



### Eatin' at Mom's- How Diet Influences Breastmilk

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## Objectives

- Describe the role of the maternal diet in allergic disease of the breastfeeding infant.
- Explain the role of DHA in the maternal diet, and current recommendations on DHA intake.
- Identify how vitamin supplementation influences vitamin levels in breastmilk.
- Describe how calcium supplementation for breastfeeding women influences maternal bone density.
- Discuss the role of maternal Vit D supplementation and BM vitamin D level
- Explain the role of choline in infant development and dietary sources of choline
- Explain why BM has an off-odor
- Understand the effect of maternal probiotic supplementation and BM probiotic levels



### Why 1,000 Days

The 1,000 days between a woman's pregnancy and her child's 2nd birthday offer a unique window of opportunity to build healthier and more prosperous futures.

*"Poor nutrition in the first 1000 days can cause irreversible damage to a child's growing brain... It can also set the stage for later obesity, diabetes, and other chronic diseases..."*

### BREAST FEEDING

It seems unnecessary to present arguments that every mother who can should nurse her infant, and most mothers can, at least for the first few months. It is in these early months that natural feeding is of greatest importance. Despite the fact that human milk is such an excellent food, it must be recognized that the milk varies in quality and vitamins cannot be present in the milk unless they have been taken in adequate quantities by the mother. In order that her milk be at its best and serve well its intended purpose, the mother must observe the common rules of good hygiene and diet. These rules are fully as necessary for her own health as for that of the baby. Mothers frequently develop cavities in their teeth during lactation, because they secrete more calcium in the milk than they ingest. It is desirable also that the mother have sufficient sleep and moderate exercise but never to the point of fatigue. Worry and other nervous states often have a harmful effect which may be reflected in the quality of the milk.

The diet of the mother may be quite varied, and any food is permissible unless it causes digestive disturbance. The avoidance of acid foods is a fallacy. Examples of a well-balanced diet for the pregnant

The Modern Home Medical Advisor, 1940

## Maternal Diet Recommendations by the CDC

**CDC** Centers for Disease Control and Prevention  
CDC 24/7: Saving Lives, Protecting People™

- An additional 450-500 kcal/day
- Drink enough water to quench thirst
- Limit intake of beverages with added sugars
- Talk to your doctor before drinking alcohol or caffeine
- Talk to your doctor about taking a vitamin supplement
- Eat at least 8-12 of seafood a week that is low in mercury
- Low fat dairy
- Use whole grains
- Vary proteins
- Use vegetable oils rather than butter

### Daily Food Checklist

The Checklist shows different amounts of food depending on how much of your baby's diet is human milk. Moms who feed only human milk to their baby need slightly more food. This is a general checklist. You may need more or less amounts of food.\*

Food Group	Breastfeeding only	Breastfeeding plus formula	What counts as 1 cup or 1 ounce?
<b>Fruits</b>	2 cups	2 cups	1 cup fruit or 100% juice 1/2 cup fruit
<b>Vegetables</b>	3 cups	2 1/2 cups	1 cup raw or cooked vegetables or 100% juice 2 cups raw leafy vegetables
<b>Grains</b>	8 ounces	6 ounces	1 slice bread 1 ounce ready-to-eat cereal 1/2 cup cooked pasta, rice, or cereal
<b>Protein Feeds</b>	6 1/2 ounces	5 1/2 ounces	1 ounce lean meat, poultry, or seafood 1/2 cup cooked beans 1 ounce nuts or 1 Tbsp peanut butter 1 egg
<b>Dairy</b>	3 cups	3 cups	1 cup milk 8 ounces yogurt 1 1/2 ounces natural cheese 2 ounces processed cheese

\*If you are not living weight you gained in pregnancy, you may need to cut back on the amount or change the types of food you are eating.

Get a Daily Food Checklist for Moms designed just for you.  
Go to [Checklist4Moms.gov/Checklist](https://Checklist4Moms.gov/Checklist)

## Breastfeeding and Food Allergies



A woman reports that her first child is allergic to eggs and peanuts. She is contemplating a second pregnancy asks you if she should avoid eggs and peanuts in her diet during pregnancy and lactation, with the hope that her next child won't have these food allergies.

You advise:

- A. Yes, it would be wise to avoid these foods during pregnancy and lactation
- B. You just need to avoid them during lactation
- C. Avoiding these foods during pregnancy and lactation will not prevent food allergies.

