Nipple Health in lactating women

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Introduction

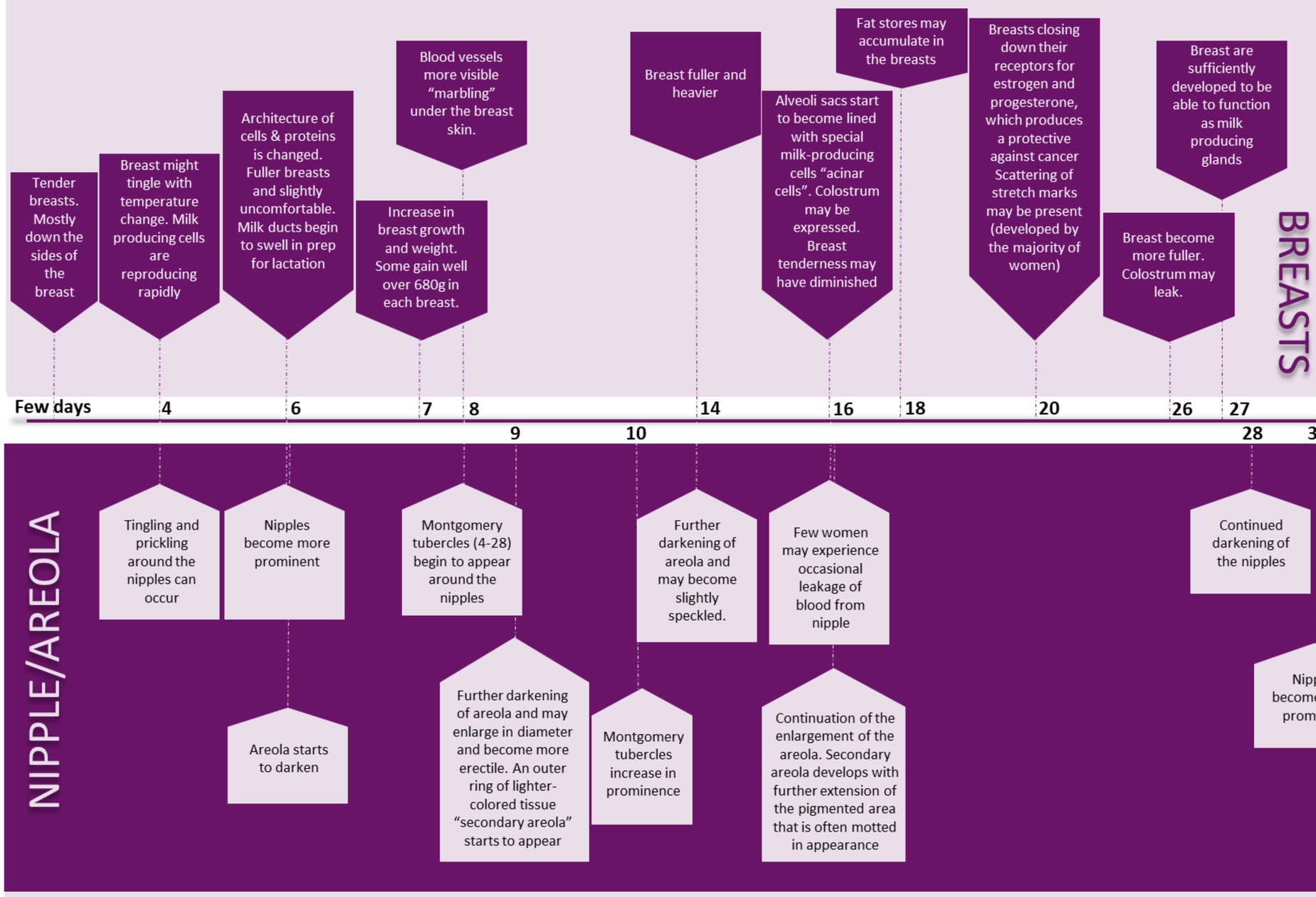
During pregnancy the breasts and nipples undergo many changes, which are all for the preparation of the lactation phase. In lactating women, nipple pain is a common problem, occurring in up to 96% of the women. Pain and discomfort are common in the first few weeks postpartum. Beyond this early period, reports of pain generally decline, but as many as one in five women report persistent pain at 2 months postpartum. Symptoms of nipple pain include (but are not limited to): stinging, itching, stabbing, aching, erytemic and blistered nipples (with or without fissures and eschar present). Nipple pain can occur at the start of a feed, during the feed or persist between feeding sessions [1,2].

