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Publication on

sialic acid

The role of sialic acid in infant nutrition has been studied by researchers due to its potential supportive roles in brain development and function, resistance to pathogens, gut maturation and immune function.[1,2]

What is sialic acid?

Sialic acid is a naturally occurring breast milk carbohydrate. It is also present in body fluids such as saliva and urine.[3] Sialic acid exists in humans as N-acetylneuraminic acid (Neu5Ac), a 9-carbon carbohydrate.[3]

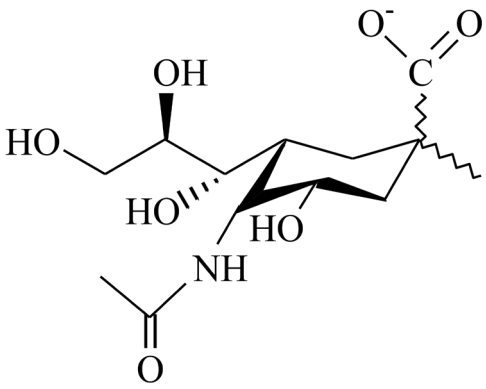

FIGURE 1. Chemical structure of N-acetylneuraminic acid (Neu5Ac)

Early milk or human colostrum contains higher amounts of sialic acid compared with mature milk.[4,5] In human milk, sialic acid is mainly bound to human milk oligosaccharides (e.g. sialyllactose) or found in complex brain lipids called gangliosides.[6-8] The various sialic components play a role in the development of the intestinal cell walls, as substrate for the gut microflora and, in the infants' neurological development.[7,9,10]

Potential benefits of sialic acid

Effects on cognitive development

The highest amount of sialic acid in the body is found in the brain's grey matter, where it is present in gangliosides and glycoproteins.[1] Sialic acids are highly concentrated in the synaptosomal fraction and may play a role in communication between nerve cells and enhance cognitive function.[3,11,12]

Brain growth and maturation are associated with an increase in gangliosides and sialoproteins. Learning and memory formation are associated with brain glycoproteins and sialoproteins. Advancing age and congenital retardation syndromes are associated with a decrease in gangliosides and sialoproteins in the brain.[3,7,10] Dietary gangliosides may be beneficial to neonatal cognitive development, especially for premature and infants with neurologic damage at birth.[2]

- Higher brain ganglioside and glycoprotein sialic acid concentrations in breast-fed infants compared with formula-fed infants suggest differences in neurodevelopment.[13]
- Sialic acid-containing glycosphingolipids constitute a major component of neuronal cells and are thought to be essential for brain function.[14]
- Preclinical studies suggest that early sialic acid supplementation may improve both memory and cognitive performance.[3,13,15]

Effects on gut and respiratory health

In vitro studies suggest sialic acid may serve as an inhibitor of pathogenic microorganisms, preventing them from attacking cell layers of the gastrointestinal, urogenital and respiratory tract.[1,11,16] Additionally, *in vitro* studies show:

- Sialylated oligosaccharides in human milk may act as highly specific receptors.[3,11]
- Sialyl oligosaccharides may bind enterotoxinogenic (e.g. children and traveler diarrhea) and uropathogenic E. coli species.[6,9,11,16,17]
- Sialylated compounds may have growth-promoting effects on bifidobacteria and lactobacilli, both of which are predominantly present in the intestinal microflora of infants fed breast milk.[7,9,10]
- Sialylated oligosaccharides may promote intestinal maturation in early life via modulation of the epidermal growth factor (EGF) receptor activation and enhanced adhesion of maternal IgG to infant intestinal epithelium.[1]
- Sialylated compounds may reduce risk of respiratory tract infections by altering mucin composition and increasing pathogen phagocytosis.[1]

Effects on immune function and inflammation

Limited evidence shows that sialic acid and sialylated compounds may play a role in immunomodulation or has an effect on the immune system. For instance, sialic acid may reduce necrotizing enterocolitis in preterm infants and paediatric inflammatory bowel disease. More studies are needed to explore the mechanism, and below are some working hypotheses[1]:

- Stimulate endocytosis by dendritic cells.[18,19]
- Induce immune regulation by sialic acid-receptors on immune cells.[20]
- Induce T-cell skewing, which may lead to suppressed allergy manifestations.[21]

Key points

- Breast milk is the best food for babies. Breast milk plays a key role in optimal development of newborns and sialic acids are suggested as one of the components responsible for the many benefits of breast milk.[11]
- Dietary sialic acid supplementation has been shown to improve cognitive function in preclinical studies.[2,15] Higher brain ganglioside and glycoprotein sialic acid concentrations in breast-fed infants compared with formula-fed infants suggest differences in neurodevelopment.[13] More research is needed to confirm whether sialic acid can also contribute to brain function in infants.
- Sialylated compounds have been shown to inhibit pathogen adhesion to host cells, suggesting they may play a role in protection against infections[11] and improving gut microbiota via growth-promoting effects on bifidobacteria and lactobacilli.[7,9,10]
- They may also play a role in immunomodulation and inflammation[1], and more research is needed to better understand the mechanism.

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Important note

Breastfeeding is the best nutrition for healthy growth and development of babies. Exclusive breastfeeding for six months is the optimal way of feeding infants. Thereafter infants should receive complementary foods with continued breastfeeding up to two years or beyond. Mothers should receive guidance on proper maternal nutrition in order to help sustain an adequate supply and quality of breast milk. Unnecessary introduction of bottle-feeding, partially or fully, or of other complementary foods and drinks may have a negative impact on breastfeeding, which may be irreversible. Mothers should consult their doctor and consider the social and financial implications before deciding to use breast milk substitutes or if they have difficulty breastfeeding. Usage, preparation and storage instructions of breast milk substitutes or of other complementary foods and drinks should be followed carefully as improper or unnecessary use may pose a health hazard.

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