



# Making our Children Well: The Microbiome

Michelle Perro, MD, DHom  
2024

# Agenda:

## Key concepts

- The parents' role in the baby biota
- How the baby's biome supports their needs
- How the baby's microbial make-up differs from adults
- Discussion of the factors affecting the development of a robust microbiome
- The affects of both breastmilk and formula-fed nutrition on babies' microbiome
- Artificial breastmilk: Boon or bust?
- How to optimize the children's biome

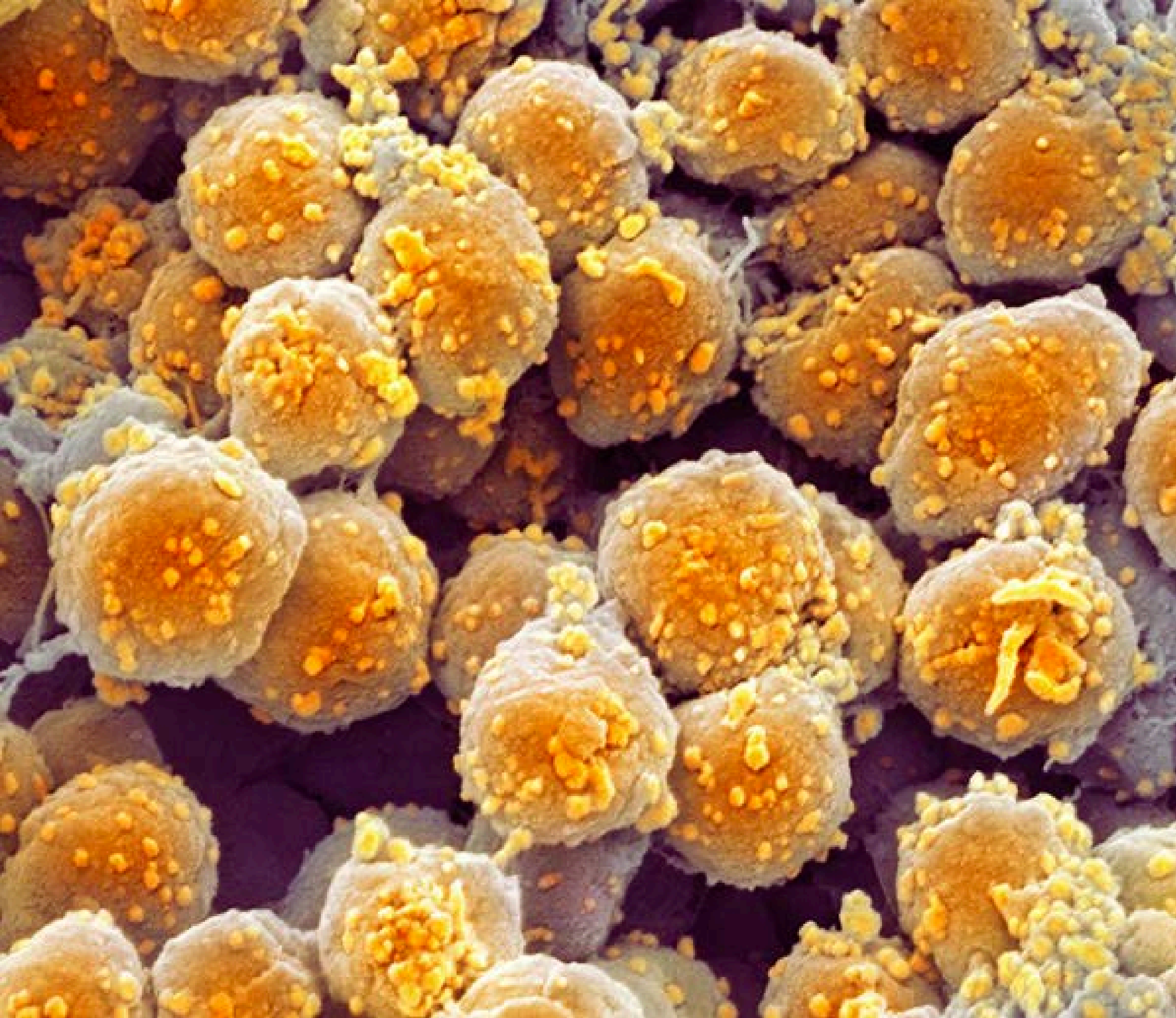




# A Healthy Microbiome

- A vast community of microorganisms, including bacteria, fungi, viruses, protozoa, and archaea
- Dynamic: Diet, lifestyle, medications, stressors, environmental exposures
- Imbalances: Dysbiosis: Can create digestive disorders, autoimmunity, metabolic disruption, etc.
- Food matters!
- The process how the food was made matters!
- Microbes eat the rainbow, too!

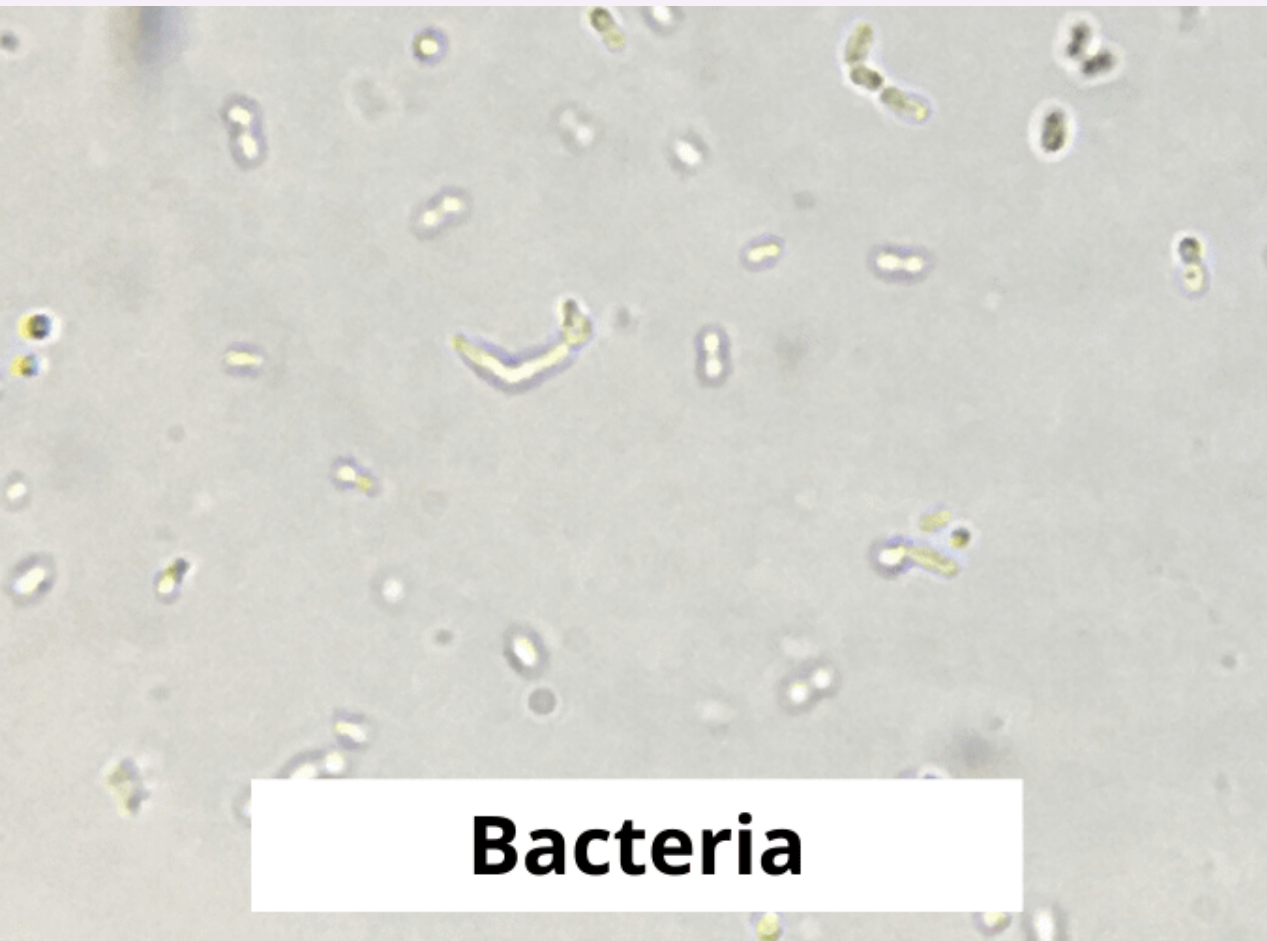




## **Archaea:**

- Microbes similar to bacteria
- No cell wall
- Can live in extreme environments (geysers, Artic, etc.)

