UF IFAS Extension UNIVERSITY of FLORIDA

UF/IFAS PEER REVIEWED FSHN24-4

https://doi.org/10.32473/edis-FS459-2024

Breastfeeding Benefits and Resources: Breastmilk feeds more than just babies![1]

Diana Hazard Taft[2]

This publication explains the importance of breastmilk to the infant gut microbiome. First, it defines the gut microbiome, then introduces the source of infant microbes, and finally, discusses the role of breastfeeding in infant gut microbiome and infant health. This publication is intended for a general audience of all educational backgrounds.

What is the gut microbiome?

Microbes live on us and in us — on our skin (Grice and Segre 2011), in our mouths (Deo and Deshmukh 2019), and even in our lungs (Whiteside et al. 2021). If you count up all the cells in the human body needed to stay healthy, the microbes will outnumber human cells (Sender et al. 2016)! The majority of these microbes live in our guts (Sender et al. 2016). The microbes living in our guts are especially important as they help our immune systems (Kau et al. 2011), brains (Galland 2014), and digestion (Banerjee et al. 2022).

Where do these microbes come from?

At birth, babies receive either vaginal microbes (in a vaginal delivery) or skin microbes (in a C-section delivery) from their mothers (Biasucci et al. 2010). These microbes form the start of the gut microbiome (Biasucci et al. 2010). But the microbes keep coming! They come from the environment (Nielsen et al. 2020), from Dad (Enav et al. 2022), from other family members (Tavalire et al. 2021), from pets (Panzer et al. 2023), and from all sorts of other places (Enav et al. 2022) to live in the baby's gut. As a result, the number of microbes that live in a baby's gut increases quickly during the first two or three years of life.

What does breastmilk have to do with these microbes?

Not all microbes a baby encounters are equally good. Some microbes are pathogens, meaning they can make a baby sick. Other microbes protect against serious diseases later in life, like asthma (Depner et al. 2020) or type 1 diabetes (Kostic et al. 2015). Breastmilk is important because it helps keep babies safe from pathogens (Hanson and Winberg 1972) and feeds the microbes that keep babies healthy (Bode 2012).

Breastmilk is made of many different things. The four most abundant things in breastmilk are water, lactose (a sugar the baby can digest), fat, and human milk oligosaccharides (HMOs) (Petherick 2010). HMOs are specialized sugars that the baby cannot digest. However, some microbes can eat them — especially microbes that are important to a baby's health! A group of microbes called *Bifidobacterium* is particularly likely to eat HMOs (Underwood et al. 2015). *Bifidobacterium* is important because babies who have lots of these microbes in their guts are less likely to have asthma (Seppo et al. 2021) or type 1 diabetes (Insel and Knip 2018)

1. This document is FSHN24-4, one of a series of the Department of Food Science and Human Nutrition, UF/IFAS Extension. Original publication date October 2024. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Diana Hazard Taft, assistant professor, Department of Food Science and Human Nutrition; UF/IFAS Extension, Gainesville, FL 32611.

later in life. Breastmilk is not just food for babies; breastmilk also feeds the microbes that help keep babies healthy. Only a few formulas contain any HMOs, and the HMOs in these formulas are at lower levels than those found in breastmilk. So, to feed your baby and your baby's microbes, breastmilk is the most nutritious option!

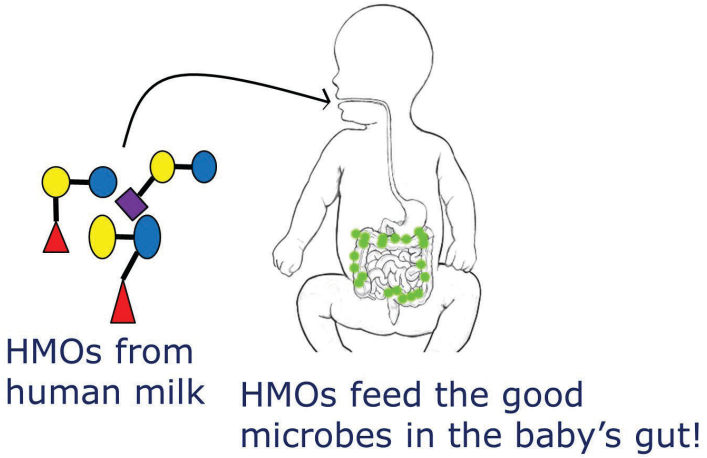

Figure 1. Infants do not digest the human milk oligosaccharides (HMOs) found in breastmilk. HMOs are specialized sugars, and moms make a lot of them in breastmilk. But HMOs are not digested by babies! Instead, these specialized sugars feed beneficial microbes to help keep the baby healthy.
Credits: Adapted from National Institute of Diabetes and Digestive and Kidney Disease, National Institutes of Health

References

Banerjee, P., K. Adhikary, A. Chatterjee, R. Sarkar, D. Bagchi, N. Ghosh, and A. Das. 2022. "Chapter 9 - Digestion and Gut Microbiome." In *Nutrition and Functional Foods in Boosting Digestion, Metabolism and Immune Health*, edited by D. Bagchi and S. E. Ohia. Academic Press. https://doi.org/10.1016/B978-0-12-821232-5.00029-X

