

A still life photograph of various fruits including figs, grapes, and pears on a wooden surface. The background is dark and textured. The text is overlaid on the upper portion of the image.

Microbiota-Connection to Disease & Personalized Nutritional Interventions

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Faculty Disclosure

Commercial Interest	Nature of Relevant Financial Relationship (Include all those that apply)	
	What was received	For what role
• None	• N/A	N/A

Presentation Learning Objectives

After participating in this presentation, learners should be better able to:

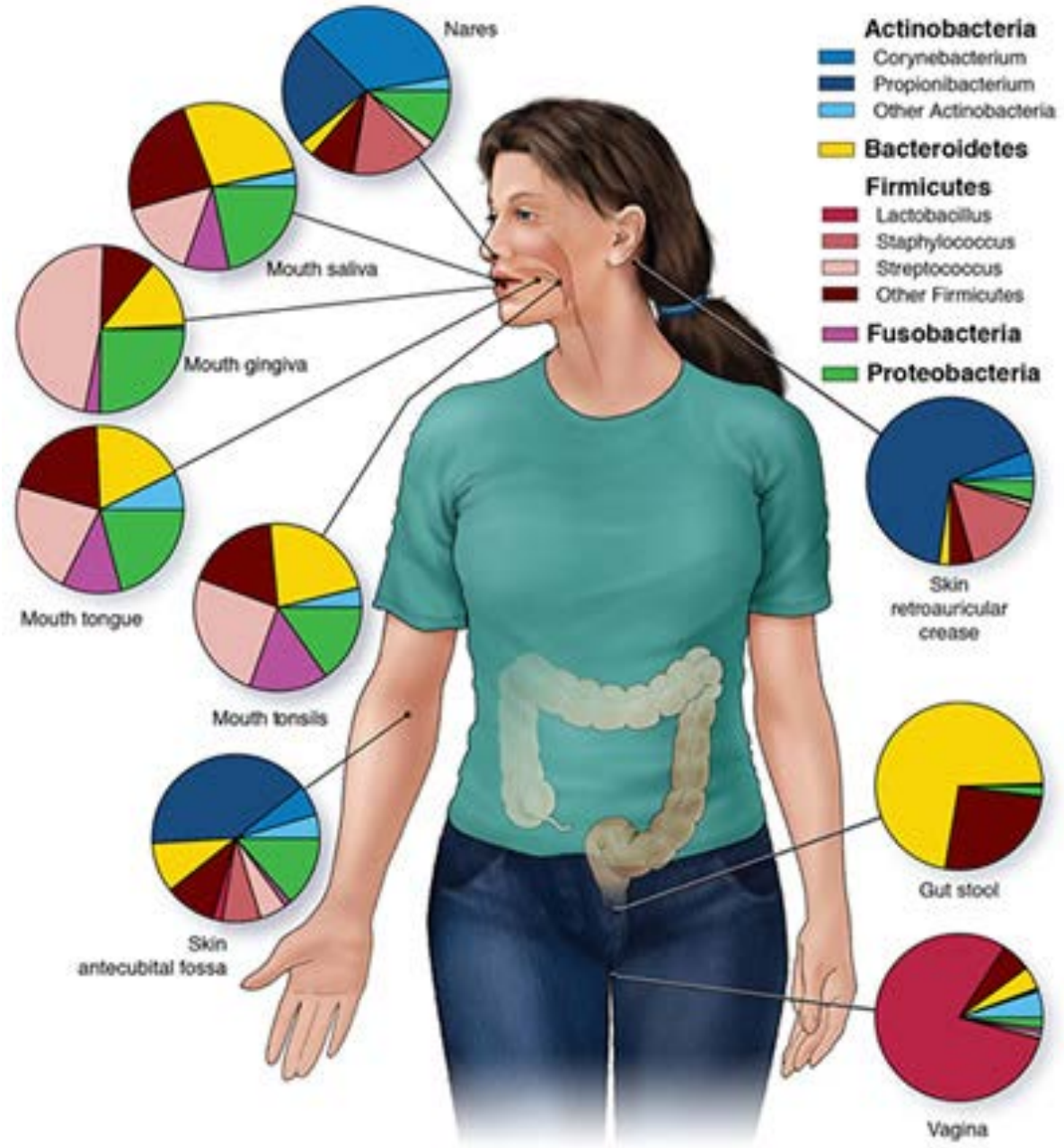
1. Understand the emerging role of the microbiome in health maintenance and systemic conditions;
2. Provide an overview to emerging research on the gut-brain, and on the microbiome and metabolic disease;
3. Explore the health benefits of cultured and fermented food in health maintenance;
4. Review current research in the use of therapeutic diets to restore dysbiosis;
5. Recognize the role that therapeutic diets play in restoration of the microbiota and modulation of health.

Presentation Clinical Actions

After participating in this presentation, clinicians should be better able to:

- Utilize a food first approach to balancing GI and systemic conditions
- Discern which dietary approach may be most useful for a given person including Comprehensive Elimination Diet, FODMAP, Specific Carbohydrate Diet, anti-fungal diets, and restorative diets
- Implement personalized nutritional interventions to maintain and restore the microbiota

Human Microbiome



<http://unlockinglifescode.org/explore/genomic-medicine/microbiome>

Microbiome Regulates

- Metabolism
- Depression
- Obesity
- Food Choices
- Schizophrenia
- Pain set point
- Diabetes
- Allergies
- IBS
- Nervous system



Diet and Microbiome

“Diet has the most powerful influence on gut microbial communities in healthy human subjects.”