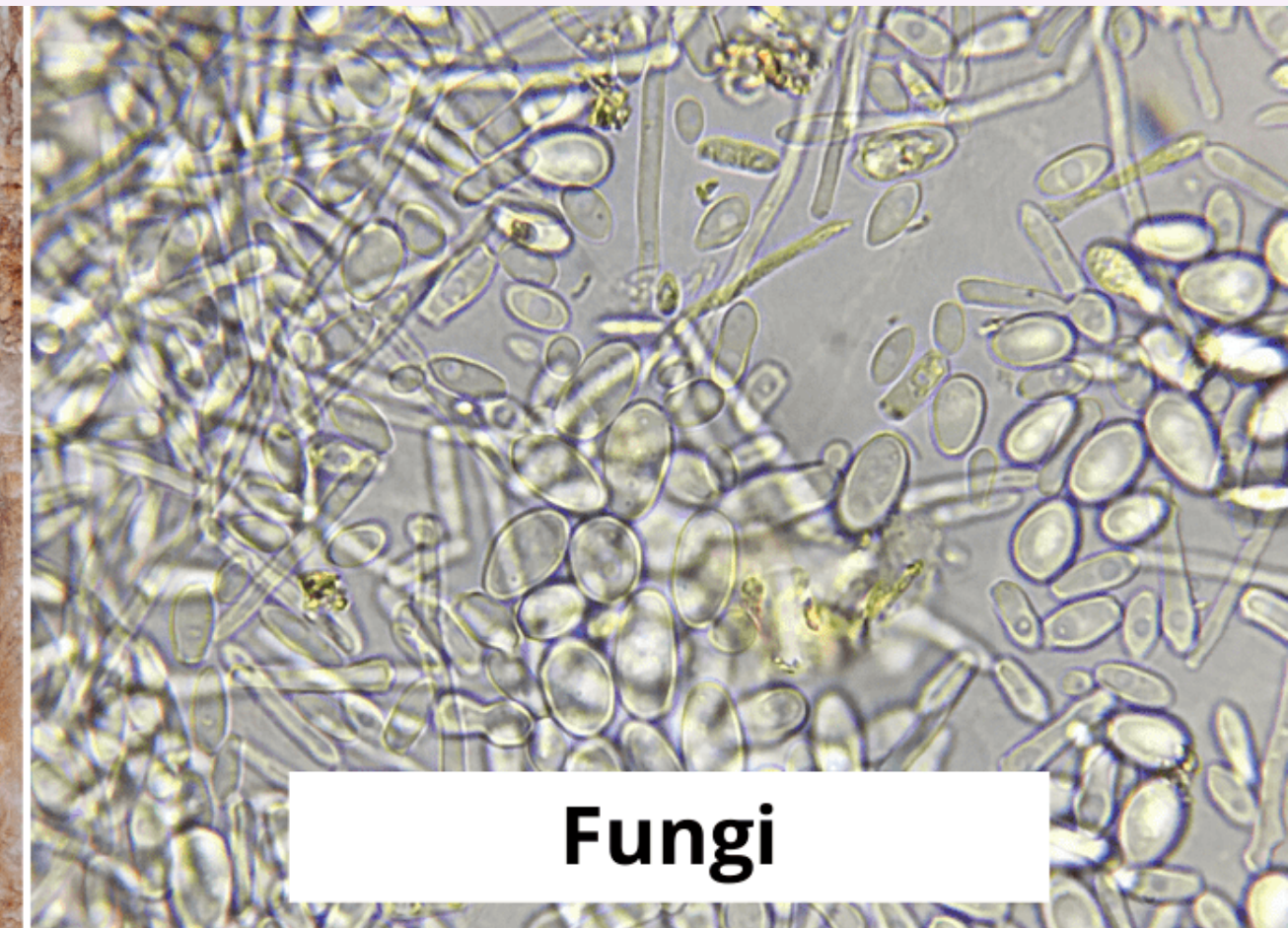




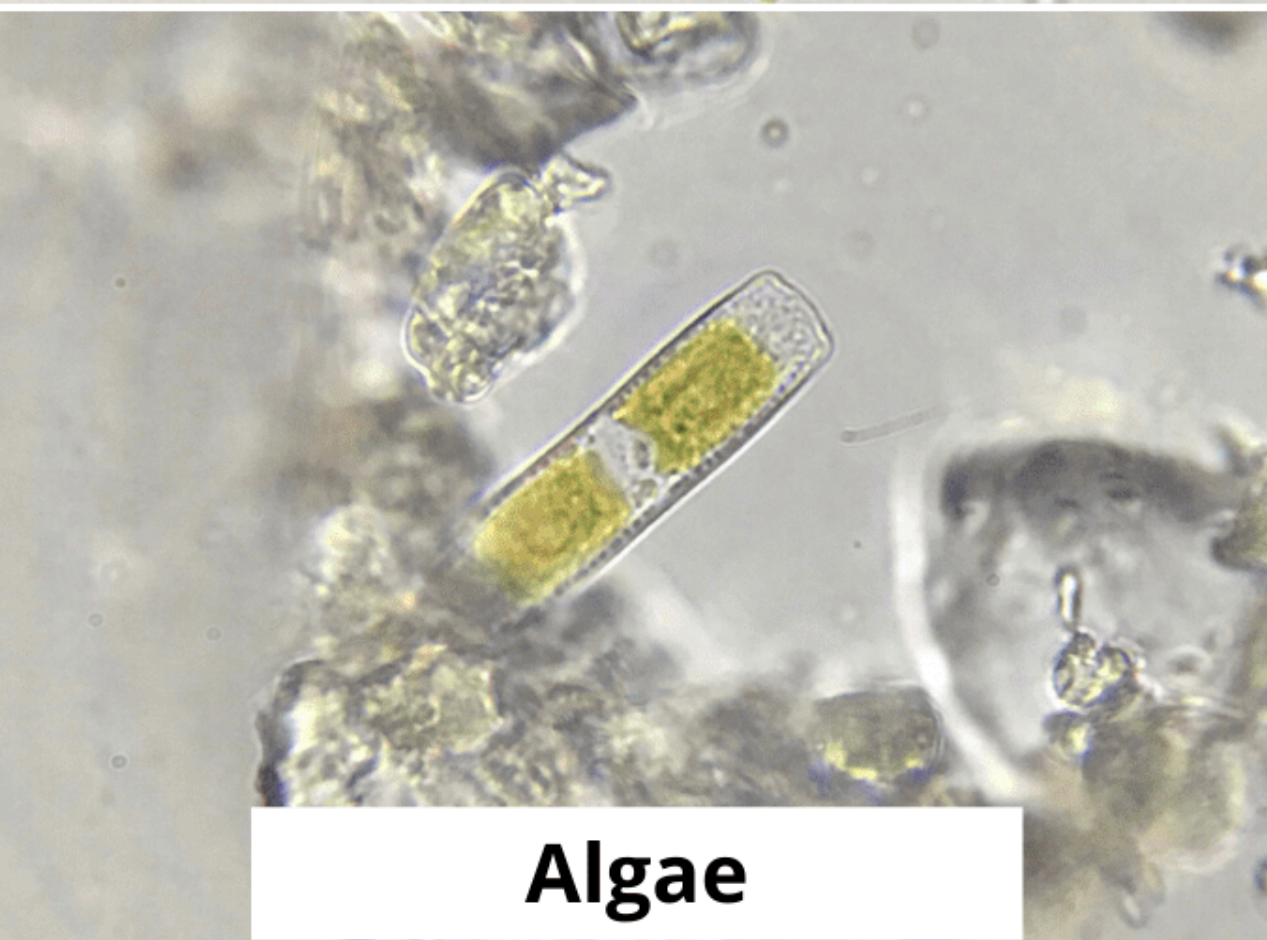
**Bacteria**



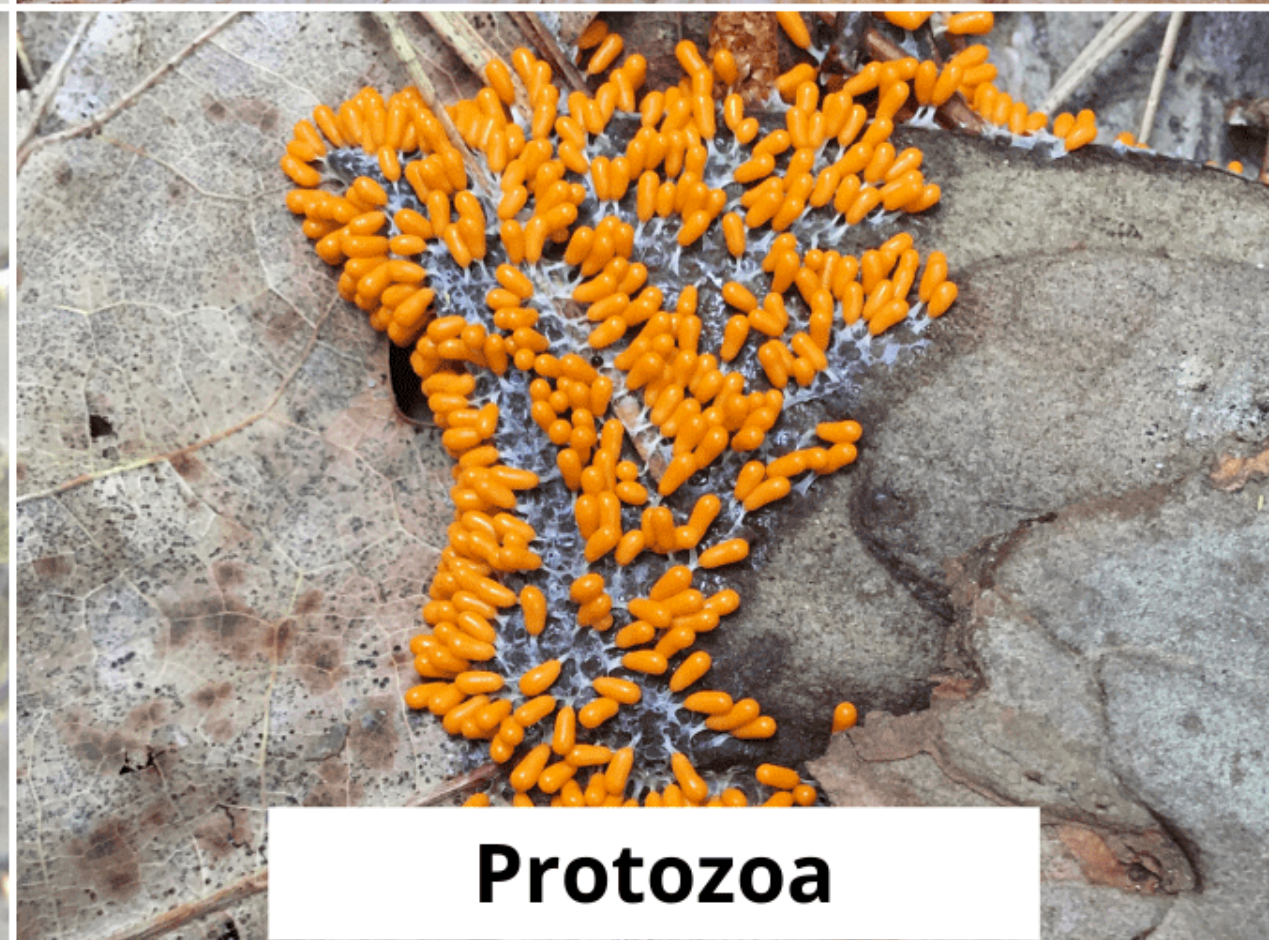
**Archaea**



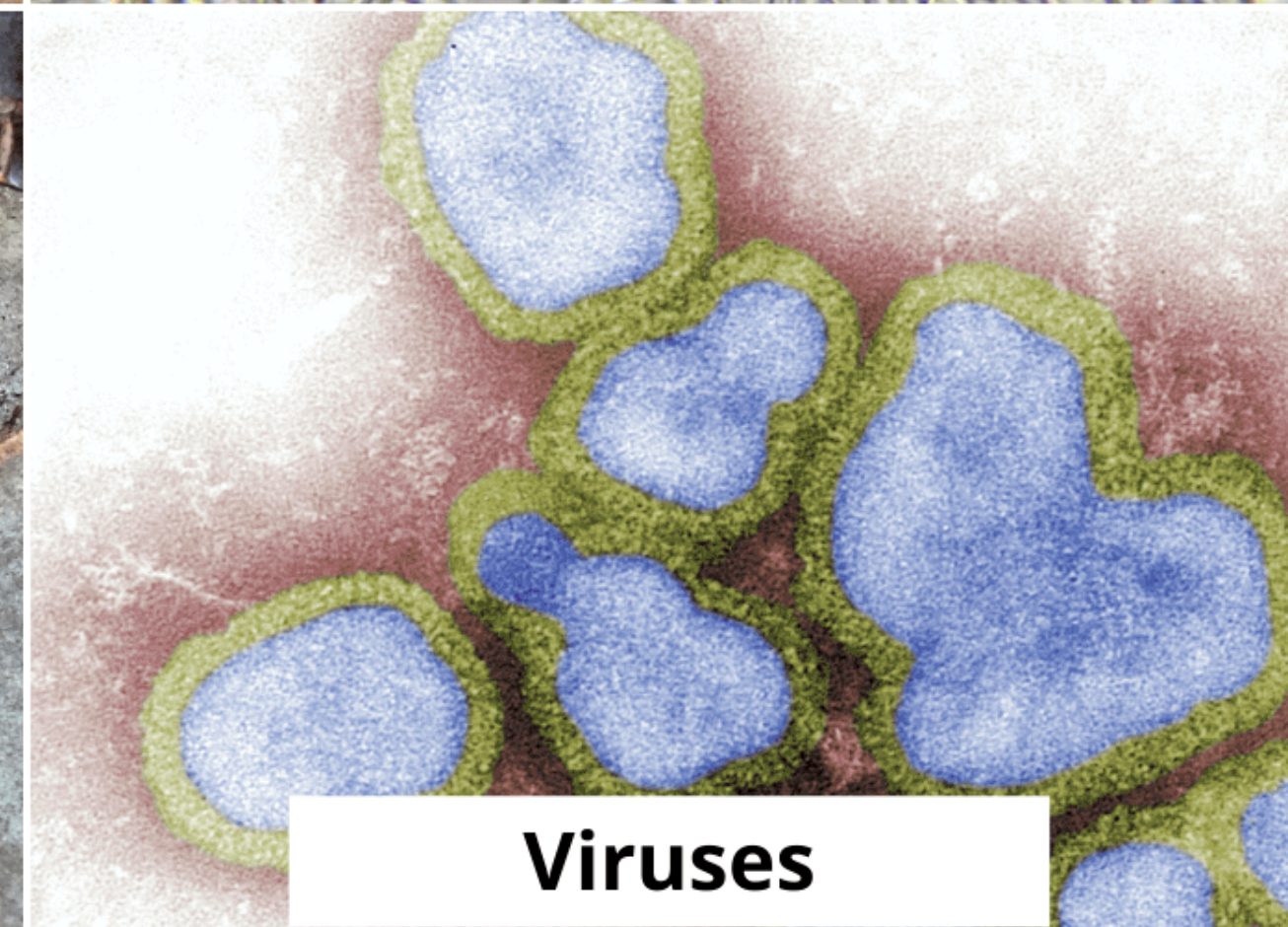
**Fungi**



**Algae**



**Protozoa**

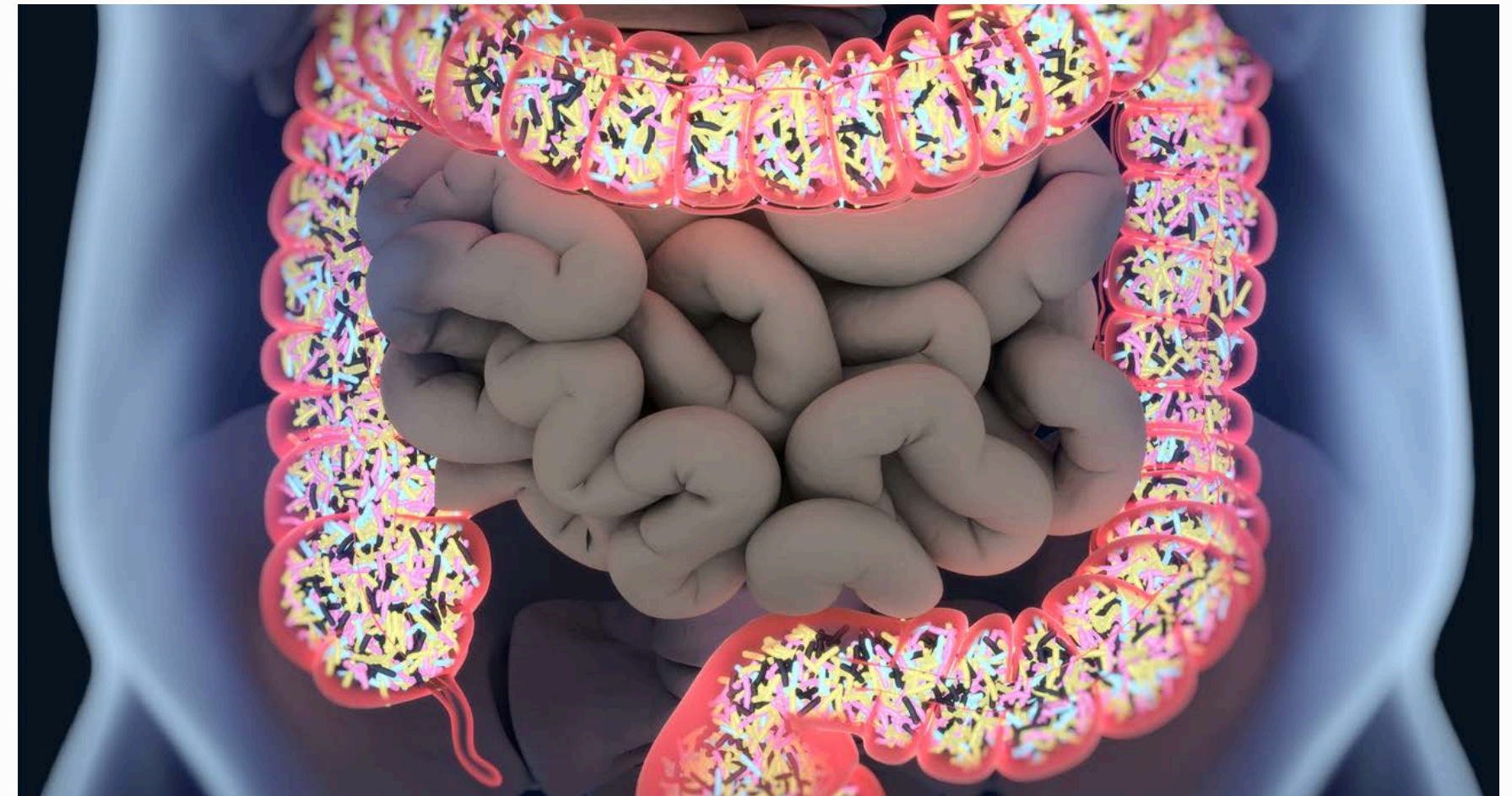


**Viruses**



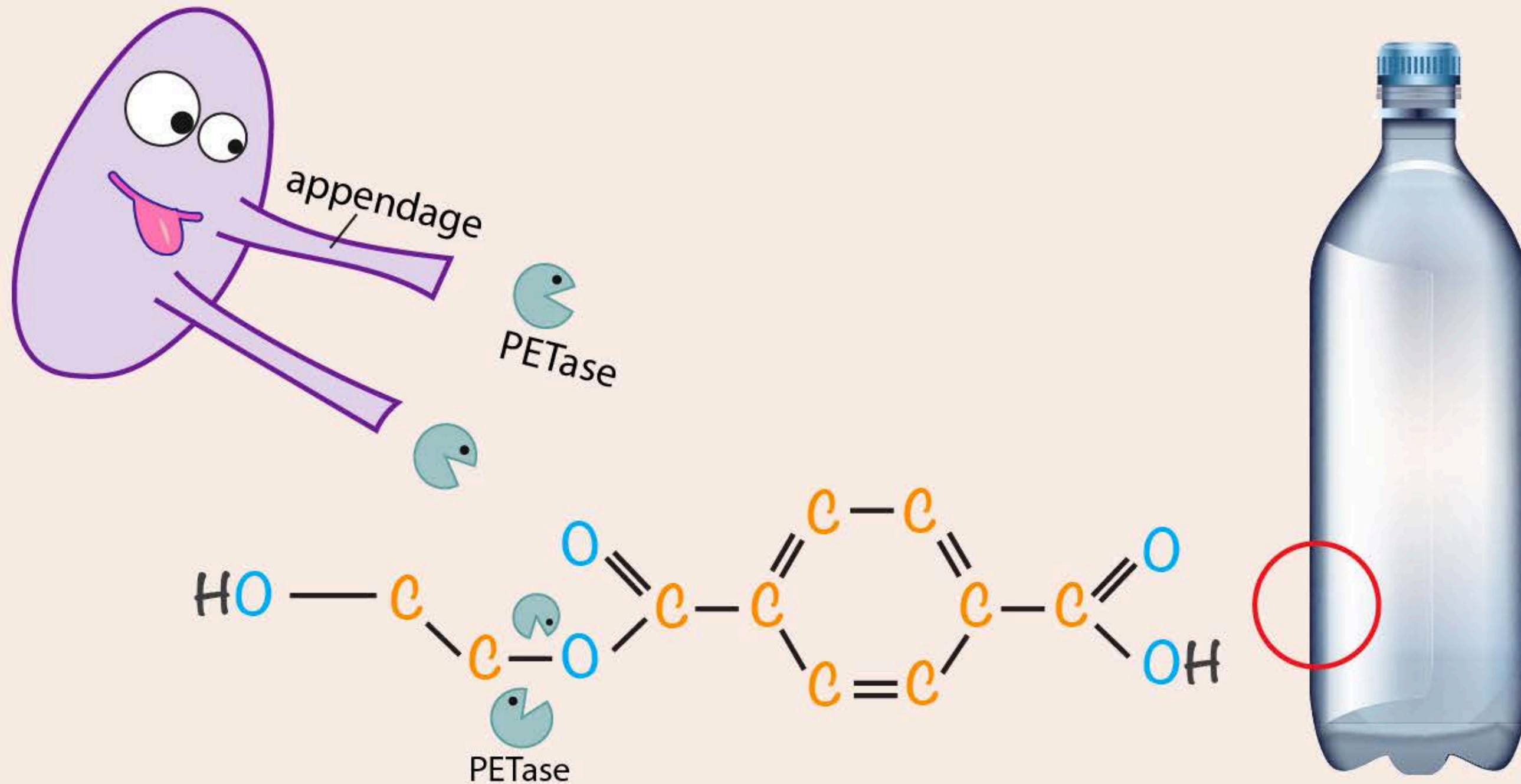
# What Does the Microbiome Do?

- Metabolism of xenobiotics: Microbes contain enzymes metabolizing toxics
- Production of short-chain fatty acids (SCFAs): Butyrate, acetate, and propionate: Regulate inflammation, support gut barrier integrity, and enhance liver function
- Protect and enhance the gut barrier
- Modulates the immune response





# Plastic-eating bacteria



- A diverse microbiome of bacteria and plastic-degrading fungi lives in salt marshes on the coast of Jiangsu, China.
- These fungi can break down polypropylene, a type of plastic that is commonly used in food packaging and other products.
- The fungi are able to do this by producing enzymes that break down the plastic into smaller molecules.
- The discovery of these fungi could help to develop new ways to recycle plastic and reduce pollution.



## Scientists find bacteria and fungi that eat plastic waste

Scientists have discovered plastic-degrading fungi in salt marshes in China. The fungi can break down polypropylene, a type of plastic that is difficult to recycle. This discovery could help to reduce plastic waste...



## Diet sources

Whole grains  
Fruits  
Nuts  
Vegetables  
Human milk  
Mushrooms



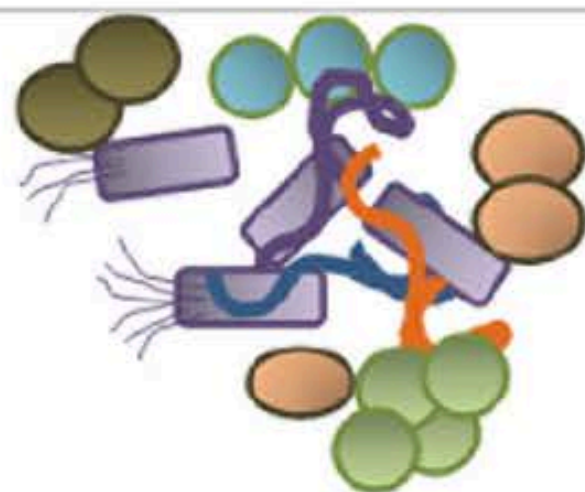
## Dietary fiber



Inulin  
Arabinoxylan  
 $\beta$ -glucan  
Pectin  
Oligosaccharides  
Digestion-resistant starch

## Gut microbes

(e.g. Lachnospiraceae/  
Ruminococcaceae)



Degradation by  
carbohydrate  
active enzymes

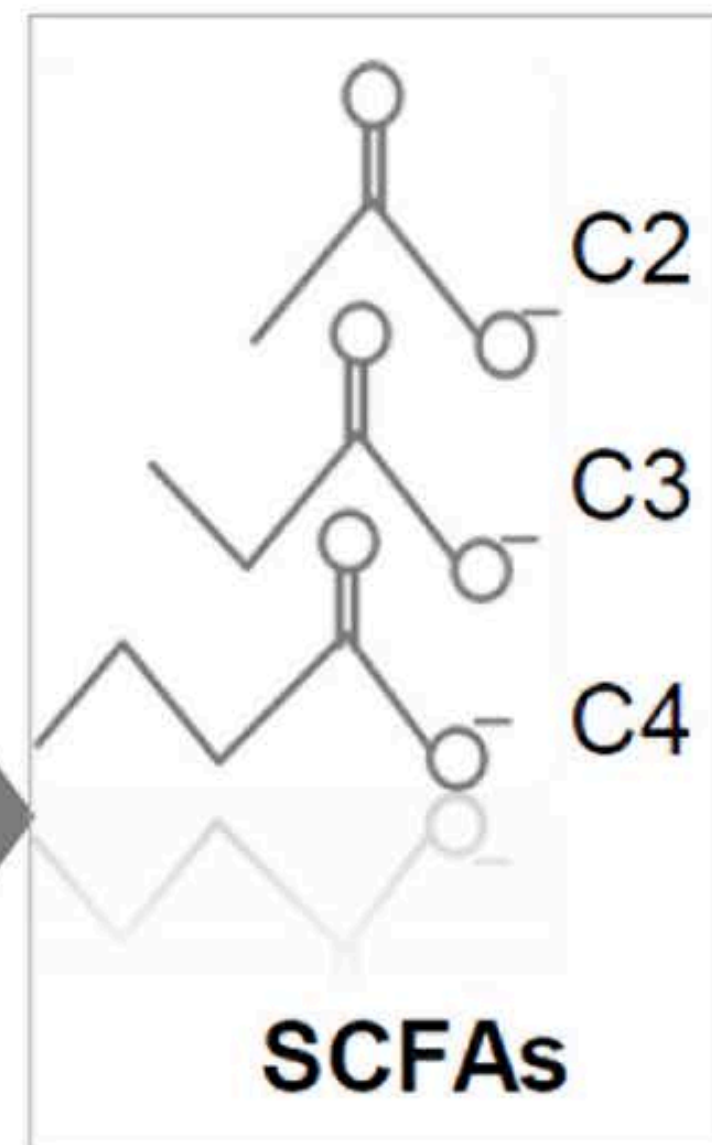
SCFA production  
by Succinate/  
Acrylate/  
Propanediol  
pathways

## Systemic effects



Blood

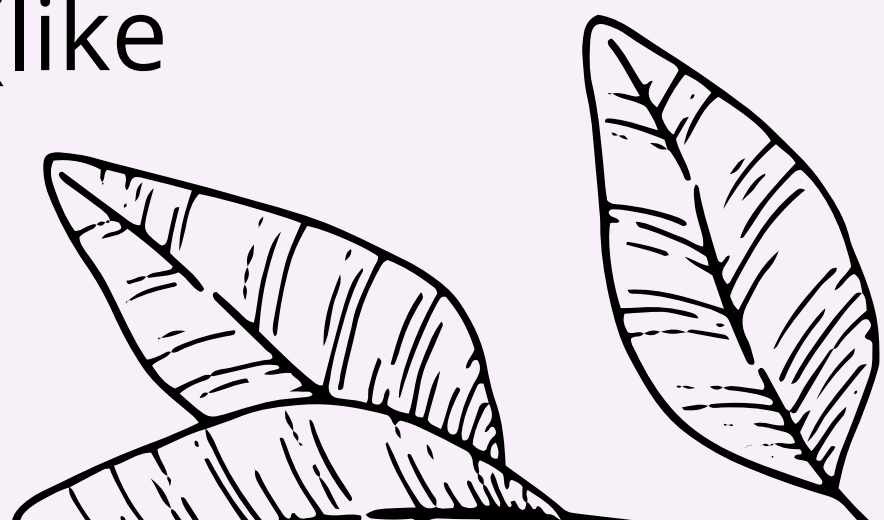
## Local gut effects







## What do Microbes Like to Eat?

- Polyphenols: found in colorful foods like berries, herbs, spices, nuts, and seeds - microbes break them down into smaller compounds to be used by our bodies
  - If dysbiotic, food intolerances can be created
  - If depleted, (*Bifidobacteria*, *Lactobacilli*), the production of neurotransmitters can be affected (like GABA)
- 

## Types of Dysbiosis

There are three types of dysbiosis. In most cases, you can have all three types of dysbiosis. This is not uncommon. These types of dysbiosis include:

**Type 1.** This form of dysbiosis is caused when you lose good bacteria from your gut.



**Type 2.** When you have too much growth of harmful bacteria in your stomach, this type of dysbiosis occurs.

**Type 3.** Dysbiosis can also happen when you lose your overall gut microbiome diversity. This means you lose both the good and the bad bacteria in your stomach.