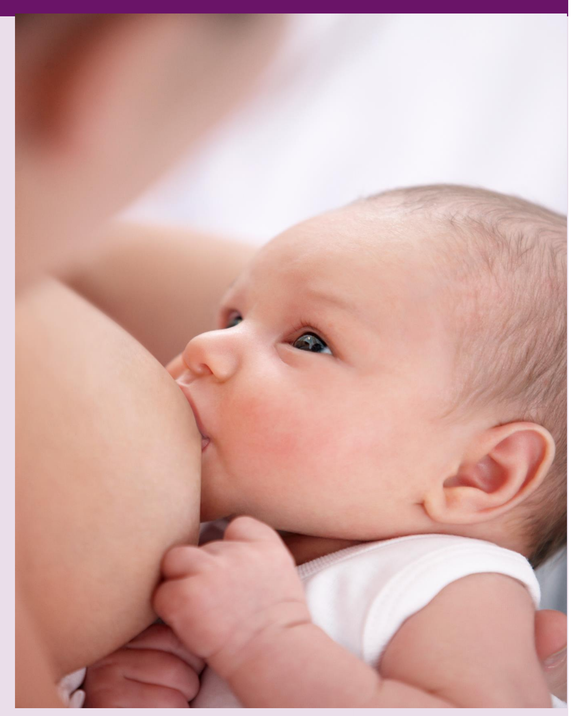
Methods & Results

Literature search was performed to create a detailed insight of the skin (including nipple & areola) changes during pregnancy and to identify nipple pain causes in lactating women. The breast skin and nipples undergo many changes during pregnancy; however, it is unclear if these changes have an effect on nipple pain during the lactation phase.

Results

Skin changes during pregnancy [3,4,5,6]





Studies have reported that among the women (n=1323) who stopped breastfeeding during the first month postpartum, 29.3% cited pain and 36.8% identified sore, cracked or bleeding nipples [7]. Nipple pain is the second most common reason for early weaning and it can be caused by mechanical, physiological, dermatological and infective reasons [8].

Mechanical [9,10]	Physiological [7,11]	Dermatological [7]	Infective [7,12]
Poor positioning and attachment	*Breast engorgement*	*Dermatitis*	*Mastitis*
Blocked duct	*Nipple vasospasm*	*Psoriasis*	*Candida infection*
Anatomical variations in the infant	*Hormonal sensitivity*	*Mammary Paget's disease*	*Herpes simplex*

Conclusions

The results from the literature search showed that:

- Many changes occur in the breast skin and nipple during pregnancy.
- Nipple pain is the second most common reason to stop lactating.
- Nipple pain during lactation could be caused by many factors.

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Pilot study: Tactile stimulation of the nipple by a novel breast shield

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Introduction

To establish and maintain milk production it is important that the lactating breast is both stimulated and emptied sufficiently. The milk ejection reflex (MER) is a vital mechanism in the lactation process, triggered by tactile stimulation of the nipple-areola complex of the mother's breast. The MER occurs much faster due to nipple stimulation by the baby during breastfeeding compared to stimulation patterns of conventional breast pumps during milk expression. Therefore, we aimed to investigate the concept of tactile stimulation, implemented in a novel breast shield designed to mimic the baby, by including active touch of the nipple-areola complex during milk expression.

