The Nature of Immune Intelligence: Therapeutic Integration of Lifestyle Medicine Approaches

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American Nutrition Association, Board Member
May 2021

Faculty Disclosure

Commercial Interest	Nature of Relevant Financial Relationship	
	What was received	**For what role**
• Metagenics, Inc.	• Fee	• Independent Contractor
• Clean/Organic India	• Fee	• Independent Contractor

- This presentation contains ***educational material only*** and is not intended to take the place of advice from your own physician(s) or to be a means of diagnosing or treating an illness.
- Deanna Minich is a health educator with a professional platform focused on plant-based eating. She is a consultant to a variety of companies selling nutritional products.

Presentation Learning Objectives

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

- Define the nature of ‘immune intelligence’
- Understand how immunity is a systems web more accurately described as the psychoneuroendocrine immune system
- Identify how aligning with nature, specifically plants, may help with immune intelligence
- Understand the scientific research of a plant-based diet for immune health
- Summarize evidence-based food and lifestyle strategies to support psychoneuroendocrineimmune health

Immune Intelligence

DEFINITION OF IMMUNE INTELLIGENCE

Immune intelligence is the inherent and conscious ability to harmonize the inner milieu with outer environmental factors in an effective homeodynamic manner enabling the organism to equilibrate to optimal function

CHARACTERISTICS OF IMMUNE INTELLIGENCE

Characteristics of immune intelligence:

- Acts with consciousness
- Exhibits emotional and sentient qualities
- Operates in an algorithmic manner, blending physiology, psychology, inner and outer inputs
- Utilizes multiple sensors, including skin, eyes, gut, fields
- Engages in constant reframing and learning
- Gathers data over a lifetime
- Recognizes patterns and acts for the best end goal
- Includes teams and collectives such as microorganisms, viruses, fungi

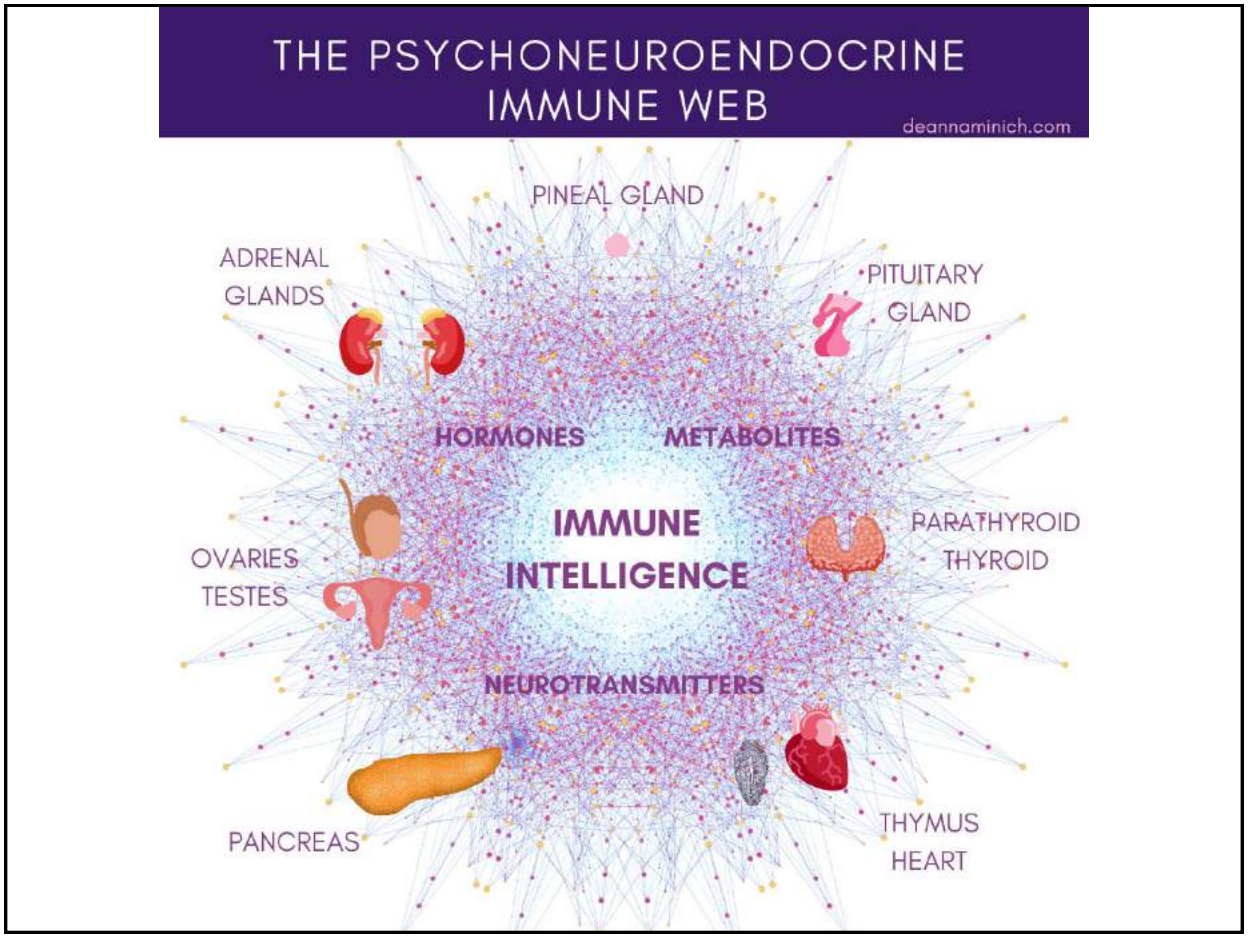
Immune system vs. Psychoneuroendocrineimmune web

It's not the 'immune system' but the psychoneuroendocrine-immune system

Adrenal fatigue is an outdated, simplistic term: Go upstream

- HPA axis dysfunction or maladaptation
- Hypocortisolism
- Psychoneuroendocrine immune imbalance

References: Guilliams TG. *The role of stress and the HPA axis in chronic disease management*. Point Institute, 2015. Minich DM. Upstream healing: Tips for a healthy hypothalamus. 2017 May 17. https://www.deannaminich.com/upstream-healing-tips-for-a-healthy-hypothalamus/


THE PSYCHONEUROENDOCRINE IMMUNE WEB
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PINEAL GLAND
ADRENAL GLANDS
PITUITARY GLAND
HORMONES
METABOLITES
IMMUNE INTELLIGENCE
PARATHYROID
THYROID
OVARIES
TESTES
NEUROTRANSMITTERS
PANCREAS
THYMUS
HEART

Bio-psycho-social health:
The web of our interactions

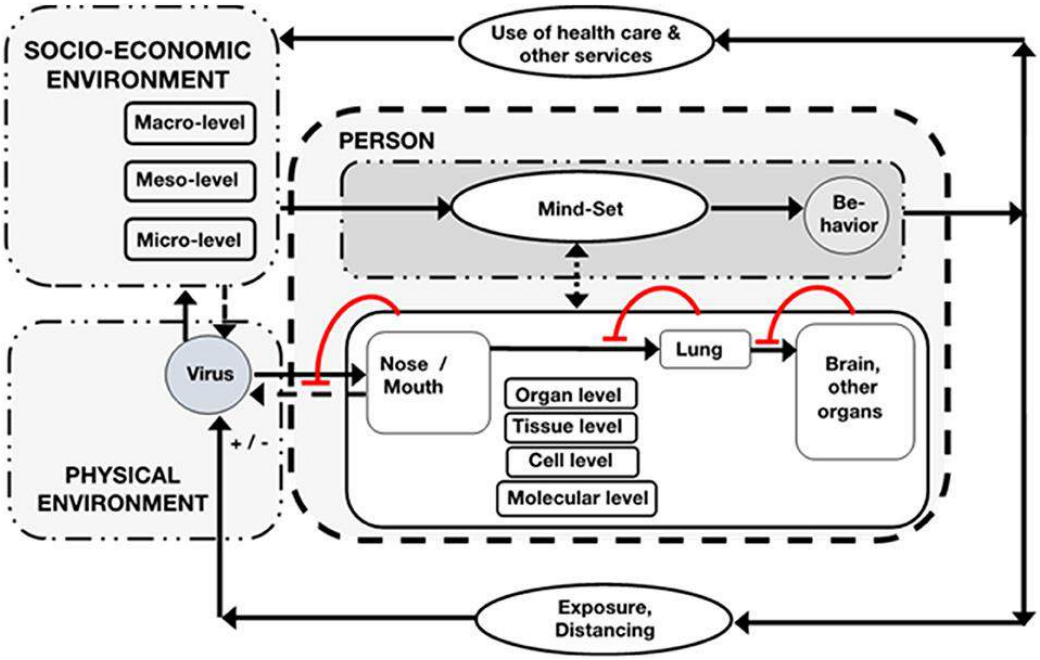
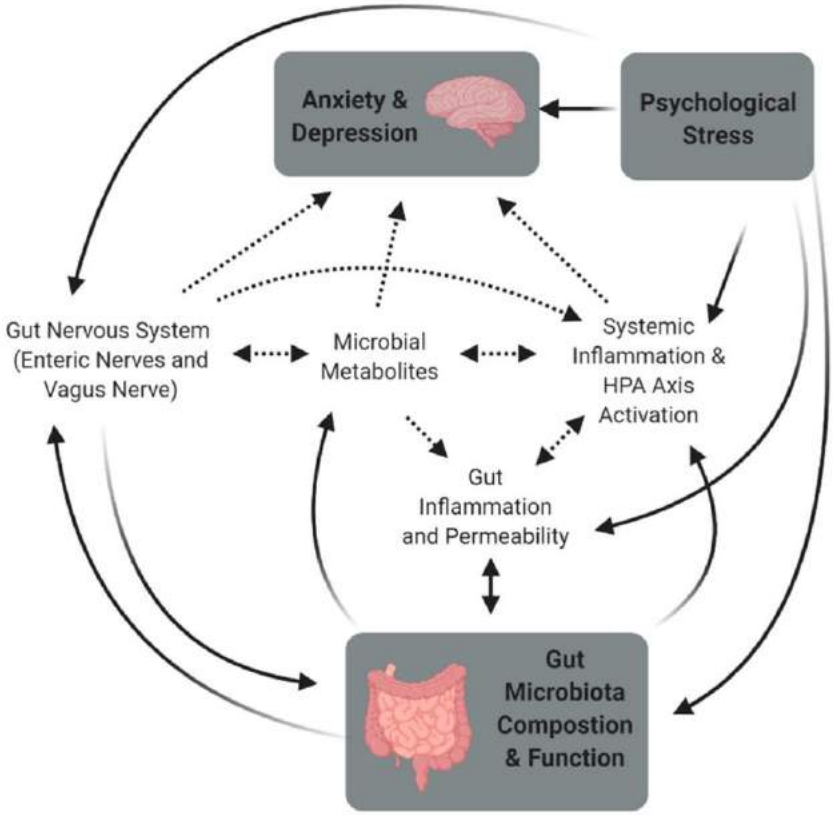


Image Credit: Tretter F, Wolkenhauer O, Meyer-Hermann M, Dietrich JW, Green S, Marcum J and Weckwerth W (2021) The Quest for System-Theoretical Medicine in the COVID-19 Era. *Front. Med.* 8:640974. doi: 10.3389/fmed.2021.640974. CCBY.

Stress Results in Shifts in Microbial Populations

- Stress has a 'ripple effect' through the gut, resulting in activation of the vagus nerve and enteric nervous system
- Results in immune changes, inflammation, intestinal damage, and increased GI permeability → all have the potential to influence the gut microbiota

Karl JP, Hatch AM, Arcidiacono SM, et al. Effects of Psychological, Environmental and Physical Stressors on the Gut Microbiota. *Front Microbiol*. 2018;9:2013. Published 2018 Sep 11. doi:10.3389/fmicb.2018.02013



Bear, T.; Dalziel, J.; Coad, J.; Roy, N.; Butts, C.; Gopal, P. The Microbiome-Gut-Brain Axis and Resilience to Developing Anxiety or Depression under Stress. *Microorganisms* **2021**, *9*, 723. https://doi.org/10.3390/microorganisms9040723. CCBY. No changes made.

Stress and the Gut

Effects of stress on the gut include:

1) alterations in motility (could be slower or faster);
2) visceral sensations (“butterflies in the stomach”);
3) alterations in secretions (higher or lower);
4) increase in intestinal permeability (“leaky gut”);
5) changes in intestinal cell turnover and blood flow;
6) changes to the microbiome

Reference: Konturek PC, Brzozowski T, Konturek SJ. Stress and the gut: Pathophysiology, clinical consequences, diagnostic approach and treatment options. *J Physiol Pharmacol*. 2011 Dec;62(6):591-9.

Linking the Gut to Depression

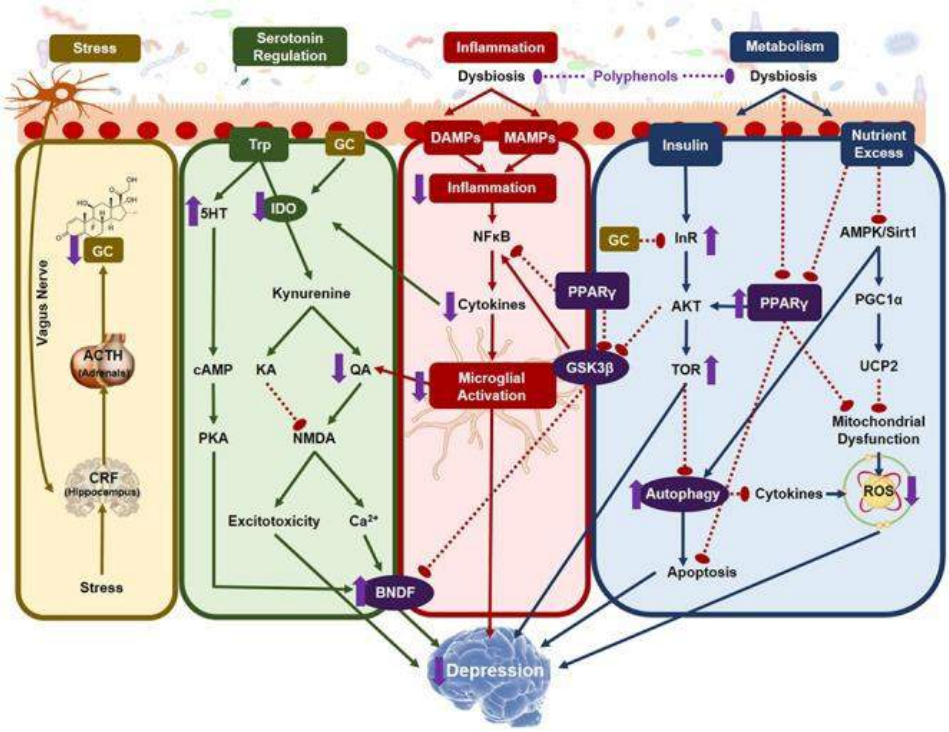


Image Credit: Westfall S, Pasinetti GM. The Gut Microbiota Links Dietary Polyphenols With Management of Psychiatric Mood Disorders. *Front Neurosci*. 2019;13:1196. Published 2019 Nov 5. doi:10.3389/fnins.2019.01196.

Psychobiotics

Defined as probiotics that have mood-altering or psychological effects such as reducing depression or anxiety

"…patients diagnosed with both IBS and major depression, a twice daily dose of *Bacillus coagulans* MTCC 5856 was administered and treated patients demonstrated reduced depressive phenotypes on multiple scales (Majeed et al., 2018)."