## Dysbiosis

## Mainstream medicine:

- <https://www.webmd.com/digestive-disorders/what-is-dysbiosis>
- When the gut microbial community becomes imbalanced



# Dysbiosis and Babies

- US infants have a low abundance of beneficial bacteria
- High levels of potentially pathogenic bacteria which carry antibiotic resistant genes
- These issues confer serious long-term health consequences
- Why? Many factors: Glyphosate and other antibiotic microbiome disruptors





# Pregnancy

Changes that occur during pregnancy encourage energy storage in fat that benefits fetal growth and lactation. The microbes affect these states.



# Microbe-Mediated Immune Education Begins During Gestation

- Both bacteria-produced molecules and maternally derived antibodies drive immune development in utero
- Maternal antibodies which cross placenta and in breast milk, can bind certain pathologic bacteria
- Maternal microbial metabolites have a wide-range of immune-modulatory functions
- Moms are the stewards of immune education via their microbiome
- Prenatal antibiotic exposure (<https://doi.org/10.1016/j.jaut.2016.05.001>) can modify the offspring's immune systems (links to DM, asthma, obesity, colitis, and ASD)





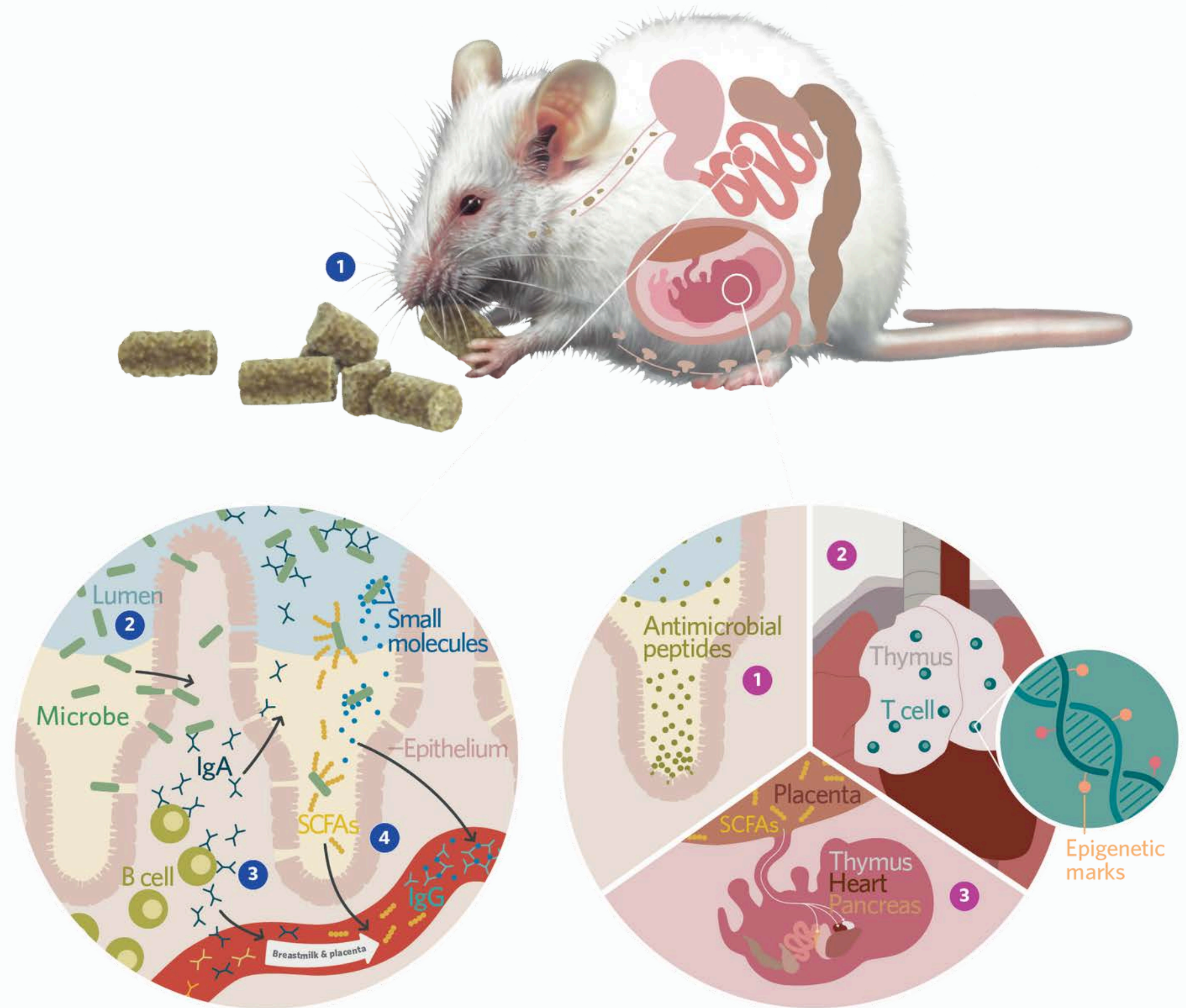
# The Vaginal Microbiome

- During pregnancy, the composition of the microbiota undergoes changes with increases in beneficial *Lactobacilli*, creating an acidic, inhospitable environment for pathogens
- Colonization after birth begins, playing a role in the development of the innate immune system
- C-Section babies have a different microbial profile
- Breastfeeding provides microbial exchanges with the infant via retrograde flow - by 3 months, the baby's microbiome looks like a vaginally-delivered baby's microbiome
- By 3 y/o the microbiome is established



Bacteria-produced molecules or metabolites and maternally derived antibodies appear to drive immune development in utero.

**Mom and microbes are working together!**

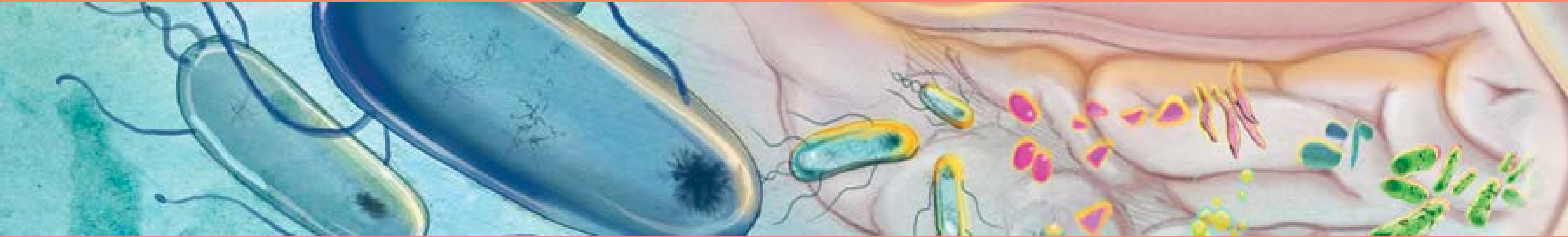


“

**Manipulating the microbiota of pregnant mice can modify the function of the offspring's immune systems and alter their disease outcomes.**

”



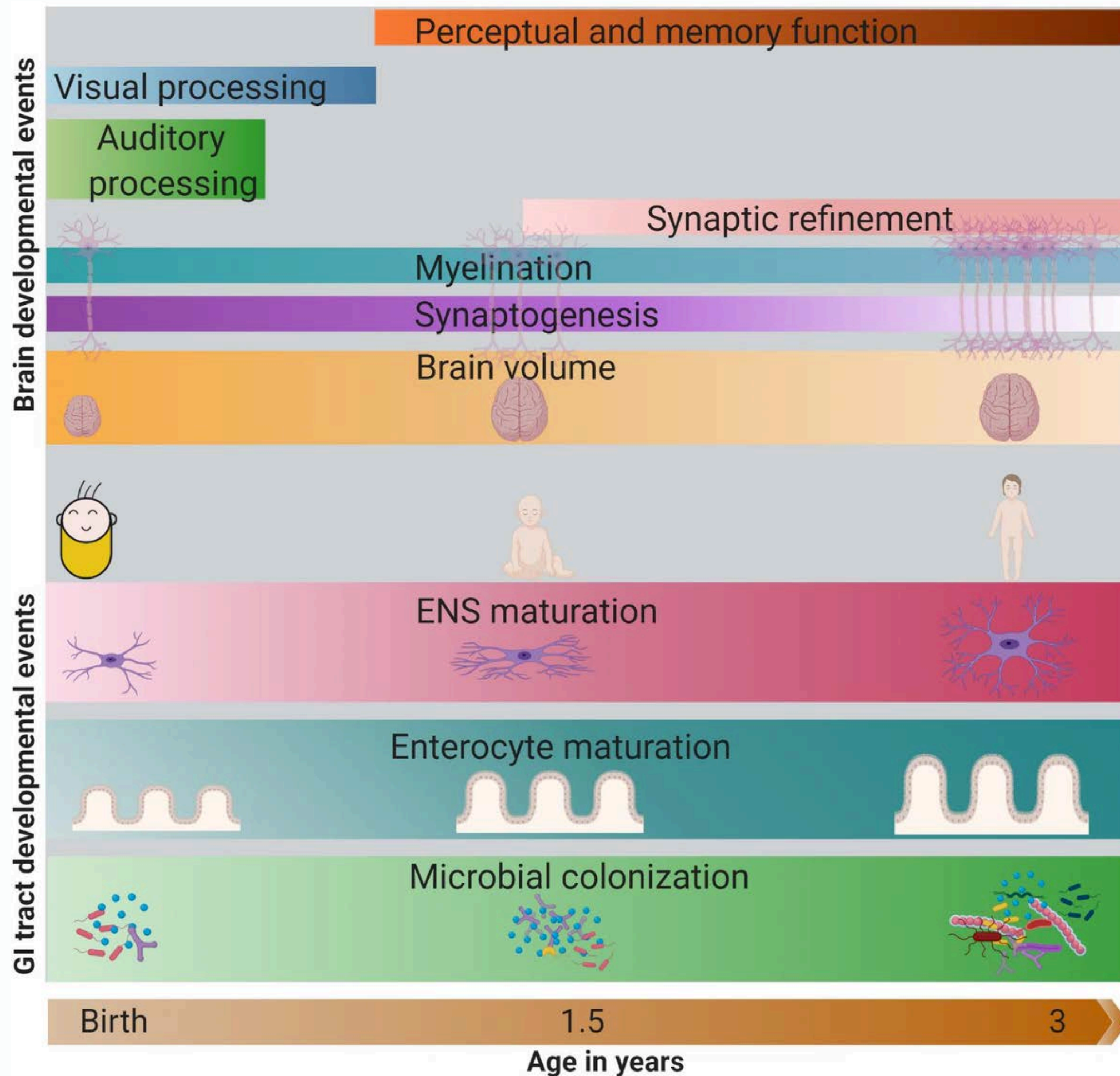


In 2015, researchers from Yale University showed that prenatal antibiotic exposure influenced the development of Type I diabetes in the offspring. (<https://doi.org/10.1016.j.jaut.2016.05.001>)

# Do Fetuses Have Their Own Microbiota?

- Microbes have been detected in meconium (infants' first stool), amniotic fluid, and placenta
- Microbes in meconium (PMID: 24614698), ~60% are similar to those in amniotic fluid; fetus may be swallowing amniotic fluid – gestational age and mode of delivery have largest influence on microbial community – play a role in prematurity (1 in 10 in the US, < 37 weeks)
- At birth, mostly facultative anaerobes (Enterobacteriaceae family mostly from mom); by 6 months, Bifidobacteria, Clostridia, and Bacteroides – different from 100 years ago
- Role of other microbes (phages, archaea, fungi, and viral) – not well understood





- Parallel development of the GI tract and the brain in first 3 years
- Increase in microbial abundance and diversity, enterocyte maturation, and ENS maturation occurs rapidly
- Developmental timing of the cellular events may vary across different regions of the brain

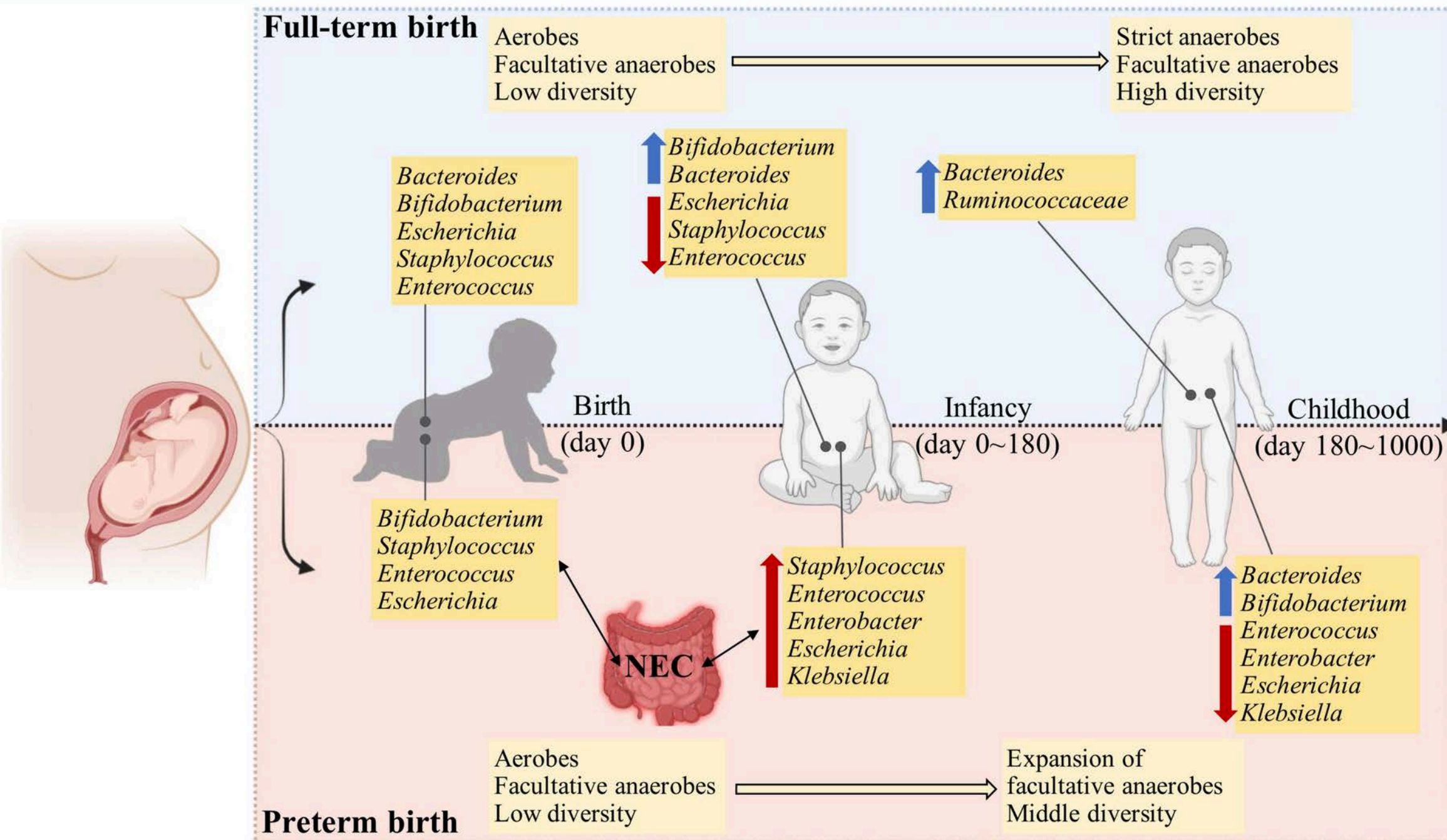
<https://www.frontiersin.org/articles/10.3389/fnint.2020.00044/full>

## **Bacteroides fragilis**

"A study by Carlson et al. (PMID: 28793975) showed that infants with a high relative abundance of Bacteroides in their stools had better cognitive performance in terms of receptive language and expressive language. In contrast, infants with a high level of Faecalibacterium in their stools had lower cognitive performance."



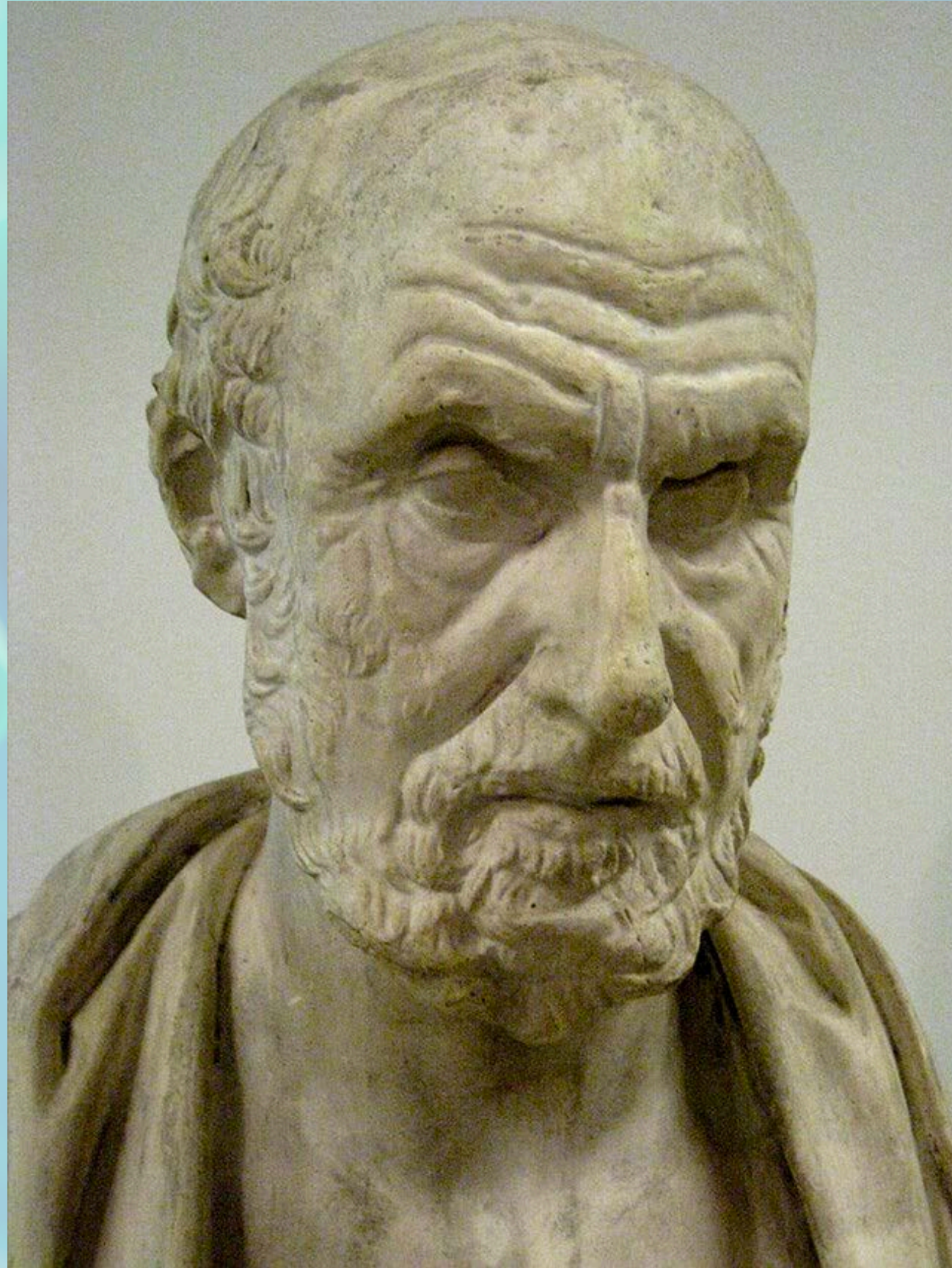
# Preterm vs Full Term Births



- Comparisons of full-term and preterm infants 1st 1000 days after birth
- Preterm infants; higher abundance and longer persistence of facultative anaerobes and opportunistic pathogens
- Physiological immaturity?
- Increase in oxygen level in the gut lumen, which inhibits the proliferation/ colonization of anaerobic microbes?

