Research Overview: The Storage of Breastmilk

The benefits of breastfeeding and the negatives of formula feeding are becoming increasingly apparent through research based evidence. Importantly, this evidence is being communicated to pregnant women, mothers and healthcare professionals. As a result breastfeeding rates in the US have recorded modest increases as reported by the CDC in its latest ‘Breastfeeding Report Card – United States 2010’. Currently, 75% of mothers start breastfeeding, however, research indicates many stop shortly thereafter with exclusive breastfeeding rates at three months at only 33%.

There are many barriers to increased breastfeeding duration in the US, however, separation of the mother from her baby, for whatever reason, stands out as one of the more significant obstacles to overcome. At times of separation, expressed breastmilk is the preferred feeding option for babies (WHO, 2003). Indeed, the act of expressing breastmilk provides distinct benefits for both mother and baby. With regard to the mother, the regular and adequate removal of milk from the breast (in the absence of the infant) supports the ‘supply and demand’ relationship between milk synthesis and removal (Daly et al, 1993) allowing for the continuation of lactation (Win et al, 2006) so that breastfeeding may last as long as the mother and baby mutually wish. For the baby, the known benefits of breastmilk over formula are well documented and new research continues to unearth more benefits at a rapid pace.

For the mother expressing and collecting her breastmilk there are extra challenges. Regardless of the setting (home or hospital) her milk will need to be collected and stored prior to being fed to her baby. This raises the question of optimal storage conditions for breastmilk. While there has been a significant amount of research attempting to optimize storage conditions for cow’s milk, much less work has been done for breastmilk. With respect to milk storage two main questions continually arise, those of bacterial contamination and degradation of milk components. In this edition we have sourced three noteworthy, peer-reviewed research publications all addressing these issues and have summarized the key points for each one.


- Academy of Breastfeeding Medicine, Clinical protocol #8: Human milk storage information for home use for full-term infants (2010).

In reviewing these three articles we cover the biochemistry and breastmilk storage scenarios in both hospital and home.
References:


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The Storage of Breastmilk

Mothers often refer to breastmilk as ‘liquid gold,’ therefore for mothers who express breastmilk, storage is of a key concern -- regardless of their environment (home or hospital). In the next few pages please find summaries of two key research articles as well as the clinical protocols for milk storage from the Academy of Breastfeeding Medicine (ABM). These data provide an up-to-date view of the evidence supporting the development of optimal breastmilk storage conditions and provide you with key talking points.

Key points to note are:

• Bactericidal activity in refrigerated human milk declines in the first 2-3 days of storage; however, the sequestration of bacteria seems to increase at this time. Both activities provide protection to the breastmilk fed infant.

• Human milk has unique properties specifically tailored to human infants.

• Human milk stored in a NICU refrigerator for 96 hours maintains its overall integrity and is safe for infant consumption.

• Fresh milk refrigerated for 4 days compares favorably to frozen or donor milk.

• The ABM guidelines are for full-term infants, not preterm or hospitalized infants.

• Cleanliness of milk expression, storage and handling are emphasized as it affects the numbers and types of bacteria in expressed milk. Milk that has higher bacteria counts will have a shorter shelf life.

• The ABM is very specific about this protocol serving as a guideline, not “an exclusive course of treatment” or standard of care.

• The CDC cites the ABM guidelines for human milk storage on their website.
Research Summary

Prepared by: Jean Rhodes PhD, CNM, IBCLC

Effects of Storage on the Physiochemical and Antibacterial Properties of Human Milk.

Study Background

• This highly technical study examines the effects of different storage temperatures on bactericidal activities, bacteria sequestration activities and the pH of human milk.

• Human milk samples, obtained from 13 healthy lactating women, were grouped by postpartum period of lactation: colostrum, transitional milk and mature milk.

• Some milk samples were exposed to bacteria (e.coli) to test the degree to which human milk can destroy bacteria.

• The authors studied this bactericidal activity of human milk after exposure to refrigeration and freezing.

• Of particular interest, the authors also studied the milk fat globule membrane’s (MFGM) ability to sequester bacteria, preventing them from infecting their host. “Electron microscopic studies of the outer later of human MFGM shows the presence of numerous thin filaments…oriented…into the aqueous phase of milk.” These glycoprotein stands trap bacteria, preventing them from adhering to the mucosal lining of the GI system.

Study Results

• Milk became more acidic over time due to an increase in free fatty acids rather than an increase in bacterial growth.

• Bactericidal properties were diminished but survived in samples frozen for up to 12 weeks.