About 75% of the food in the Western diet is of limited or no benefit to the microbiota in the lower gut. Most of it, comprised specifically of refined carbohydrates, is already absorbed in the upper part of the GI tract, and what eventually reaches the large intestine is of limited value, as it contains only small amounts of the minerals, vitamins and other nutrients necessary for maintenance of the microbiota.

Bengmark S. “Nutrition of the Critically Ill: a 21st-Cent perspective”

Probiotics Benefits

- **Modulate the Immune System**
 - Infection
 - Diarrhea
 - Eczema
 - Infant Colic
 - Decrease lactose intolerance
 - Reduce colds and respiratory tract infection (especially in children)
- **Improve metabolism:**
 - Make B-complex vitamins and Vitamin K
 - Increase absorption of minerals
 - Obesity
 - Diabetes
 - Cholesterol and triglyceride balance
 - Improve digestion
- **Reduce Inflammation**
 - Inflammatory Bowel Disease
 - GERD
 - Necrotizing enterocolitis

Common Probiotic Supplements

- *Lactobacillus* sp.
 - *reuteri*
 - *casei*
 - *rhamnosus*
 - *Acidophilus*
 - *plantarum*
- *Streptococcus* sp.
- *Bifidobacterium* sp.
 - *infantis*
 - *lactis*
 - *longum*
 - *breve*
 - *bifidum*
- *S. boulardii* (nonhuman)



Cultured and Fermented Foods





- **India:** Acar; achar; tandal achar; garam nimboo achar; gundruk; lemon, mango and lime pickles, fermented milks
- **Africa:** fruit vinegar, hot pepper sauce, lamoun makbouss, mauoloh, msir, mslalla, olive oil seeds, ogili, ogiri, hibiscus seed
- **Asia:** asinian, burong mangga, dalok, jeruk, kimchi, kong-chai, naw-mai-dong, pak-siam-dong, nata de coco, nata de pina, bai-ming, cha-ts'ai, hiroshimana, janagee, nara, etc
- **Middle East:** Kushuk, lamoun makbouss, olives, torshi, tursu, wines
- **Europe and World:** mushrooms, yeast, olives, sauerkraut, sauerruben, vinegars, wines, citron, cheeses, fermented dairy
- **Americas:** cucumber pickles, sauerkraut, lupinseed, oilseeds, vanilla, wines, cheeses, fermented dairy

Fermentation of Food

- Food more digestible
- Polyphenols into active state
- > vitamins, enzyme activity & amino acid production
- Breakdown of phytates, tannins, oxalic acid
- Extends shelf life/food preservation
- Improves health due to increased nutrient intake
- Improved food security



Polyphenols in food promote growth of Probiotic microbes

- Green tea
 - Red wine
 - Apples
 - Onions
 - Chocolate
 - Panax ginseng
- > Lactobacilli
 - > Bifidobacteria
 - < pathogens



Common Microbes in Fermented Fruits & Vegetables

- *Lactobacillus plantarum*, *L. pentosus*, *L. brevis*, *L. acidophilus*, *L. fermentum*, *Leuconostoc fallax*, and *L. mesenteroides*, *L. kimchi*, *L. fallax*,
- *Weissella confusa*, *W. koreensis*, *W. cibaria*,
- and *Pediococcus pentosaceus*



Miso Soup



- 160 bacterial strains or more
- Reduces breast cancer risk (from radiation)
- Contains salt but doesn't raise blood pressure
- Unami taste
- Nutrients: copper, manganese, vitamin K, vitamin A, B-complex vitamins, protein, zinc, choline, phosphorus, fiber, omega 3 fatty acids, calcium, iron, magnesium, potassium
- Antioxidants

World's Healthiest Foods www.whfoods.com; [J Toxicol Pathol](http://J.Toxicol.Pathol). 2013 Jun; 26(2): 91–103; www.nutritiondata.com

Kefir Therapeutic Effects

- Antimicrobial
- Supports GI immune health
- > lactose digestion
- Anti-tumor
- Anticancer
- Russia: peptic ulcers stomach and duodenum

Historical use:

- gastrointestinal
- Hypertension
- Allergies
- Ischemic heart disease



de Oliveira Leite, A.M., et al., Braz J Microbiol, 2013. 44(2): p. 341-9.

Kim Chee Health Effects

- Anticancer
- Antiobesity
- Anticonstipation
- > Colorectal health
- Probiotic properties
- Cholesterol reduction
- Fibrolytic effect
- Antioxidant and anti-aging properties
- Brain health promotion
- Immune promotion
- Skin health promotion

Park, K.Y., et al., Health benefits of kimchi (Korean fermented vegetables) as a probiotic food. J Med Food, 2014. 17(1): p. 6-20.