<https://www.frontiersin.org/articles/10.3389/fnint.2020.00044/full>





**"The life so  
short, the craft  
so long to  
learn."**

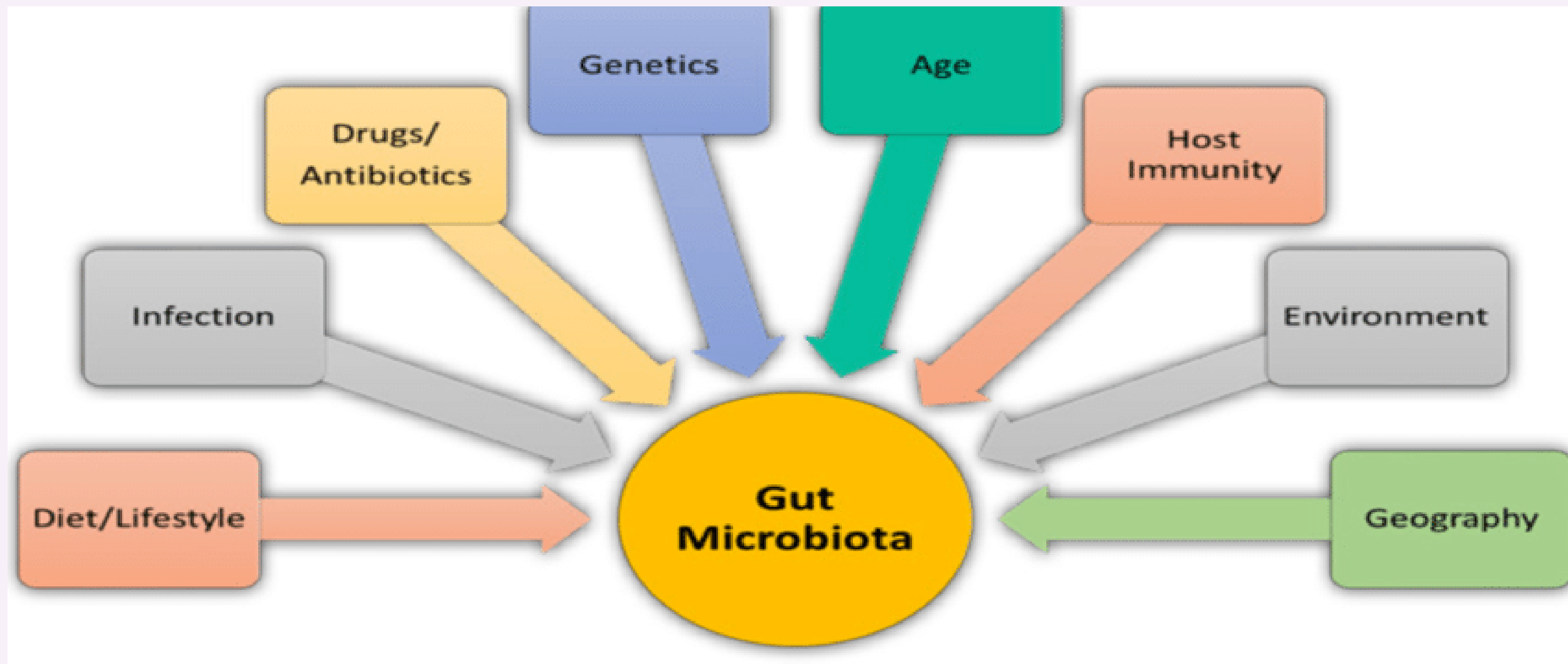


# Microbe Superstars: Summary

- Immune function: 70-80% of immune function stems from gut microbes
- Digestion: Aids in the breakdown of complex carbs, protein, and fats; provides nutrients and energy from our food
- Nutrient absorption: Produces vitamins (K, folate, biotin, cobalamin, nicotinic acid, pantothenic acid, pyridoxine, riboflavin, thiamine)
- Gut barrier integrity: Protects against inflammation and immune system activation
- Metabolism: Production of SCFAs and other metabolites that regulate energy balance, appetite, and fat storage; Impacts metabolic health
- Gut-brain-microbiome-axis (GBMA): Communicates bidirectionally with the CNS: Influences mood, behavior, cognitive function
- Protects against pathogens



# Factors Affecting Microbiome Diversity







## Is the Uterus Sterile?

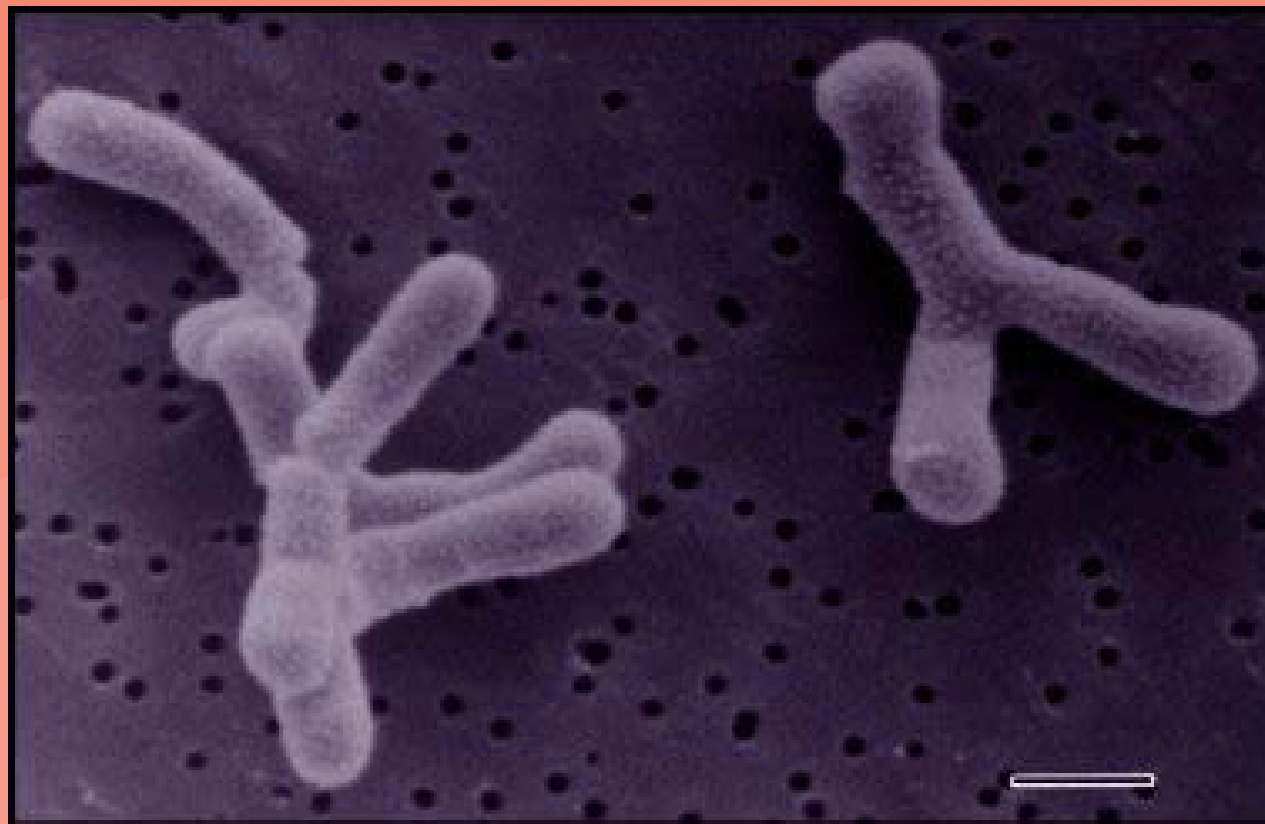
- Immunity of the mother depends on the lower genital tract
- Placental microbiome (Firmicutes, Tenericutes, Bacteroidetes, etc.), similar to oral microbiome
- Placenta has innate and acquired immune system; mother, placenta, and fetus all possess unique innate immune systems
- Vaginal flora is stable throughout pregnancy and changes at delivery

# Benefits of Probiotics During Pregnancy?





## Probiotics for Mom and Baby: Health or Hype?



Probiotics coined in 1965 by Lilly and Stillwell as “growth-promoting factors produced by microorganisms

Probiotic supplementation with B. infantis within the first month postnatal, in combination with breast milk, resulted in stable colonization that persisted until at least 1 year postnatal

Formula? Probiotics introduced in 2004: Reduction in colic and antibiotic usage (Several infant formulas now contain B. Lactis and Lactobacillus GG)

Brast mik increased the number of bifidobacterium in the gut via human milk oligosaccharides (HMOs = prebiotics)

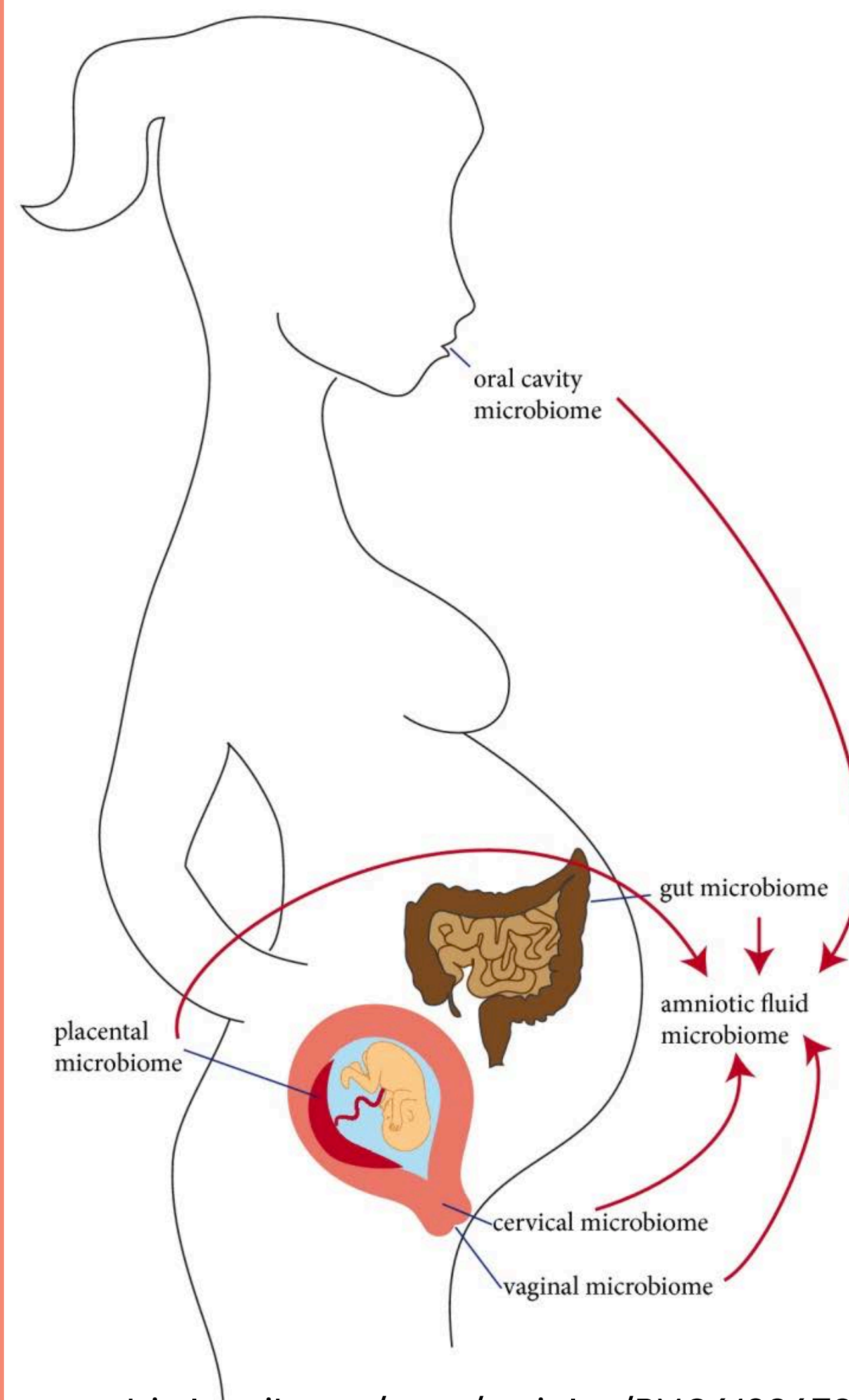






## Probiotics and Some Beneficial Effects on Pregnancy

- Lactobacillus rhamnosus improves glucose metabolism (PMID: 32399477) and aids in heavy metal detoxification (<https://doi.org/10.1128/mBio.01580-14>)
- Lactiplantibacillus plantarum improves lipid profile (PMID: 33000822)
- Preterm labor may be due to a decrease in lactobacilli (PMID: 19538417)







# Summary of Probiotic Benefits

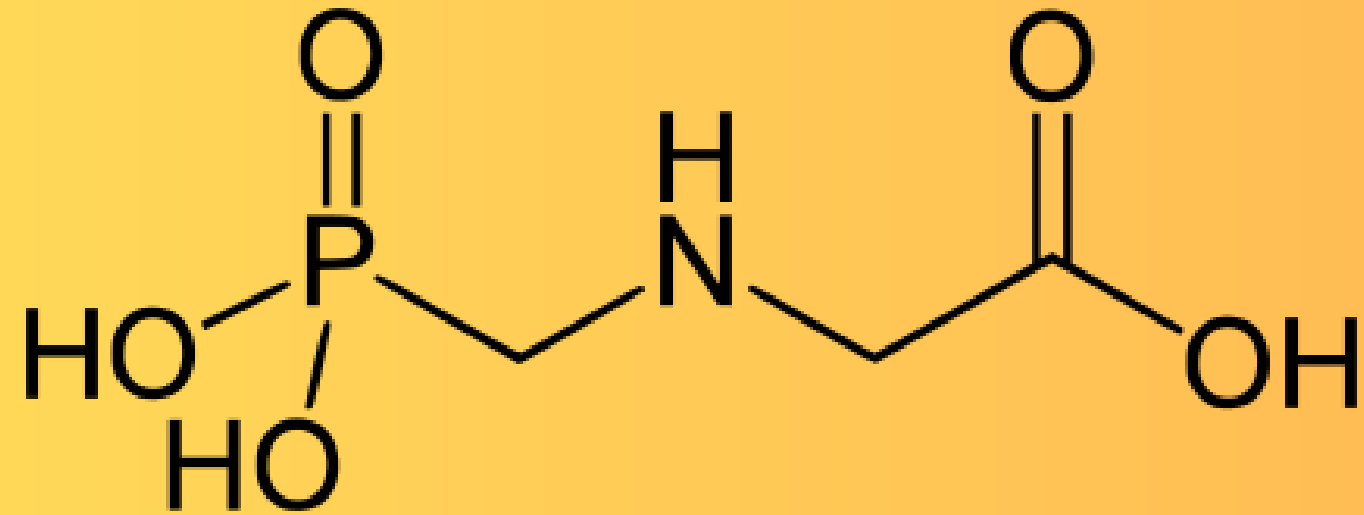
- Decrease gestational DM
- Prevent infant obesity/metabolic issues
- Decrease infant eczema/allergies
- Lower the risk of preterm labor
- Decreased risk of miscarriage
- Improve infant brain health
- Decrease maternal/infant stress
- Reduce the risk of ASD
- Decrease pregnancy constipation
- Increase colostrum nutrition
- Reduce mastitis



## MOM

- Organic diet
- Fiber-enriched foods – increase fetal regulatory T cells (Tregs); reduce inflammation/prevent autoimmunity
- Fermented products
- Probiotic supplements (oral and intravaginally)
- Diet hi in omegas; may need supplement
- Testing mom (GI and vaginally)






## **Glyphosate and the Microbiome**

- Antibiotic
- US Patent 7,771,736
- Effective against Lactobacilli, Bifidobacteria, and Enterococcal species
- Resistant against Clostridium species and Salmonella
- Affects microbes via the shikimate pathway - makes aromatic amino acids - necessary to produce neurotransmitters/thyroid hormone

ARTICLE

# Alterations in infant gut microbiome composition and metabolism after exposure to glyphosate and Roundup and/or a spore-based formulation using the SHIME technology

Robin Mesnage<sup>1</sup> , Marta Calatayud<sup>2</sup>, Cindy Duysburgh<sup>2</sup>, Massimo Marzorati<sup>2,3</sup> and Michael N. Antoniou<sup>1,\*</sup>

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R.M. and M.C. are co-first authors.