Reference: Westfall S, Pasinetti GM. The Gut Microbiota Links Dietary Polyphenols With Management of Psychiatric Mood Disorders. *Front Neurosci*. 2019;13:1196. Published 2019 Nov 5. doi:10.3389/fnins.2019.01196

Immune dysfunction and disorders from repeat stressors

- Various brief and chronic stressors impact the immune system
  - e.g., public speaking, medical school examinations, unemployment, marital discord, divorce, death of spouse, burnout and job strain, caring for a relative with Alzheimer's disease, and exposure to the harsh climate of Antarctica
- Stressors are associated with weakened immunity
  - Glaser & Kiecolt-Glaser, 2005; Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002; Segerstrom & Miller, 2004

Reference: https://opentext.wsu.edu/ospsychrevisions/chapter/stress-and-illness/

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Autoimmune conditions

- Stress load cannot easily be accommodated
- Role of psychological stress and stress-related hormones in autoimmune disease
- Immune dysregulation and inflammatory cytokine production
- AI disease requires stress management techniques to assist with physiological rebalancing

Reference: Assad S, Khan HH, Ghazanfar H, et al. Role of sex hormone levels and psychological stress in the pathogenesis of autoimmune diseases. *Cureus*. 2017;9(6):e1315. Published 2017 Jun 5. doi:10.7759/cureus.1315

Examples of ways people manage stress

- Stimulants in AM (i.e. coffee)
- Depressants in the PM (i.e. alcohol)
- Highly-processed comfort foods
- High-sugar/chocolate
- Caffeinated beverages throughout the day
- Over-eating and under-eating
- Over-working
- Over-sleeping
- Risk-taking behaviors

Reference: Based on presenter's clinical experience

What about stress genes?

- Redox pathways
- Heat shock proteins
- Immune-related genes
- Genes associated with inflammation
- Environmental stress and detoxification
- Glucocorticoid receptors

Cornelius C, Perrotta R, Graziano A, Calabrese EJ, Calabrese V. Stress responses, vitagenes and hormesis as critical determinants in aging and longevity: Mitochondria as a "chi". *Immun Ageing*. 2013;10(1):15. Published 2013 Apr 25. doi:10.1186/1742-4933-10-15

Resilience = Adaptation

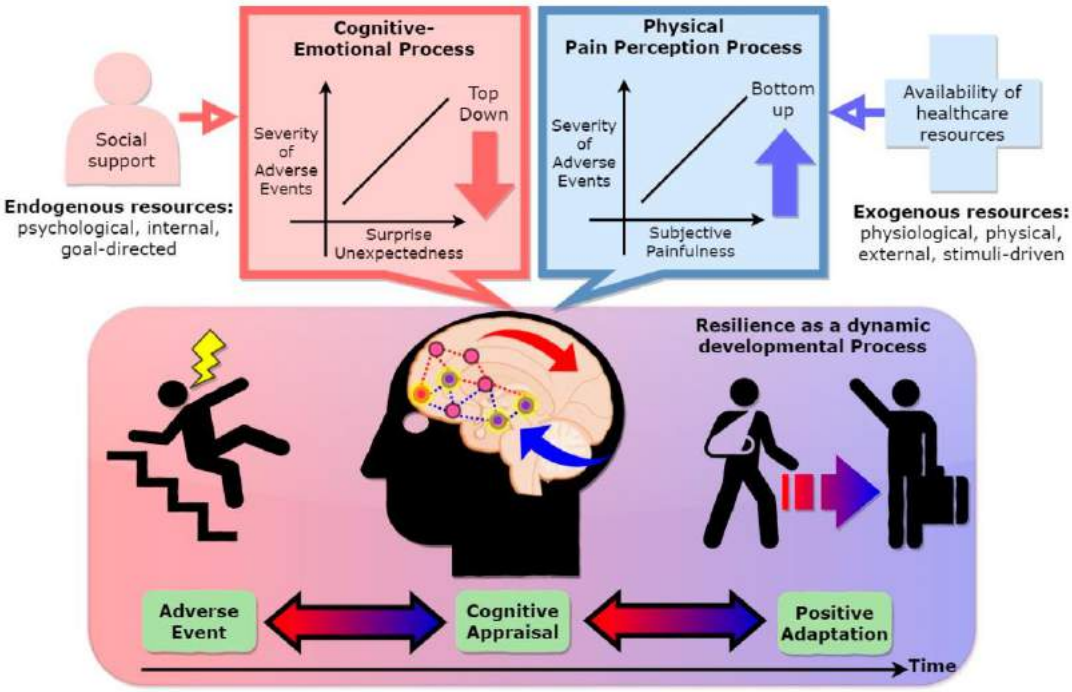


Image Credit: Yao, Z.-F.; Hsieh, S. Neurocognitive Mechanism of Human Resilience: A Conceptual Framework and Empirical Review. *Int. J. Environ. Res. Public Health* **2019**, *16*, 5123. CCBY. No changes made.

Select laboratory biomarkers of resilience

- **Inflammaging**
  - High hsCRP
  - Low vitamin D
  - High fasting glucose/insulin
  - Low Omega-3 Index
  - Reduced lean body mass
  - High homocysteine (risk factor for chromosome damage, Fenech)
- **Elevated oxidative Stress Markers**
  - 8-OHdG
  - Urine lipid peroxides
- **Low levels of vitamins and minerals**
- **Advanced Glycation Endproducts** – High Hgb A1C
- **Elevated autoantibodies**
- **Lowered immune function** (reduced WBCs)

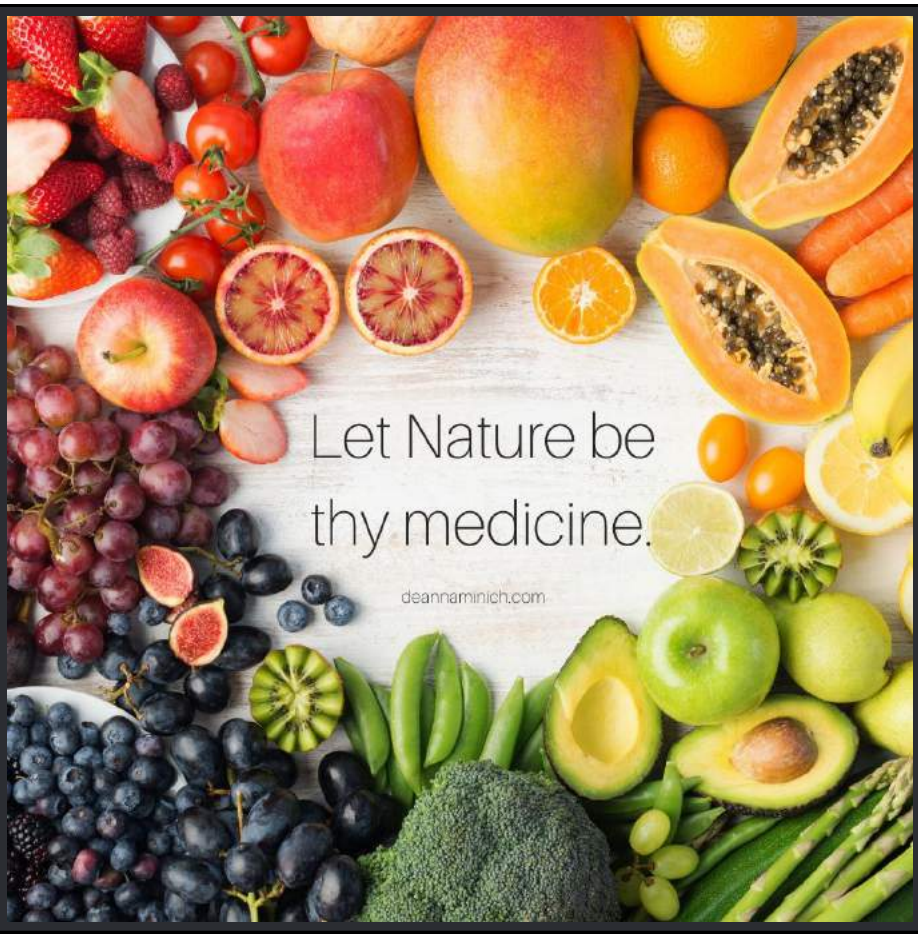
Reference: Based on presenter's clinical experience

The antidote is – NATURE.
Outside us, inside us.

“As above, so below, as within, so without, as the universe, so the soul…”

- Hermes Trismegistus


THE NATURE
OF IMMUNE
INTELLIGENCE
IS NATURE.



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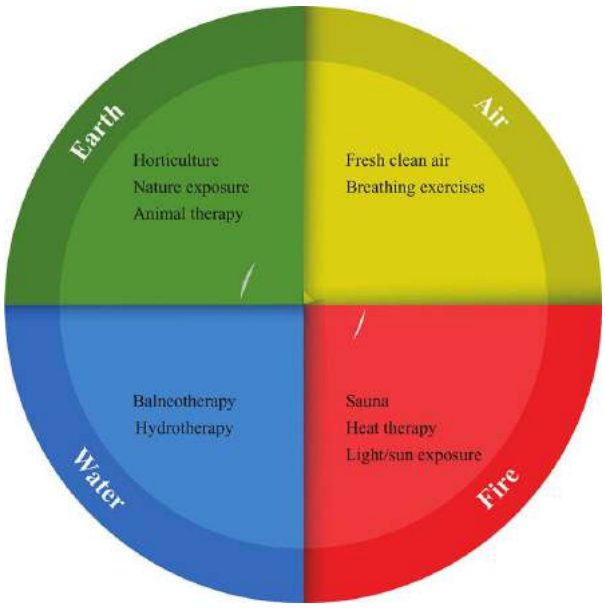
The immune system is the sum of our relationship with the natural environment

- Are we out of touch with nature?
- How are we connected into our food?
- Are plants the ‘divining rod’ between nature and the human body to keep us balanced?

Nurminen N, Lin J, Grönroos M, et al. Nature-derived microbiota exposure as a novel immunomodulatory approach. Future Microbiol. 2018;13:737-744. doi:10.2217/fmb-2017-0286

Immune intelligence is aligned to the elements of nature.



frontiers in Psychiatry

REVIEW

Harnessing the Four Elements for Mental Health

Jerome Sarris, Michael de Manincor, Fiona Hargraves and Jack Tsonis

Humans are intimately connected to nature, and our physical and mental health is influenced strongly by our environment. The "elements," classically described in humoral theory as Fire, Water, Earth, and Air, all may impact our mental health. In a contemporary sense, these elements reflect a range of modifiable factors: UV light or heat therapy (Fire); sauna, hydrotherapy, and balneotherapy (Water); nature-based exposure therapy and horticulture (Earth); oxygen-rich/clean air exposure; and breathing techniques (Air). This theoretical scoping review paper details the emerging evidence for a range of these elements, covering epidemiological and interventional data, and provides information on how we can engage in "biophilic" activities to harness their potential benefits. Interventional examples with emerging evidentiary support include "forest-bathing," heat therapy, sauna, light therapy, "greenspace" and "bluespace" exercises, horticulture, clay art therapy activities, and pranayamic yoga breathing exercises. Further robust research is however required to firmly validate many of these interventions, and to establish their therapeutic applications for the benefit of specific mental health disorders.

OPEN ACCESS

INTRODUCTION

Sarris J, de Manincor M, Hargraves F and Tsonis J (2019) Harnessing the Four Elements for Mental Health. Front. Psychiatry 10:256. doi: 10.3389/fpsyt.2019.00256. CCBY. No changes made.

Nature outside
- Forest bathing
- Biogenic volatile compounds
- Stress modulating effects

Nature-Outer Biomes

- Forest
- Garden
- Trees/bushes/flowers
- Air
- Ocean

Moelling K, Broecker F. Air Microbiome and Pollution: Composition and Potential Effects on Human Health, Including SARS Coronavirus Infection. *J Environ Public Health*. 2020;2020:1646943. Published 2020 May 28. doi:10.1155/2020/1646943


EVIDENCE-BASED HEALTH BENEFITS OF NATURE CONTACT
• Reduced stress
• Better sleep
• Improved mental health (reduced depression & anxiety)
• Greater happiness, well-being, life satisfaction
• Reduced aggression
• Reduced ADHD symptoms
• Increased prosocial behavior and social connectedness
• Lower blood pressure
• Improved postoperative recovery
• Improved birth outcomes
• Improved congestive heart failure
Taken from: Frumkin H, Bratman GN, Breslow SJ, et al. Nature Contact and Human Health: A Research Agenda. Environ Health Perspect. 2017;125(7):075001. Published 2017 Jul 31. doi:10.1289/EHP1663
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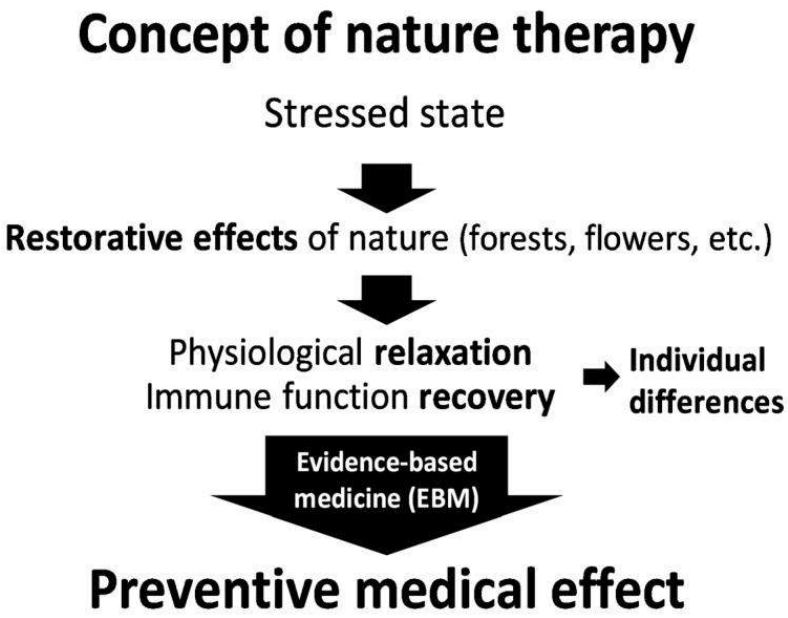
The healing green of nature

"Many studies have reported the effect of viewing green plants on physiological relaxation. The findings confirmed that **viewing green plants**, such as foliage plants, in an indoor environment can elicit positive health outcomes with **greater stabilization of prefrontal cortex activity and autonomic nervous activity**."

Reference: Jo H, Song C, Miyazaki Y. Physiological Benefits of Viewing Nature: A Systematic Review of Indoor Experiments. *Int J Environ Res Public Health*. 2019 Nov 27;16(23). pii: E4739. doi: 10.3390/ijerph16234739.