Honey: LAB Symbionts

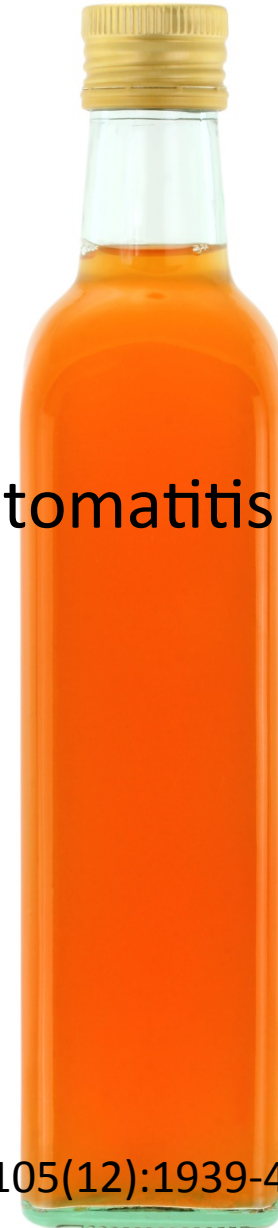
- 13 unique strains of LAB and BB in fresh honey
- They exist in biofilms
- 1 billion CFU/gm
- 40 LAB's in bee's stomachs
- Active against MRSA, pseudomonas aeruginosa, and vancomycin-resistant Enterococcus
- Long known as antimicrobial, and anti-inflammatory in wounds

Oloffson TC, et al. (2014) *International Wound J.* Sept 8,



Vinegar

- Helps modulate glycemic response in diabetics
- May have some small benefit in weight loss
- Shows promise for anti-fungal in people with denture stomatitis
- Used as a vaginal douche
- Improves digestive function
- Antiseptic



Mota AC. *J Prosthodont.* 2014 Sep 14. Johnston, [J Am Diet Assoc.](#) 2005 Dec;105(12):1939-42.
Johnston, [Diabetes Res Clin Pract.](#) 2009 May;84(2):e15-7



Prebiotics are dietary fibers that are selectively fermented by beneficial microbes of the intestine...prebiotics take advantage of the commensals in the gut microbiota to break down otherwise non-digestible fibers. Also called “resistant starch”



Prebiotic Beneficial Effects

- Improved bowel function
- Promote growth of Bifidobacteria, Lactobacilli and other beneficial microbes
- Colon pH
- Protect against negative effects of bile acids
- Substrate for SCFA
- Improves intestinal permeability
- Improved Metabolism of microbiota
- Adds sweetness to food
- > bone density (+ calcium)
- > serum cholesterol and triglycerides
- Cancer protective
- Used in treatment of atherosclerosis
- Immune function
- Neural and cognitive function
- Skin
- > insulin sensitivity & glucose regulation (in all and Type 2 DM)
- > mineral absorption
- Small but sig. effects body weight

Prebiotics: Oligosaccharides

- Fructoooligosaccharides (FOS)
- Galactooligosaccharides (GOS)
- Lactulose derived galactooligosaccharides (LDGOS)
- Xylooligosaccharides (XOS)
- Arbinooligosaccharides (AOS)
- Algae derived marine oligosaccharides (ADMO)
- Pectin-derived oligosaccharides (pAOS)
- Human milk oligosaccharides (HMO)

Prebiotic Rich Foods

- Artichoke
- Asparagus
- Avocado
- Bananas (under ripe)
- Burdock root
- Chicory
- Chinese chives
- Eggplant
- Dandelion Greens
- Fruit
- Garlic
- Green Tea
- Honey
- Jerusalem artichokes
- Jicama
- Leeks
- Legumes
- Lentils
- Onions
- Peas
- Plaintains
- Soybeans
- Sugar maple
- Yogurt, cottage cheese, kefir



Natural occurrence of FOS(%)

