Mother's Own Milk: How Does It Differ from Donor Milk for the Baby

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Keywords: mother's own milk, donor milk, human milk

GUIDELINES FROM the American Academy of Pediatrics recommend that all preterm infants receive mother's own milk or pasteurized donor milk if mother's own milk is unavailable.¹ However, donor milk lacks sufficient levels of protein and other nutrients (e.g., calcium and phosphorus) to support adequate growth in preterm infants, and fortification is required to meet nutrient requirements.^{2–4} Furthermore, many essential bioactive components of breast milk are lost with standard pasteurization techniques (Table 1). For example, the activity of bile salt-stimulated lipase, an enzyme that facilitates lipid hydrolysis and helps with fat digestion, is completely abolished with pasteurization and is not found in formula.^{5,6} Similarly, alkaline phosphatase, an enzyme that dephosphorylates lipopolysaccharide to downregulate inflammatory responses, is nearly completely inactivated after pasteurization. Pasteurization also destroys the majority of live microbes present in donor milk.

Human milk feeding contributes to the development of the infant gut microbiome, yet recent studies have reported the presence of microbes in the placenta, amniotic fluid, and meconium, suggesting that the initial colonization of the infant gut may begin in the womb.^{8–11} The mode of delivery (i.e., cesarean versus vaginal delivery) can also influence development of the early intestinal microbiota and may have long-term consequences. Infants delivered through cesarean section have been shown to have higher odds of several chronic diseases, such as type 1 diabetes, obesity, asthma, and allergies, possibly due to perturbations in the early microbiota.¹² Initial studies suggest that exposing infants born through cesarean delivery to vaginal fluids at birth can partially restore the microbiota¹³; however, the American College of Obstetricians and Gynecologists recommends against vaginal seeding until better efficacy and safety data are available.¹⁴ In addition to mode of delivery, the method of feeding (i.e., formula fed or breastfed) has also been shown to impact the gut microbiota, and it is possible human milk could be used to restore the microbiome in infants born through cesarean delivery.¹⁵

TABLE 1. EFFECT OF HOLDER PASTEURIZATION ON THE COMPONENTS OF DONOR HUMAN MILK

Total lipid	NA or ↓3.5–5.5%
Free fatty acids	↑83%
Lactose and oligosaccharides	NA
Total protein	NA or 4% reduction
Alkaline phosphatase	↓99%
Bile salt-stimulated lipase	Abolished
Lactoferrin	NA or ↓44–91%
Lactoferrin iron binding capacity	↓71%
IgA	NA or ↓20–60%
IgM	Abolished
IgG	↓34%
Lactoperoxidase	↓82%
Lactoperoxidase activity	↓88%
Lysozyme	↓24–60%
Lysozyme activity	NS or ↓65–85%
TGF-β	NA
IGF-I	↓39%
IGF-II	↓10%
IGFBPs	↓7–19%
EGF	NA

EGF, epidermal growth factor; Ig, immunoglobulin; IGF, insulin-like growth factor; IGFBP, insulin-like growth factor-binding protein; NA, not available; TGF, transforming growth factor.

Source: Table courtesy of Dr. Peter Hartmann.

The use of antibiotics in the mother during pregnancy and in preterm infants may also affect development of the infant microbiome. The majority of preterm infants born at <33 weeks gestation are treated with ampicillin and gentamicin for at least 48 hours. Antibiotic exposure can result in dysbiosis and may lead to adverse events, such as increased risk of necrotizing enterocolitis. Human milk contains a diverse array of microbes unique to each mother that may be able to overcome dysbiosis in the intestinal tract.¹⁶ The microbial dose from human milk, assuming an intake of 800 mL per day, is estimated to be ~10 to the 7–8th power bacterial

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cells daily, which is close to the amount used in most probiotic studies. The act of breastfeeding may also influence gut bacteria through the enteromammary pathway, which involves the transfer of antigen-specific antibodies through breast milk. This concept was supported in a study in humans that showed changes in immunomodulatory components in mothers' milk (CD45 leukocytes, macrophages, and tumor necrosis factor- α) in response to active infection in the nursing infant.¹⁷ It is important to note that simply providing mothers' milk is not the same as breastfeeding; pumping and freezing mothers' own milk and lack of direct mother-infant contact may diminish some of the beneficial effects of breastfeeding.

There are several techniques that may be useful in increasing the use of mothers' own milk or at least making donor milk more like the original, including stimulation of early lactation, transfaunation, and improved pasteurization methods. Compared with donor milk, mothers' own milk has a higher concentration of most microbes and differs in the relative abundance of bacterial genera.¹⁸ Mothers' own milk could potentially be used to personalize the microbiota of donor milk.¹⁸ A recent study demonstrated that incubation of donor milk with 10% of mothers' own milk for 4–8 hours resulted in microbe levels similar to those seen in mothers' own milk.¹⁸ Alternative pasteurization techniques, such as ultraviolet C radiation, can be developed that help preserve the essential bioactive components that are lost in the processing of donor milk.¹⁹ Because many aspects of donor milk are suboptimal for preterm infants, there is a theoretical rationale for preferring mothers' own milk over banked donor milk; however, well-designed randomized controlled studies are needed to further evaluate the benefits of mothers' own milk and donor milk in preterm infants.

Disclosure Statement

No competing financial interests exist.

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