Nature Therapy: Forest Bathing



Hansen MM, Jones R, Tocchini K. Shinrin-Yoku (Forest Bathing) and Nature Therapy: A State-of-the-Art Review. *Int J Environ Res Public Health*. 2017;14(8):851. Published 2017 Jul 28. doi:10.3390/ijerph14080851

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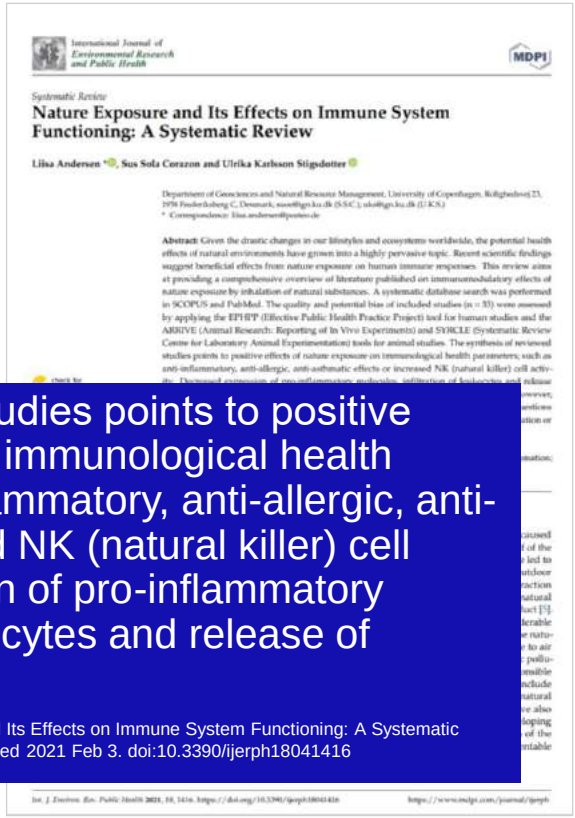
The Results of Forest Therapy

- Enhanced positive mood and reduced negative mood
- Blood pressure and heart rates decreased
- Peripheral oxygen saturation increased
- NK activity increased
- Number of NK cells and perforin-, granulysin-, and granzyme A/B-expressing cells increased
- Corticosterone level in peripheral blood lymphocytes decreased

Lyu B, Zeng C, Xie S, et al. Benefits of A Three-Day Bamboo Forest Therapy Session on the Psychophysiology and Immune System Responses of Male College Students. Int J Environ Res Public Health. 2019;16(24):4991. Published 2019 Dec 8. doi:10.3390/ijerph16244991

Being in nature provides nourishment



International Journal of Environmental Research and Public Health

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Systematic Review

Nature Exposure and Its Effects on Immune System Functioning: A Systematic Review

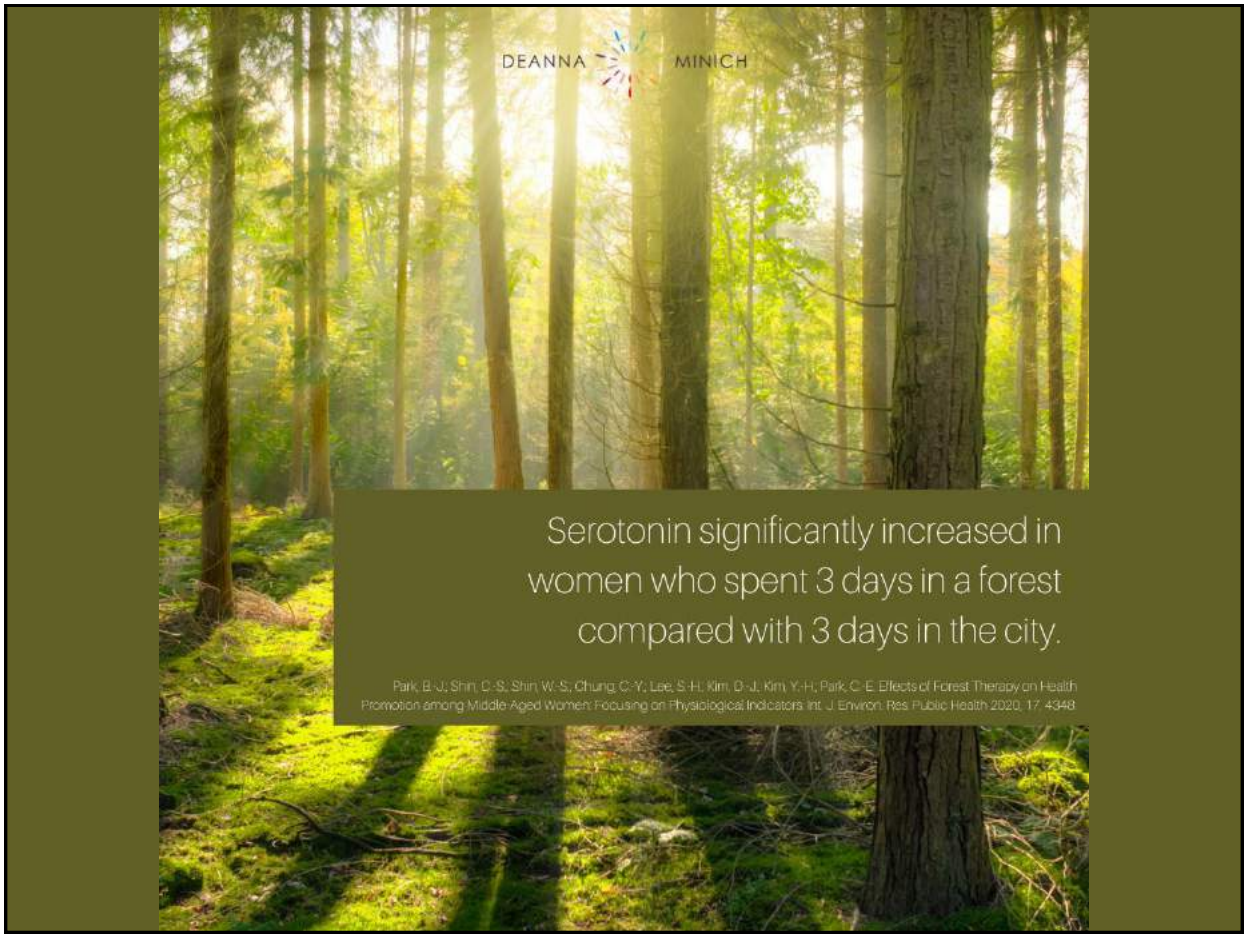
Liisa Andersen *, Sus Sola Corazon and Ulrika Karlsson Stigsdotter

Department of Geosciences and Natural Resource Management, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, Denmark; suso@ign.ku.dk (S-S.C.); uks@ign.ku.dk (U.K.S.)
* Correspondence: liisa.andersen@outlook.de

Abstract: Given the drastic changes in our lifestyles and ecosystems worldwide, the potential health effects of natural environments have grown into a highly pervasive topic. Recent scientific findings suggest beneficial effects from nature exposure on human immune responses. This review aims at providing a comprehensive overview of literature published on immunomodulatory effects of nature exposure by inhalation of natural substances. A systematic database search was performed in SCOPUS and PubMed. The quality and potential bias of included studies (n = 33) were assessed by applying the EPHPP (Effective Public Health Practice Project) tool for human studies and the ARRIVE (Animal Research: Reporting of In Vivo Experiments) and SYRCLE (Systematic Review Centre for Laboratory Animal Experimentation) tools for animal studies. The synthesis of reviewed studies points to positive effects of nature exposure on immunological health parameters; such as anti-inflammatory, anti-allergic, anti-asthmatic effects or increased NK (natural killer) cell activ-

"The synthesis of reviewed studies points to positive effects of nature exposure on immunological health parameters; such as anti-inflammatory, anti-allergic, anti-asthmatic effects or increased NK (natural killer) cell activity. Decreased expression of pro-inflammatory molecules, infiltration of leukocytes and release of cytotoxic mediators…"

Andersen L, Corazon SSS, Stigsdotter UKK. Nature Exposure and Its Effects on Immune System Functioning: A Systematic Review. *Int J Environ Res Public Health*. 2021;18(4):1416. Published 2021 Feb 3. doi:10.3390/ijerph18041416


DEANNA MINICH
Serotonin significantly increased in women who spent 3 days in a forest compared with 3 days in the city.
Park, B.-J.; Shin, C.-S.; Shin, W.-S.; Chung, C.-Y.; Lee, S.-H.; Kim, D.-J.; Kim, Y.-H.; Park, C.-E. Effects of Forest Therapy on Health Promotion among Middle-Aged Women: Focusing on Physiological Indicators. Int. J. Environ. Res. Public Health 2020, 17, 4348

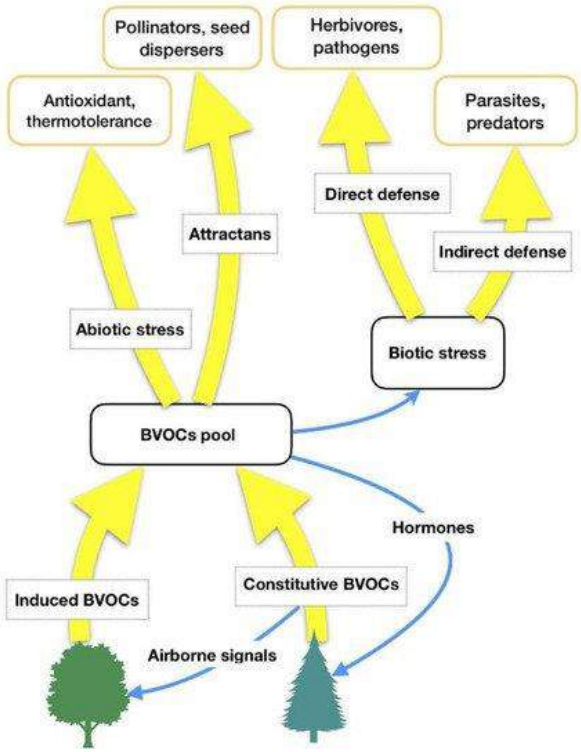
Forest Volatile Compounds

- Trees emit a broad range of up to 200 different biogenic volatile organic compounds (BVOCs) which are primarily terpenes and terpenoids
- While they are for the survival of the tree, they may have benefit for human health.
- Cell and animal studies have shown anti-inflammatory effects upon exposure to these terpenes and terpenoids emitted in the forests

Kim T, Song B, Cho KS, Lee IS. Therapeutic Potential of Volatile Terpenes and Terpenoids from Forests for Inflammatory Diseases. *Int J Mol Sci*. 2020;21(6):2187. Published 2020 Mar 22. doi:10.3390/ijms21062187

Forest Volatiles and Human Health

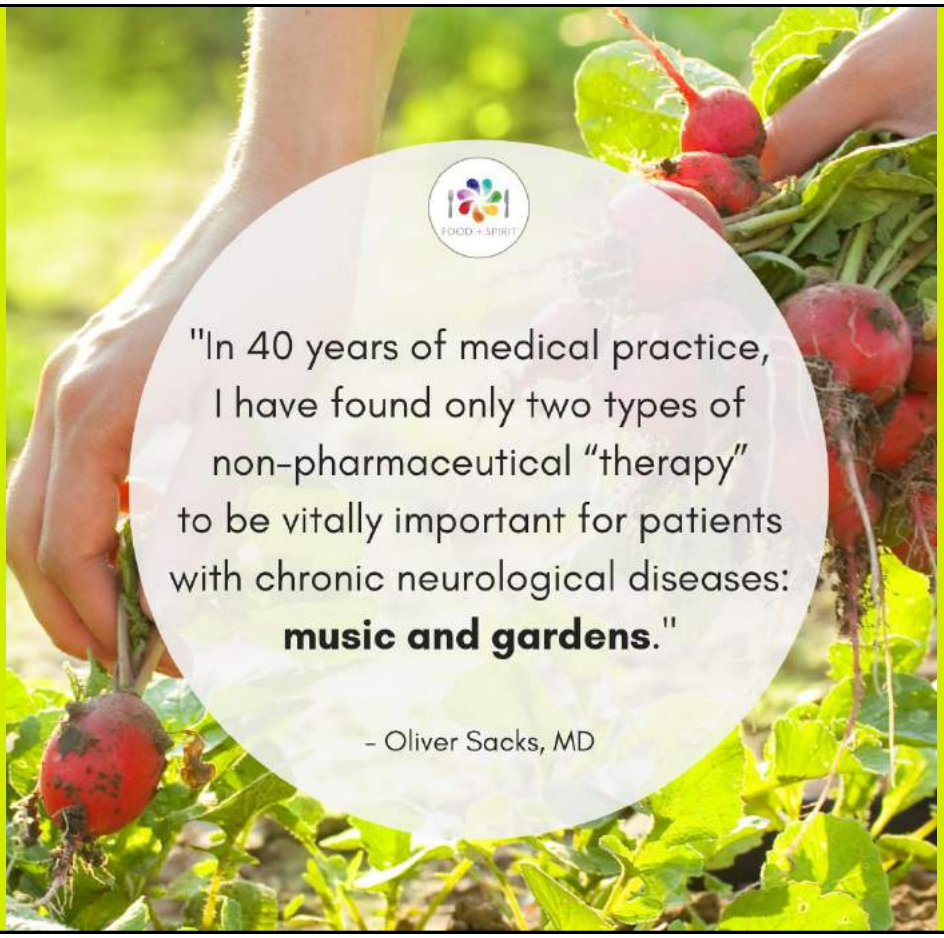
"Inhaling forest VOCs like limonene and pinene can result in useful antioxidant and anti-inflammatory effects on the airways, and the pharmacological activity of some terpenes absorbed through inhalation may be also beneficial to promote brain function by decreasing mental fatigue, inducing relaxation, and improving cognitive performance and mood."



The case for essential oils

Eucalyptus and ginger EOs have the most compelling data to date for beneficial effects on the immune system.

Peterfalvi, A.; Miko, E.; Nagy, T.; Reger, B.; Simon, D.; Miseta, A.; Czéh, B.; Szereday, L. Much More Than a Pleasant Scent: A Review on Essential Oils Supporting the Immune System. *Molecules* **2019**, *24*, 4530.


"In 40 years of medical practice,
I have found only two types of
non-pharmaceutical "therapy"
to be vitally important for patients
with chronic neurological diseases:
music and gardens."
- Oliver Sacks, MD

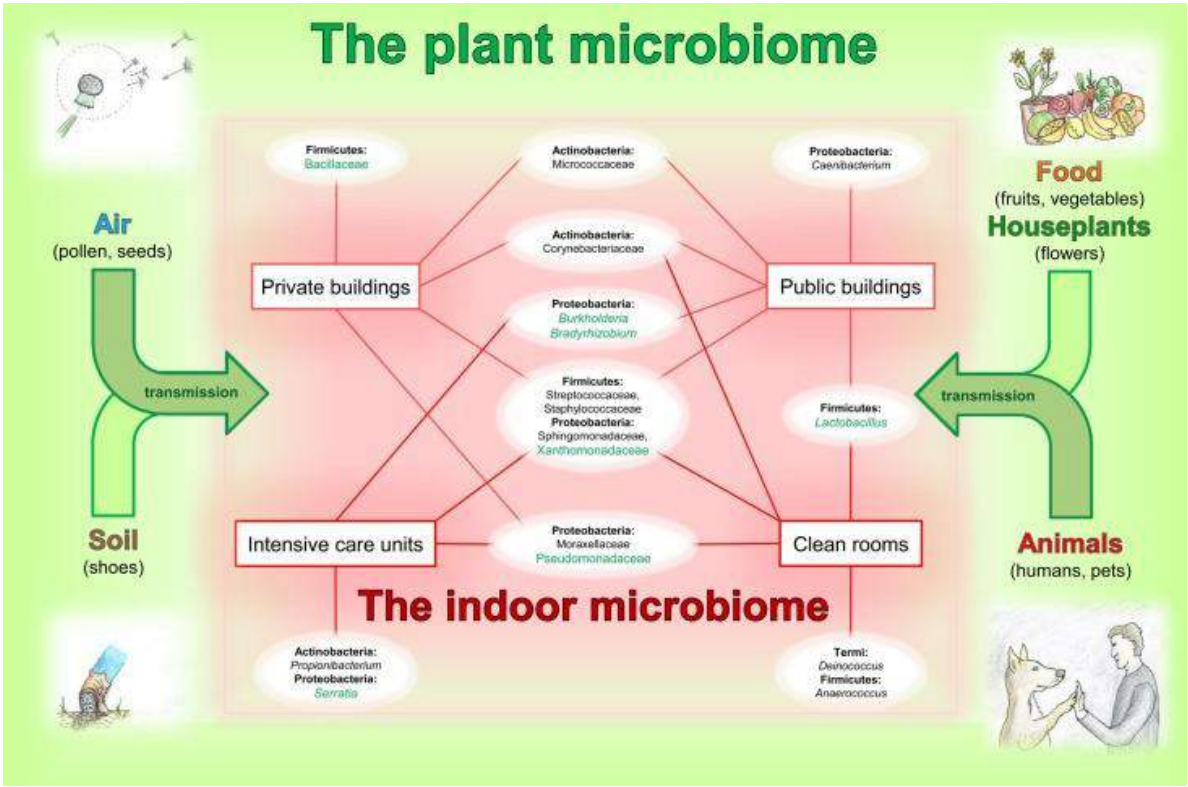


Image Credit: Berg G, Mahnert A, Moissl-Eichinger C. Beneficial effects of plant-associated microbes on indoor microbiomes and human health?. *Front Microbiol*. 2014;5:15. Published 2014 Jan 29. doi:10.3389/fmicb.2014.00015

Yard vegetation is associated with gut microbiota composition

Shrubs and flowering plants are associated with a healthier gut microbiota composition