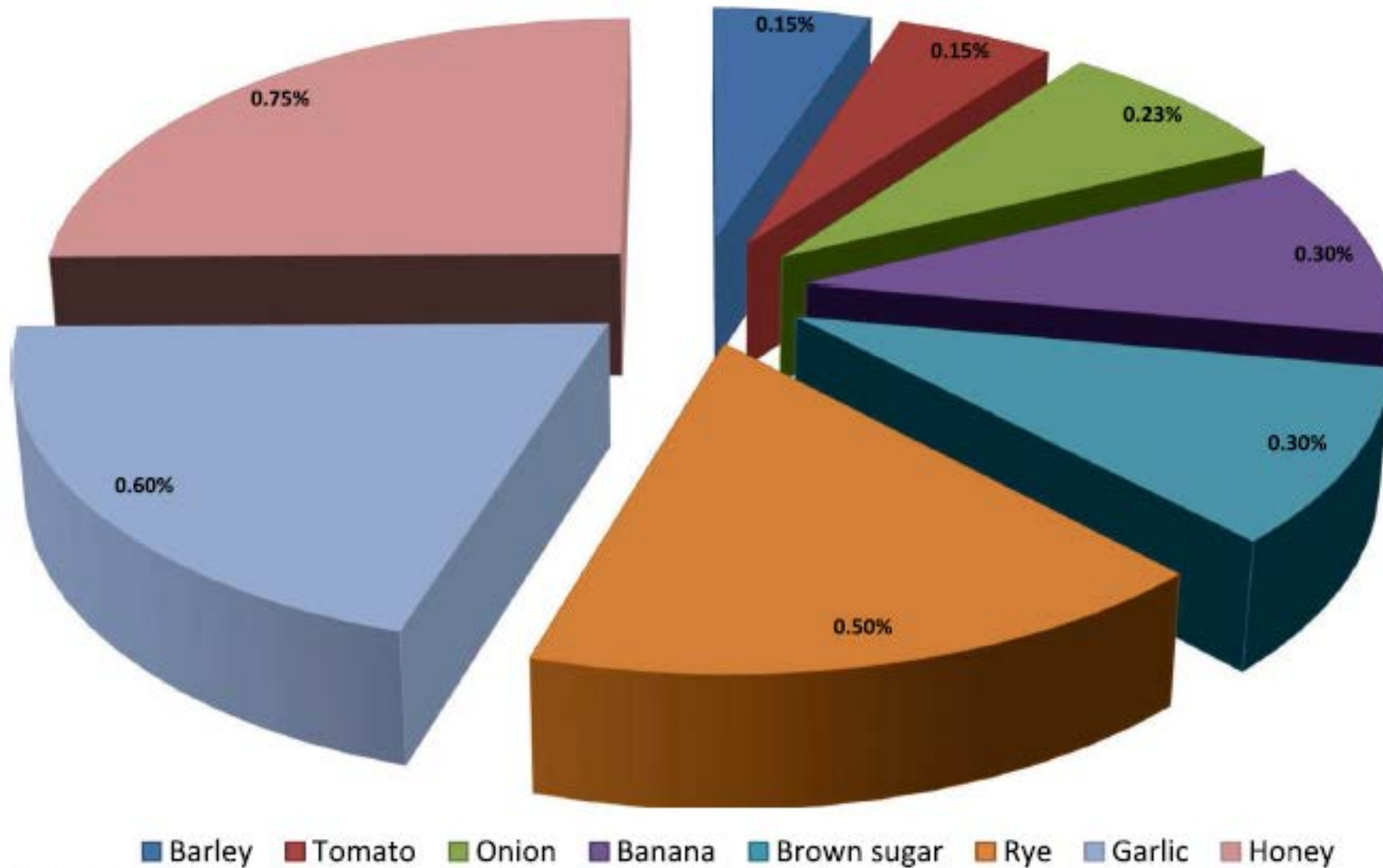
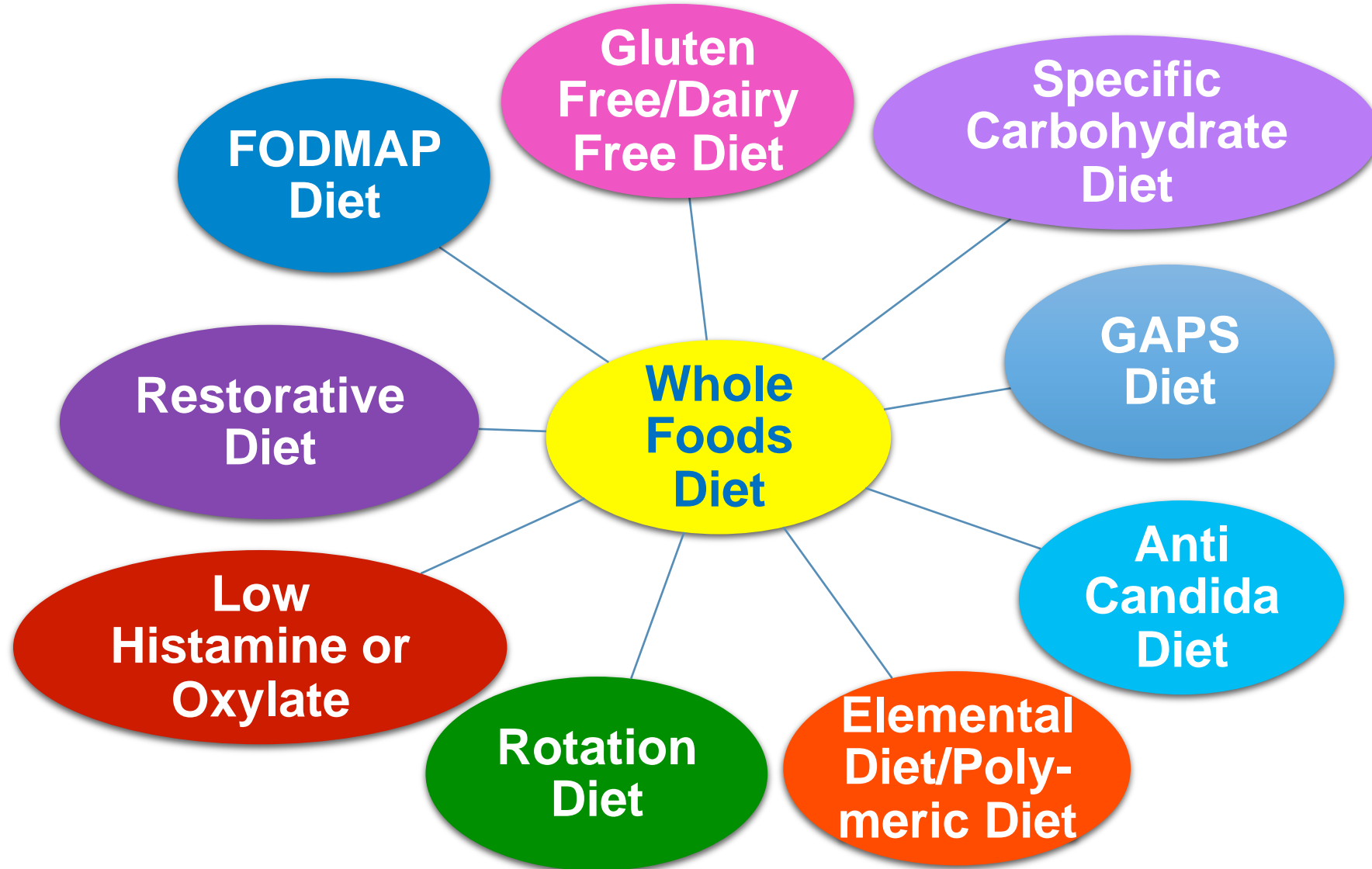