• Milk bacterial sequestration - or the ability of milk fat globule membrane to adhere to suspended bacteria - was greatly enhanced during the first three to seven days in refrigerated milk when compared to fresh milk. Bacterial sequestration was evident to a lesser degree in human milk frozen for four weeks.

Conclusion:

This study suggests enhanced bacteria sequestration activity compensates for the loss of bactericidal activity in human milk during the first week of refrigeration. The decline in pH of stored human milk is not due to excessive contamination or deterioration of its protective abilities, but rather, the rise in free fatty acids from lipolysis.
Research Summary

Prepared by Jean Rhodes, PhD, CNM, IBCLC

Refrigerator Storage of Expressed Human Milk in the Neonatal Intensive Care Unit.

Study Background

• The goal of this study was to provide recommendations for refrigerator storage of fresh human milk in the NICU setting.

• This is a descriptive, comparative, longitudinal study of 36 samples of fresh, un-fortified human milk stored in NICU refrigerators at 4° C for 96 hours.

• Milk samples were tested at 24, 48, 72 and 96 hours after collection. Variables analyzed were: pH, white blood cells (WBC) and osmolality.

• Additional samples were frozen and analyzed later for bacteria, fat, protein, and several factors known to or which may inhibit the growth of pathogens - secretory IgA, lactoferrin and free fatty acids.

• Results were compared to 5 samples of thawed pasteurized human donor milk (HDM) that were refrigerated for 96 hours and tested for bacteria, pH and free fatty acid concentrations.

Study Results

• Study results suggest human milk stored in a NICU refrigerator for 96 hours maintains its overall integrity and is safe for infant consumption.

• Small changes after 96 hours included:

  - Gram-positive bacteria declined and free fatty acids increased (both reflect anti-microbial aspects of human milk).
  - Milk pH declined.
  - WBCs declined but were higher than WBC levels in frozen or pasteurized milk.
Study Results (continued)

- Total protein declined.
- When compared to HDM, refrigerated fresh milk had a higher pH (more normal pH) and lower free fatty acid concentrations but at levels deemed safe for infant feeding.

Study limitations

The authors did not study the changes or evaluate the safety of fresh refrigerated milk beyond 4 days.

- Clinical trial data is available regarding feeding mothers’ milk stored for 96 hours in the refrigerator to NICU infants.

Notes
ABM Clinical Protocol #8: Human Milk Storage Information for Home Use for Full-Term Infants.

Background

- The Academy of Breastfeeding Medicine (ABM) recognizes the importance of human milk storage and handling guidelines to the overall success of breastfeeding.

- These guidelines are a revision of the 2004 Clinical Protocol on human milk storage. They are an excellent synthesis of the issues related to human milk storage and handling, both in terms of what is known and what information is lacking. These guidelines are for term infants, not preterm or hospitalized.

Preparation for Human Milk Storage

- The protocol stresses the importance of hand and pump cleaning prior to milk expression and the use of clean storage containers.

- The authors recommend avoiding milk containers with bisphenol A (BPA) for the storage of Human Milk.

- The authors discuss many of the variables involved in milk storage at different temperatures including cleanliness of collection, room temperature variation and the effects of temperature on specific milk components.

- Recommendations include avoid adding warm milk to previously cooled or frozen milk, and store milk in small increments to avoid wastage.

Using Stored Human Milk

- Infants may drink thawed milk at a variety of temperatures from cool to warm, depending on infant preference.

- Milk that has been brought to room temperature should be used within several hours.
Using Stored Human Milk (continued)

- Milk that has been used for a feeding, i.e., infant’s mouth has had contact with the milk, should be used within 1-2 hours after the feeding.

- Milk from a mother with a breast infection is acceptable for use.

- However, milk that is “stringy, foul or purulent” should be discarded.

- The authors do not have enough data to make recommendations about refreezing thawed milk.

ABM Milk Storage Guidelines

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<tr>
<th>Location of storage</th>
<th>Temperature</th>
<th>Maximum recommended storage duration</th>
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| Room temperature    | 16-29°C (60-85°F) | • 3-4 hours optimal  
|                     |                   | • 6-8 hours acceptable under very clean conditions                      |
| Refrigerator        | ≤ 4°C (39°F)      | • 72 hours optimal  
|                     |                   | • 5-8 days under very clean conditions                                   |
| Freezer             | < - 4°C (24°F)    | • 6 months optimal  
|                     |                   | • 12 months acceptable                                                 |

Notes
Additional Human Milk Collection and Storage Resources


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Collection & Storage of Human Milk

www.medela.com

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