
  - Food sources, acidity (pH), temperature, and humidity
  - Different bacteria thrive in different conditions
- Small alterations can have massive effects on the ecosystem



healthy.iu.edu

---

---

---

---

---

---

---

---



<http://www.deviantart.com/art/Green-Forest-51096798>

healthy.iu.edu



---

---

---

---

---

---

---

---



<http://humblebeez.deviantart.com/art/desert-stock-4-186033207>

healthy.iu.edu



---

---

---

---

---

---

---

---

## Functions of the gut microbiome

- Regulates immune function
- Prevents growth of harmful microorganisms
- Fermentation of indigestible food (fiber)
- Production of nutrients
  - Vitamin K2
  - B vitamins
  - Short chain fatty acids (SCFA)
- Influences hormone and neurotransmitter production



healthy.iu.edu

---

---

---

---

---

---

---

---

## Health effects of an altered gut microbiome

- Impaired immune function
  - Increased susceptibility to infection
  - Allergies and auto-immune conditions may be related to altered microbiome
- Increased inflammation, both in the gut and systemically
  - Increases risk of chronic diseases and obesity
- Aging
  - Gut microbiota in older adults is significantly different from young adults
- Altered brain function



healthy.iu.edu

---

---

---

---

---

---

---

---

## Gut Bacteria & The Brain

- Gut bacteria impact many brain functions
  - Sleep regulation
  - Mood
  - Pain sensitivity
  - Appetite regulation
- Stress
  - Bacteria may influence stress response
  - Stress response may alter the microbiome



healthy.iu.edu

---

---

---

---

---

---

---

---

### The development of the microbiome

- Begins at birth
  - Vaginal birth: exposure to vaginal and intestinal microbes
  - C-sections: minimal bacterial exposure
    - Correlate with increased risk of allergies and auto-immune conditions
- Breastfeeding
  - Prebiotics (food for gut bacteria): oligosaccharides
  - Probiotics (live bacteria that populates gut): beneficial bacteria



healthy.iu.edu

---

---

---

---

---

---

---

---

### Antibiotic Use

- An average child is prescribed antibiotics 10-20 times by the age of 18
- Antibiotics are often necessary, but their use alters the microbiome
  - The microbiome may never recover from these changes
  - This may contribute to increased risk of many diseases



<http://oceanservice.noaa.gov/news/weeklynews/jan13/antibiotics.html>  
healthy.iu.edu



healthy.iu.edu

---

---

---

---

---

---

---

---

### Sterile modern lifestyle – Are we too clean?

- Antibacterial soaps and cleaners
- Spending 90% or more of our time indoors
- Aversion to getting dirty
- Lack of beneficial bacteria in food supply
  - Abundance of beneficial bacteria found in dirt/soil
  - Bacteria is reduced in thoroughly washed or highly processed foods
- Dishwashers



healthy.iu.edu

---

---

---

---

---

---

---

---

### Ways to promote a healthy skin microbiome

- Get a dog
- Swim in a natural body of water
- Spend more time outdoors
- Open your windows
- Get your hands dirty (with actual dirt)



<http://www.hingham-ma.gov/barecove/DogRules.html>



healthy.iu.edu

---

---

---

---

---

---

---

---

### Food & The Microbiome

- Dietary changes can significantly alter the microbiome within 24 hours
- The gut microbiome impacts nutrient absorption and production
- Unhealthy diet consequences
  - Nutritional deficiencies from poor diet
  - Nutritional deficiencies from altered microbiome
    - Decreased absorption
    - Decreased production



<http://healthfinder.gov/News/Article.aspx?id=686737>



healthy.iu.edu

---

---

---

---

---

---

---

---

### Feed your Flora with Fiber

- Gut bacteria eat (ferment) fiber.
- Whole plant foods are main sources of fiber
  - Vegetables
  - Fruits
  - Whole grains
  - Beans and legumes
  - Nuts and seeds
- Association between high fiber diet and reduced risk of:
  - Obesity
  - Heart disease
  - Cancer