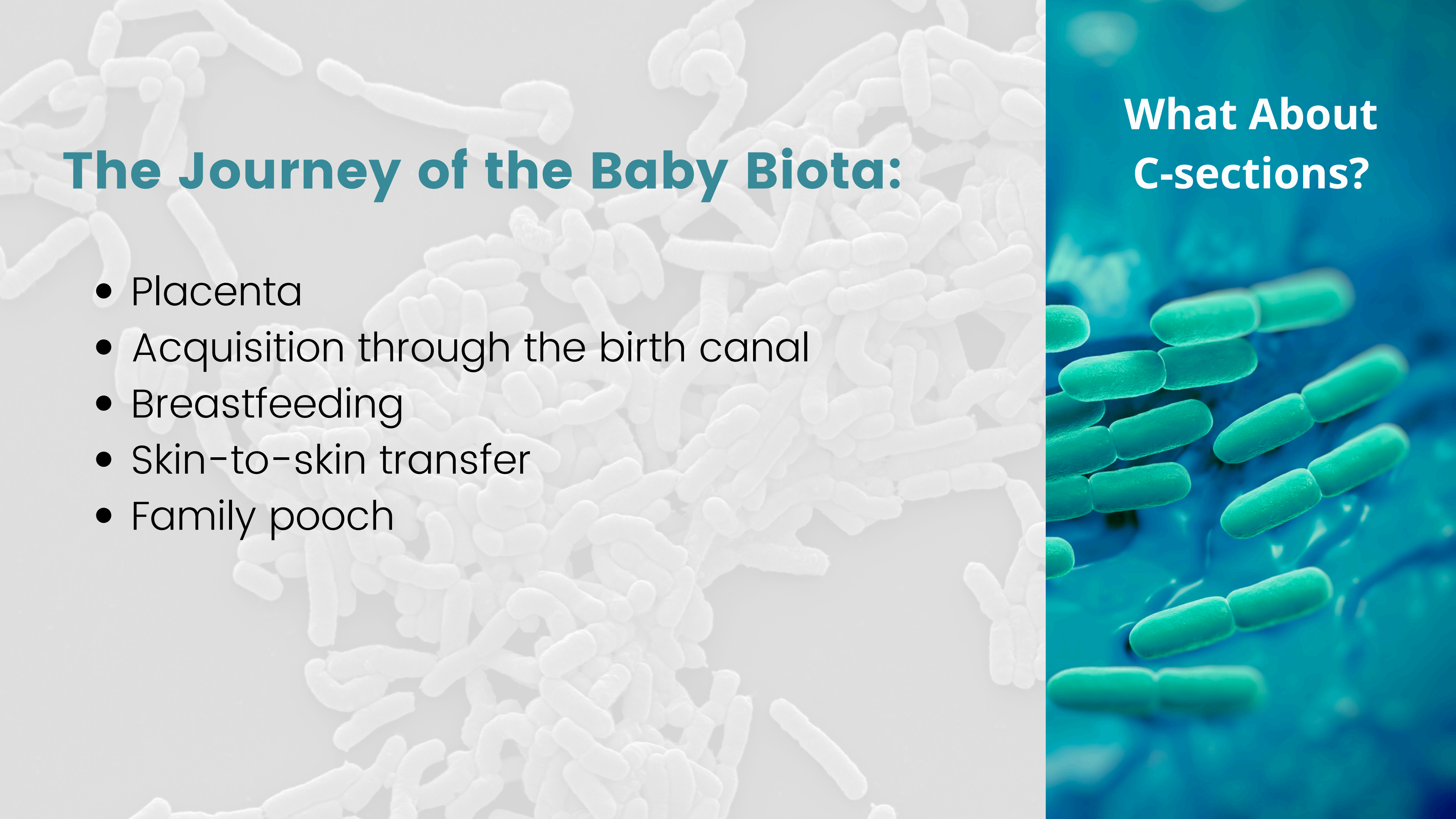
(Received 17 December 2021; revised 04 April 2022; accepted 05 July 2022)



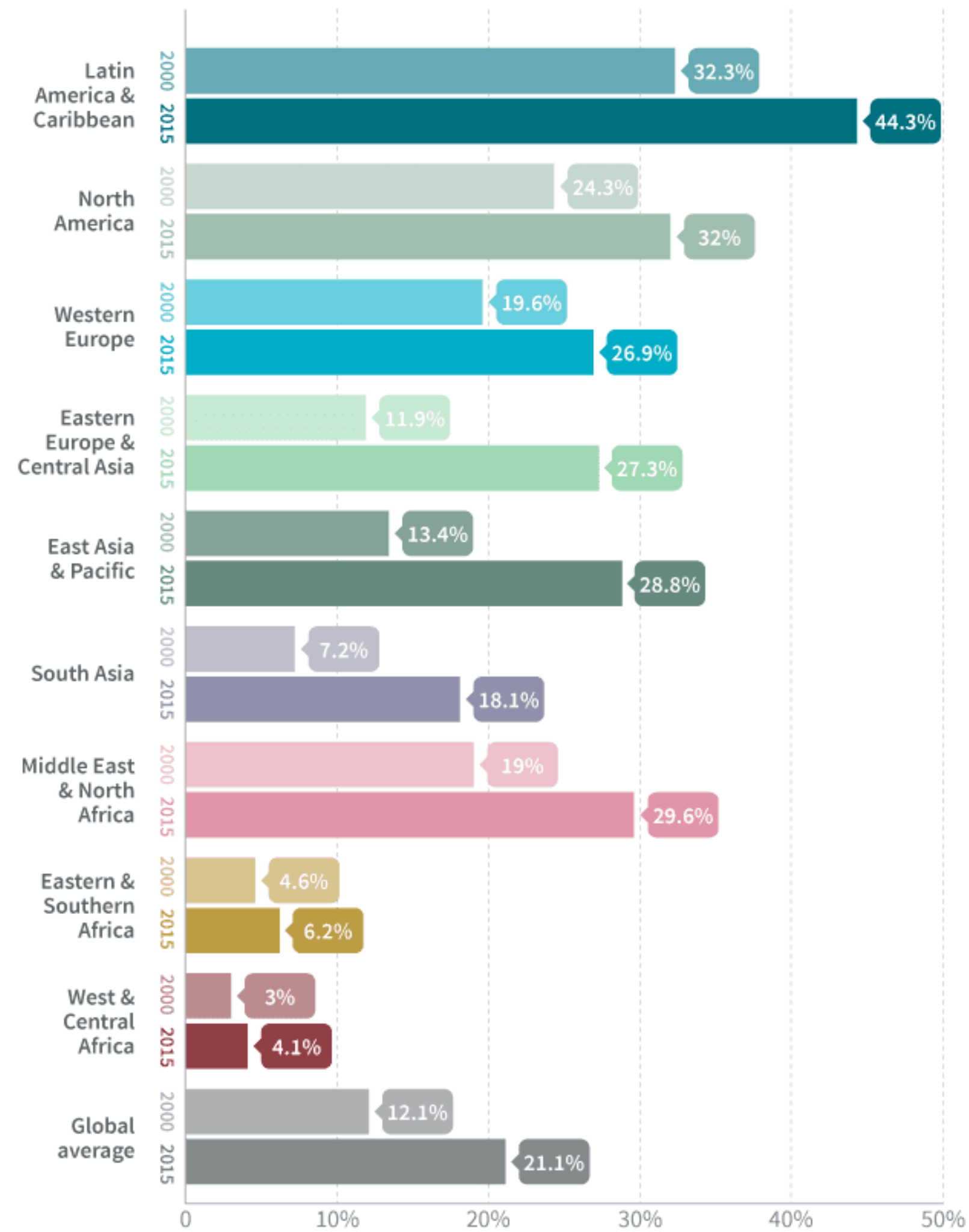
# The Journey of the Baby Biota:

- Placenta
- Acquisition through the birth canal
- Breastfeeding
- Skin-to-skin transfer
- Family pooch

**What About  
C-sections?**



Global



C section  
rates



## Adverse Affects on the Baby Biota:

- Infertility
- Surrogacy
- Gestational age at birth
- Prenatal stress
- Low milk production/no BF
- Antibiotics
- Inhospitable hospitals
- In-laws

Dad?











An artistic illustration of a fetus in the womb, rendered in soft, pastel colors. The fetus is positioned centrally, with its head tilted back and arms crossed. Surrounding the fetus are numerous stylized, colorful bacteria and microorganisms in various shapes and sizes, including long blue rods, green clusters, and purple spheres, suggesting a rich microbial environment. The background is a light, textured blue.

## Key Point:

Mother's microbiome may modulate neurodevelopment in the offspring, even providing protection from neurological diseases later in life.



# Breastmilk is Best for Babies

- Contains approximately 600 kinds of bacteria
- Can contain up to 200 different carbohydrates (human milk oligosaccharides/HMOs): Some are prebiotics (nourishment for the baby biota)
- Infant formulas (organic only) have added probiotics to replicate the nutritional composition of breast milk
- Improving the ecosystem helps mom and baby: Prebiotics, probiotics, organic/diversified diet, time in nature, loving relationships
- The microbiota is set by about 3 years old, but 20–30% may be manipulated and changed
- **Symbiogenesis with our microbes**

Infant gut dysbiosis is a widespread health problem in US newborns

Casaburi et al. *Scientific Reports*. 2021: 11:1472

Intestinal dysbiosis in infants can disrupt immune development

Frese SA et al. *mSphere*. 2017: 2(6):e00501-17

# Human Milk Oligosaccharides (HMOs)

Complex carbohydrates that microbial species of the milk-oriented microbiome can use as a food source.

*Bifidobacterium infantis* encodes proteins that bind and transport all types of HMOs into its cell and digest them internally and externally.

Digestion by *Bifidobacterium* results in the production of SCFAs that are secreted into the gut lumen.

The acidic environment creates a less hospitable environment for pathogens



# Bifido's History

- The concept of a baby biota is not new
- Dr. Logan, a pathologist from Scotland, reported in 1913 that the fecal smears of breastfed infants were nearly a monoculture of *Bacillus bifidus* (now termed *Bifidobacterium*)
- Formula-fed infants were noted to have a microbial mix with less diversity and fewer *Bifidobacterium* comparable to breastfed babies today
- This loss of bifido species has produced a subsequent rise in fecal pH and subsequent loss of protection from pathogens.

## THE INTESTINAL FLORA OF INFANTS AND YOUNG CHILDREN.<sup>1</sup>

By W. R. LOGAN, M.D.

*From the Research Laboratory of the Royal College of Physicians, Edinburgh.*

(PLATES XLV.–XLVII.)

IN attempting to discover in what way the intestinal flora in disease differed from that of normal conditions, it was first necessary to be familiar with the range of variety possible in health. To commence with the simplest and proceed to the more complex meant, in this case, to commence with infants and advance to adults. In this first paper I propose, therefore, to deal with organisms met with in children who were free from intestinal disorder, including such organisms met with in cases of diarrhoea as were clear of suspicion of causal connection or secondary implication.

To get an unbiassed view of morbid changes in a flora it is necessary to include the entire flora in one's analyses, with the attendant risk of becoming so involved in ramifications as to arrive nowhere. To overcome as far as possible this risk, I dealt with the intestinal flora in groups, and by comparison of a group from one case with, on the one hand, the corresponding group from another, and with, on the other hand, the remaining groups from the same case, I was able to proceed with the research on more or less mathematical lines.

A study of the literature, and preliminary experimentation, showed that the flora as seen in Gram-stained films of the faeces might be divided into (1) Gram-positive bacilli of the acid-tolerant type, (2) Gram-negative bacilli and coccobacilli, (3) Gram-positive cocci, and (4) spore-bearing bacilli; and that the Gram-negative bacilli might be divided by cultural methods into (a) the lactose-fermenting group (type *B. coli*), and (b) the non-lactose-fermenting group (type *B. paratyphosus* or *B. dysenteriae*).

With the flora subdivided in this manner I first studied the appropriate means of isolation of each subdivision, and then combined these methods into the scheme of routine examination given below.

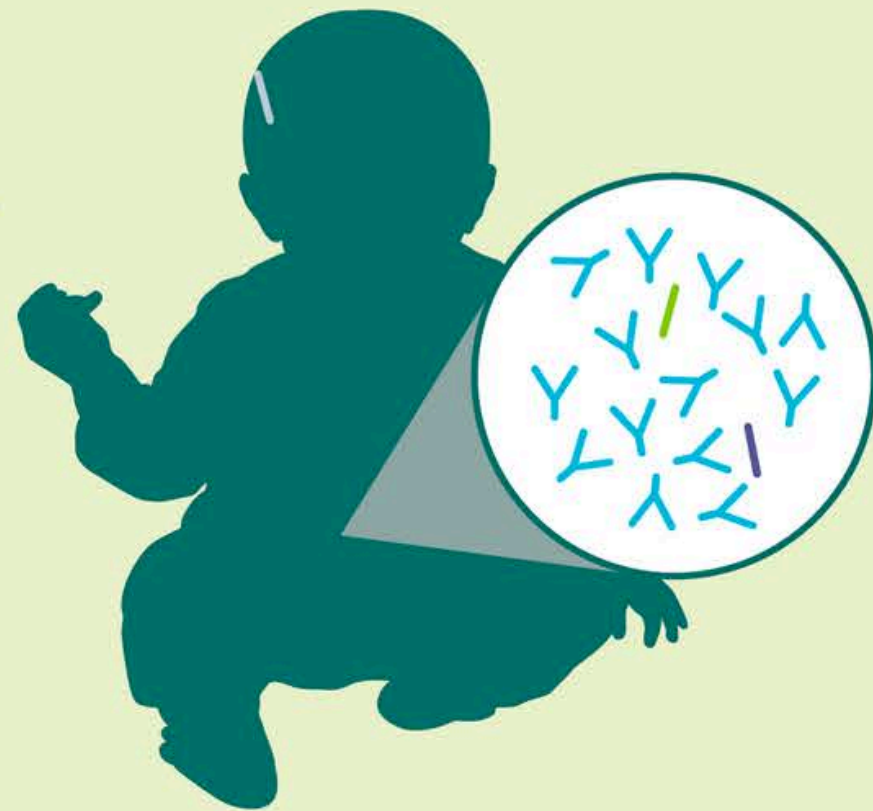
Of the total number of cases put through this routine examination I propose to deal in this paper mainly with twenty-one, all completely free from diarrhoea, of whom six were fed on the breast alone, five on the breast and bottle, seven on the bottle only, while three were getting

<sup>1</sup>Received September 3, 1913.

Y *Bifidobacterium*  
/ / Other microbes



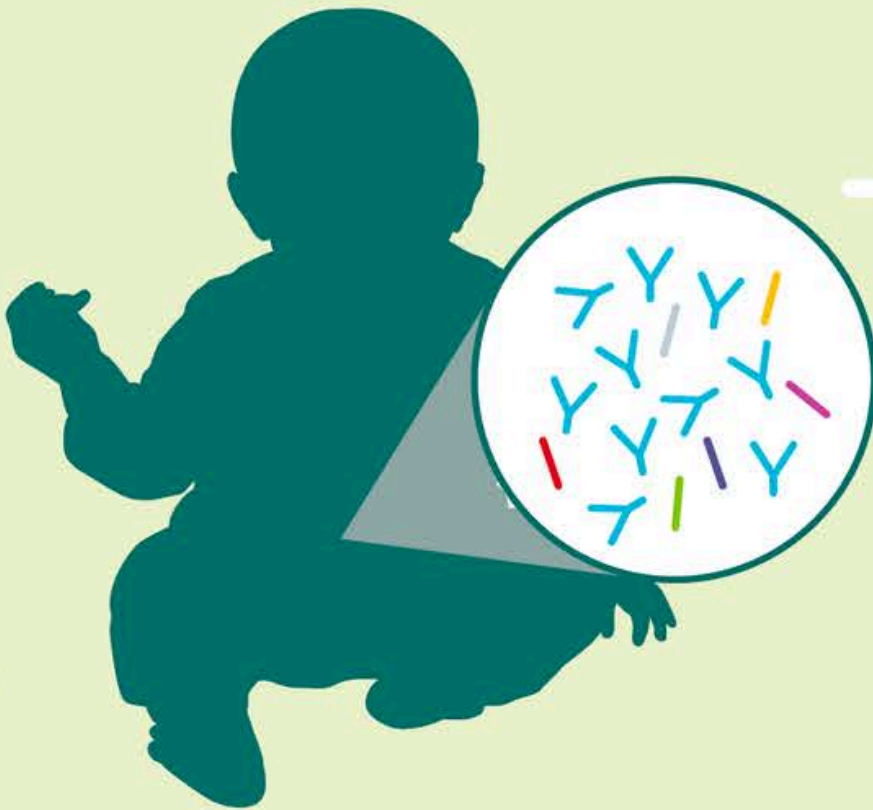
BREASTFED



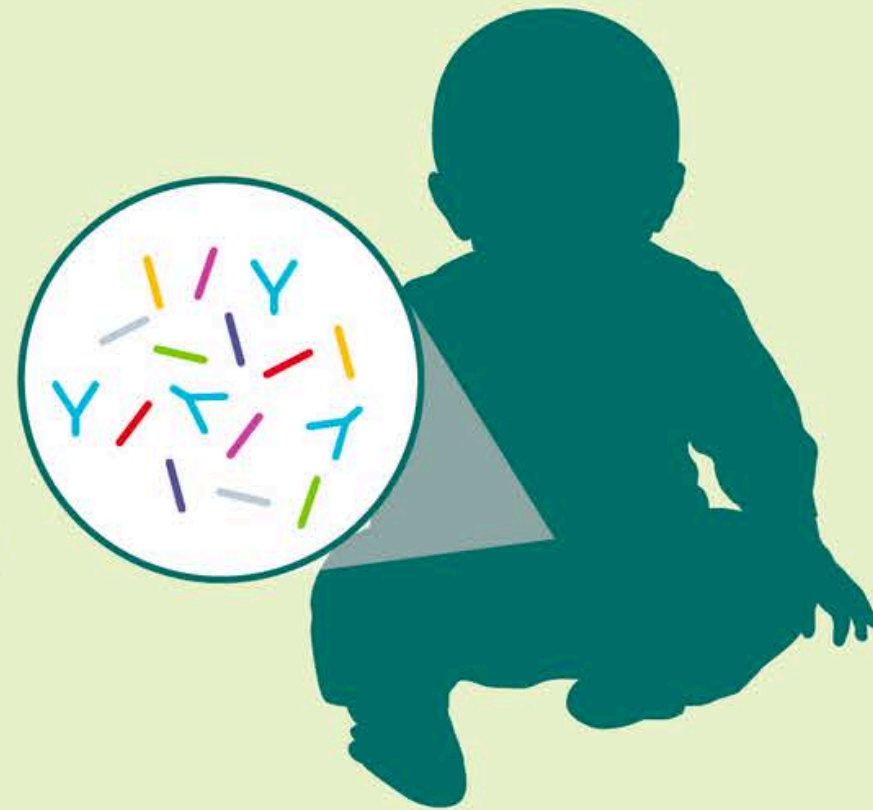
Historical



FORMULA FED

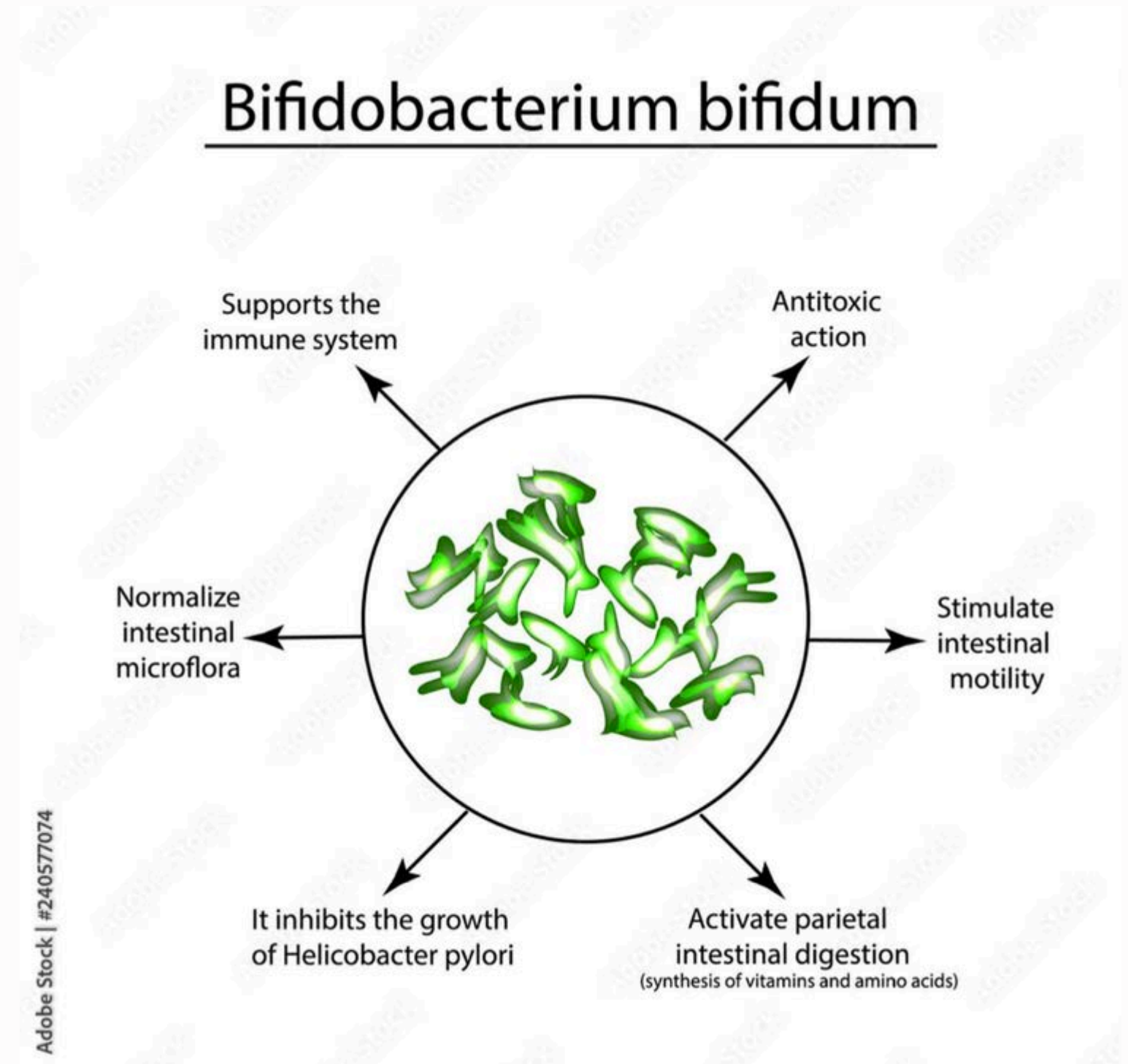


Modern





- Short-chain fatty acids (SCFAs) are produced when gut bacteria ferment dietary fiber
- The gut bacteria produce three types of SCFAs; acetate, butyrate, and propionate
- SCFAs reduce the risk of inflammatory bowel disease, colon cancer, promoting healthy weight, improve blood sugar control, etc.
- High-fiber foods include legumes, beans, green beans, avocados, apples, oats, and citrus fruits; support mom's microbiota

