**Benefits of Human Breastmilk on the Gut Microbiome of Infants**

**Abstract**

​ It is a popular belief that breastfeeding an infant is better than feeding an infant formula, but why? Specifically, what are the benefits of breastfeeding on the microbiota in an infants’ intestinal tract? Scientists have began exploring this question to determine how breastmilk aids in the development of a persons’ gut microbiota starting from infancy. Recent research has found that infants receive numerous types of bacteria from their mothers in their first two years of life. This is important because a vast amount of the bacteria transmitted from mother to infant are extremely beneficial for the infant as he/she gets older.

Recently, scientists have been discovering that different modes of transmission provide the infant with different types of bacteria. Bottle-feeding an infant formula delivers different bacteria than breastfeeding an infant milk from their mothers’ breasts. Another mode of transmission is feeding an infant breastmilk via bottle. Is bottle-feeding an infant breastmilk more beneficial like direct breastfeeding, or more detrimental like bottle-feeding an infant formula?

**Introduction**

​ Microbiomes contain a variety of microorganisms, such as bacteria. These microbiomes can be found in environments such as the mouth, the skin, the urogenital tract and the gastrointestinal tract (gut). In some months, breastmilk is the best food for the rapidly-growing infant since breastfeeding protects the newborn against some disease such as infections disease, asthma and allergy (Mehanna *et al.* 2013). Though much of the bacteria can be very beneficial for infants, other bacteria can be detrimental. *Cronobacter sakazakii* can be found in some infant formulas. This particular bacteria can cause infections such as meningitis and sepsis, which can be very deadly to infants. To create a flourishing microbiome with healthy bacteria, receiving an abundant amount of beneficial bacteria is crucial in the first 24 months of life.

Microbiomes play a very important role in the human body from infancy throughout adulthood. Healthy microbiomes aid in fighting off pathogens, immune support and maintaining a healthy digestive system among other beneficial functions. Starting from birth, infants begin receiving bacteria through numerous modes of transmission. From breastfeeding to bottle-feeding, vaginal delivery to cesarean delivery, and other human to human contact, children receive a large amount of their bacteria during infancy. After being transmitted to the infant, the bacteria then gather in numerous microbiome environments all throughout the infants’ body.

Many of the microorganisms found in microbiomes form symbiotic relationships with their host, meaning that they both benefit from one another. However, some microorganisms are parasitic and do not provide any benefits for the host. Recent research has found that an abundance of bacteria provided from breastmilk is beneficial for infants’ microbiomes whereas bacteria provided from bottle-feeding with formula is more detrimental to their microbiomes. To find a correlation in the bacteria from mother to child, scientists have collected and ran numerous tests on bacteria from the breastmilk of the mother, her areolar skin and the infants’ stool. Out of strictly breastfed infants, each of the infants’ stool bacteria was mostly similar to their own mothers’ breastmilk and areolar skin bacteria.

Recently, cultures of *Enterococcus faecalis* isolated from human milk have been shown to inhibit growth of indicator bacteria, such as *Escherichia coli* O157:H7*, Pseudomonas aeruginosa* and *Salmonella* (Mehanna *et al.* 2013). Certain strains of these bacteria are harmless when found in human microbiomes, but strains like *E. coli* O157:H7 are not favored. This strain usually causes symptoms such as diarrhea, nausea, pain and even vomiting. This type of *E. coli* infection can be very harmful and even deadly to infants and young children. Diseases, like *E. coli*, are much more lethal in infants that live in developing countries due to the lack of resources available to help prevent diseases and infections. Fortunately, the United States has many resources, such as medicine and clean water, to help protect infants from disease and infection.

**Discussion**

Studies show that breastfeeding confers protection against respiratory and gastrointestinal tract infections and allergic diseases in addition to reducing the risk of chronic diseases, such as diabetes, obesity and inflammatory bowel disease (Pannaraj *et al.* 2017). Breastmilk is an important food for infants in their first year of life. It provides prebiotics to infants’ gut microbiomes that will ultimately benefit them well throughout adulthood. The healthier the microbiome, the healthier the person will be.

Infants who are formula fed receive more harmful bacteria than infants who are strictly breastfed. No infant formula produced to date can provide the wealth of maternal bacteria and complex prebiotic oligosaccharides that human milk provides (Jost *et al*. 2015). As the infants age, their microbiomes continue to carry less beneficial bacteria than those who were strictly breastfed. In the Human Microbiome Project, Ding and Schloss found breastfeeding during infancy to be a major life-history characteristic that affects bacterial composition in adults (Pannaraj *et al.* 2017).

Starting out from delivery, mothers should breastfeed their infants to provide them with the best quality of a healthy microbiome. This ultimately will aid greatly in the health of the child from infancy to adulthood. Unfortunately, not all mothers can breastfeed and are forced to feed their infants formula from delivery. How can these infants receive the proper microorganisms that they desperately need during infancy without having been fed breastmilk? Hopefully in the future scientists will find a way to provide these infants with the beneficial microorganisms that they need through a source other than breastmilk to maintain a healthy microbiome. Possibly by adding prebiotics to formula; it could give these infants the healthy bacteria needed to help form a healthy microbiome.

**References**

Jost, T., Lacroix, C., Braegger, C. and Chassard, C. (2015). Impact of human milk bacteria and oligosaccharides on neonatal gut microbiota establishment and gut health, *Nutrition Reviews* (73):7, pg. 426–437.

Mehanna, N. S. H., Tawfik, N. F., Salem, M. M. E., Effat, B. A. M. and Gad El-Rab, D. A. (2013). Assessment of potential probiotic bacteria isolated from breast milk, *Middle-East Journal of Scientific Research* (14):3, pg. 354-360.

Pannaraj, P.S., Li, F., Cerini, C., Bender, J. M., Yang, S., Rollie, A., Adisetiyo, H.,Zabih, S., Lincez, P. J., Bittinger, K., Bailey, A., Bushman, F.D., Sleasman, J.W. and Aldrovandi, G. M. (2017). Association between breast milk bacterial communities and establishment and development of the infant gut microbiome. *JAMA Pediatrics*, pg. 647-654.