<http://smokefree.gov/tips-for-eating-more-fruits>



healthy.iu.edu

---

---

---

---

---

---

---

---

### Types of Fiber

- Fermentable (feeds your gut bacteria)
  - Soluble fiber: Onions, oats, nuts, apples, fruits, vegetables
  - Resistant starch: Unripe bananas, oats, beans, cooked and cooled starches
- Non-fermentable (increases stool bulk)
  - Insoluble fiber: Whole grains, nuts, fruits, vegetables
- Most plant foods contain a combination of soluble and insoluble fiber.
- Some bowel conditions may require restriction of fermentable fiber.



healthy.iu.edu

---

---

---

---

---

---

---

---

### Types of Soluble Fiber

- Inulin
  - Garlic, onion, leek, artichoke, asparagus
- Pectin
  - Pears, apples, plums, oranges (and other citrus fruits)
- Raffinose
  - Beans, cabbage, broccoli, Brussels sprouts
- Eating a variety of soluble fiber sources promotes diversity of gut species.



healthy.iu.edu

---

---

---

---

---

---

---

---

### Inflammation, polyphenols, and gut bacteria

- Less inflammation  $\leftrightarrow$  a healthier gut
- Polyphenols (plant-based antioxidant compounds)
  - Anti-inflammatory effects
  - Gut bacteria promote polyphenol absorption
  - Polyphenols promote growth and diversity of healthy microbiome
- Sources of polyphenols:
  - Whole plant foods: vegetables, fruits, whole grains, nuts, beans, seeds, etc.
  - Herbs and spices: garlic, turmeric, ginger, cinnamon, oregano, rosemary, etc.
  - Others: tea, coffee, dark chocolate, red wine, extra virgin olive oil



healthy.iu.edu

---

---

---

---

---

---

---

---

## Probiotics & Gut Health

- May be beneficial for some conditions but research results are mixed
  - Irritable bowel syndrome
  - Inflammatory bowel disease (Crohn's disease, ulcerative colitis)
  - Diarrhea
  - Constipation
- Adverse effects
  - Probiotics may worsen symptoms in some individuals
  - Immunocompromised should not use probiotics without medical supervision
- Effects may vary based on species, strain, combination, and prebiotics



healthy.iu.edu

---

---

---

---

---

---

---

---

## Prebiotics

- Prebiotics feed gut bacteria
  - Fermentable fiber in foods
  - Prebiotic supplements
- Types of supplemental prebiotics:
  - Fructo-oligosaccharide (FOS)
  - Mannan-oligosaccharide (MOS)
  - Galacto-oligosaccharide (GOS)



healthy.iu.edu

---

---

---

---

---

---

---

---

## Choosing a Probiotic

- In one study, only 1 out of 14 probiotic supplements contained exactly what was listed on the label (some had more, some had less)
- Even the best probiotics may not make it to the gut intact.
- If taking probiotics, you should:
  - Buy from a reliable source
  - Compare the CFUs (colony forming units)
  - Keep refrigerated to maximize shelf life
  - Use before expiration date



healthy.iu.edu

---

---

---

---

---

---

---

---

## Fermented Foods

- Fermented foods may act as natural probiotics
- Fermentation is a traditional way of preserving food
- Fermented foods include:
  - Dairy: yogurt, kefir
  - Vegetables: sauerkraut, kimchi, pickles
  - Soy: miso, tempeh
- Not all versions of these foods act as probiotics. Check the label.



healthyiu.edu

---

---

---

---

---

---

---

---

## Artificial Sweetener

- Artificial sweeteners may cause alterations in the microbiome that lead to glucose intolerance and metabolic dysfunction.



