



The Effect of Breast-milk on Newborn Gut Maturation

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The gut of the newborn is functionally immature and immunonaive at birth. The gut is permeable and leaves open junctions which increases the risk for necrotizing enterocolitis, diarrheal disease and allergies. The GI (gastrointestinal) tract experiences rapid growth and maturation following the birth process. However, it takes many weeks for these junctions of the GI mucosa to mature and close tightly protecting the passage of pathogens and whole proteins to the infant. This permeability decreases faster in breastfed infants compared to formula-fed infants. While this GI development is occurring, colostrum and breast-milk coat the gut providing passive immunity. The mother's IgA from the milk is antigen specific and targets pathogens in the infant's immediate surroundings via the enteromammary pathway. Antibodies are synthesized as she ingests, inhales, or comes in contact with a threatening pathogen.

The newborn is exposed to a variety of bacteria immediately following delivery. The method of delivery utilized has a direct impact on microbial development within the infant's system. Infants born vaginally are colonized with their mother's bacteria, but those born by cesarean are exposed to environmental microbes from the air, other infants, and the nursing staff. The

primary gut flora of these babies may be disturbed for up to six months after birth. Additionally, infants requiring admission to the Intensive Care Unit are at risk for development of undesirable gut flora. For the first six weeks, the normal pH of the breastfed gut is acidic and is dominated by bifidobacteria with minimal pathogenic microbes. This flora is diet-dependant and by the fourth day after delivery 47% of the bacteria in the gut are bifidobacteria. The pH of the formula-fed newborn is higher, allowing a variety of pathogenic bacteria to grow. A primary organism needed to mature and protect the immature gut is bifidobacterium. Interestingly, if a breastfed newborn receives even a single dose of formula the gut flora may be permanently altered.

The newborn gut flora resembles that of a formula-fed newborn. At a minimum it takes two to four weeks for the gut to return to the gram-positive state. If a breastfed newborn is going to receive formula it is ideal to wait until the gut closures occur and permeability is decreased. During this precarious time, infants at risk for cow's milk protein may be exposed to it through formula use, increasing risk of allergy development. Also, infants at risk for insulin-dependent diabetes mellitus (IDDM) may be exposed to cow's milk protein which often increases the risk for developing this disease. Human milk insulin content is relatively high compared to bovine insulin in formula. This insulin plays an important role in the process of gut maturation by supporting intestinal immunities and generating mechanisms to suppress the development of autoimmune diabetes.

The immature newborn gut is protected and supported in its development through breast-milk ingestion. Newborn gut flora remains normal and prevents invasion of pathogens during this time. Breast-milk coats and protects the open junctions which helps aid immunity and prevent exposure to undesirable cow's milk proteins. Taking all of this information into account, one can see that breast-milk ingestion is needed for normal development of the gut following birth.

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