Biasucci, G., M. Rubini, S. Riboni, L. Morelli, E. Bessi, and C. Retetangos. 2010. "Mode of delivery affects the bacterial community in the newborn gut." *Early Human Development* 86 (1, Supplement): 13–15. https://doi.org/10.1016/j.earlhumdev.2010.01.004

Bode, L. 2012. "Human milk oligosaccharides: Every baby needs a sugar mama." *Glycobiology* 22 (9): 1147–1162. https://doi.org/10.1093/glycob/cws074

Deo, P. N., and R. Deshmukh. 2019. "Oral Microbiome: Unveiling the Fundamentals." *Journal of Oral and Maxillofacial Pathology* 23 (1): 122–128. https://doi.org/10.4103/jomfp.JOMFP_304_18

Depner, M., D. H. Taft, P. V. Kirjavainen, K. M. Kalanetra, A. M. Karvonen, S. Peschel, E. Schmausser-Hechfellner, C. Roduit, R. Frei, and R. Lauener. 2020. "Maturation of the gut microbiome during the first year of life contributes to the protective farm effect on childhood asthma." *Nature Medicine* 26 (11): 17661775. https://doi.org/10.1038/s41591-020-1095-x

Enav, H., F. Bäckhed, and R. E. Ley. 2022. "The Developing Infant Gut Microbiome: A Strain-level View." *Cell Host & Microbe* 30 (5): 627–638. https://doi.org/10.1016/j.chom.2022.04.009

Galland, L. 2014. "The Gut Microbiome and the Brain." *Journal of Medicinal Food* 17 (12): 1261–1272. https://doi.org/10.1089/jmf.2014.7000

Grice, E. A., and J. A. Segre. 2011. "The Skin Microbiome." *Nature Reviews Microbiology* 9 (4): 244–253. https://doi.org/10.1038/nrmicro2537

Hanson, L. A., and J. Winberg. 1972. "Breast Milk and Defence against Infection in the Newborn." *Archives of Disease in Childhood* 47 (256): 845848. https://doi.org/10.1136/adc.47.256.845

Insel, R., and M. Knip. 2018. "Prospects for Primary Prevention of Type 1 Diabetes by Restoring a Disappearing Microbe." *Pediatr Diabetes* 19 (8): 1400-1406. https://doi.org/10.1111/pedi.12756

Kau, A. L., P. P. Ahern, N. W. Griffin, A. L. Goodman, and J. I. Gordon. 2011. "Human Nutrition, the Gut Microbiome and the Immune System." *Nature* 474: 327–336. https://doi.org/10.1038/nature10213

Kostic, A. D., D. Gevers, H. Siljander, T. Vatanen, T. Hyötyläinen, A. -M. Hämäläinen, A. Peet, V. Tillmann, P. Pöhö, and I. Mattila. 2015. "The Dynamics of the Human Infant Gut Microbiome in Development and in Progression toward Type 1 Diabetes." Cell Host & Microbe 17 (2): 260–273. https://doi.org/10.1016/j.chom.2015.01.001

Nielsen, C. C., M. Gascon, A R. Osornio-Vargas, C. Shier, D. S. Guttman, A. B. Becker, M. B. Azad, et al. 2020. "Natural Environments in the Urban Context and Gut Microbiota in Infants." *Environment International* 142: 105881. https://doi.org/10.1016/j.envint.2020.105881

Panzer, A. R., A. R. Sitarik, D. Fadrosh, S. L. Havstad, K. Jones, B. Davidson, S. Finazzo et al. 2023. "The Impact of Prenatal Dog Keeping on Infant Gut Microbiota Development." *Clinical & Experimental Allergy* 53 (8): 833–845. https://doi.org/10.1111/cea.14303

Petherick, A. 2010. "Development: Mother's Milk: A Rich Opportunity." *Nature* 468: S5–S7. https://doi.org/10.1038/468S5a

Sender, R., S. Fuchs, and R. Milo. 2016. "Revised Estimates for the Number of Human and Bacteria Cells in the Body." *PLOS Biology* 14 (8): e1002533. https://doi.org/10.1371/journal.pbio.1002533

Seppo, A. E., K. Bu, M. Jumabaeva, J. Thakar, R. A. Choudhury, C. Yonemitsu, L. Bode, et al. 2021. "Infant gut microbiome is enriched with *Bifidobacterium longum* ssp. infantis in Old Order Mennonites with traditional farming lifestyle." *Allergy* 76 (11): 3489–3503. https://doi.org/10.1111/all.14877

Tavalire, H. F., D. M. Christie, L. D. Leve, N. Ting, W. A. Cresko, and B. J. M. Bohannan. 2021. "Shared Environment and Genetics Shape the Gut Microbiome after Infant Adoption." *mBio* 12 (2). https://doi.org/10.1128/mBio.00548-21

Underwood, M. A., J. B. German, C. B. Lebrilla, and D. A. Mills. 2015. "*Bifidobacterium longum* subspecies *infantis*: Champion Colonizer of the Infant Gut." *Pediatric Research* 77 (1): 229–235. https://doi.org/10.1038/pr.2014.156

Whiteside, S. A., J. E. McGinniss, and R. G. Collman. 2021. "The Lung Microbiome: Progress and Promise." *The Journal of Clinical Investigation* 131 (15). https://doi.org/10.1172/JCI150473