<http://www.ncaats.nih.gov/news-and-events/features/glucose.html>



healthyiu.edu

---

---

---

---

---

---

---

---

## Avoid produce with high pesticide residues

**EWG'S 2015 Dirty DOZEN<sup>®</sup>**  
Shopper's Guide to Pesticides in Produce

APPLES	PEACHES
CELERY	POTATOES
CHERRY	SNAP PEAS
TOMATOES	SPINACH
CUCUMBERS	STRAWBERRIES
GRAPES	SWEET BELL PEPPERS
NECTARINES	
HOT PEPPERS & KALE/COLLARD GREENS	

**EWG'S 2015 Clean FIFTEEN<sup>®</sup>**  
Shopper's Guide to Pesticides in Produce

ASPARAGUS	MANGOES
AVOCADOS	ONIONS
CABBAGE	PAPAYAS
CANTALOUPE	PINEAPPLES
CAULIFLOWER	SWEET CORN
EGGPLANT	SWEET PEAS (FROZEN)
GRAPEFRUIT	SWEET POTATOES
KIWI	



healthyiu.edu

---

---

---

---

---

---

---

---

## Putting together a healthy diet

- Does your diet feed only 10% of you?
  - 90% of your cells are bacteria
  - Make sure you are feeding them!
- Eat more plants (greater quantity and variety)
  - Aim for consuming at least 30 different plant species per week
- Limit intake of highly processed foods due to:
  - Lack of fermentable fiber
  - Potentially harmful effects of chemical additives and preservatives



<http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm262031.htm>



healthy.iu.edu

---

---

---

---

---

---

---

---

## Vitamin D

- Vitamin D is another important regulator of the immune system
- Vitamin D deficiency is common (42% of U.S. population)
  - May alter the gut microbiome
  - May trigger immune response to "good" bacteria
  - Associated with increased inflammation in the gut
- Sources of vitamin D
  - Sunlight
  - Food: fatty fish, eggs, fortified foods (milk, cereal, etc.)
  - Supplementation
- Testing your Vitamin D status



healthy.iu.edu

---

---

---

---

---

---

---

---

## Circadian Rhythm

- Circadian rhythm: body's internal 24-hour clock
  - Gut bacteria have circadian rhythms too!
- Disrupting normal sleep-wake cycle may:
  - Alter the microbiome
  - Increase risk of obesity and chronic disease
- Gut microbiome composition varies depending on the time of day
  - Less variation is observed in obesity
- Correcting circadian rhythm disruption may help restore the circadian rhythm of the gut microbiome and promote normal metabolism



<http://women.smokefree.gov/sleep,-stress-relaxation-rejuvenate-body-mind.aspx>



healthy.iu.edu

---

---

---

---

---

---

---

---

## Correcting your Circadian Rhythm

- Light
  - Avoid artificial light exposure at night
  - Spend time outdoors during the daytime
- Food intake
  - Avoid eating late at night (stop eating within 3-4 hours of bedtime)
  - Start your day with a healthy breakfast
- Get at least 7-8 hours of sleep each night
  - Sleep is also important for limiting inflammation
- Watch "Reset your Rhythm" presentation for more information
  - <https://healthy.iu.edu/wellness-information/workshop-handouts.html>

healthy.iu.edu  LIVE YOUR BEST YOU

---

---

---

---

---

---

---

---

## Test your own gut bacteria

- American Gut Project
  - <http://humanfoodproject.com/americangut/>
- uBiome
  - <http://ubiome.com/>
- Both use results anonymously for research purposes
- Results are not intended to diagnose or treat any medical condition

healthy.iu.edu  LIVE YOUR BEST YOU

---

---

---

---

---

---

---

---

## Bristol Stool Chart

Type 1		Separate hard lumps, like nuts (hard to pass)
Type 2		Sausage-shaped but lumpy
Type 3		Like a sausage but with cracks on the surface
Type 4		Like a sausage or snake, smooth and soft
Type 5		Soft blobs with clear-cut edges
Type 6		Luffy pieces with ragged edges, a mushy stool
Type 7		Watery, no solid pieces. Entirely liquid