The relative abundance of *Faecalibacterium* was high and *Clostridium* was low

Parajuli A, Hui N, Puhakka R, et al. Yard vegetation is associated with gut microbiota composition. Sci Total Environ. 2020;713:136707. doi:10.1016/j.scitotenv.2020.136707

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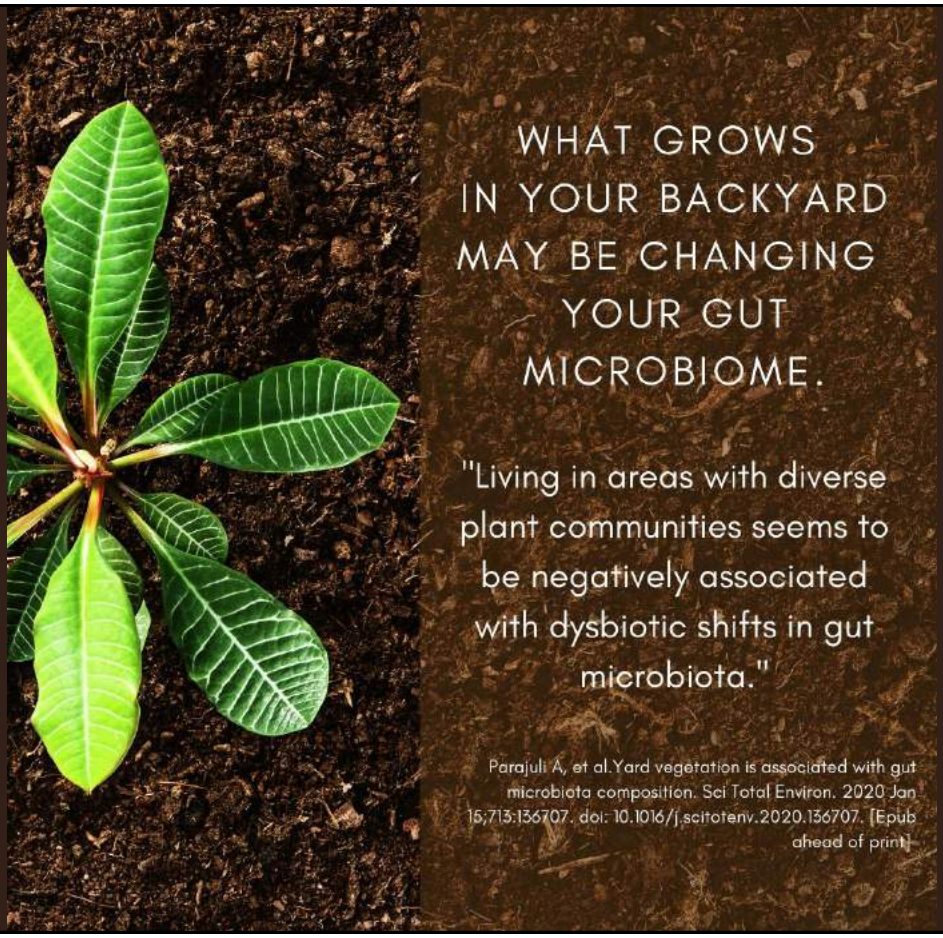
WHAT GROWS
IN YOUR BACKYARD
MAY BE CHANGING
YOUR GUT
MICROBIOME.
"Living in areas with diverse plant communities seems to be negatively associated with dysbiotic shifts in gut microbiota."
Parajuli A, et al.Yard vegetation is associated with gut microbiota composition. Sci Total Environ. 2020 Jan 15;713:136707. doi: 10.1016/j.scitotenv.2020.136707. [Epub ahead of print]

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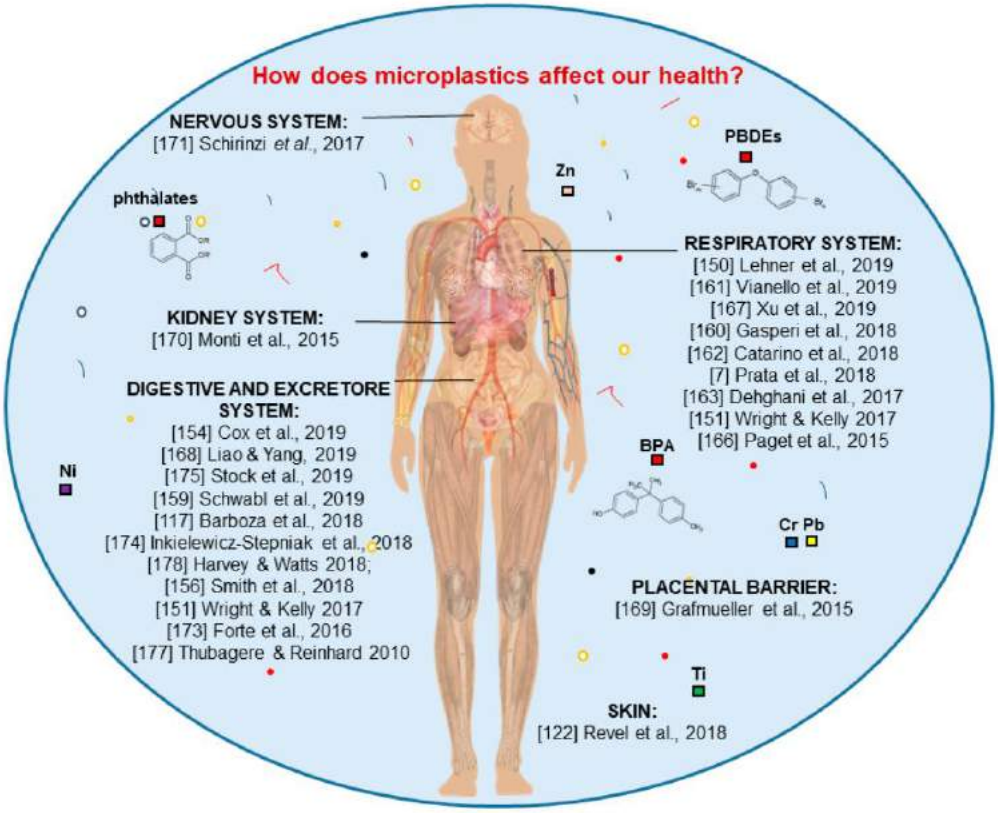
Nature, Immunity, and Spirituality

Being in nature, such as with ‘forest bathing’ seems to have an effect on a person’s spirituality and sense of well-being.

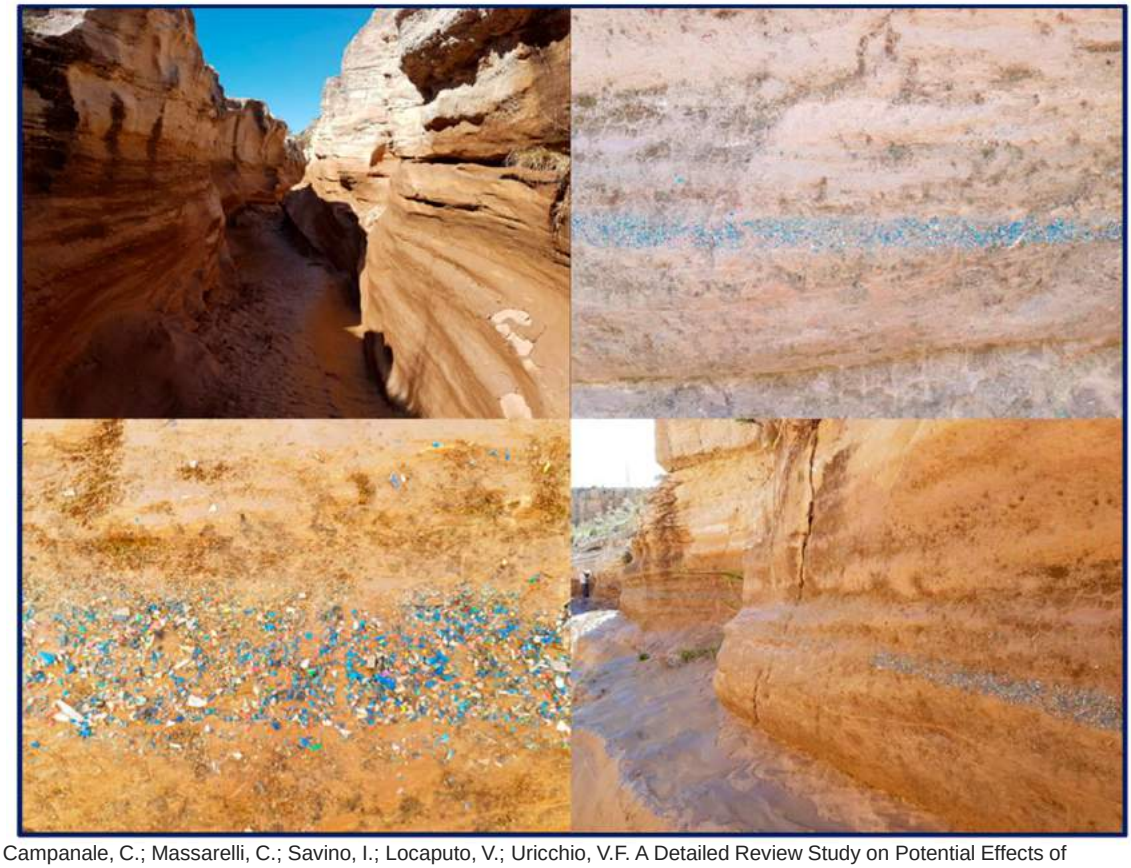
Hansen MM, Jones R. The Interrelationship of Shinrin-Yoku and Spirituality: A Scoping Review. J Altern Complement Med. 2020 Dec;26(12):1093-1104. doi: 10.1089/acm.2020.0193. Epub 2020 Sep 15. PMID: 32931299.

“Who knows? Plastic pollution may be the next world pandemic.”

Fadare OO, Okoffo ED. Covid-19 face masks: A potential source of microplastic fibers in the environment [published online ahead of print, 2020 Jun 16]. *Sci Total Environ*. 2020;737:140279. doi:10.1016/j.scitotenv.2020.140279



Campanale, C.; Massarelli, C.; Savino, I.; Locaputo, V.; Uricchio, V.F. A Detailed Review Study on Potential Effects of Microplastics and Additives of Concern on Human Health. *Int. J. Environ. Res. Public Health* **2020**, *17*, 1212. CCBY. No changes made.



Campanale, C.; Massarelli, C.; Savino, I.; Locaputo, V.; Uricchio, V.F. A Detailed Review Study on Potential Effects of Microplastics and Additives of Concern on Human Health. *Int. J. Environ. Res. Public Health* **2020**, *17*, 1212. CCBY. No changes made.

Nature inside
- Plant-based eating
- Modulating herbs

The way to get back to nature is to be more like a plant.

Surround yourself with them.
Eat them.


"FOODS THAT ARE
GOOD FOR YOU
ARE GOOD FOR THE PLANET."
- Rob Knight, PhD
Michael A. Clark, Marco Springmann, Jason Hill, David Tilman. Multiple health and environmental impacts of foods. Proceedings of the National Academy of Sciences Nov 2019, 116 (46) 23357-23362; DOI: 10.1073/pnas.1906908116.
deannaminich.com

What makes plants protective

- They are ‘jack/jill of all trades’ – they have pleiotropic effects.
- They modulate cellular response.
- They help us adapt to our environment through several mechanisms (e.g., microorganisms).
- The can upregulate endogenous defense systems (Nrf2, MRE, glutathione, etc.).
- They are major dietary sources of:
  - Fibers
  - Micronutrients
  - Phytonutrients

Hodges RE, Minich DM. Modulation of Metabolic Detoxification Pathways Using Foods and Food-Derived Components: A Scientific Review with Clinical Application. J Nutr Metab. 2015;2015:760689. doi: 10.1155/2015/760689. Epub 2015 Jun 16. PMID: 26167297; PMCID: PMC4488002.

Plants can heal, plants can be problematic:

We need to take a personalized approach

Petroski, W.; Minich, D.M. Is There Such a Thing as "Anti-Nutrients"? A Narrative Review of Perceived Problematic Plant Compounds. *Nutrients* **2020**, *12*, 2929.

nutrients

MDPI

Review

Is There Such a Thing as "Anti-Nutrients"? A Narrative Review of Perceived Problematic Plant Compounds

Weston Petroski and Deanna M. Minich *

Human Nutrition and Functional Medicine Graduate Program, University of Western States, 2900 NE 132nd Ave, Portland, OR 97230, USA; wpetroski@students.uws.edu
* Correspondence: deannaminich@hotmail.com

Received: 2 August 2020; Accepted: 22 September 2020; Published: 24 September 2020

Abstract: Plant-based diets are associated with reduced risk of lifestyle-induced chronic diseases. The thousands of phytochemicals they contain are implicated in cellular-based mechanisms to promote antioxidant defense and reduce inflammation. While recommendations encourage the intake of fruits and vegetables, most people fall short of their target daily intake. Despite the need to increase plant-food consumption, there have been some concerns raised about whether they are beneficial because of the various 'anti-nutrient' compounds they contain. Some of these anti-nutrients that have been called into question included lectins, oxalates, goitrogens, phytoestrogens, phytates, and tannins. As a result, there may be select individuals with specific health conditions who elect to decrease their plant food intake despite potential benefits. The purpose of this narrative review is to examine the science of these 'anti-nutrients' and weigh the evidence of whether these compounds pose an actual health threat.

Keywords: anti-nutrient; goitrogens; oxalates; phytates; phytoestrogens; plant-based diet; phytonutrients; tannins

1. Introduction

Longstanding evidence suggests that consuming a diet rich in plant-based foods plays a significant role in prevention and reduction of chronic diseases, such as cardiovascular disease, cancer, stroke, dementia, diabetes, cataracts, and others [1,2]. Well-researched dietary patterns including the Mediterranean, Dietary Approaches to Stop Hypertension (DASH), vegan and vegetarian, as well as the hunter-gatherer (Paleolithic) diet, all provide ample amounts of whole foods in some capacity, including fruits, vegetables, nuts, legumes, and/or whole grains. Though specific aspects of these eating patterns may differ, they all encourage a variety of nutrient-dense, unprocessed plant foods, and reduced consumption of processed grains, added sugars and salt [3–7].

Similarly, the 2015–2020 Dietary Guidelines for Americans recommends eating a variety of nutrient-dense foods, particularly dark green vegetables, red and orange vegetables, and legumes [8]. Despite continuing educational efforts by the USDA, total fruit and vegetable intake remains exceedingly low, with less than 10% of Americans meeting recommended vegetable and fruit guidelines of 2.5 servings/day and two servings/day, respectively [9]. On the other hand, daily intakes of energy-dense refined grains are significantly higher than recommended values. Consuming a wide spectrum of plant foods ensures that individuals meet nutritional needs while staying within suggested energy requirements.

Plant-based foods, beyond micro- and macronutrients, contain significant concentrations of bioactive plant compounds. Research demonstrates that the reduction in chronic disease risk

What about ‘anti-nutrients’?

- Lectins
- Oxalates
- Phytates
- Tannins
- Phytoestrogens
- Goitrogens
- Sulfur?

Antibodies to lectins found in blood of 8-15% of blood samples. These undigested lectins may be problematic in some individuals with autoimmunity.

Vojdani A, Afar D, Vojdani E. Reaction of Lectin-Specific Antibody with Human Tissue: Possible Contributions to Autoimmunity. *J Immunol Res*. 2020;2020:1438957. Published 2020 Feb 11. doi:10.1155/2020/1438957.

Most traditional preparation methods, including cooking, boiling, soaking, fermenting, roasting, milling, and sprouting have been shown to reduce the activities of lectins, oxalates, phytates, tannins, and goitrogens.

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Functional Medicine for Healthy Immunity through Food:

The common denominator is plants

- Eat plenty of fruits and vegetables; 9-13 servings daily
- Consume dietary fiber, 28-35 grams daily
- Eat fermented vegetables or other probiotic-containing foods
- Reduce or avoid immune offenders like sugar, salt

REVIEW OF EMERGING RESEARCH

The Functional Medicine Approach to COVID-19: Nutrition and Lifestyle Practices for Strengthening Host Defense

Minich DM, Hanaway PJ

Abstract

Food/Nutrition

Specific recommendations for patients:

1. Balancing inflammatory pathways.
2. Reducing oxidative stress and increasing antioxidant levels.
3. Harmonizing the gut microbiome.

