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N-Acetylneuraminic Acid in Breast Milk and Infant Growth in a Gut Microbiota-Dependent Way

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Abstract

Breast milk is often referred to as "liquid gold" due to its remarkable nutritional and immunological benefits for infants. It is well-established that breast milk provides essential nutrients, antibodies and other bioactive components that support optimal growth and development during the early stages of life. One such component that has gained significant attention in recent years is N-Acetylneuraminic Acid (Neu5Ac), a sialic acid derivative found abundantly in human breast milk. Emerging evidence suggests that Neu5Ac plays a crucial role in infant growth, particularly in a gut microbiota-dependent manner. Sialic acids are a family of nine-carbon sugars that are widely distributed in nature. Neu5Ac is the most prevalent sialic acid in mammalian cells and secretions, including human breast milk. It serves as a precursor for the biosynthesis of gangliosides, glycoproteins, and glycolipids, which are crucial for brain development, neuronal function, and immune modulation. Additionally, Neu5Ac acts as a receptor for certain pathogens, preventing their adherence to host cells and subsequent infection.

Keywords: N-Acetylneuraminic acid • Liquid gold • Ganglioside• Glycoproteins

Introduction

The composition and function of the gut microbiota in early life have been the focus of intense research due to their impact on health and disease later in life. The establishment of a diverse and stable gut microbiota during infancy is essential for immune system development, nutrient metabolism, and protection against pathogens. Recent studies have shown that the presence of Neu5Ac in breast milk significantly influences the gut microbiota composition in breastfed infants. It has been observed that certain bacterial species, such as Bifidobacterium longum subsp. infantis, possess the metabolic machinery to metabolize Neu5Ac. These bacteria break down Neu5Ac into short-chain fatty acids, including acetate and lactate, which serve as a source of energy for the growing infant. The utilization of Neu5Ac by specific gut bacteria also leads to the production of other metabolites, such as butyrate, which provides additional health benefits, including anti-inflammatory effects and the maintenance of gut barrier integrity. The interplay between Neu5Ac, the gut microbiota, and infant growth has been investigated in several studies. A study conducted by researcher demonstrated that breastfed infants with higher levels of Neu5Ac in their fecal samples had a higher abundance of Bifidobacterium species, including *B. longum* subsp. These infants also exhibited enhanced growth parameters, such as increased length and weight gain, compared to those with lower Neu5Ac levels [1].

Literature Review

These findings suggest that the presence of Neu5Ac in breast milk promotes the growth of beneficial gut bacteria, which, in turn, positively influences infant growth. Moreover, the gut microbiota plays a pivotal role in the development and maturation of the infant's immune system. The presence of Neu5Ac in breast milk has been shown to modulate the production of immune-related molecules and enhance the development of immune tolerance in the gut. This effect is particularly important in preventing excessive immune responses, such as allergies and autoimmune diseases, later in life. While the evidence linking Neu5Ac in breast milk to infant growth is promising, it is essential to acknowledge that the composition of breast milk can vary between individuals. Several factors, including maternal diet, genetics, and environmental influences, can influence the levels of Neu5Ac and other bioactive components in breast milk. Thus, the impact of Neu5Ac on infant growth may differ between populations and should be investigated further [2].

Understanding the role of Neu5Ac in breast milk and its influence on infant growth opens up new avenues for potential interventions to promote healthy growth and development in infants. Manipulating the gut microbiota through probiotics, prebiotics, or postbiotics that enhance the utilization of Neu5Ac could be a potential strategy to optimize infant growth outcomes. However, more research is needed to determine the optimal dosage, timing, and duration of such interventions. In conclusion, N-Acetylneuraminic Acid (Neu5Ac) is a bioactive component found abundantly in human breast milk. Its presence has been linked to the growth and development of infants, mediated through the gut microbiota. Neu5Ac influences the composition of the gut microbiota, promotes the growth of beneficial bacteria, and enhances the metabolism of short-chain fatty acids, which contribute to infant growth and immune system maturation. Further research is required to elucidate the precise mechanisms underlying this relationship and explore potential interventions to optimize infant growth outcomes. Nonetheless, the emerging evidence highlights the importance of Neu5Ac in breast milk as a key factor in early-life nutrition and sets the stage for future investigations in this fascinating area of research. Breast milk is widely recognized as the optimal source of nutrition for infants, providing a range of essential nutrients that support healthy growth and development [3].

Discussion

One of the lesser-known components of breast milk is N-Acetylneuraminic Acid (NANA), a sialic acid derivative. Recent research has shed light on the importance of NANA in infant growth, suggesting that its presence in breast milk is not only beneficial but also dependent on the gut microbiota. This article explores the relationship between NANA in breast milk, the gut microbiota, and infant growth, highlighting the intricate interplay between these factors. Breast milk is a complex fluid containing an array of bioactive components that provide optimal nutrition and immune support for infants. These include carbohydrates, proteins, lipids, vitamins, minerals, and nucleotides. Among these constituents, N-Acetylneuraminic Acid (NANA) stands out as a vital component. NANA is a type of sialic acid, a sugar molecule involved in various physiological processes,

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including brain development, immune function, and cellular communication [4].