Methods

During 6 milk expression sessions of 8 lactating women we collected data on milk weight, comparing the novel breast shield to a conventional breast shield. Milk flow data was calculated from the milk weight measurements. The main outcome parameters were milk weight, expression time and time to MER. Questionnaires were used to capture perception of breast pump performance.

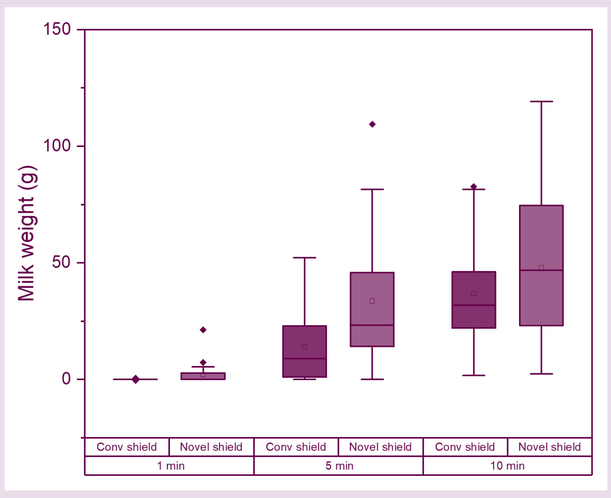
Results

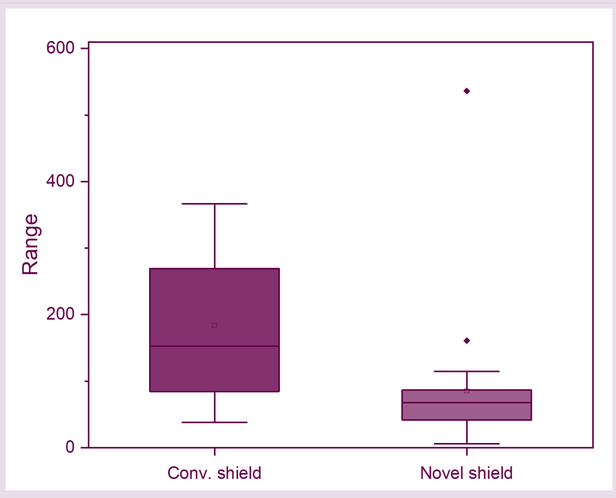
There was a significant reduction of 1m39s ($p<0.05$) in time to first milk ejection reflex when using the novel breast shield.

Moreover, the expression time was reduced by 3m39s ($p<0.05$) compared to the conventional breast shield, with the same amount of milk expressed.

More than double the weight of milk was expressed with the novel breast shield in the first 5 minutes after the start of expression.

Comfort was rated significantly higher with the novel breast shield.





	Novel breast shield Median (SEM) (n=24)	Conventional breast shield Median (SEM) (n=22)	p-value
Total milk weight (g) (both breasts)	58.50 (14.2)	75.80 (13.0)	0.692
Milk weight at 10 min (g) (right breast only)	46.81 (7.6)	31.88 (5.1)	0.116
Milk weight at 5 min (g) (right breast only)	**23.25 (5.7)**	**8.91 (3.3)**	**0.003**
Milk weight at 1 min (g) (right breast only)	**0.01 (0.93)**	**0.00 (0.03)**	**0.020**
Time to milk ejection (s) (right breast only)	**67.60 (20.8)**	**152.80 (23.0)**	**0.001**
Peak milk flow (g/s) (right breast only)	0.22 (0.02)	0.22 (0.02)	0.187
Average milk flow (g/s) (right breast only)	**0.08 (0.02)**	**0.05 (0.01)**	**0.047**
Expression time (min)	**11.91 (1.2)**	**15.13 (1.3)**	**0.022**
Time to reach 50% (min) (from start)	**4.42 (0.9)**	**7.16 (1.0)**	**0.035**
Time to reach 80% (min) (from start)	**6.93 (1.0)**	**9.29 (1.1)**	**0.015**

Conclusions

This study shows that the novel breast shield with an active touch of the nipple-areola complex designed to mimic natural sucking behavior of a baby, results in more efficient and comfortable milk expression. The measured time to first MER in this study with the novel breast shield is in the same range as the time to first MER during breastfeeding. This shows that the stimulation of the novel breast shield is similar to that of the natural nipple stimulation of the baby.