Balancing Inflammatory Pathways

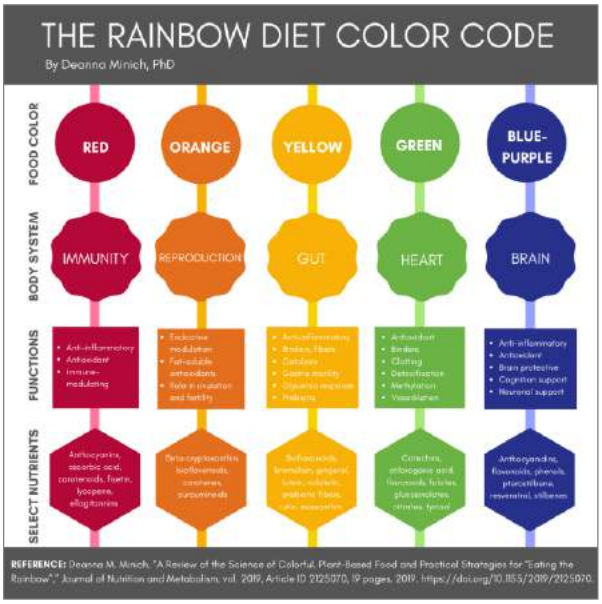
Overall Therapeutic Intervention: Building a Foundation Based in Plants

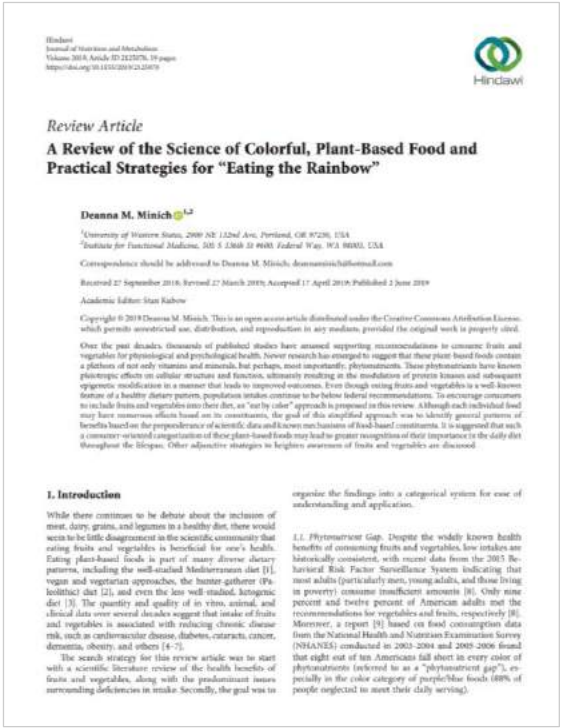
- Color
- Creativity
- Variety

Overall Therapeutic Intervention: Building a Foundation Based in Plants

- Color
- Creativity
- Variety

The Science of the "Rainbow"of Foods





Hindawi
Journal of Nutrition and Metabolism
Volume 2019, Article ID 2125070, 19 pages
https://doi.org/10.1155/2019/2125070

Review Article

A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for "Eating the Rainbow"

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Received 27 September 2018; Revised 27 March 2019; Accepted 17 April 2019; Published 2 June 2019

Academic Editor: Stan Kubow

Over the past decades, thousands of published studies have amassed supporting recommendations to consume fruits and vegetables for physiological and psychological health. Newer research has emerged to suggest that these plant-based foods contain a plethora of not only vitamins and minerals, but perhaps, most importantly, phytonutrients. These phytonutrients have known pleiotropic effects on cellular structure and function, ultimately resulting in the modulation of protein kinases and subsequent epigenetic modification in a manner that leads to improved outcomes. Even though eating fruits and vegetables is a well-known feature of a healthy dietary pattern, population intakes continue to be below federal recommendations. To encourage consumers to include fruits and vegetables into their diet, an "eat by color" approach is proposed in this review. Although each individual food may have numerous effects based on its constituents, the goal of this simplified approach was to identify general patterns of benefits based on the preponderance of scientific data and known mechanisms of food-based constituents. It is suggested that such a consumer-oriented categorization of these plant-based foods may lead to greater recognition of their importance in the daily diet throughout the lifespan. Other adjunctive strategies to heighten awareness of fruits and vegetables are discussed.

1. Introduction

While there continues to be debate about the inclusion of meat, dairy, grains, and legumes in a healthy diet, there would seem to be little disagreement in the scientific community that eating fruits and vegetables is beneficial for one's health. Eating plant-based foods is part of many diverse dietary patterns, including the well-studied Mediterranean diet [1], vegan and vegetarian approaches, the hunter-gatherer (Paleolithic) diet [2], and even the less well-studied, ketogenic diet [3]. The quantity and quality of in vitro, animal, and clinical data over several decades suggest that intake of fruits and vegetables is associated with reducing chronic disease risk, such as cardiovascular disease, diabetes, cataracts, cancer, dementia, obesity, and others [4–7].

The search strategy for this review article was to start with a scientific literature review of the health benefits of fruits and vegetables, along with the predominant issues surrounding deficiencies in intake. Secondly, the goal was to organize the findings into a categorical system for ease of understanding and application.

1.1. Phytonutrient Gap. Despite the widely known health benefits of consuming fruits and vegetables, low intakes are historically consistent, with recent data from the 2005 Behavioral Risk Factor Surveillance System indicating that most adults (particularly men, young adults, and those living in poverty) consume insufficient amounts [8]. Only nine percent and twelve percent of American adults met the recommendations for vegetables and fruits, respectively [8]. Moreover, a report [9], based on food consumption data from the National Health and Nutrition Examination Survey (NHANES) conducted in 2003–2004 and 2005–2006 found that eight out of ten Americans fall short in every color of phytonutrients (referred to as a "phytonutrient gap"), especially in the color category of purple/blue foods (88% of people neglected to meet their daily serving).

Deanna M. Minich, "A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for "Eating the Rainbow"," Journal of Nutrition and Metabolism, vol. 2019, Article ID 2125070, 19 pages, 2019. https://doi.org/10.1155/2019/2125070.

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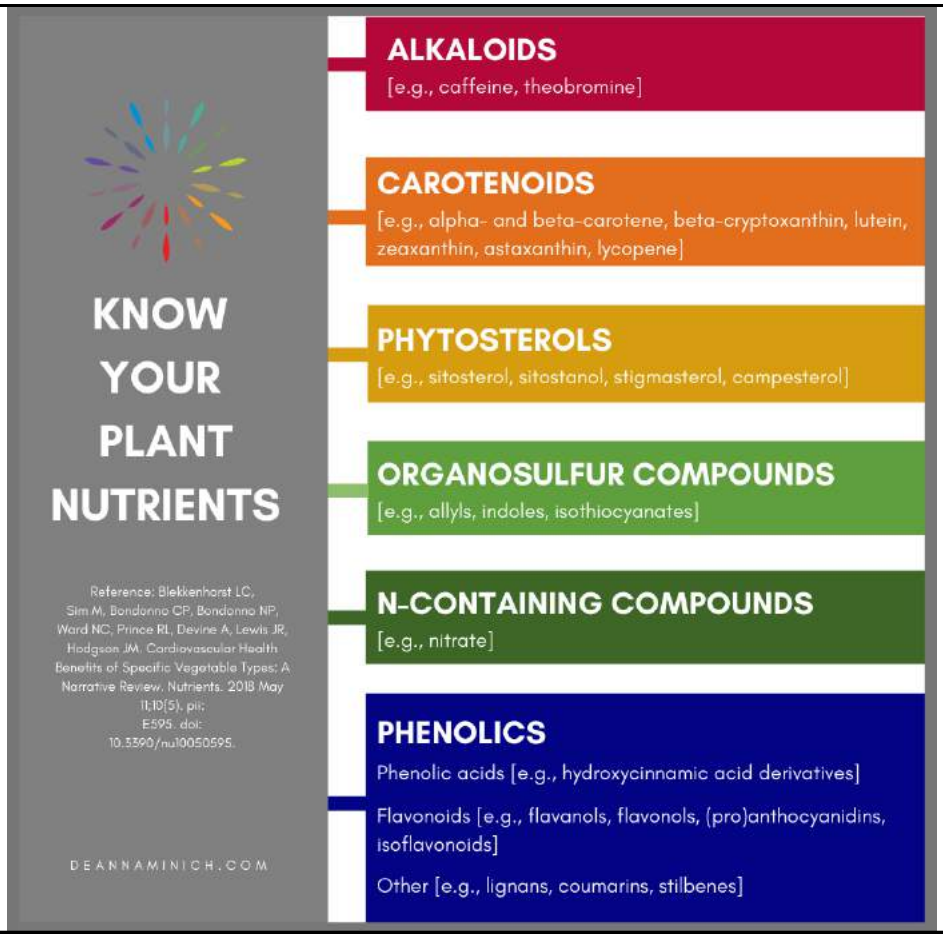
Colors of Food Associated with Antioxidant Level

Red, blue, purple foods shown to be highest in total antioxidant capacity

Cömert ED, Mogol BA, Gökmen V. Relationship between color and antioxidant capacity of fruits and vegetables. Curr Res Food Sci. 2019;2:1-10. Published 2019 Nov 21. doi:10.1016/j.crfs.2019.11.001

**we also know that blue-purple foods are most rare and not eaten by most people on a daily basis


KNOW YOUR PLANT NUTRIENTS
Reference: Blekkenhorst LC, Sim M, Bondonno CP, Bondonno NP, Ward NC, Prince RL, Devine A, Lewis JR, Hodgson JM. Cardiovascular Health Benefits of Specific Vegetable Types: A Narrative Review. Nutrients. 2018 May 11;10(5). pii: E595. doi: 10.3390/nu10050595.
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ALKALOIDS
[e.g., caffeine, theobromine]
CAROTENOIDS
[e.g., alpha- and beta-carotene, beta-cryptoxanthin, lutein, zeaxanthin, astaxanthin, lycopene]
PHYTOSTEROLS
[e.g., sitosterol, sitostanol, stigmasterol, campesterol]
ORGANOSULFUR COMPOUNDS
[e.g., allyls, indoles, isothiocyanates]
N-CONTAINING COMPOUNDS
[e.g., nitrate]
PHENOLICS
Phenolic acids [e.g., hydroxycinnamic acid derivatives]
Flavonoids [e.g., flavanols, flavonols, (pro)anthocyanidins, isoflavonoids]
Other [e.g., lignans, coumarins, stilbenes]

"Color Density Index":

Presence of more than one phytonutrient

- Carrots
- Grapefruit
- Mango
- Papaya
- Red cabbage
- Rutabaga
- Tomatoes
- Watermelon

- Lycopene (red)
- Beta-carotene (orange)
- Lutein/zeaxanthin (yellow)
- Folates (green)
- Flavonoids (blue-purple)

Deanna M. Minich, "A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for "Eating the Rainbow"," Journal of Nutrition and Metabolism, vol. 2019, Article ID 2125070, 19 pages, 2019. https://doi.org/10.1155/2019/2125070.

EAT THE RAINBOW OF PLANT FOODS

WHY?

- TO REDUCE RISK OF CHRONIC DISEASE
- TO HELP WITH BETTER MOOD
- TO OPTIMIZE HEALTH AND FUNCTION

WHAT?

- FRUITS
- HERBS AND SPICES
- JUICES (100% JUICE)
- LEGUMES
- NUTS AND SEEDS
- SALADS
- SMOOTHIES
- TEAS
- VEGETABLES
- WHOLE GRAINS

HOW?

- INCLUDE IN EVERY MEAL
- VARY YOUR CHOICES
- AIM FOR A MINIMUM OF 5 SERVINGS DAILY
- TRY A NEW FOOD EVERY WEEK
- BUY COLORFUL PRODUCE AT THE MARKET

WHERE?

- HAVE FROZEN AND FRESH FOODS AT HOME
- ASK FOR SUBSTITUTIONS WHEN EATING OUT
- BRING WHOLESOME SNACKS WITH YOU WHEN TRAVELING

EAT THE RAINBOW FOOD TRACKER

Name:

AIM FOR 7 COLORS EVERY DAY OF THE WEEK AND GET TO THE RAINBOW!

RED ORANGE YELLOW GREEN PURPLE BROWN WHITE

You can use this weekly tracker in at least two ways:

- Put an X in the circle when you have had one serving of the food.
- If you want to eat multiple servings of a color, put the total number of foods eaten in the circle.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

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Overall Therapeutic Intervention: Building a Foundation Based in Plants

- Color
- Creativity
- Variety

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Enhanced creativity is associated with fruit and vegetable intake.

Conner TS, Brookie KL, Richardson AC, Polak MA. On carrots and curiosity: eating fruit and vegetables is associated with greater flourishing in daily life. Br J Health Psychol. 2015;20(2):413-427. doi:10.1111/bjhp.12113.

Creative activities are therapeutic for the immune system due to their effects on mental health.

Leckey J. The therapeutic effectiveness of creative activities on mental well-being: a systematic review of the literature. J Psychiatr Ment Health Nurs. 2011;18(6):501-509. doi:10.1111/j.1365-2850.2011.01693.x

Overall Therapeutic Intervention: Building a Foundation Based in Plants

- Color
- Creativity
- Variety

Gut microbiome diversity & food:

A healthy gastrointestinal microbiome is dependent on dietary diversity

"The more diverse the diet, the **more diverse the microbiome** and the **more adaptable it will be to perturbations**. Unfortunately, dietary diversity has been lost during the past 50 years and dietary choices that exclude food products from animals or plants will narrow the GI microbiome further."

Heiman ML, Greenway FL. A healthy gastrointestinal microbiome is dependent on dietary diversity. Mol Metab. 2016 Mar 5;5(5):317-320. doi: 10.1016/j.molmet.2016.02.005. eCollection 2016 May.

Food Diversity & Immune Resilience:

Greater diversity, better immune outcomes

- Decreased food allergy
- Maternal diet altering child outcomes for risk of allergic or autoimmune disease

Venter C, Maslin K, Holloway JW, et al. Different Measures of Diet Diversity During Infancy and the Association with Childhood Food Allergy in a UK Birth Cohort Study. J Allergy Clin Immunol Pract. 2020;8(6):2017-2026. doi:10.1016/j.jaip.2020.01.029. Garcia-Larsen V, Ierodiakonou D, Jarrold K, et al. Diet during pregnancy and infancy and risk of allergic or autoimmune disease: A systematic review and meta-analysis. PLoS Med. 2018;15(2):e1002507. Published 2018 Feb 28. doi:10.1371/journal.pmed.1002507

Clinical Tool: Variety Tracker

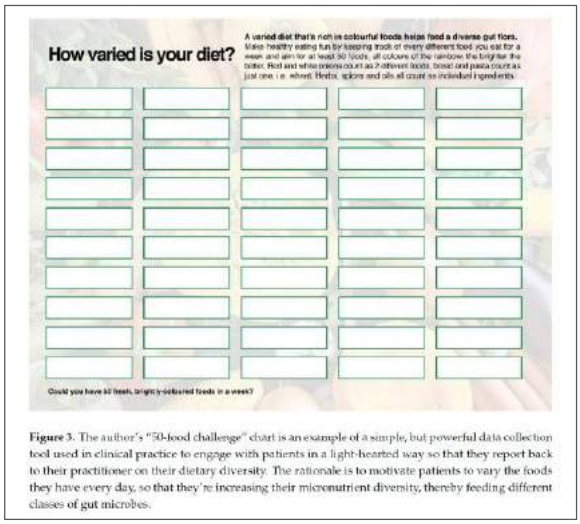

Figure 3. The author's "50-food challenge" chart is an example of a simple, but powerful data collection tool used in clinical practice to engage with patients in a light-hearted way so that they report back to their practitioner on their dietary diversity. The rationale is to motivate patients to vary the foods they have every day, so that they're increasing their micronutrient diversity, thereby feeding different classes of gut microbes.