[http://en.wikipedia.org/wiki/Bristol\\_stool\\_scale/media/File:bristol\\_stool\\_chart.png](http://en.wikipedia.org/wiki/Bristol_stool_scale/media/File:bristol_stool_chart.png)

healthy.iu.edu  LIVE YOUR BEST YOU

---

---

---

---

---

---

---

---

## Constipation

- Approximately 15% of the U.S. population experiences chronic constipation
- Altered microbiome  $\leftrightarrow$  Constipation
- Dietary factors
  - Fiber
  - Water
- Lifestyle factors
  - Physical activity
  - Stress
  - Toilet posture: sitting vs. squatting



[http://www.state.com/articles/health\\_and\\_scienc/science/2010/08/Don't\\_just\\_sit\\_there.html](http://www.state.com/articles/health_and_scienc/science/2010/08/Don't_just_sit_there.html)



healthy.iu.edu

---

---

---

---

---

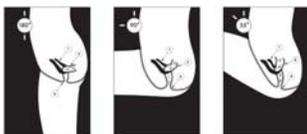
---

---

---

## Squatting is a more natural posture than sitting

- Greater hip flexion  $\rightarrow$  straighter recto-anal canal  $\rightarrow$  easier elimination
- Squatting may reduce risk of constipation, hemorrhoids, and diverticulosis



<http://www.petencoding.com/LE-PENSEUR>



healthy.iu.edu

---

---

---

---

---

---

---

---

## Squat toilet



healthy.iu.edu

---

---

---

---

---

---

---

---

### Toilet platform



Nature's Platform™

healthy.iu.edu



---

---

---

---

---

---

---

---

### Toilet Stool



Squatty Potty™

healthy.iu.edu



---

---

---

---

---

---

---

---

### How to improve your toilet posture



<http://www.badgerandbowelfoundation.org/wp-content/uploads/2015/02/toiletting-positions.pdf>  
healthy.iu.edu



---

---

---

---

---

---

---

---

### How to improve your toilet posture

**Step two**



Lean forwards and put elbows on your knees

<http://www.bladderandbowelfoundation.org/wp-content/uploads/2015/02/toileting-positions.pdf>  
healthy.iu.edu



---

---

---

---

---

---

---

---

### How to improve your toilet posture

**Step three**



Bulge out your abdomen  
Straighten your spine

<http://www.bladderandbowelfoundation.org/wp-content/uploads/2015/02/toileting-positions.pdf>  
healthy.iu.edu



---

---

---

---

---

---

---

---

### How to improve your toilet posture

**Correct position**



Knees higher than hips  
Lean forwards and put elbows on your knees  
Bulge out your abdomen  
Straighten your spine

<http://www.bladderandbowelfoundation.org/wp-content/uploads/2015/02/toileting-positions.pdf>  
healthy.iu.edu



---

---

---

---

---

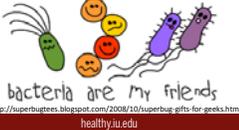
---

---

---

## Feed Your Flora Tips

- Diet
  - Eat a whole food based diet that includes good sources of fiber
  - Consume at least 30 different plant species each week
  - Include fermented foods in your diet
  - Avoid intake of highly processed foods
  - Avoid artificial sweeteners




healthy.iu.edu

---

---

---

---

---

---

---

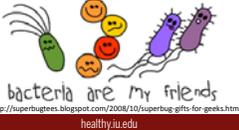
---

---

---

## Feed Your Flora Tips

- Lifestyle
  - Incorporate stress management practices into your daily routine
  - Engage in regular physical activity
  - Spend more time outdoors
  - Correct circadian rhythm disruption
  - Consider squatting instead of sitting