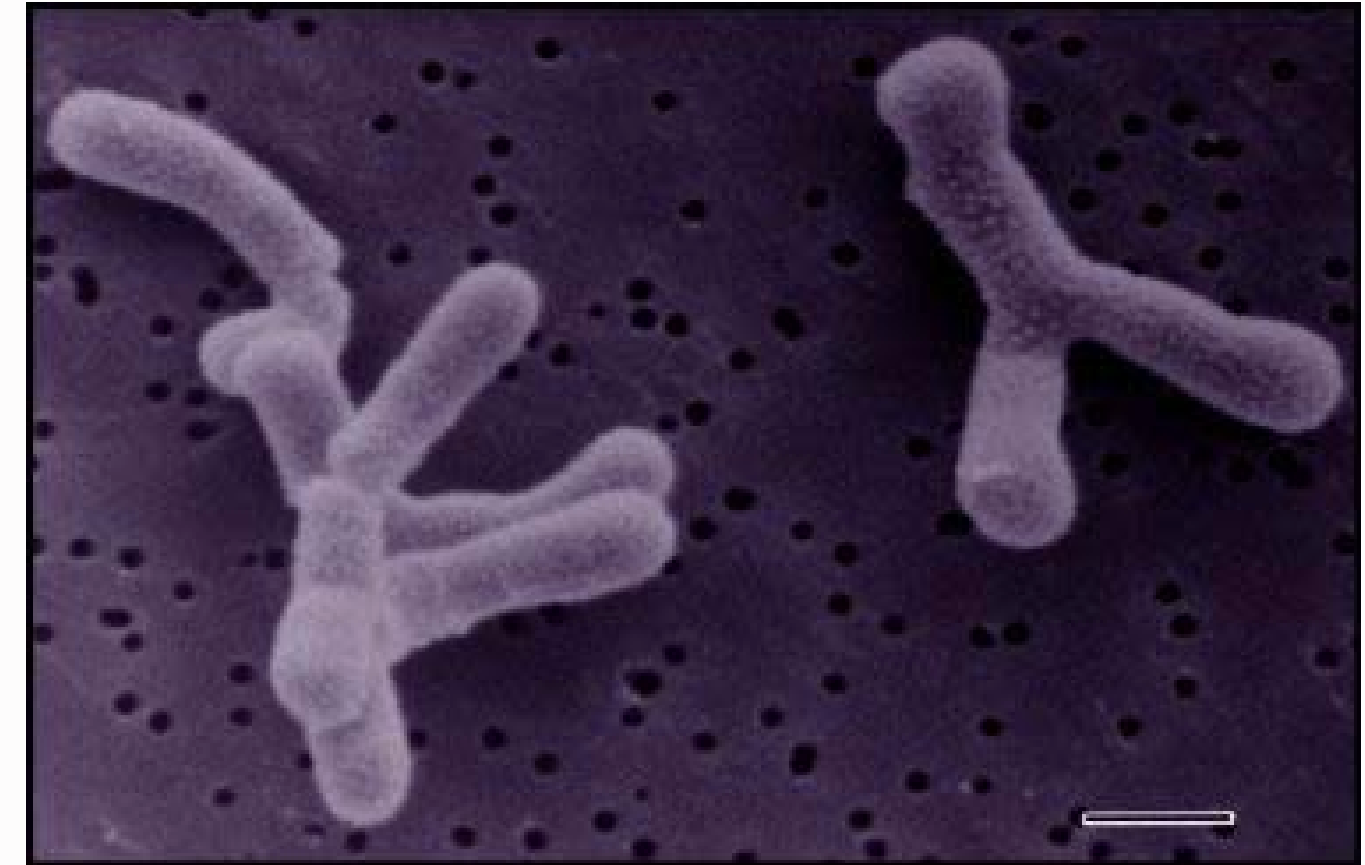


## Article

# Bifidobacteria-mediated immune system imprinting early in life

## Highlights

- An ordered sequence of immune changes after birth driven by microbial interactions
- Lack of gut bifidobacteria and HMO-utilization genes correlates with systemic inflammation
- Feeding *B.infantis* EVC001 upregulates IFN $\beta$  and silences intestinal Th2 and Th17
- EVC001-associated indole-3-lactic acid upregulates inhibitory galectin-1 in Tcells








## Interferon-beta:

- Polypeptide produced by fibroblasts (cells that synthesize the extracellular matrix and collagen)
- Antiviral and antiproliferative effects
- Th17 maintain mucosal immunity, when dysregulated, involved with autoimmune inflammation



# Vitamin C improves gut *Bifidobacteria* in humans

Sabine Hazan , Sonya Dave , Andreas J Papoutsis , Nirupama Deshpande , Mark C Howell & Leisha MA Martin 

Published Online: 8 Dec 2022 | <https://doi.org/10.2217/fmb-2022-0209>

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## Abstract

**Aims:** Numerous beneficial effects of vitamin C (ascorbic acid) supplementation have been reported in the literature. However, data on its effects toward the gut microbiome are limited. We assessed the effect of vitamin C supplementation on the abundance of beneficial bacterial species in the gut microbiome. **Materials and methods:** Stool samples were analyzed for relative abundance of beneficial bacterial species using metagenomic shotgun sequencing. The relative abundance of the genus *Bifidobacterium* was significantly increased following vitamin C supplementation.

“...The beneficial effects of vitamin C supplementation may be attributed to modulation of the gut microbiome and the subsequent health benefits...”



Ahead of Print

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# Persistent Damage to the Gut Microbiome following Messenger RNA SARS-CoV-2 Vaccine

Abstract  
E0141  
(S2108)

Sabine Hazan<sup>1</sup>, Sonya Davé<sup>2</sup>, Thomas J. Borody<sup>3</sup>

<sup>1</sup>ProgenaBiome, LLC, Ventura, CA, USA, <sup>2</sup>Microbiome Research Foundation, Ventura, CA, USA, <sup>3</sup>Centre for Digestive Diseases, Five Dock, NSW, AUS

## Introduction

- The human gut microbiome is an essential determinant of human health.
- Bifidobacterium* decline is associated with inflammatory bowel disease, obesity, neurological disorders, *C. difficile* infection and severe COVID-19 (1-3).
- Long-term effect of messenger RNA vaccines for SARS-CoV-2 on the human gut microbiome is unknown.
- The purpose of this study was to explore longitudinal changes in the Relative Abundance of *Bifidobacterium* after mRNA SARS-CoV-2 vaccination.

## Methods

We longitudinally recorded the Relative Abundance of *Bifidobacterium* in four subjects before receiving a mRNA vaccine (Pfizer or Moderna) for SARS-CoV-2, approximately one post-vaccination, as well as 6-9 months post-vaccination. Additional SARS-CoV-2 vaccines were given during that period, totaling 2 to 3 doses. Samples were collected at the time points mentioned. No dietary changes or new medications were introduced throughout the study period. Metagenomic next generation sequencing-based methods were applied to samples obtained from fecal collection. DNA was extracted, and the library prepped, enriched and sequenced on an Illumina Nextseq 550 system. This study was IRB approved.

## Results

Subject	Change in Relative Abundance of <i>Bifidobacterium</i> (% of pre-vaccine level)	
	1 month post-vaccine	6-9 months post-vaccine
1	38%	15%
2	258%	0%
3	49%	35%
4	90%	60%

Table 1. Change in Relative Abundance of *Bifidobacterium* after SARS-CoV-2 mRNA vaccination.

## Discussion

- At 1 month post-vaccination, 3 of 4 subjects experienced a decrease in Relative Abundance of *Bifidobacterium* below pre-vaccination levels.
- At 6-9 months post-vaccination, all subjects experienced a decrease in Relative Abundance of *Bifidobacterium* below pre-vaccination levels.
- No subjects exhibited significant post-vaccine complications.
- The lasting decrease in *Bifidobacterium* levels may contribute to SARS-CoV-2 infection post vaccination.
- Gut dysbiosis after mRNA SARS-CoV-2 vaccination may be a future indication for restoration of *Bifidobacterium* via oral or fecal transplant routes.

## References

- Ruiz L, et al. *Front Microbiol.* 2017;8:2345.
- Suganya K, Koo BS. *Int J Mol Sci.* 2020;21(20):7551.
- Hazan S, et al. *BMJ Open Gastro.* 2022;9(1):e000871.

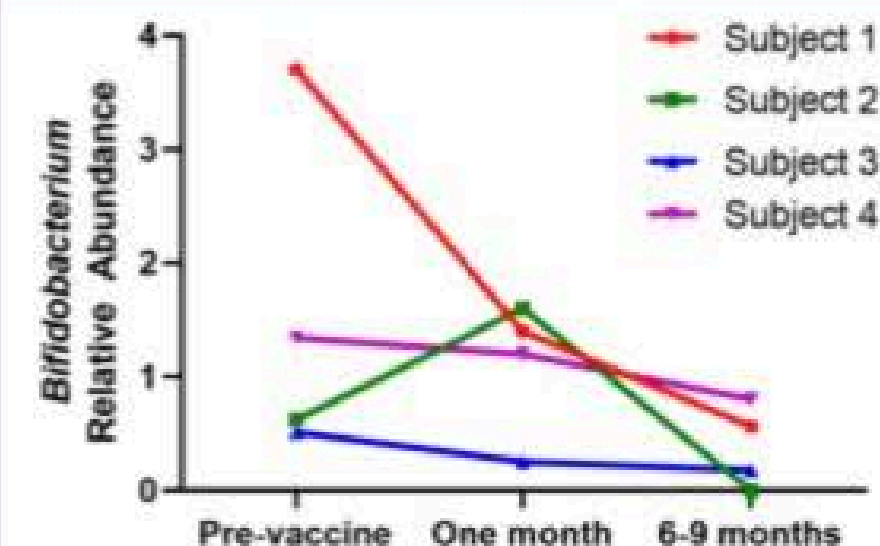


Figure 1. Decline in Relative Abundance of *Bifidobacterium* after SARS-CoV-2 mRNA vaccination.



HYPOTHESIS AND THEORY article

Front. Microbiol., 10 July 2022

Sec. Infectious Agents and Disease

Volume 13 - 2022 | <https://doi.org/10.3389/fmicb.2022.952321>

# RETRACTED: Microbiome-Based Hypothesis on Ivermectin's Mechanism in COVID-19: Ivermectin Feeds Bifidobacteria to Boost Immunity Updated



Sabine Hazan\*

Progenabiome, LLC, Ventura, CA, United States

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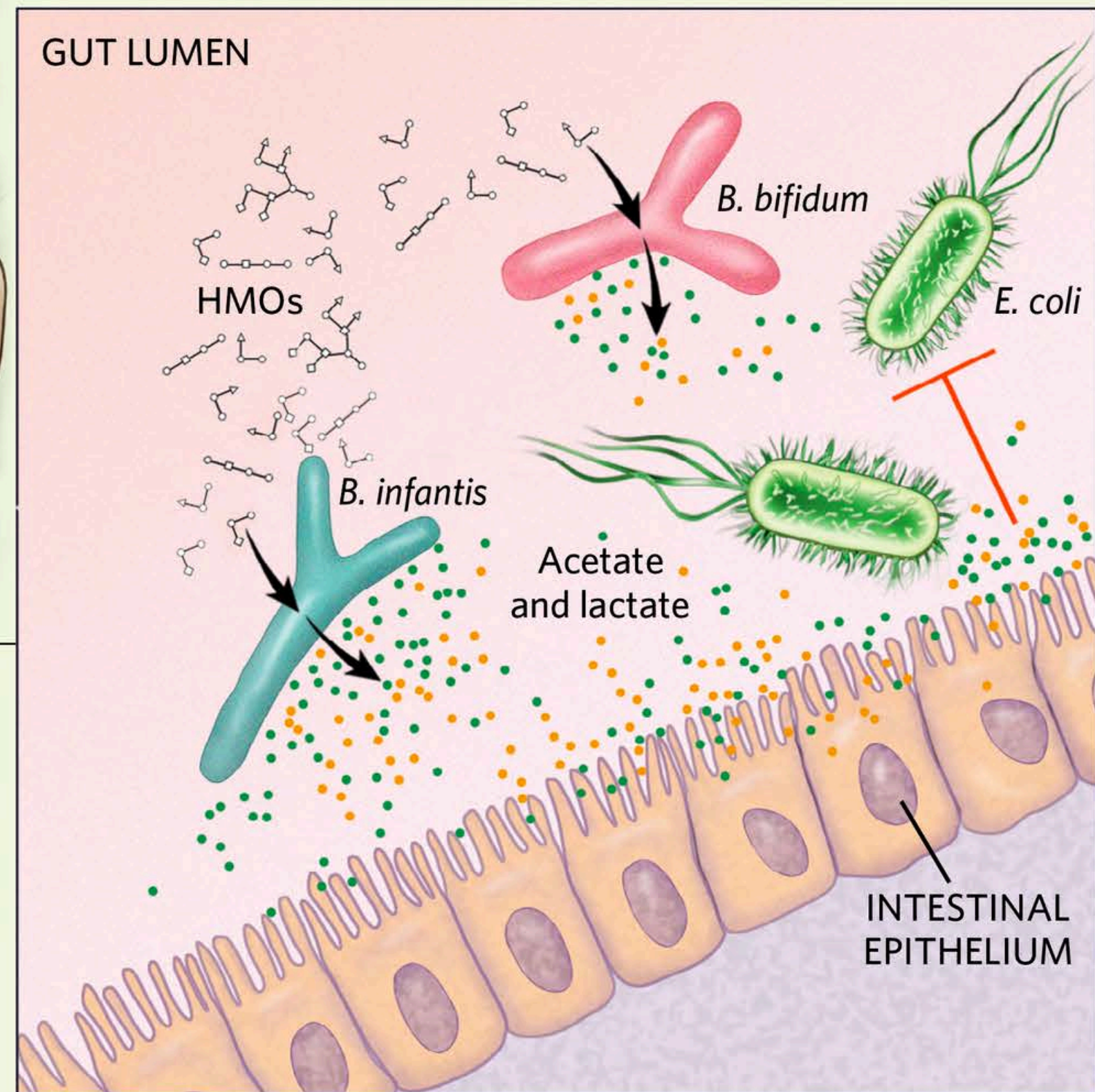


Mohammad Yousef Alikhani

Hamadan University of Medical Sciences, Iran



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# The 9 Best Baby Formulas, According to Pediatricians



by **Kathleen Felton**



Medically Reviewed by **Micah Resnick, M.D., F.A.A.P.** | December 21, 2023

## Infant Formula





## From the Experts:

**Ingredients:** Although most infant formulas **are basically the same**, experts say, some varieties contain additional ingredients that may be beneficial for baby or target different concerns, such as prebiotics or probiotics to support immune health. We've included a few such options, noting the types of conditions they might benefit. Most infant formulas are made from non-genetically modified ingredients, which we also made sure is true of each product on this list.