NANA is predominantly found in human milk, with concentrations varying among individuals. It is believed that NANA is transferred to breast milk through a process known as de novo biosynthesis, in which it is synthesized in the mammary glands from precursors obtained from the maternal diet. However, recent studies suggest that NANA biosynthesis may be influenced by the gut microbiota. The human gut microbiota, a collection of trillions of microorganisms inhabiting the gastrointestinal tract, plays a crucial role in various aspects of human health. Recent research has highlighted the connection between the gut microbiota and the presence of N-Acetylneuraminic Acid in breast milk. It has been observed that certain bacteria in the infant gut, specifically Bifidobacterium species, possess the ability to metabolize NANA and produce Short-Chain Fatty Acids (SCFAs) in the process. These SCFAs, particularly butyrate, serve as an energy source for the intestinal epithelial cells and play a vital role in maintaining gut health [5]. Furthermore, butyrate has been associated with enhanced gut barrier function, reduced inflammation, and improved immune response. In turn, these beneficial effects of butyrate promote a healthy gut microbiota composition, leading to improved nutrient absorption and overall growth in infants.

Emerging evidence suggests that N-Acetylneuraminic Acid (NANA) present in breast milk plays a critical role in infant growth and development. NANA acts as a substrate for the biosynthesis of gangliosides, a class of glycolipids found in high abundance in the central nervous system. Gangliosides are essential for neurodevelopment, as they regulate neuronal differentiation, synaptogenesis, and myelination. Consequently, the presence of NANA in breast milk is thought to positively influence cognitive development and brain function in infants. Furthermore, NANA serves as a signaling molecule involved in cellular interactions and immune responses. It has been shown to modulate the expression of immune-related genes and regulate the activity of immune cells, such as macrophages and lymphocytes. This immune-modulating effect of NANA is crucial for the development of a healthy immune system in infants. The gut microbiota-dependent metabolism of NANA further enhances its impact on infant growth. Bifidobacterium species metabolize NANA to produce short-chain fatty acids (SCFAs), including butyrate. Butyrate, as a major energy source for intestinal epithelial cells, promotes their growth, differentiation, and integrity, thereby enhancing nutrient absorption and gut barrier function. These effects not only optimize the utilization of nutrients from breast milk but also protect against pathogens and reduce the risk of inflammation and intestinal disorders [6].

Conclusion

N-Acetylneuraminic Acid (NANA) in breast milk has emerged as a crucial component influencing infant growth and development. Its involvement in neurodevelopment, immune modulation, and gut health highlights its multifaceted role in infant nutrition. Moreover, the gut microbiota plays a significant part in the metabolism of NANA, Producing Short-Chain Fatty Acids (SCFAs) that contribute to gut health and overall growth. Further research is needed to elucidate the intricate interplay between NANA, the gut microbiota, and infant growth, which may have important implications for maternal nutrition, breastfeeding practices, and infant health outcomes.

Acknowledgement

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Conflict of Interest

None.

References

1. Zucker, Inbar, Yair Zloof, Aya Bardugo and Avishai M. Tsur, et al. "Obesity in late adolescence and incident type 1 diabetes in young adulthood." *Diabetologia* 65 (2022): 1473-1482.
2. Forbes, Jessica D., Meghan B. Azad, Lorena Vehling and Hein M. Tun, et al. "Association of exposure to formula in the hospital and subsequent infant feeding practices with gut microbiota and risk of overweight in the first year of life." *JAMA Pediatr* 172 (2018): e181161-e181161.
3. Stanislawski, M. A., D. Dabelea, B. D. Wagner and N. Iszatt, et al. "Gut microbiota in the first 2 years of life and the association with body mass index at age 12 in a Norwegian birth cohort. mBio 9: e01751-18." (2018).
4. Juge, Nathalie, Louise Tailford and C. David Owen. "Sialidases from gut bacteria: A mini-review." *Biochem Soc Trans* 44 (2016): 166-175.
5. Wang, Bing, Janette Brand-Miller, Patricia McVeagh and Peter Petocz. "Concentration and distribution of sialic acid in human milk and infant formulas." *Am J Clin Nutr* 74 (2001): 510-515.
6. Claumarchirant, Lorena, Luis Manuel Sanchez-Siles, Esther Matencio and Amparo Alegría, et al. "Evaluation of sialic acid in infant feeding: Contents and bioavailability." *J Agric Food Chem* 64 (2016): 8333-8342.

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