healthy.iu.edu

---

---

---

---

---

---

---

---

---

---

## References

- American Chemical Society. The precise reason for the health benefits of dark chocolate: mystery solved. 2014. <http://www.acs.org/content/acs/en/pressroom/newsreleases/2014/ march/the-precise-reason-for-the-health-benefits-of-dark-chocolate-mystery-solved.html>
- Blaser M. Antibiotic overuse: Stop the killing of beneficial bacteria. Nature. 2011;476(7361):393-4.
- Forrest KY, Stuhlreher WL. Prevalence and correlates of vitamin D deficiency in US adults. Nutr Res. 2011;31(1):48-54.
- Galland L. The gut microbiome and the brain. J Med Food. 2014;17(12):1261-72.
- Joyce SA, Gahan CG. The gut microbiota and the metabolic health of the host. Curr Opin Gastroenterol. 2014;30(2):120-7.
- The Low FODMAP Diet. Stanford Hospital & Clinics: <https://stanfordhealthcare.org/content/dam/SHC/for-patients-component/programs-services/clinical-nutrition-services/docs/pdf/lowfodmapdsh.pdf>
- Marcobal A, Underwood MA, Mills DA. Rapid determination of the bacterial composition of commercial probiotic products by terminal restriction fragment length polymorphism analysis. J Pediatr Gastroenterol Nutr. 2008;46(5):608-11.
- O'Mahony SM, Clarke G, Borre YG, Dinan TG, Cryan JF. Serotonin, tryptophan metabolism and the brain-gut-microbiome axis. Behav Brain Res. 2015;277:1-248.
- Picard C, Fioramonti J, François A, Robinson T, Neant F, Matuchansky C. Review article: bifidobacteria as probiotic agents -- physiological effects and clinical benefits. Aliment Pharmacol Ther. 2005;22(6):495-512.



healthy.iu.edu

---

---

---

---

---

---

---

---

---

---

## References

- Pollan M. Some of my best friends are germs. New York Times. 2013. [http://www.nytimes.com/2013/05/19/magazine/say-hello-to-the-100-trillion-bacteria-that-make-up-your-microbiome.html?pagewanted=all&\\_r=1&](http://www.nytimes.com/2013/05/19/magazine/say-hello-to-the-100-trillion-bacteria-that-make-up-your-microbiome.html?pagewanted=all&_r=1&)
- Queipo-ortuño MI, Boto-ordóñez M, Murri M, et al. Influence of red wine polyphenols and ethanol on the gut microbiota ecology and biochemical biomarkers. *Am J Clin Nutr.* 2012;95(6):1323-34.
- Ramirez-farias C, Slezak K, Fuller Z, Duncan A, Holtrop G, Louis P. Effect of inulin on the human gut microbiota: stimulation of *Bifidobacterium adolescentis* and *Faecalibacterium prausnitzii*. *Br J Nutr.* 2009;101(4):541-50.
- Reardon S. Gut-brain link grabs neuroscientists. *Nature.* 2014;515(7526):175-7.
- Siener R, Bangen U, Sidhu H, Hönow R, Von unruh G, Hesse A. The role of *Oxalobacter formigenes* colonization in calcium oxalate stone disease. *Kidney Int.* 2013;83(6):1144-9.
- Sikrov D. Comparison of straining during defecation in three positions: results and implications for human health. *Dig Dis Sci.* 2013;48(7):1201-5.
- Suez J, Korem T, Zeevi D, et al. Artificial sweeteners induce glucose intolerance by altering the gut microbiota. *Nature.* 2014;514(7521):181-6.
- Wu GD, Chen J, Hoffmann C, et al. Linking long-term dietary patterns with gut microbial enterotypes. *Science.* 2011;334(6052):105-8.



healthyiu.edu

---

---

---

---

---

---

---

---

## Questions?

For additional questions, or to schedule a one-on-one nutrition counseling appointment, email: [askanrd@indiana.edu](mailto:askanrd@indiana.edu)



healthyiu.edu

---

---

---

---

---

---

---

---