## Is This True?



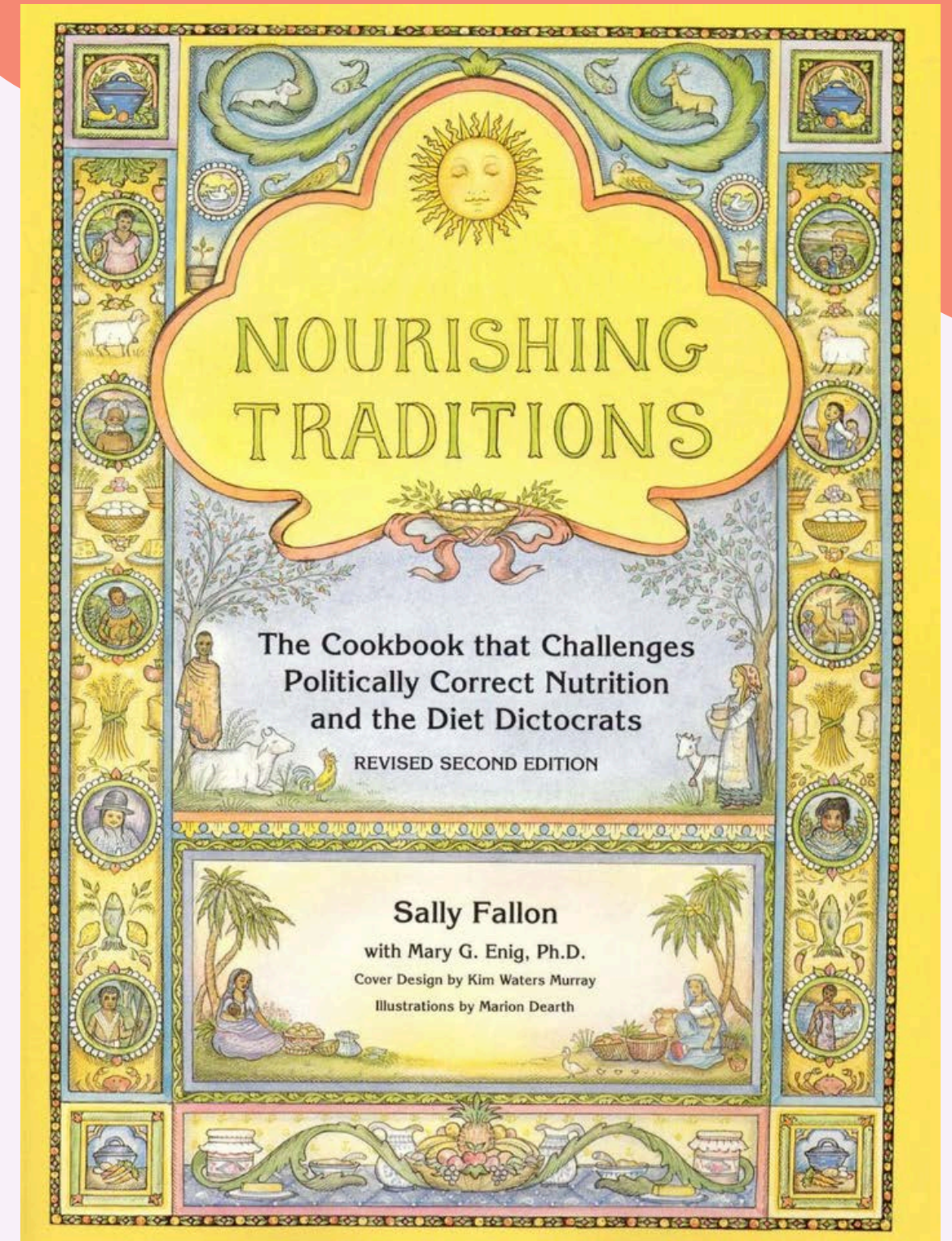


## From the Experts:

To help, we've included some resources below on what to do if your go to formula is sold out. Keep in mind that homemade formula is never safe for your baby, and it's also not safe to water down powdered formula to make it last longer — this could result in your baby not getting enough critical nutrients. If you're struggling to find formula in your area, reach out to your pediatrician for guidance.

### Is This True?





<https://www.westonaprice.org/health-topics/formula-homemade-baby-formula/>





# Infant Formula Overview



- Major US producers are Abbott (Similac), Nestle (Gerber), Mead Johnson (Enfamil), and Perrigo (generic formulas)
- Turn of the 20th C., wet nurses: Dates back 2000 B.C.
- Various animal milks have been offered also over 2,000 years
- Improved sanitation largely eliminated contamination, however an outbreak in 2022 created shortages
- Toxicants have been found: Melamine, toxic/heavy metals (FDA)

**There is NO safe level of heavy metals for children.**



# What's in formula?

1. Fluoridated tap water - interacts with Mn - alters brain function
2. Synthetic nutrients - neurotoxins
3. High fructose corn syrup (HFCS) - obesity, ADHD, NAFLD, Hg
4. Preservatives (even organic) - except Baby's Only Organic
5. Palm oil - deforestation (not the same as palmitic oil in BM)
6. Advanced Glycation End products (AGEs)
7. Dioxin - endocrine disruptor, carcinogen
8. Carrageenan - stabilizer - causes inflammation
9. Soy lecithin/soy formulas - phytoestrogens, phytic acid, GMOs
10. Artificial DHA and ARA - essential fatty acids extracted with hexane
11. Melamine - increase cow milk supply
12. Perchlorate - thyroid toxic
13. GMOs - corn, sugar, soy
- 14. Glyphosate**

(<https://www.ewg.org/release/toxic-weed-killer-found-breast-milk-infant-formula>)





FIELD TRIP

D.C.







## **‘Who’s to Blame’? How Lunchables Got on School Lunch Menus**

Industry lobbying and weak regulations made it possible for Kraft Heinz to get “Lunchables” on school menus, according to a Washington Post investigation. Critics said the onus is on federal regulators to ensure...





# Aluminum and Autism

- UK study showed high levels of Al in ASD male brains
- Al was found in neurons, microglia, white blood cells: Indicates it enters the brain via the lymphatic system
- Authors point out ~.25% of ingested Al is absorbed into circulation; may be more if there is intestinal mucosa damage
- Nearly 100% of AlOH (adjuvant in vaccines enters the circulation when injected IM)
- The injected Al binds with transferrin, which allows it to cross the blood-brain-barrier and the blood-CSF barrier. Unlikely to be excreted once it enters the brain
- Glyphosate binds Al 6 different ways and can transport it across the BBB





# What Does Aluminum Do in the Brain?



- Al promotes the formation and accumulation of insoluble amyloid beta protein (AD)
- Al increases Fe-induced oxidative injury
- Al disrupts Ca regulation
- Al is a mutagen - with subsequent alterations in the expression of genetic materials
- Al is an immunogen - this reactivity may play a role with Al and autoimmunity

Exley: <https://www.tandfonline.com/doi/full/10.1586/14737175.2014.915745>





IMAGINE YOU  
ARE AN  
**ALUMINUM  
ATOM**

DISCUSSIONS  
WITH  
**MR. ALUMINUM**

CHRISTOPHER EXLEY, Ph.D., FASE



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**Silica Water**  
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Healthy Longevity  
in the Aluminum Age



**DENNIS N CROUSE PH.D.**

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A FORMER FDA INVESTIGATOR REVEALS HOW HEAVY METALS  
FOUND IN OUR FOODS ENDANGER YOU AND YOUR FAMILY,  
AND WHAT YOU NEED TO KNOW TO SURVIVE AND THRIVE

# UNSAFE AT ANY MEAL

What the FDA Does Not Want You  
To Know About the Foods You Eat



**DR. RENEE JOY DUFAULT**

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## HFCS

- Dr. Dufault, FDA whistleblower/US Public Health Service Officer
- Found undisclosed mercury residues in HFCS
- FDA commanded her to stop her investigation
- Manufacturers are not required to report heavy meals to regulators.
- Oct. 23, Newsom signed AB-899 that requires manufacturers to test for arsenic, cadmium, lead, and mercury in finished baby foods
- Baby food does not include infant formula



# Enfamil NeuroPro Gentlease Powder Infant Formula - 27.4oz

\$51.99 (\$1.90/reconstituted ounce (USA))

## Ingredients

Corn Syrup Solids, Partially Hydrolyzed Nonfat Milk And Whey Protein Concentrate Solids (Soy)++, Vegetable Oil (Contains One Or More Of The Following: Palm Olein Oil, Coconut Oil, Soy Oil, High Oleic Sunflower Oil), And Less Than 2%: 2'-Fucosyllactose++++, Mortierella Alpina Oil§§ Schizochytrium Sp. Oil~~, Calcium Carbonate, Sodium Citrate, Calcium Phosphate, Potassium Chloride, Magnesium Phosphate, Ferrous Sulfate, Zinc Sulfate, Cupric Sulfate, Manganese Sulfate, Potassium Iodide, Sodium Selenite, Choline Chloride, Inositol, Ascorbic Acid, Niacinamide, Calcium Pantothenate, Riboflavin, Thiamin Hydrochloride, Vitamin D3, Vitamin B6 Hydrochloride, Folic Acid, Vitamin K1, Biotin, Vitamin B12, Vitamin E Acetate, Vitamin A Palmitate, Soy Lecithin, Taurine, L-Carnitine. ++A Source Of Mfgm (Milk Fat Globule Membrane Composed Of Proteins And Fats) Components ++++A Source Of 2'-Fl Hmo (2'-Fucosyllactose Human Milk Oligosaccharide) §§A Source Of Arachidonic Acid (Ara) ~~A Source Of Docosahexaenoic Acid (Dha)





## Breastfeeding is hard-won.



More than 4 out of 5 moms stop breastfeeding before the recommended six months. That means many of us face serious trade-offs, as infant formula lacks the critical nutrients of breastmilk and carries a heavy environmental burden.

There need to be more options for parents to turn to when feeding gets tough.

Let BIOMILQ support you.

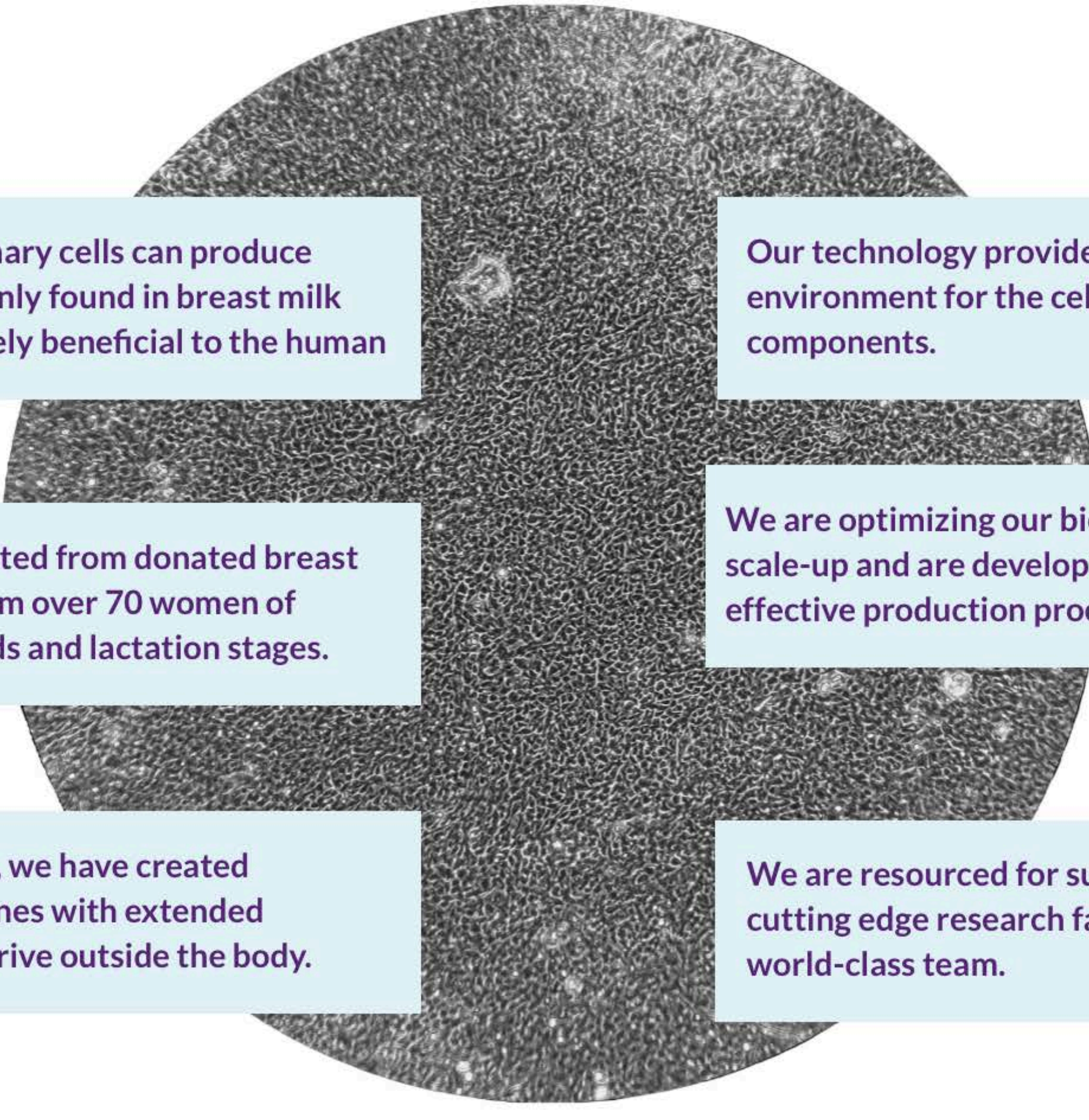
# Protect Babies Now!

- **Biomilq** – targeting infant nutrition by attempting to reproduce mother’s breast milk in a lab from culturing mammary epithelial cells
- The co-founders hope that the breast milk will help reduce the carbon footprint from the global infant formula market



Key Breastfeeding Indicators	Current Rates
Percentage of infants who are breastfed: <b>Ever.</b> <sup>a</sup>	84.1
Percentage of infants who are breastfed: <b>At 6 months.</b> <sup>a</sup>	58.3
Percentage of infants who are breastfed: <b>At 1 year.</b> <sup>a</sup>	35.3
Percentage of infants who are breastfed: <b>Exclusively through 3 months.</b> <sup>a</sup>	46.9
Percentage of infants who are breastfed: <b>Exclusively through 6 months.</b> <sup>a</sup>	25.6
Percentage of employers that have worksite lactation support programs. <sup>b</sup>	51.0
Percentage of breastfed newborns who receive formula supplementation within the first 2 days of life. <sup>a</sup>	19.2



A large, circular, grayscale microscopic image of human mammary cells, showing a dense, textured surface with some lighter, circular features. It is positioned in the center of the slide, behind six light blue text boxes.

Human mammary cells can produce components only found in breast milk and are uniquely beneficial to the human body.

Our technology provides the appropriate environment for the cells to make milk components.

The cells, isolated from donated breast milk, come from over 70 women of all backgrounds and lactation stages.

We are optimizing our bioprocess for scale-up and are developing a cost-effective production process.

From the cells, we have created multiple cell lines with extended lifespans to thrive outside the body.

We are resourced for success with a cutting edge research facility and a world-class team.



## Lactation is Not Only For Cisgender Biological Mothers

Updated: Dec 2, 2022

*Classic observations of nonconventional lactation and new findings offer hope for all parents*

Lactation is most commonly associated with a mother who has just given birth. But, it's 2022 and the narrative around who can lactate has expanded. First, a fun fact: in the 1990's, researchers found that some male fruit bats naturally lactate as they have functional mammary glands that produce small amounts of milk [3]. Because male humans do indeed have mammary glands, albeit typically inactive, male lactation is physiologically possible if a myriad of factors align, including hormonal cues that give the greenlight to produce milk. But, since male humans a) are not male fruit bats, and b) don't experience the hormonal changes during pregnancy that prepare the body for a baby's arrival, external interventions are necessary to induce lactation. But, in 2010, a man did lactate *naturally* because he had a pituitary tumor that increased his prolactin level to 13,050 pmol/L (normal: 109-522) and decreased his testosterone level to 6.4 nmol/L (normal: 10.4-31.0) [9]. Among other factors, hormones are key players in lactation.

## BIOMILQ at the International Milk Genomics Consortium Symposium 2023

For the past three years, BIOMILQ has been fortunate enough to attend, speak, and present at the [International Milk Genomics Consortium](#) (IMGC) Symposium. IMGC is a flagship conference that features the most “cutting-edge scientific research and discoveries in milk science and their applications for human health” ([IMGC](#)). This year was the 20th annual symposium, and a wonderful opportunity to appreciate the acceleration of discovery in milk science that the community has encouraged. At BIOMILQ, we want to ensure that our work is focused on the most impactful applications of our technology, and IMGC is a fantastic place to showcase our progress, receive feedback on what we are building, and learn about other ground breaking milk research being done. With worldwide attendance from the leaders who are moving milk forward in both academia and industry, BIOMILQ has returned from the symposium energized by new ideas and a growing list of collaborations that will guide our strategy going forward.

TECH

## Bill Gates' climate-change investment firm bets on lab-produced breast milk

PUBLISHED TUE, JUN 16 2020·9:14 AM EDT | UPDATED TUE, JUN 16 2020·2:31 PM EDT



Aditi Roy  
@ADITIROYCNBC

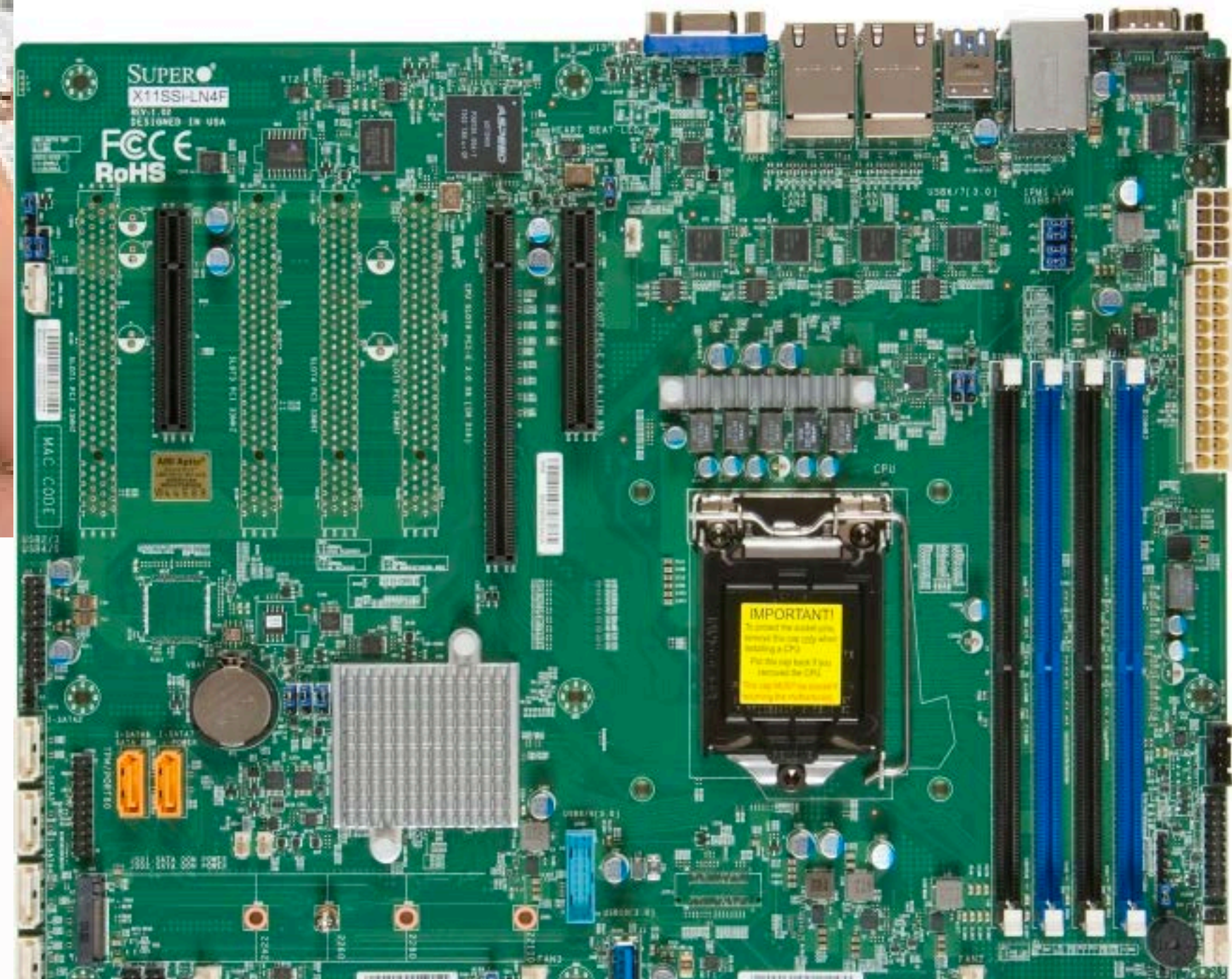
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**“...Will help reduce the carbon footprint from the global infant formula market...”**