Fig. 2 Distribution of FOS in various natural products

Many Specific Dietary Food Plans in the Conversation



Six Food Elimination Diet - SFED

Empiric 6-food elimination diet induced and maintained prolonged remission in patients with adult eosinophilic esophagitis: A prospective study on the food cause of the disease

Alfredo J. Lucendo, MD, PhD, FEBG,^a Ángel Afías, BSc, MSc,^b Jesús González-Cervera, MD,^a
José Luis Yagüe-Compadre, MD,^d Daniela Guagnozzi, MD,^a Teresa Angueira, MD,^a Susana Jiménez-Contreras, MD,^a

Forty-nine (73.1%) patients exhibited significant reduced eosinophil counts (< 15 eos /hpf)... a single offending food was identified in 35.71% of patients...2 triggers ...in 30.95% and 3 or more triggers in 30.95% **cows milk** was the most common food antigen (61.9%), followed by **wheat** (28.6%), eggs (26.2%) and legumes 23.8%). **Prior allergy testing showed NO CONCORDANCE with food reintroduction challenge results.**

From the Departments of ^aGastroenterology and ^bAllergology, Hospital General de Tomelloso, Tomelloso, Ciudad Real, and ^cThe Research Unit and ^dthe Department of Pathology, Hospital General La Mancha Centro, Alcazar de San Juan, Ciudad Real. Supported in part by grants from the Association of Biomedical Research La Mancha Centro (Asociación de Investigación Biomédica La Mancha Centro). Disclosure of potential conflicts of interest: The authors declare that they have no relevant conflicts of interest. Received for publication June 15, 2012; revised December 6, 2012; accepted for publication December 10, 2012. Available online January 31, 2013. Corresponding author: Alfredo J. Lucendo, MD, PhD, FEBG, Department of Gastroenterology, Hospital General de Tomelloso, Avenida de San Sebastián, s/n, 13700 Tomelloso, Spain. E-mail: alucendo@vodafone.es. 091-674951610 © 2013 American Academy of Allergy, Asthma & Immunology <http://dx.doi.org/10.1016/j.jaci.2013.12.664>

with EoE seems to be caused by exposure to certain foods^{8,9} or inhalant antigens,¹⁰ which explains why it has traditionally been considered immunologic in nature and treated with the same topical corticosteroids used for bronchial asthma.¹¹ Because EoE is frequently associated with alterations in esophageal caliber, endoscopic dilation has also been frequently used in these patients.¹² However, both of these treatment options have a limited effect, necessitating either repeated interventions or long-term maintenance therapy. In 1995, Kelly et al¹³ provided firm evidence for the immunologic origin of EoE after effectively resolving eosinophilic inflammation and its derived symptoms in pediatric patients by feeding them exclusively with elemental amino acid-based formula for 8 weeks. These results were subsequently corroborated in

Lucendo et al. *J Allergy Clin Immunol* 2013;131:797-804

Remission of EoE

- Demonstrates for the first time that continued avoidance of offending foods from the diets of patients with quiescent EoE can lead to a maintained disease remission in terms of symptoms and eosinophilia inflammation up to 3 years.
- Food Allergy tests based on demonstrating an IgE driven hypersensitivity showed limited usefulness in identifying EoE triggers.