"Increasing the diversity of brightly-coloured plant foods, even in small amounts, can have a dramatic effect on SCFA production."

Toribio-Mateas M. Harnessing the Power of Microbiome Assessment Tools as Part of Neuroprotective Nutrition and Lifestyle Medicine Interventions. Microorganisms. 2018 Apr 25;6(2):35. doi: 10.3390/microorganisms6020035. PMID: 29693607; PMCID: PMC6027349.

From Foundation to Specifics:
Therapeutic Phytonutrients

The Science and the Clinical Translation of Immune Mechanisms

THE SCIENCE	THE CLINICAL TRANSLATION

• **Borders**
  • Brush border membranes (gut)
  • Gut microbiome
  • Mucin layer
	• Digestive tract (oral)
	• Respiratory tract
	• Skin
	• Nasal and ear passages

• **Inflammation**
  • Oxidative stress/cytokine storm
  • Antioxidants
	• Pain
	• Inflammation
	• Fatigue

• **Immune Dysregulation**
  • Toxins
  • Endocrine disruption
  • Chronic stress
	• Autoimmune dysregulation
	• Comorbidities

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The Yin and Yang of Immunity

OVERACTIVE	DEPRESSED
• High WBC • High inflammatory markers/cytokines • May have upregulated sympathetic stress HPA response • Active inflammation/inflammaging • Metabolic dysfunction (e.g., high cortisol, insulin, glucose) • Sleeps poorly; may have sleep apnea	• Low WBC • Unable to mount a response to infection • Easily falls ill • Immunocompromised due to chronic conditions (e.g., cancer) or medications • Sex hormone alterations • Low cholesterol • High fatigue • Increased need for sleep

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The Borders and Boundaries:
Therapeutic Phytonutrients

Leaky gut
Leaky brain
Leaky skin
Leaky heart
Leaky membranes
Leaky mitochondria

We have an epidemic of '**leakiness**'.

DEANNA MINICH

The Gut Microbiome:

Functional Roles in Health

- Epithelial cell growth and development
- Preventing the entry of pathogens:
  - Integrity of the brush border membrane
  - Production of mucin layer (eugenol) and anti-microbial peptides
  - Secretory IgA protects commensal bacteria
- Anti-inflammatory activities and cytokine balance
- Immune system regulation
- Digestion of food
- Mood, memory
- Production of vitamins (B12, K)
- Biotransformation of heavy metals and other toxicants
- Conversion of primary bile acids into secondary bile acids (helps with shaping the milieu)

Reference: Dupont HL, Jiang ZD, Dupont AW, Utay NS. THE INTESTINAL MICROBIOME IN HUMAN HEALTH AND DISEASE. *Trans Am Clin Climatol Assoc*. 2020;131:178-197. Altveş S, Yildiz HK, Vural HC. Interaction of the microbiota with the human body in health and diseases. *Biosci Microbiota Food Health*. 2020;39(2):23-32. doi:10.12938/bmfh.19-023. Hills RD Jr, Pontefract BA, Mishcon HR, Black CA, Sutton SC, Theberge CR. Gut Microbiome: Profound Implications for Diet and Disease. *Nutrients*. 2019;11(7):1613. Published 2019 Jul 16. doi:10.3390/nu11071613; Wlodarska M, Willing BP, Bravo DM, Finlay BB. Phytonutrient diet supplementation promotes beneficial Clostridia species and intestinal mucus secretion resulting in protection against enteric infection. *Sci Rep*. 2015;5:9253. Published 2015 Mar 19. doi:10.1038/srep09253

Dietary Patterns and the Microbiome

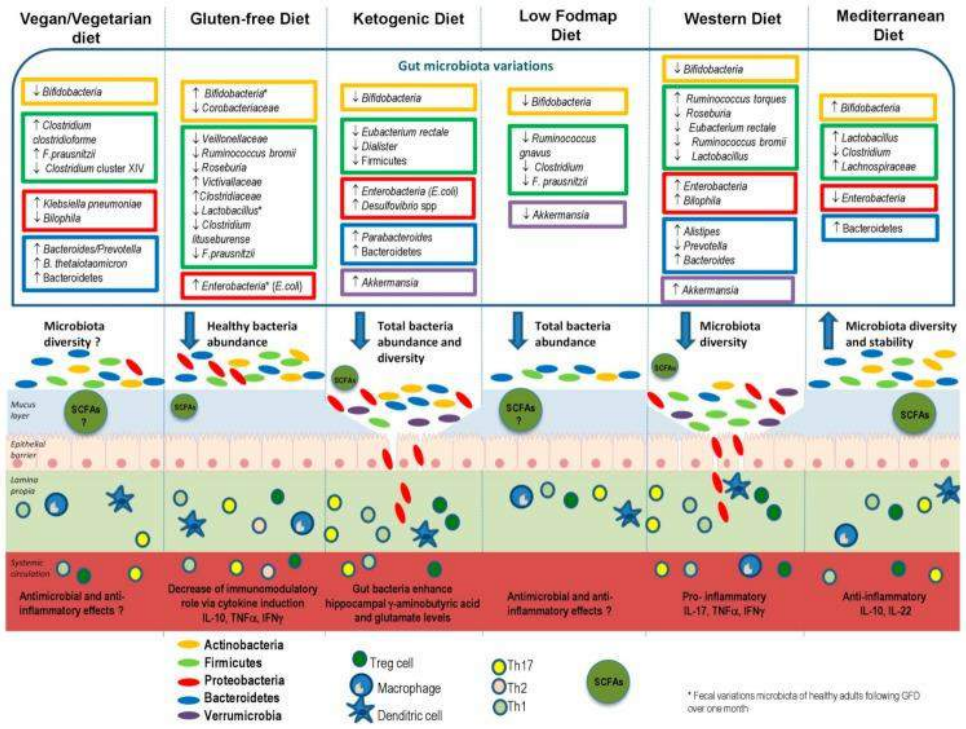

Image Credit: Rinninella E, Cintoni M, Raoul P, et al. Food Components and Dietary Habits: Keys for a Healthy Gut Microbiota Composition. *Nutrients*. 2019;11(10):2393. Published 2019 Oct 7. doi:10.3390/nu11102393. (http://creativecommons.org/licenses/by/4.0/). No changes made.

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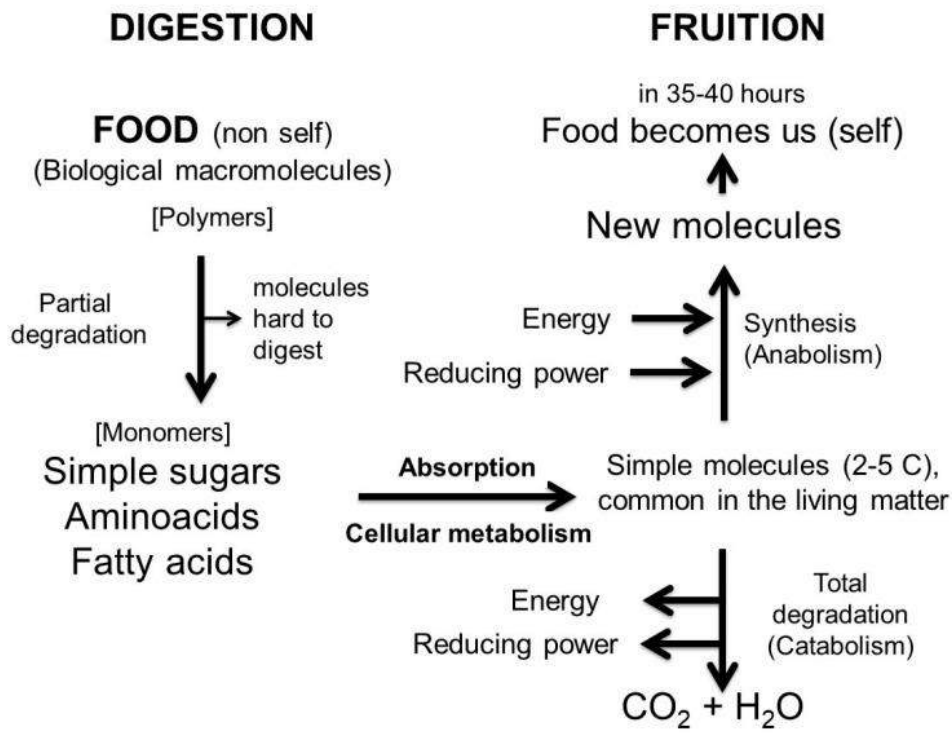

Food Allergies

- "Hygiene Hypothesis"*
- Factors associated with less food allergies:
  - Growing up in a large family
  - Being raised on a farm that practices non-industrialized agricultural methods
  - Earlier introduction of solid foods as an infant**
  - Having pets
  - A healthy microbiome

Nance CL, Deniskin R, Diaz VC, Paul M, Anvari S, Anagnostou A. The Role of the Microbiome in Food Allergy: A Review. Children (Basel). 2020;7(6):50. Published 2020 May 26. doi:10.3390/children7060050; *Strachan DP. Hay fever, hygiene, and household size. BMJ. 1989;299(6710):1259-1260. doi:10.1136/bmj.299.6710.1259. **Hicke-Roberts A, Wennergren G, Hesselmar B. Late introduction of solids into infants' diets may increase the risk of food allergy development. BMC Pediatr. 2020;20(1):273. Published 2020 Jun 3. doi:10.1186/s12887-020-02158-x

Select Nutrients & Intestinal Permeability*

Increase Permeability	Decrease Permeability
• Zinc depletion • Ethanol • Acetaldehyde	• Glutamine • Tryptophan • Vitamin A (retinol) • Vitamin D • Quercetin • Kaempferol • Genistein • EGCG • Curcumin • EPA/DHA • SCFAs: Acetic and propionic acids

***As tested primarily in cell models; Reference:** De Santis S, Cavalcanti E, Mastronardi M, Jirillo E, Chieppa M. Nutritional Keys for Intestinal Barrier Modulation. *Front Immunol*. 2015;6:612. Published 2015 Dec 7. doi:10.3389/fimmu.2015.00612

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KNOW THE -BIOTICS IN GUT HEALTH

• **Dys**biosis:	imbalance in microorganisms
• **Para**biotics:	non-living, inactivated probiotics
• **Phyto**biotics:	active, plant-based compounds
• **Pre**biotics:	fermentable dietary fibers
• **Pro**biotics:	living, non-harmful microorganisms
• **Post**biotics:	compounds created by probiotics
• **Syn**biotics:	combination of pre- and probiotics

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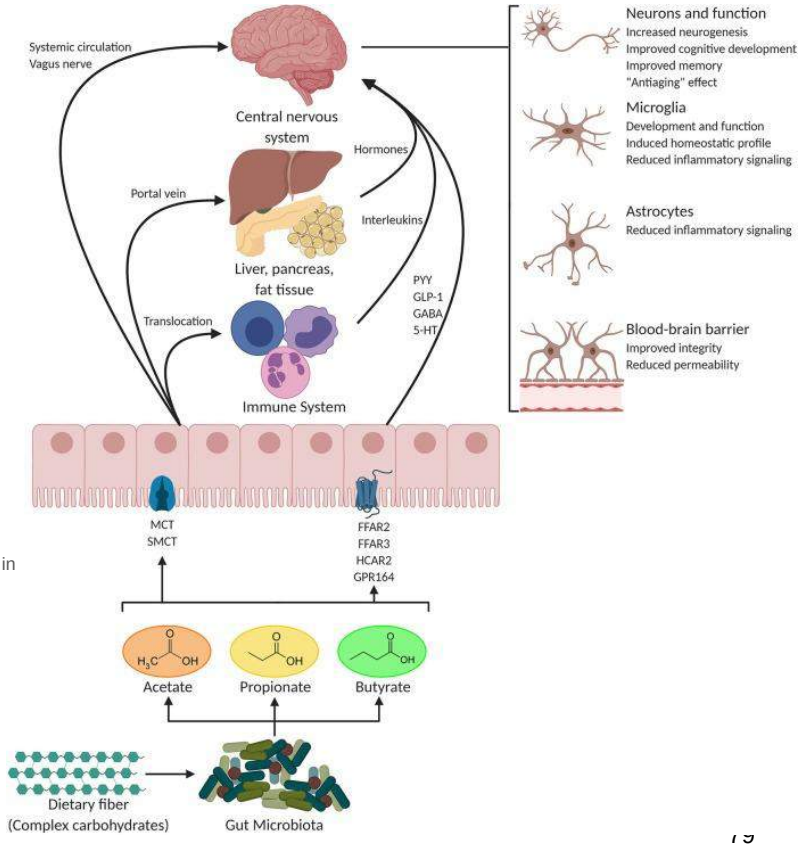
Crosstalk through SCFAs



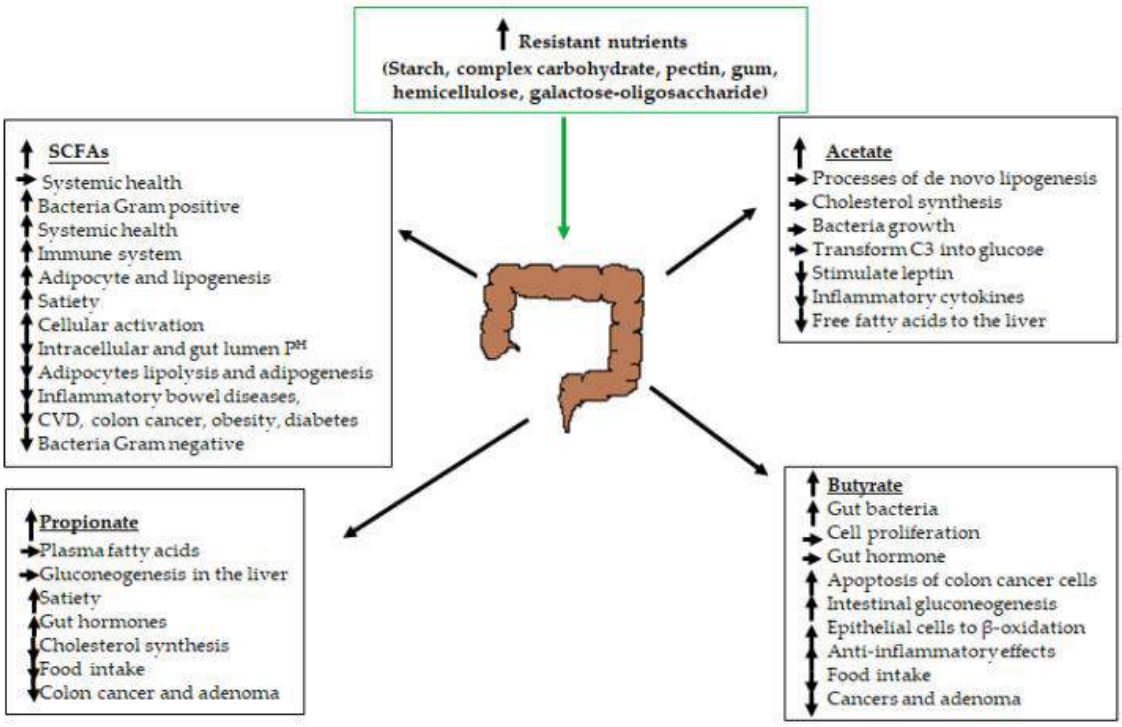


Image Credit: Machate DJ, Figueiredo PS, Marcelino G, et al. Fatty Acid Diets: Regulation of Gut Microbiota Composition and Obesity and Its Related Metabolic Dysbiosis. *Int J Mol Sci*. 2020;21(11):4093. Published 2020 Jun 8. doi:10.3390/ijms21114093. (http://creativecommons.org/licenses/by/4.0/). No changes made.