Tongue movement during breast-feeding

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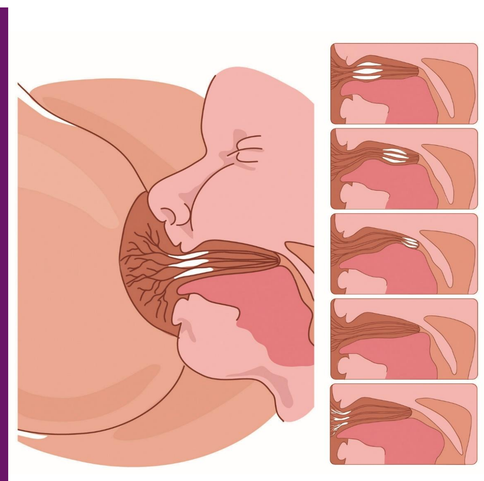
Introduction

Historically, two main theories regarding the removal of milk from the breast by the infant have evolved and remained a controversy[1].
The main reason behind this ongoing controversy is due to the lack of objective and quantified analysis.

The stripping theory[3]

- A stripping action by upward movement of the tongue (or peristaltic movement)
- The application of vacuum to create a pressure gradient



The intra-oral vacuum theory[2,3]

- Negative pressure created, inside the oral cavity, by the infants
- Absence of peristaltic tongue movements4.

We investigated the tongue motion of infant during breast-feeding by objective analysis of submental ultrasound videos using image processing tools.

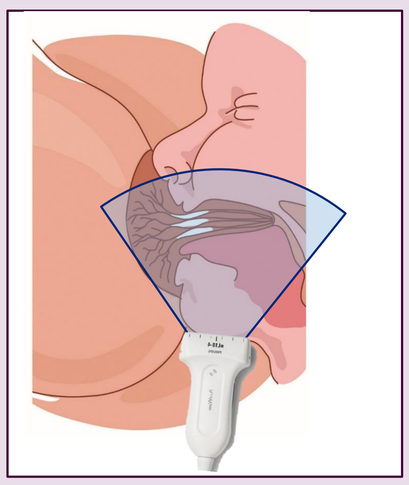
Methods & Results

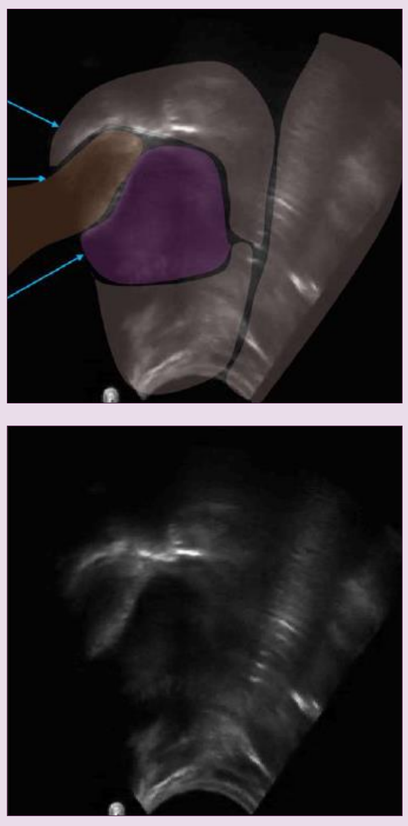
Methods
Sub-mental ultrasound video clips of 18 babies were analyzed.
The image processing approach was to directly track moving interfaces around the tongue/nipple and nipple/palate interfaces over time at several position along the nipple.