Six-Food Elimination Diet

AVOID

- Cows milk
- Soy
- Wheat
- Egg
- Peanut
- Shellfish



- Specialized Diets for GI Healing: Allowed Foods & Forbidden Foods							
	Comprehensive Elimination Diet	Gluten Free/Casein Free	Specific Carbohydrate Diet	Gut & Psychology Syndrome Diet	Anti-Candida Diet	FODMAP Diet	Restoration Diet
Protein	ALL unprocessed meats: chicken, turkey, duck, goose, quail, ostrich, fish, shellfish, lamb, venison, rabbit, eggs. Wild game.	ALL unprocessed meats	ALL unprocessed meats: beef, pork, chicken, turkey, duck, goose, quail, ostrich, fish, shellfish, lamb, venison, rabbit, eggs. Processed meats that do not have any SCD forbidden ingredients	Eggs, fresh (if tolerated) Fresh meats (not preserved), fish, shellfish Broths with every meal. Canned fish in oil or water only	ALL unprocessed meats: beef, pork, chicken, turkey, duck, goose, quail, ostrich, fish, shellfish, lamb, venison, rabbit, eggs. Tofu, tempeh, Texturized vegetable protein	All unprocessed meats Eggs	All unprocessed meats in small amounts: Pureed, well-cooked, stews, soups.
Dairy Products & Dairy Alternatives	NONE Dairy alternatives are allowed: coconut, hemp, rice	NONE Dairy alternatives are allowed: nut, coconut, hemp, rice, soy.	All natural cheeses except for: ricotta, mozzarella, cottage cheese, cream cheese, feta, processed cheeses and spreads. Homemade yogurt cultured 24 hours.	All natural cheeses Yogurt-homemade	Eggs, plain yogurt (cow, sheep, goat) with live cultures, organic soy milk, soy cheese, coconut milk, unaged goat cheese	Lactose-free dairy products: milk, cottage cheese Rice milk, almond milk, hemp milk	Goat milk or sheep milk kefir. Dairy alternatives as coconut kefir
Fats & Oils	Sunflower, olive, flax, ghee, coconut, avocado, nut oils.	ALL	Avocados, olive oil, coconut oil, corn oil, avocado oil, etc.	Butter, ghee, coconut, avocado oil, olive	ALL	ALL	Ghee, coconut, olive, Sam Queen's restorative ghee
Nuts & Seeds	Coconut, pine nuts, chia seeds, flaxseeds, almonds, Brazil nuts, walnuts, chestnuts, filberts, pecans, nut flours, and meals	ALL that are non-processed with dairy or gluten.	Almonds, Brazil nuts, walnuts, chestnuts, filberts, pecans, nut flours and meals	Almonds, avocado, Brazil nuts, coconut, filberts, walnuts, chestnuts, pecans, nut flours and meals, peanuts, nut	ALL raw. Can roast at home or cook them.	Nuts & Seeds in moderation Nut butters in moderation, Psyllium	Nut butters in tiny amounts

Who Benefits from a FODMAP Diet?

- **Symptoms that may respond to the FODMAP approach include Functional Gut Disorders such as IBS, Gas, Bloating, and Diarrhea.**
- **Should be undertaken for a minimum of 2 months.**
- **Often used when someone suspects a problem with Wheat/Gluten but a gluten-free diet doesn't help as much as we would want (they are still eating FODMAPs and having symptoms).**

FODMAP

Family of poorly absorbed, short-chain carbohydrates

- Fermentable
- Oligosaccharides (fructans, and galactooligosaccharides)
- Disaccharides (lactose)
- Monosaccharides (fructose)
- Polyols (Sugar Alcohols: sorbitol, mannitol, malitol, xylitol, polydestrose, isomalt)

Phases of FODMAP Diet

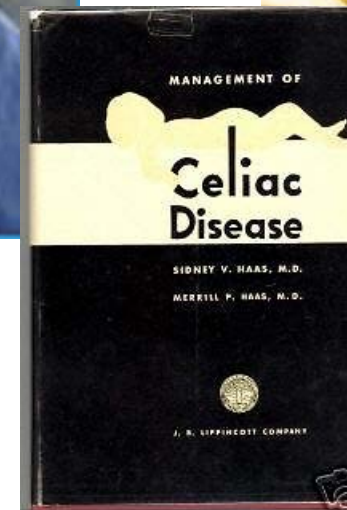
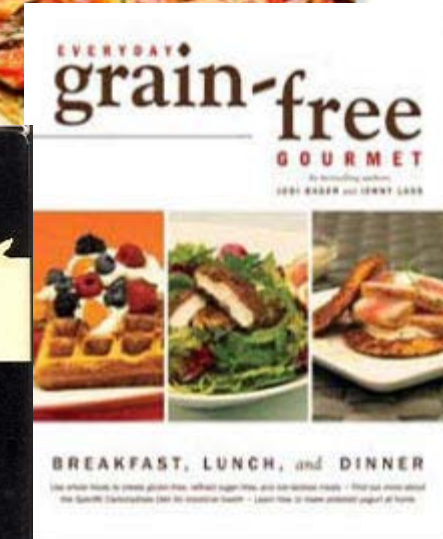
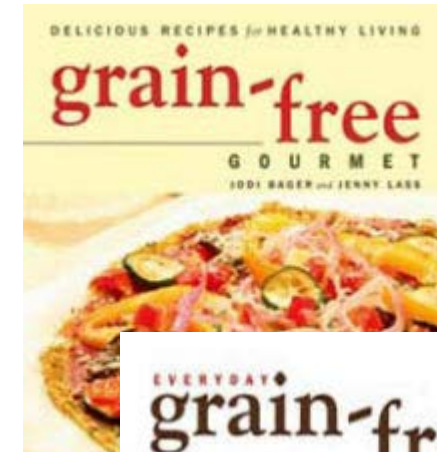
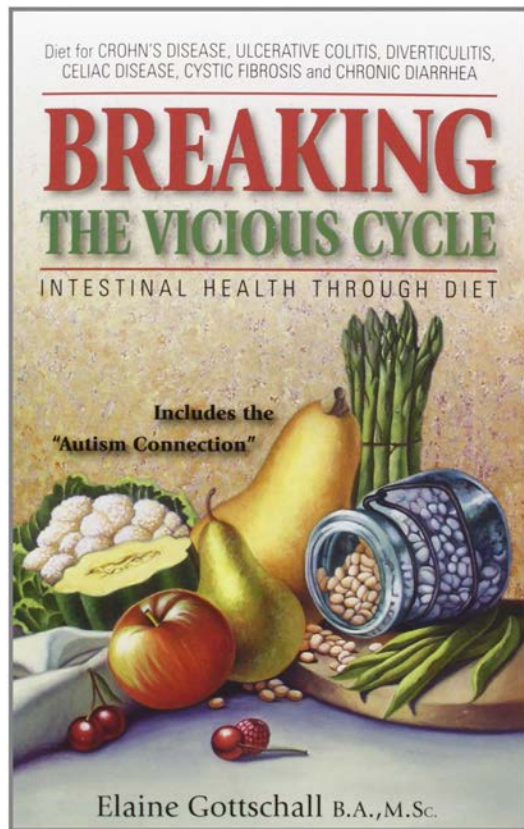
1. Elimination: 6-8 weeks of eliminating all FODMAPs; symptoms should diminish during this time.
2. Reintroduction: over 5 weeks FODMAPs are reintroduced and close monitoring for symptoms to re-emerge.
3. Trial Diet: continued low-FODMAP diet with the addition of tolerated foods.
4. Maintenance: Long term eating plan with continued avoidance of problematic foods.