**Are breastmilk and  
breastfeeding to be  
replaced by a  
motherboard?**







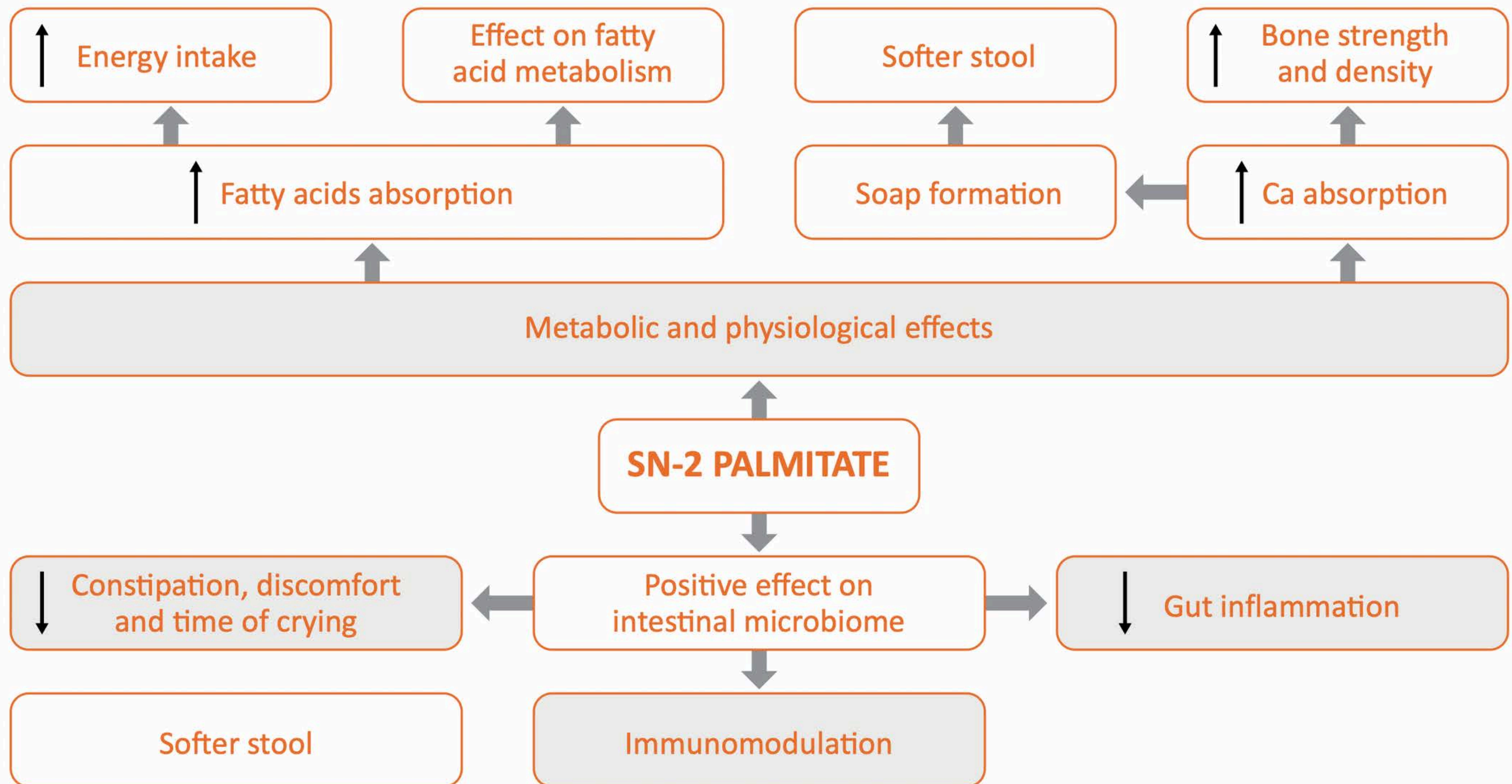
[Front Nutr.](#) 2024; 11: 1341527.

PMCID: PMC10861784

Published online 2024 Jan 30. doi: [10.3389/fnut.2024.1341527](https://doi.org/10.3389/fnut.2024.1341527)

PMID: [38352706](https://pubmed.ncbi.nlm.nih.gov/38352706/)

## Development and large-scale production of human milk fat analog by fermentation of microalgae



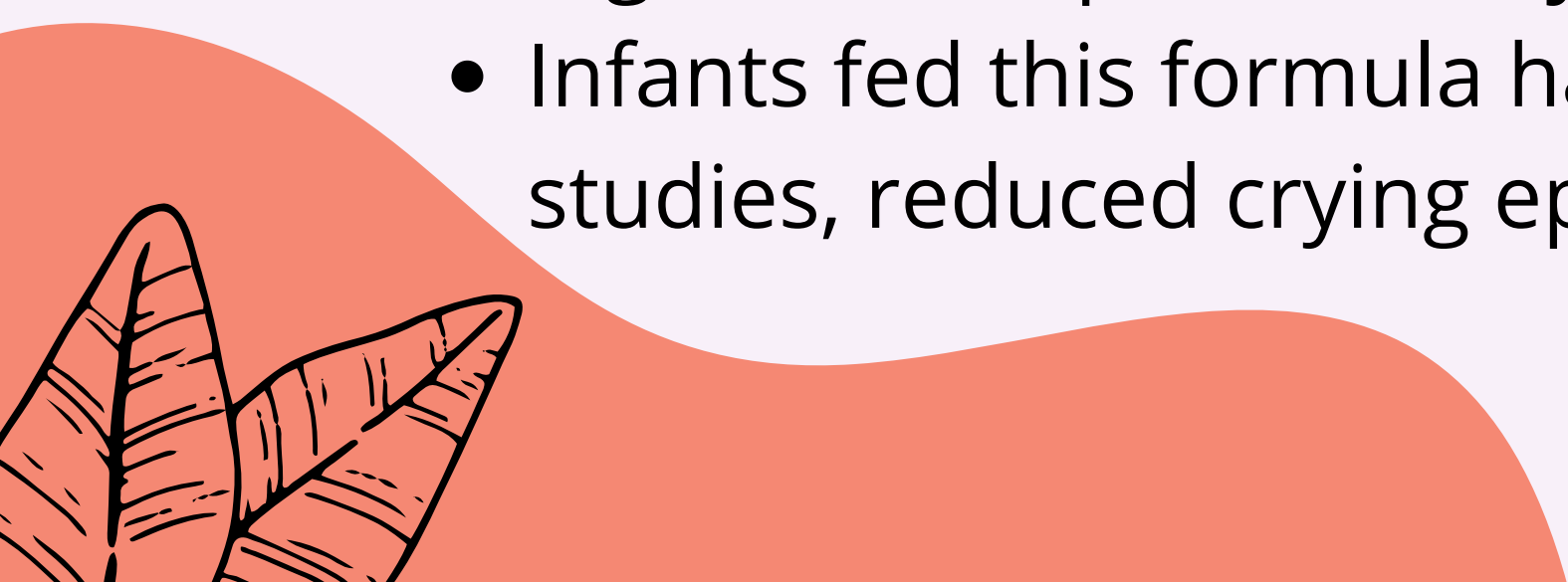
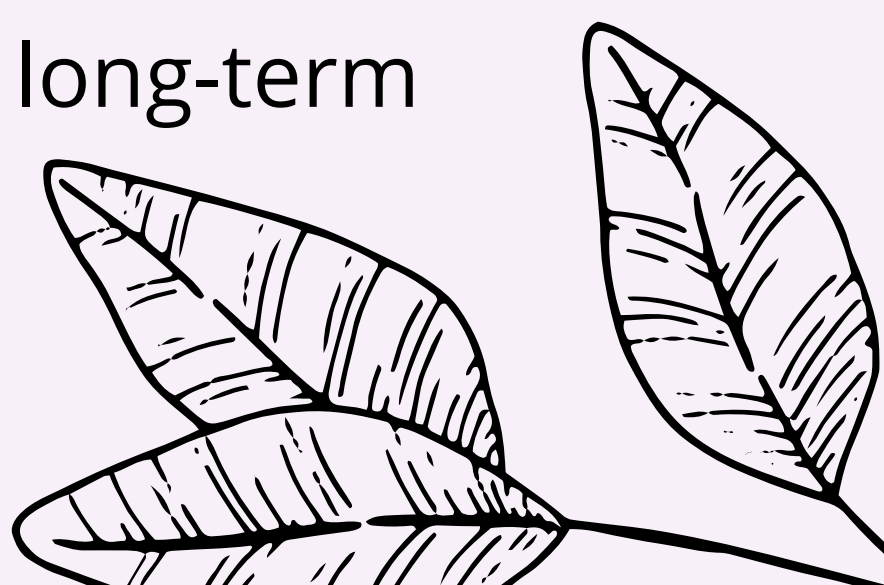
**Figure 6. Health benefits associated with the occurrence of high-level of palmitic acid esterified in the internal position of triglycerides (*sn*-2 palmitate) in newborns.** Source: adapted from Havlicekova *et al.*, *Nutr J* 15, 28, 2015





# Study Details


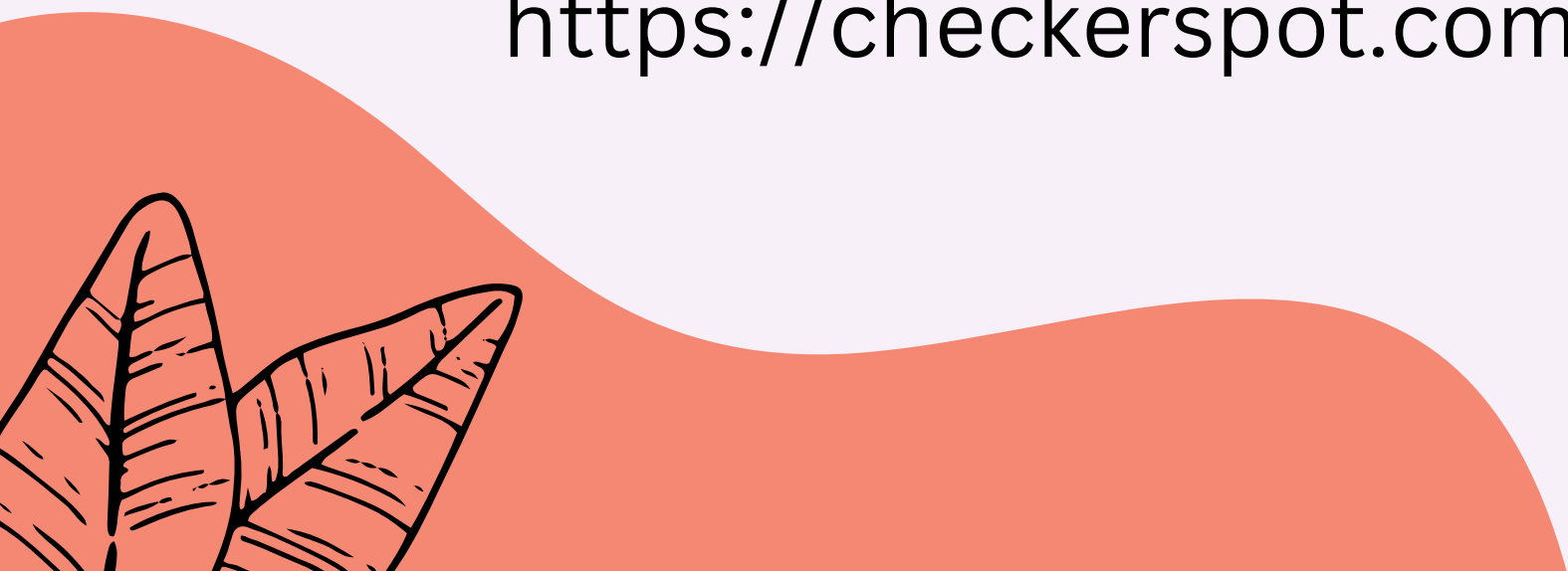


- In breastmilk, lipids are the primary source of calories, as triacylglycerols (TAG)
  - Assists in the absorption of essential nutrients and confers immunological and anti-inflammatory properties
  - Modified *prototheca moriformis* via mutagenesis to increase palmitic acid (fatty acid)
  - The “improved” strain was then genetically modified
  - Algae oil was produced by the GMO strain
  - Infants fed this formula had higher bone mineral mass - no long-term studies, reduced crying episodes
- 
- 



**“A comprehensive food safety evaluation will be essential before introducing this new ingredient to the market, ensuring compliance with regulatory approvals in various legislations.”**

The authors of the study were all employees of the Biotech firm:  
<https://checkerspot.com/about-us/>





# NURSING BASICS... BACK TO MOM...

Temporal development of the gut microbiome in early childhood from the TEDDY study (10.2018)

Stewart, et al

- Baby impacts moms' milk through retrograde flow back into the nipple

- Microbial exchange gives mom info to alter her milk ingredients to assist baby

- Cessation of BF was identified as a major factor in determining gut microbiota maturation with shifts in signature species

- Teddy Study: 1st y of life key phase for development of the microbiome via BM: 2nd y of life transitional: 3rd y of life microbiome stabilized

# ADULTS VS BABIES

- Probiotics may not be effective in babies if there is a mismatch
- Carbohydrate needs of the probiotics and HMOs in BM need to be aligned
- B. Infantis consumes almost all HMOs found in BM
- Allows B. Infantis to outcompete pathologic and/or proinflammatory microbes

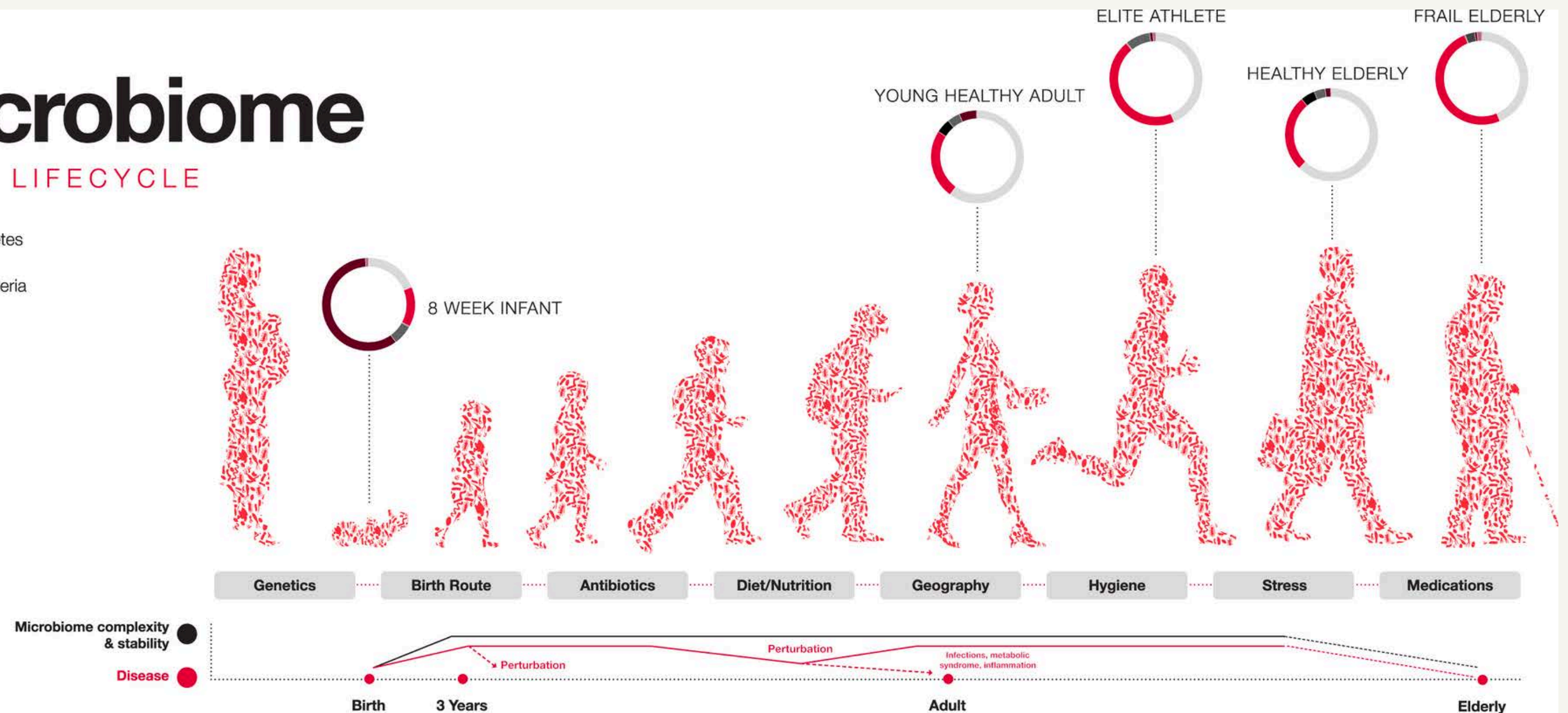


# Gut Microbiome

## CHANGES OVER LIFECYCLE



Microbiota Composition



## **Diseases Associated with the Gut Microbiota**

- Allergies
- Obesity
- Neuropsychiatric

Both ends of the spectrum:

"A double-blind, placebo-controlled clinical trial reported that B. breve A1 supplementation resulted in a significant improvement in cognitive function in older individuals."



# The Genome Complexity Conundrum

**Scientists began to realize that we humans are not just the product of our human genes. Instead, we are a bacteria-controlled **superorganism**. Scientists now realize that the bacteria in our microbiome, with their vast quantities of DNA, play a major role either directly or indirectly, in controlling how we develop and function as human beings. We are not just "us"... we are "us" plus "them".**

**Ross Pelton, RPh, PhD**

# Take-aways

- **Microbe-mediated education begins during gestation**
- **Both maternal and fetal microbiota play a role**
- **Parallel development of the GI tract and the brain occur in the first 3 years**
- **Organic regenerative food!**
- **Probiotics can benefit mom and baby during pregnancy**
- **Sporebiotics can mitigate the effects of glyphosate-based herbicides**
- **Avoid ALL factors that can offset mom and baby's microbiome**





# The New MDS

Moms, Doctors, and Scientists working together to heal our children

## Episode 28: Mental Health, Our Children, and the Microbiome

Moms, Doctors, and Scientists discussing the  
mental health crisis in our children with a lens  
on the microbiome with Dr. Sabine Hazan

Michelle Perro, MD, DHom   Dr. Sabine Hasan   Stephanie Seneff, PhD

**Tune in live  
April 22, 2025  
at 2 PM PT / 5 PM ET.**

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<https://gmoscience.org/the-new-mds/>

*Coming  
Soon!*

# Making Our Children **WELL**

A Parent's Guidebook:  
Empowering Healthy Families  
with Homeopathy and  
Nutrition

**Michelle Perro, MD**

Co-Author of the best seller  
**What's Making our Children Sick?**



# Thank you!

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