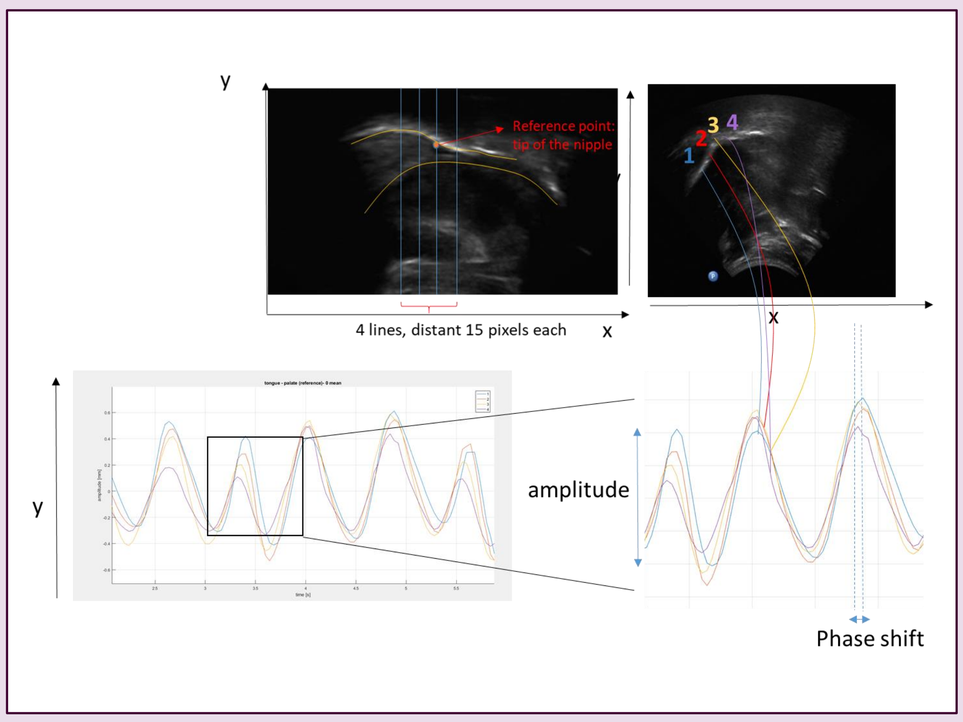
Oscillating curves corresponding to the movement of the tongue at each position can be extracted.

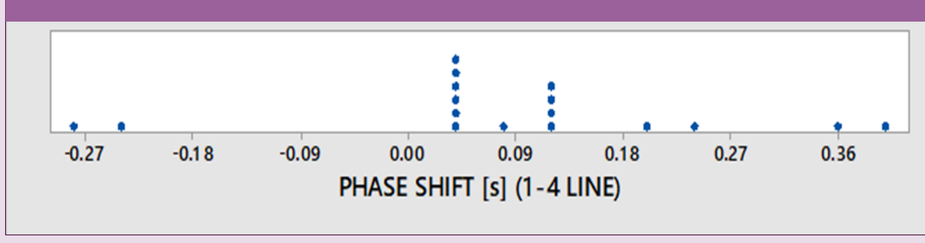
The extent of the phase shift between the curves give a direct indication on the presence of a peristaltic movement.

Results
Out of the 18 babies, 15 showed a positive phase shift. According to these results, the tongue of the babies applies a peristalsis-like action while sucking the milk from the breast.









Conclusions

The ***results obtained from this study indicate that the tongue of the babies is moving with a peristaltic-like action.*** However, our study does not tell about the actual effect of the peristaltic motion on the milk extraction. To our knowledge, ***this study is the first objective analysis made on the tongue movement showing a peristaltic-like motion.*** The simple method used to extract the curves has shown to be effective and it is a good method for future studies on the tongue movement. The quality of the US videos are however still very critical as the algorithm is not able yet to compensate for horizontal motion and may not work with low contrast images.

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Handling and storage of expressed milk

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Introduction

General guidelines exist for the storage of expressed breast milk. These are based on assumptions that people will store their milk either at room temperature, or in the fridge, or in the freezer.

But does this reflect what people actually do?