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Elimination Diet

- Removes top allergens:
  - Common foods and beverages containing corn, soy, wheat/gluten, eggs, sugar, caffeine, alcohol, shellfish, and peanuts, are omitted
  - 10, 21, 28 days
- Some additional modifications include removal of the following:
  - Nightshades, nuts, alcohol, caffeine, pork, citrus, histamines, oxalates, salicylates
- Goal is to remove these foods short-term and then reintroduce them sequentially to observe presence or absence of symptoms
- Reintroduction is to be personalized to the patient.

MacIntosh A, Ball K. The effects of a short program of detoxification in disease-free individuals. Altern Ther Health Med. 2000 Jul;6(4):70-6.

Dietary Micro-Rotation

The pulsing of small amounts of a variety of whole foods in one's daily diet rather than long-term omission of entire food categories for the purpose of building immune resilience

Inflammation & Antioxidants:
Therapeutic Phytonutrients

The Role of Antioxidants

- Internal network of antioxidants
  - Vitamin E (food sources: wheat germ, seed oils, nuts, seeds, greens)
  - Vitamin C (food sources: citrus fruits, cherries, berries, papaya, broccoli, kiwi)
  - Polyphenols (e.g., teas, fruits such as apples and berries, vegetables)
  - Carotenoids (e.g., sweet potato, bell peppers, yam, carrots, tomatoes)
- Internal system of antioxidant defense enzymes
  - Superoxide dismutase (SOD)
  - Catalase
  - Glutathione peroxidase
- External intake of antioxidants
  - Be aware of double-sided nature with high amounts of isolated agents as they can act as pro-oxidants

Iddir M, Brito A, Dingeo G, et al. Strengthening the Immune System and Reducing Inflammation and Oxidative Stress through Diet and Nutrition: Considerations during the COVID-19 Crisis. *Nutrients*. 2020;12(6):1562. Published 2020 May 27. doi:10.3390/nu12061562; Smith RE. The Effects of Dietary Supplements that Overactivate the Nrf2/ARE System. Curr Med Chem. 2020;27(13):2077-2094. doi: 10.2174/0929867326666190517113533. PMID: 31099320.

Anti-inflammatory Nutrients:
Inflammation, Immunity, Insulin

- Omega-3 fatty acids
- Antioxidant vitamins and minerals
  - Vitamins C & E
  - Selenium, zinc (e.g., nuts, fish, meats, eggs, grains)
- Hormone-like nutrients
  - Vitamin D (e.g., fish, seafood, eggs, mushrooms)
  - Vitamin K (e.g., leafy greens, fermented foods)
- Quercetin (e.g., apples, onions)
- Epigallocatechin gallate (from green tea)
- Turmeric/Curcumin

Nutrients for the Immune System:
Spice it up!

- Based on data from 163 countries, there was a correlation between number of grams of spice consumed and number of COVID cases.
- Lower spice consumption associated with greater COVID cases.
- Examples of some spices to include in one's kitchen:
  - Cloves
  - Turmeric
  - Ginger
  - Oregano
  - Cinnamon

Immunity-Boosting Spices and the Novel Coronavirus. Yehya Elsayed and Naveed Ahmed Khan. ACS Chemical Neuroscience 2020 11 (12), 1696-1698. DOI: 10.1021/acschemneuro.0c00239

Ayurvedic practices and COVID-19: A long tradition of using plants

- The Indian Government has promoted Ayurvedic practices to its citizens during the COVID-19 pandemic.
- Suggested Ayurvedic practices:
  - Drinking warm water throughout the day
  - Using spices
  - Doing yoga
  - Drinking golden milk
  - Oil pulling therapy
  - Nasal steam inhalation with mint leaves or caraway seeds
  - Using clove powder mixed with honey or sugar for throat irritation or cough

Rajkumar RP. Ayurveda and COVID-19: Where psychoneuroimmunology and the meaning response meet [published online ahead of print, 2020 Apr 22]. Brain Behav Immun. 2020;S0889-1591(20)30637-1. doi:10.1016/j.bbi.2020.04.056

Nutrients for the Immune System:
Spices cool down inflammatory pathways

- Various parts of the plant or flower impart specific activities: root, leaf, bud, seed, bark, berry, stigma of a plant or flower
- Spices add flavor to food, and there may be other health effects connected to taste receptors that we do not fully understand yet.
- Commonly used spices used in cooking with high anti-inflammatory activity: black pepper, cardamom, cinnamon, clove, cumin, fenugreek, fennel, garlic, ginger, onion, rosemary, turmeric
- A combination of spices can address multiple targets:
  - Transcription factors such as NF-κB and STAT3
  - Inflammatory enzymes such as cyclooxygenase-2 (COX-2), matrix metalloproteinase-9 (MMP-9)
  - Inflammatory cytokines such as tumor necrosis factor alpha (TNF-α), interleukins (IL) such as IL-1, -6, -8

Kunnumakkara AB, Sailo BL, Banik K, et al. Chronic diseases, inflammation, and spices: how are they linked?. *J Transl Med*. 2018;16(1):14. Published 2018 Jan 25. doi:10.1186/s12967-018-1381-2.

Ways to get more spices into everyday eating

- Add to smoothies
- Make tea first and add water to smoothies or add spice directly
- Combine finely chopped garlic and basil to extra virgin olive oil and lemon juice for a delicious and nutritious salad dressing
- Add fresh herbs such as cilantro, chives, basil or mint to salads or sandwiches
- Sprinkle spices such as cumin or fennel seeds in soups or salads
- Marinate lean meats in curry powder or curry pastes
- Sprinkle cinnamon and nutmeg over oatmeal or wholegrain toast for breakfast
- Add extra flavor to scrambled eggs with a handful of fresh parsley or chives
- Stew fruits with cinnamon and a vanilla pod
- Substitute tea by steeping lemongrass or mint in hot water
- Add freshly grated garlic to mayonnaise for an easy aioli
- Add fresh or dried herbs to your favorite pasta dish
- Ghees, honeys, oils, salts, sprinkles

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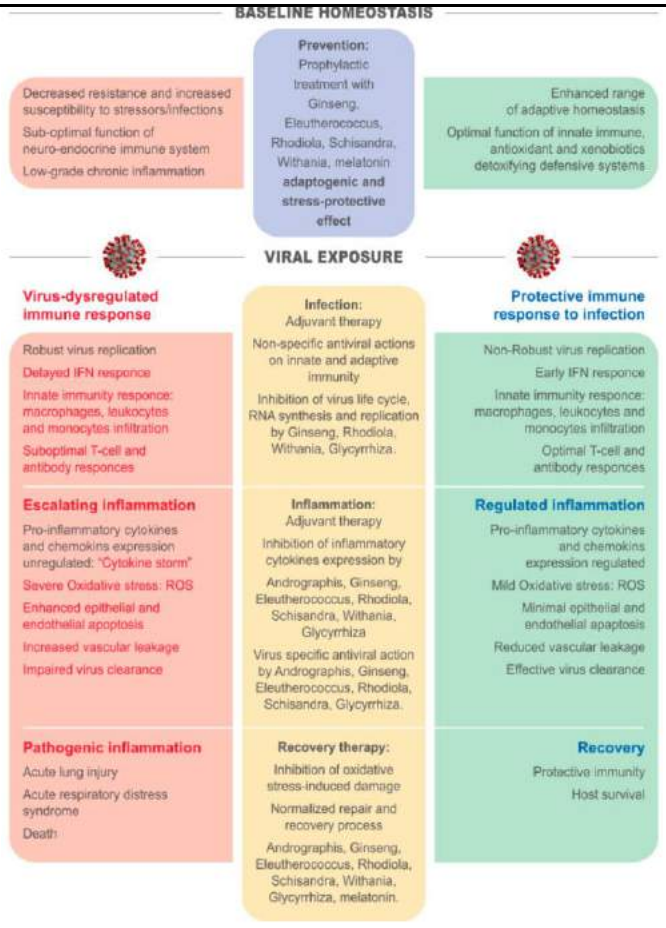
Immune Dysregulation:
Therapeutic Phytonutrients

The intelligence of plants informing the intelligence of the immune system

- Certain plants have similar structures to catecholamines.
- These botanical adaptogens work on several stress-related cascades including reducing many stress and inflammatory genes.



Orange consumption out of season leads to adipose accumulation

- N=36 rats acclimated for 4 weeks to long-day or short-day photoperiods
- Three groups (n=6) from each period were given orange from the northern or southern hemispheres harvested in the same month or a control vehicle for 10 weeks
- **The southern orange promoted a fat accumulation phenotype consumed during the short-day photoperiod**.
- **Out of ~39 phytochemicals analyzed, the northern and southern oranges statistically differed in 24 phytochemicals**

Gibert-Ramos, A., Palacios-Jordan, H., Salvadó, M.J. et al. Consumption of out-of-season orange modulates fat accumulation, morphology and gene expression in the adipose tissue of Fischer 344 rats. Eur J Nutr 59, 621–631 (2020). https://doi.org/10.1007/s00394-019-01930-9

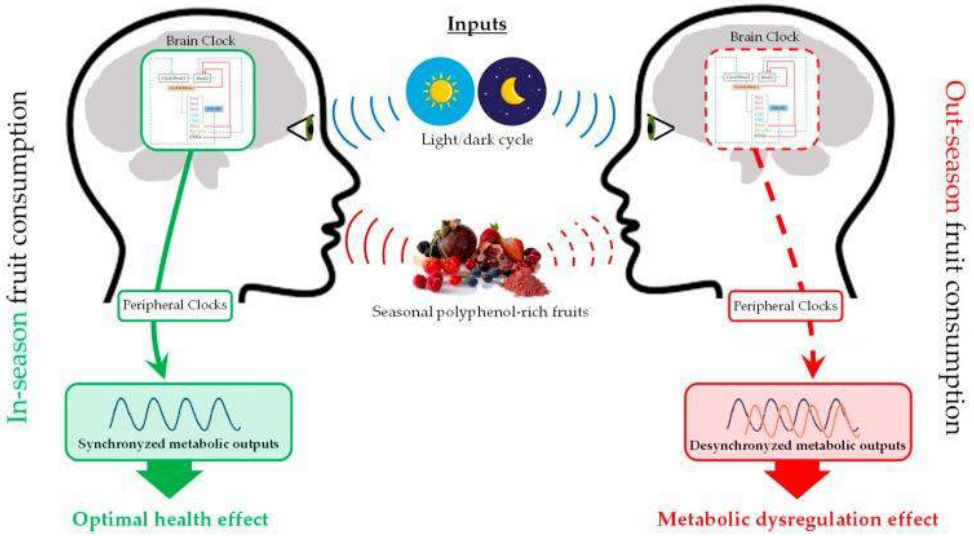


Image Credit: Arola-Arnal A, Cruz-Carrión Á, Torres-Fuentes C, et al. Chrononutrition and Polyphenols: Roles and Diseases. Nutrients. 2019;11(11):2602. Published 2019 Oct 30. doi:10.3390/nu11112602

Dietary neurotransmitters

Table recreated from: Briguglio M, Dell'Osso B, Panzica G, et al. (2018). Dietary neurotransmitters: A narrative review on current knowledge. *Nutrients*, *10*(5), 591. http://doi.org/10.3390/nu10050591. CC BY 4.0

Table 1. The dietary neurotransmitters and relative food sources.

Dietary Neurotransmitter	Foods and Botanicals
Acetylcholine	Aubergine, bitter orange, common bean, foxglove, mistletoe, mung bean, nettle, species, pea, radish, spinach, squash, wild strawberry.
Glutamate	Caviar, cheese, crackling, chips, dried cod, fermented beans, fish sauces, gravies, instant coffee powder, meats, miso, mushrooms, noodle dishes, oyster sauce, Parmesan cheese, ready-to-eat-meals, salami, savory snacks, seafood, seaweed, soups, soy sauces, spinach, stews, tomato, tomato sauce.
GABA	Adzuki bean, barley, broccoli, buckwheat, chestnut, common bean, kale, lupin, maypop, mouse-ear hawkweed, oat, pea, pokeroot, potato, rice, shiitake, soya bean, spinach, St John's wort, sweet potato, tea, tomato, valerian, wheat, wild celery.
Dopamine	Aubergine, avocado, banana, common bean, apple, orange, pea, plantain, spinach, tomato, velvet bean.
Serotonin	Banana, chicory, Chinese cabbage, coffee powders, green coffee bean, green onion, hazelnut kiwi, lettuce, nettle, Griffonia simplicifolia, paprika, passion fruit, pawpaw, pepper, pineapple, plantain, plum, pomegranate, potato, spinach, strawberry, tomato, velvet bean, wild rice.
Histamine	Anchovy, beer, billfish, Champagne and Sherry, dandelion, fermented sausages, ham and other cured dry meat products, herring, ketchup, aged cheese, nettle, red, white and dessert wines, sardine, sauerkraut, Scomberesocidae (for example, sauries), Scombridae (for example, tuna, mackerel, and bonitos) soybean food products (for example, soy, tempeh, soy sauce, soya bean milk, doenjang, doufuru, and natt0), sweet or sour cream, UHT, pasteurized, and fresh milk, yoghurt.

Phytonutrients:
Goals and Guidelines

- **Carotenoids**
  - Sweet potato, bell peppers, yam, carrot, greens, tomatoes
- **Catechins**
  - Green tea, black tea, Oolong tea, berries, cocoa
- **Curcumin**
  - Turmeric root, turmeric powder
- **Quercetin**
  - Onions, apples, berries, broccoli, citrus fruits
- **Resveratrol**
  - Grapes, berries, nuts, peanuts

Reference: Iddir M, Brito A, Dingeo G, et al. Strengthening the Immune System and Reducing Inflammation and Oxidative Stress through Diet and Nutrition: Considerations during the COVID-19 Crisis. *Nutrients*. 2020;12(6):1562. Published 2020 May 27. doi:10.3390/nu12061562

Nutrients for the Immune System:
Phytochemicals: Flavonoids

- Includes flavonols, flavones, flavanols, flavanones, anthocyanidins, proanthocyanidins, and isoflavones
- More than 6000 in nature; formed by plant in response to stress
- Commonly found in vegetables, seeds, fruit, and beverages, such as red wine and tea
- Flavonoid intake at 0.2 to 1.2 g/day
- Decreased upper respiratory tract infection incidence by 33% compared with control
- Lack of significant adverse effects
- Sick-day count reduced by 40%; mechanism unclear

Vaughan S Somerville, Andrea J Braakhuis, Will G Hopkins, Effect of Flavonoids on Upper Respiratory Tract Infections and Immune Function: A Systematic Review and Meta-Analysis, Advances in Nutrition, Volume 7, Issue 3, May 2016, Pages 488–497, https://doi.org/10.3945/an.115.010538; Russo M, Moccia S, Spagnuolo C, Tedesco I, Russo GL. Roles of flavonoids against coronavirus infection [published online ahead of print, 2020 Jul 28]. *Chem Biol Interact*. 2020;328:109211. doi:10.1016/j.cbi.2020.109211

Nutrients for the Immune System:
Quercetin

- Well-known flavonoid with antiviral properties
- Common food sources: Onions, apples, berries, broccoli, citrus fruits
- May be synergistic with vitamin C, serves as an ionophore for Zn
- Functions:
  - Antioxidant
  - Anti-inflammatory
  - Immunoprotective effects
  - Antiviral through activity in inhibiting polymerases, proteases, reverse transcriptase, and binding viral capsid proteins

Budhwar S, Sethi K, Chakraborty M. A Rapid Advice Guideline for the Prevention of Novel Coronavirus Through Nutritional Intervention [published online ahead of print, 2020 Jun 23]. *Curr Nutr Rep*. 2020;1-10. doi:10.1007/s13668-020-00325-1

Nutrients for the Immune System:
Curcumin

- Anti-inflammatory, antioxidant, anti-cancer, and anti-diabetic activity (shown in cell/animal studies)
- Can reduce IL-1, IL-6, IL-8, TNF-α
- Beneficial effects for infectious diseases
- Preclinical studies indicate it may be able to inhibit the cytokine storm
- Scavenges ROS
- Reduces injury to lung (e.g., edema as a result of inflammation)

Liu Z, Ying Y. The Inhibitory Effect of Curcumin on Virus-Induced Cytokine Storm and Its Potential Use in the Associated Severe Pneumonia. *Front Cell Dev Biol*. 2020;8:479. Published 2020 Jun 12. doi:10.3389/fcell.2020.00479