FODMAP Resources

- Taste.com.au: www.taste.com.au/recipes/collections/low+fodmap+diet+recipes
- Sue Shepherd MS, RD at Shepherd Works: <http://shepherdworks.com.au/>
- Kate Scarlata RDN: www.katescarlata.com
- Patsy Castos MS, RD, LD: www.ibsfree.net

The Specific Carbohydrate Diet (SCD)

www.Breaking the viciouscycle.info



Specific Carbohydrate Diet: Children with Crohn's Disease

- 7 children eating an SCD diet 5-30 months (average 4.6 +/- 10.8 months)
- No medications.
- All symptoms “notably resolved” 3 months
- Labs: albumin, CRP, HCT, calprotectin normalized or significantly improved

SCD and Pediatric Crohn's

- 10 children enrolled/9 completed
- 12 week SCD diet at least 85% of calories
- All indexes improved significantly: Harvey-Bradshaw, Lewis, PCDAI, blinded capsule endoscopy
- “Clinical and mucosal improvements seen in children who used SCD for 12 and 52 weeks.”

IBD and Crohn's Disease

- 40 patients with CD and UC
- 27 went on diet: 24 had significant changes in HBI and CDAI; 3 had ambivalent or negative response
- Used a 4-phase dietary approach

Why try SCD?

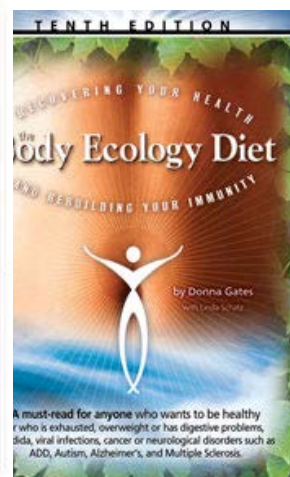
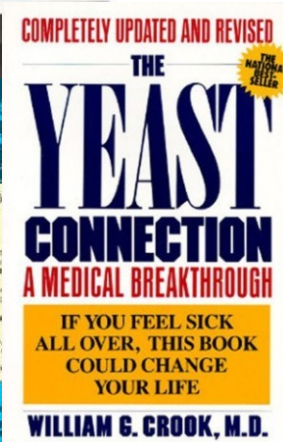
- Elimination Diet have failed
- Pediatric Crohn's/Crohn's disease
- Empiric: The foods on the diet are ones they feel well on; restricted foods make feel worse
- Disaccharidase deficiency:
 - Lactase deficiency—can't break down lactose
 - Sucrase deficiency—can't break down sucrose
 - Maltase deficiency—can't break down maltose
- Dysbiosis
 - Small intestinal bacterial overgrowth
 - Candida/Yeast/Fungal overgrowth

Allowed Foods

- Vegetables/non starchy
- Honey (SCD: Saccharine)
- Fruit & Juices
- Dairy: homemade yogurt, some cheeses
- Meat: Fish, poultry, beef, bison, lamb, +
- Legumes: string beans, lima beans
- Nuts, seeds, nut butters
- Oils: avocado, coconut, olive, ghee, etc.
- Broths
- Yogurt (homemade), hard cheeses, dry-curd cottage cheese



Body Ecology & Candida Diets



ALLOWED:

Meats, fish, poultry

Vegetables

Oils and fats, coconut oil

Cultured Dairy products

(Fermented vegetables, sauerkraut)

(Whole grains, soaked and cooked)

Fruit: typically avoid for first few weeks

When to Choose a Candida Diet?