Expressed milk goes through multiple steps, that can be represented in a user flow: after expressing the mother need to cool the milk, bring it home and prepare it for longer storage. For using the milk, some planning is required. This can involve transport of milk to a daycare, where the milk will be temporarily stored again.

Storage guidelines as published by La Leche League

(https://www.lalecheliga.de/images/Infoblaetter/LLL_Muttermilch_gewinnen_und_aufbewahren.pdf)

Storage location	Temperature	Optimal	Acceptable
Room	16 – 29 °C	3-4 hours	6-8 hours
Refrigerator	4 °C	72 hours	5-8 days
Freezer	< –18 °C	6 months	12 months

⚠Warning: Hygiene is very important. Use clean devices and storage containers. Do not touch the milk with your hands.

⚠Warning: Thawed milk should stored in the fridge and used within 24 hours.

User flow

Approach

We performed social listening on blogs, and found out that:

- There are many questions and uncertainties about the guidelines
- Even when parents are aware of guidelines, they ‘stack’ (for example: after 4 days in the fridge you can still freeze it for 6 months)
- Unfinished bottles are stored and offered a second time
- Also when stored according to guidelines, changed milk quality upon storage and bottle refusal is relatively common

I know the rules regarding how long the milk can be at room temperature and in the fridge and such but can you leave the milk out at room temperature and THEN refrigerate it and likewise can you max out the fridge time and THEN freeze it?

Know its 6 days in the fridge and 6 hours at room temperature, but how long does it last when its been in the fridge for a few days and is taken out?

I know the general guidelines for keeping expressed breastmilk, but I'm a little confused. Today at work I pumped 6oz* and kept it between ice packs in my cooler bag, got home 3hrs later and immediately put it in the fridge. It's been there for 5hrs. I don't foresee using it tomorrow, so can I put it in the freezer? If I were to leave it in the fridge, how soon do I need to use it? * 1oz = 29.6 ml

Omg I thought defrosted breastmilk would keep in fridge for 5 days like fresh breastmilk. I gave dd* a bottle of milk and she kept pulling faces so when I smelled/tasted it, it was clearly off as smelled like sick. She drank an oz** of it, do you think she will be ok? I feel terrible and a crap Mam
* dear daughter ** 1oz = 29.6 ml

My question is does anyone know if it's safe to mix the cold milk with the newly pumped milk?

Basically if I warm a bottle, and if baby doesn’t finish it within 20-30 mins of being out room temp, I put it back in the fridge for later & feed at the next feeding (including re-warming). I’ve done this 2-3 times per bottle, and kept leftover milk overnight in the fridge for up to 12 hrs and served it the next morning when baby woke up.

All the books said to freeze a stash to extend BF'ing. So I pumped and pumped and pumped, bought sterile breast milk bags and froze. Tucked into the stash by defrosting them in the fridge for 24hrs two bags at a time, and she hates it.

Breastmilk is ok out of the fridge for 6 hours and can be warmed twice. Therefore it sounds like the milk will be fine... If you won't use it within 6 hours pop it back in the fridge and use within 24 hours

Summarizing remarks

People struggle to implement the guidelines into their way of working. While doing so, they adopt habits that can cause risks for the infants.

It is known by many that the quality of stored breast milk declines due to lipolysis and bacterial spoilage. Chemical oxidation is hardly known.

Guidelines should reflect better the real life situations of and more research is needed to know the quality decline of stored breast milk.

Milk quality change

Milk is known to change during storage due to lipolysis, chemical oxidation and bacterial spoilage[1-3]. This will lead to changes in odor and taste[4,5]. Infants will notice this change, but not in all cases refuse a bottle of milk[6,7]. More research is needed to fully understand the changes upon storage of expressed breast milk.

Human milk odor changes upon storage[8] These can influence acceptance

Fresh milk	Stored milk
Hay	Soapy
Metallic	Metallic
Sweet	Sweaty
Fatty	Rancid
Cooked milk	Fishy
Soy bean	Unpleasant
Slightly buttery	Nauseating

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