Nutrients for the Immune System:

Catechins from green tea

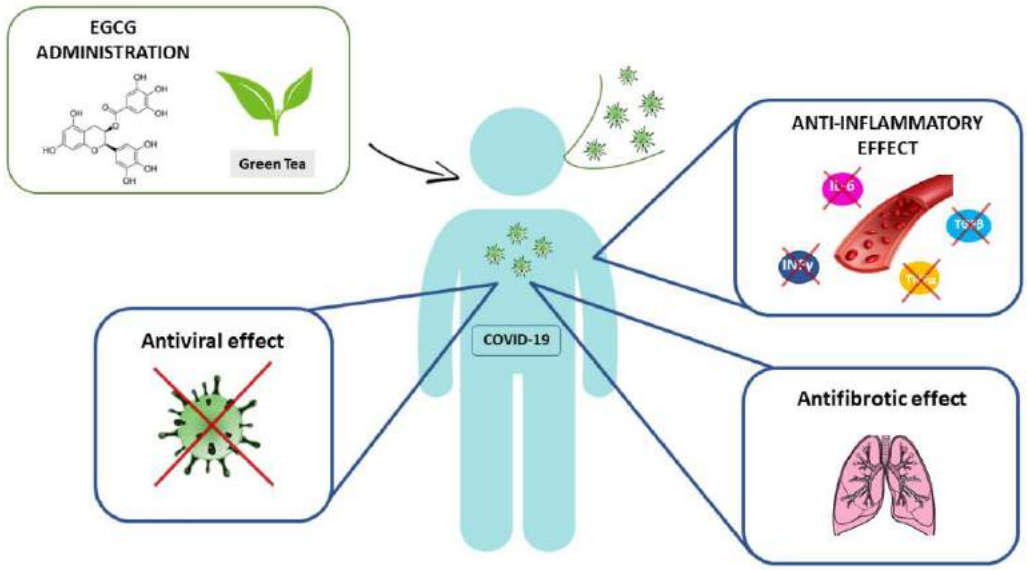


Image Credit: Menegazzi, M.; Campagnari, R.; Bertoldi, M.; Crupi, R.; Di Paola, R.; Cuzzocrea, S. Protective Effect of Epigallocatechin-3-Gallate (EGCG) in Diseases with Uncontrolled Immune Activation: Could Such a Scenario Be Helpful to Counteract COVID-19? *Int. J. Mol. Sci.* **2020**, *21*, 5171. http://creativecommons.org/licenses/by/4.0/. No changes made.

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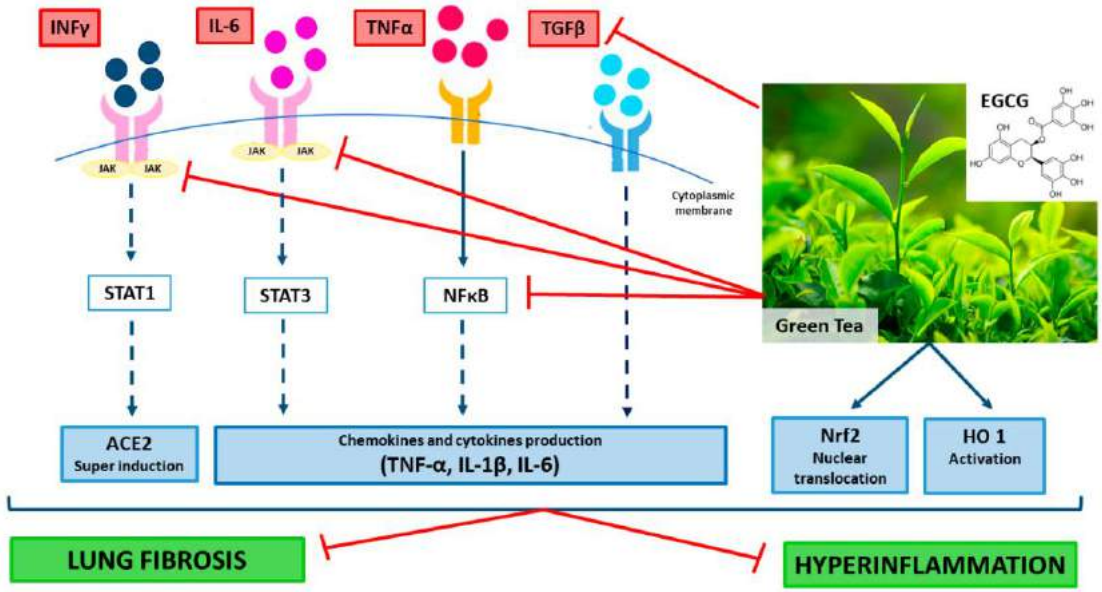
Nutrients for the Immune System:

Catechins from green tea



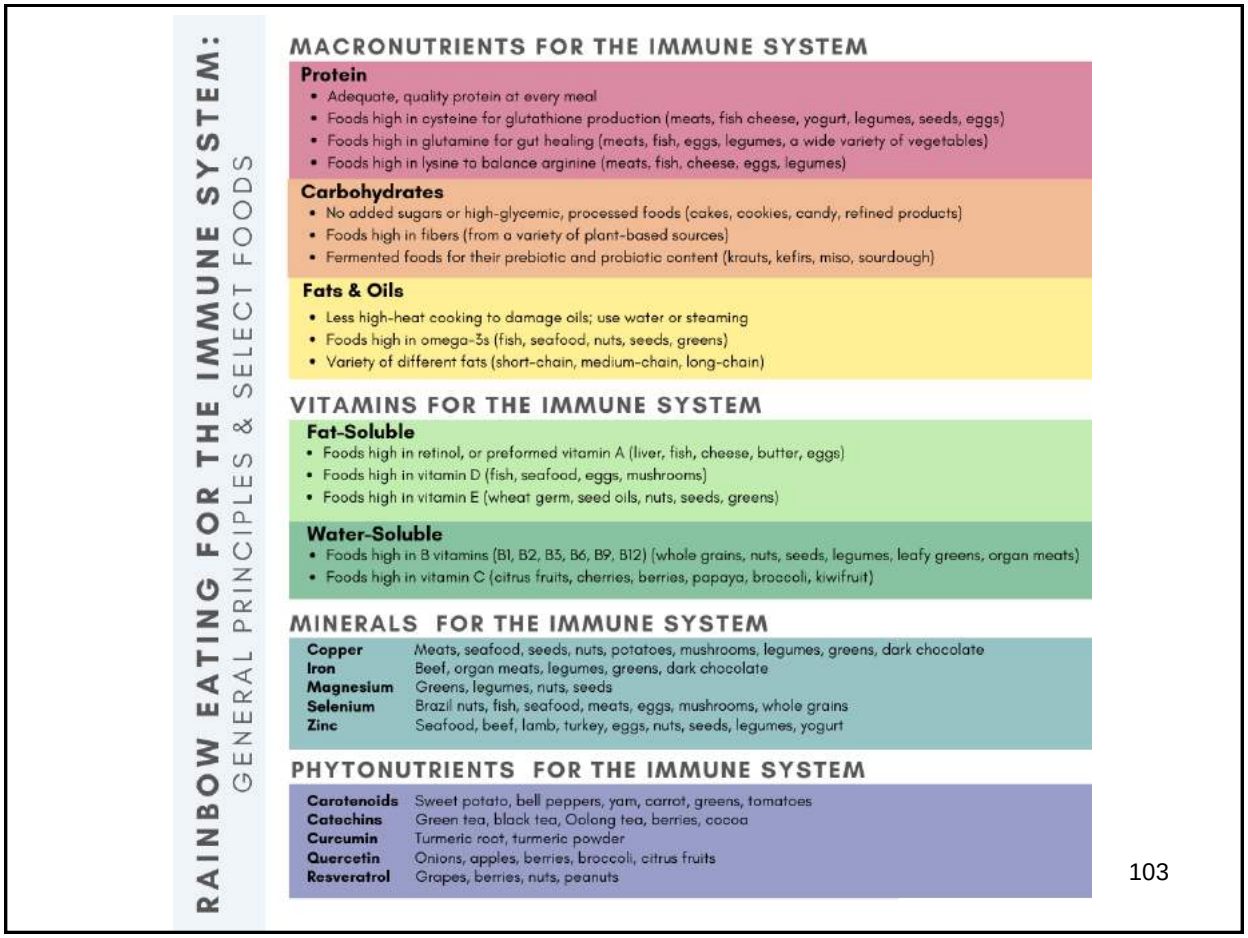
Summary
The Plant-Person Interface

- We are the sum of our environment.
- All three aspects of the immune system are assisting in the resilience of the individual.
- Food needs to be tailored to all three aspects of the immune system.
- Plants are the ‘divining rod’ to enable humans to better survive in their environments.
- Clinically, these principles are most important for reestablishing balance:
  - Color → Color and Nutrient Density
  - Creativity → Emotional-Mental Health and Quality of Life
  - Variety → Seasonality, Complexity, Spices, Whole Foods

Clinical Actions

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

- Prescribe nature
- Assess color, nutrient density and variety in a client's daily eating for immune health
- Bring the role of stress, intention, and conscious awareness into therapeutic encounter discussions


RAINBOW EATING FOR THE IMMUNE SYSTEM:
GENERAL PRINCIPLES & SELECT FOODS
MACRONUTRIENTS FOR THE IMMUNE SYSTEM
Protein
• Adequate, quality protein at every meal
• Foods high in cysteine for glutathione production (meats, fish cheese, yogurt, legumes, seeds, eggs)
• Foods high in glutamine for gut healing (meats, fish, eggs, legumes, a wide variety of vegetables)
• Foods high in lysine to balance arginine (meats, fish, cheese, eggs, legumes)
Carbohydrates
• No added sugars or high-glycemic, processed foods (cakes, cookies, candy, refined products)
• Foods high in fibers (from a variety of plant-based sources)
• Fermented foods for their prebiotic and probiotic content (krauts, kefirs, miso, sourdough)
Fats & Oils
• Less high-heat cooking to damage oils; use water or steaming
• Foods high in omega-3s (fish, seafood, nuts, seeds, greens)
• Variety of different fats (short-chain, medium-chain, long-chain)
VITAMINS FOR THE IMMUNE SYSTEM
Fat-Soluble
• Foods high in retinol, or preformed vitamin A (liver, fish, cheese, butter, eggs)
• Foods high in vitamin D (fish, seafood, eggs, mushrooms)
• Foods high in vitamin E (wheat germ, seed oils, nuts, seeds, greens)
Water-Soluble
• Foods high in B vitamins (B1, B2, B3, B6, B9, B12) (whole grains, nuts, seeds, legumes, leafy greens, organ meats)
• Foods high in vitamin C (citrus fruits, cherries, berries, papaya, broccoli, kiwifruit)
MINERALS FOR THE IMMUNE SYSTEM
Copper Meats, seafood, seeds, nuts, potatoes, mushrooms, legumes, greens, dark chocolate
Iron Beef, organ meats, legumes, greens, dark chocolate
Magnesium Greens, legumes, nuts, seeds
Selenium Brazil nuts, fish, seafood, meats, eggs, mushrooms, whole grains
Zinc Seafood, beef, lamb, turkey, eggs, nuts, seeds, legumes, yogurt
PHYTONUTRIENTS FOR THE IMMUNE SYSTEM
Carotenoids Sweet potato, bell peppers, yam, carrot, greens, tomatoes
Catechins Green tea, black tea, Oolong tea, berries, cocoa
Curcumin Turmeric root, turmeric powder
Quercetin Onions, apples, berries, broccoli, citrus fruits
Resveratrol Grapes, berries, nuts, peanuts

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Immune Nutrition in Motion

Pomegranate arils, sauerkraut, sweet potato with turmeric, Belgian endive, purple daikon radish, wild salmon with garlic, microgreens, blackberries, cauliflower rice

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Calling forth the healer within

"Everyone has a physician inside him or her; we just have to help it in its work. The natural healing force within each one of us is the greatest force in getting well."

- Hippocrates


Visualize all of your immune cells working together in dynamic harmony for the health and well-being of your body.
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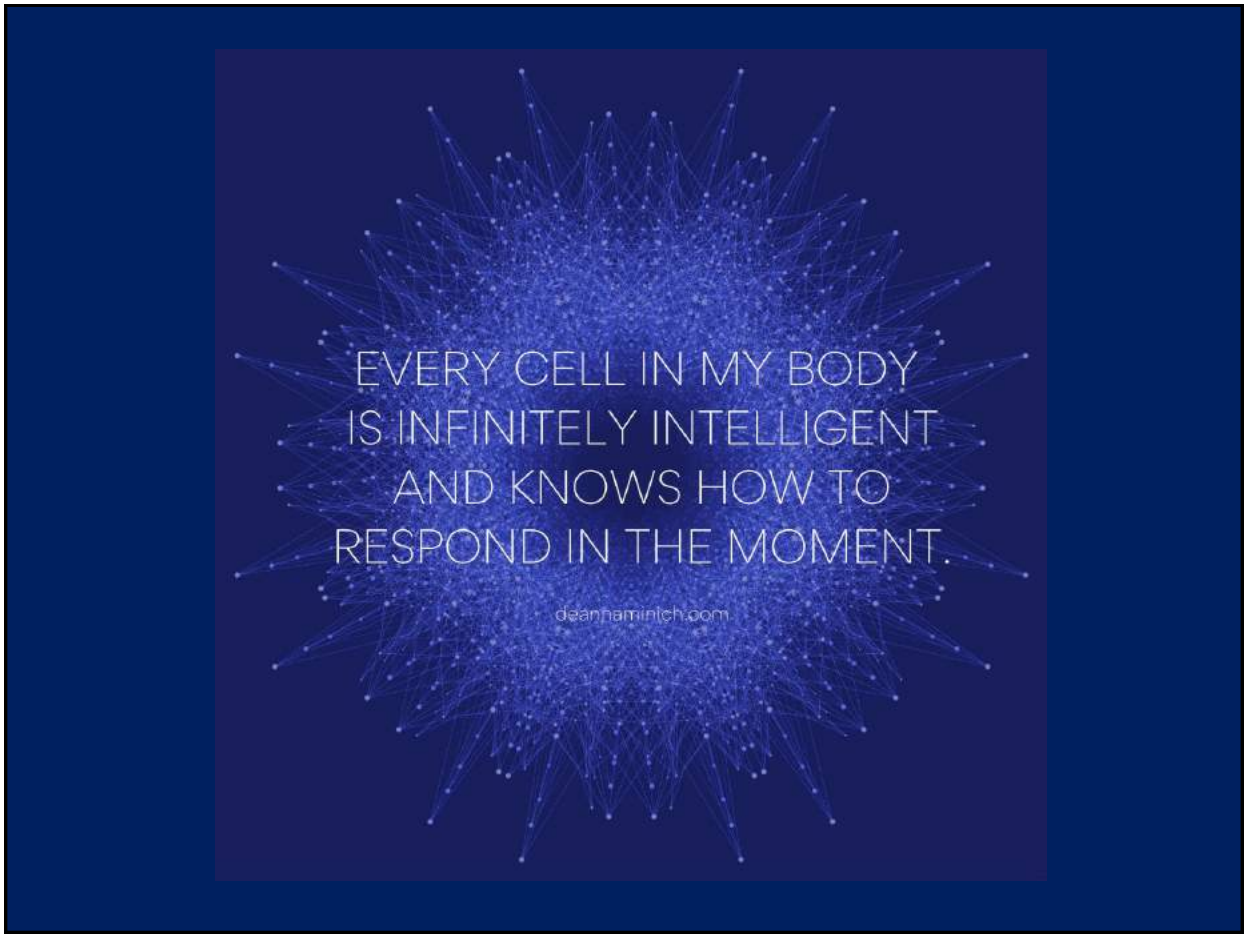
EVERY CELL IN MY BODY
IS INFINITELY INTELLIGENT
AND KNOWS HOW TO
RESPOND IN THE MOMENT.
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Thank You!

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