- When GF/CF or Elimination Diet didn't help
- Yeast/Candida overgrowth
- When there is dysbiosis
- When there is gas, bloating, IBS-like issues
- When you feel well on whole grains
- Fatigue
- Poor concentration

Restoration Diet

- Medical Foods
- Bone broths
- Pureed foods
- Poi
- Soups
- Animal protein: Stews, soups, slow cooked, pureed, marrow, eggs
- Vegetables: juiced, well-cooked, pureed
- Fruits: Really ripe fruit, cooked fruit, puree
- Fats: Coconut oil, ghee, olive oil, avocado
- Grains: Congee (Rice porridge)
- Fermented: goat or sheep kefir, coconut kefir, kraut juice, sauerkraut, umeboshi plums







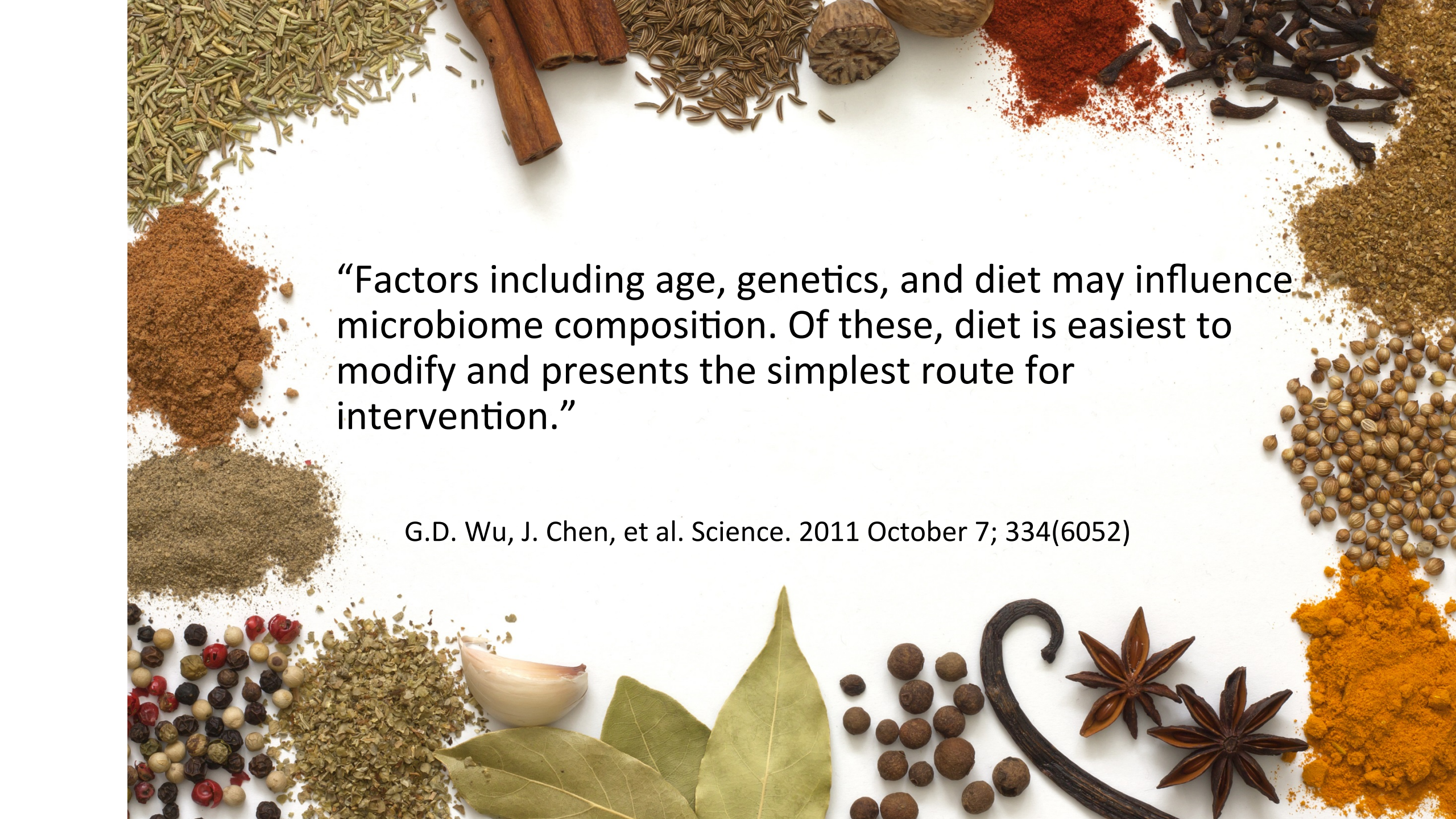
Herbal Infusions



- Herbal infusions are a simple way to increase nutrient absorption.
- More concentrated than teas
- Gut healing properties







“Factors including age, genetics, and diet may influence microbiome composition. Of these, diet is easiest to modify and presents the simplest route for intervention.”

G.D. Wu, J. Chen, et al. Science. 2011 October 7; 334(6052)







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