## Breastfeeding and Food Allergies

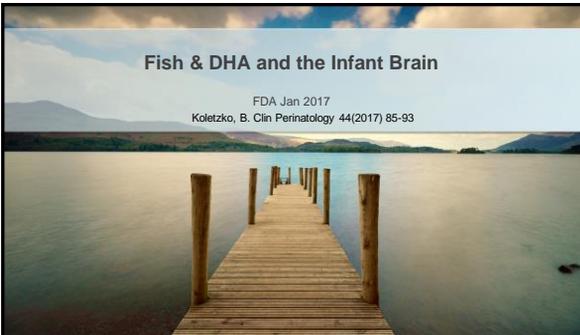


- No good evidence to support avoidance of allergenic foods during pregnancy and/or lactation to avoid childhood food allergies.
- Only 1 systematic review found that maternal diet rich in fruits, vegetables, fish, foods with vit D and Mediterranean dietary pattern may be associated with lower allergy risk in infants.

Pediatrics 2019; 143(4)

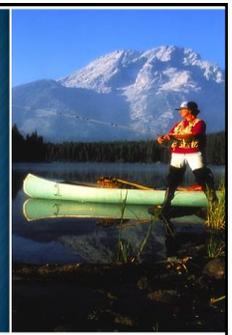
## Fish & DHA and the Infant Brain

FDA Jan 2017  
Koletzko, B. Clin Perinatology 44(2017) 85-93



## True or False?

Premature infants exposed to high amounts of DHA have improved visual function by the corrected age of 4 months.  T or F



## Fish & DHA and the Developing Infant Brain



- Breastfeeding meets the DHA needs of term infants, but not for preterm infants.
- For VLBW infants high DHA supplementation is associated with:
  - Enhanced visual and cognitive development
  - Reduced severe developmental delay
  - Reduced bronchopulmonary dysplasia
  - Reduced NEC
  - Reduced environmental allergies such as hayfever
- Mothers with VLBW infants need to take DHA supplements. Studies show that 3 grams of tuna oil/day would suffice.

## Fish & DHA and the Developing Infant Brain For Term Infants



- Fish is an important source of protein and DHA for pregnant and nursing individuals, and for children.
- DHA develops neural tissue
  - neurogenesis, neurotransmission, myelination, among other neurologic effects
- Moderate fish consumption during pregnancy is associated with a child's early verbal development and IQ.
  - If a pregnant mother eats 8-12 oz of fish a week, her child may gain 3.3 extra IQ points by age 9.
  - More than 12 oz of week not shown to be beneficial, and increases mercury exposure
  - Eating less than 3 oz a week is harmful to the fetus
- Canned light tuna is the least expensive and safest way to consume the recommended amount of fish each week.

What is a serving? As a guide, use the palm of your hand.

For an adult 1 serving = 4 ounces  
Eat 2 to 3 servings a week, from the "Best Choices" list (OR 1 serving from the "Good Choices" list).

For children, a serving is 1 ounce at age 2 and increases with age to 4 ounces by age 11.

If you eat fish caught by family or friends, check for fish advisories. If there is no advisory, eat only one serving and no other fish that week.\*

<https://www.fda.gov/food/consumers/advice-about-eating-fish>

Best Choices (Eat 2 to 3 servings a week)		Good Choices (Eat 1 serving a week)	
Anchovy	Smelt	Bluefish	Walleye
Atlantic croaker	Starling	Brook Trout	Whitefish
Atlantic menhaden	Striped bass	Carpe	Yellow perch
Black sea bass	Trout	Chinook salmon	Yellowtail
Breastfish	Walleye	Flounder	Whitefish
Catfish	Whitefish	Goatfish	Whitefish
Clam	Yellowtail	King mackerel	Whitefish
Cod	Yellowtail	Shrimp	Whitefish
Cook	Yellowtail	Shrimp	Whitefish
Crab	Yellowtail	Shrimp	Whitefish
Flounder	Yellowtail	Shrimp	Whitefish
Halibut	Yellowtail	Shrimp	Whitefish
Headstock	Yellowtail	Shrimp	Whitefish
Hake	Yellowtail	Shrimp	Whitefish
Salmon	Yellowtail	Shrimp	Whitefish
Sardine	Yellowtail	Shrimp	Whitefish

**Choices to Avoid**  
(Avoid completely)

King mackerel	Shark
Mahi-mahi	Shark
Orange roughy	Shark
	Shark
	Shark
	Shark

A mother has a history of migraines, and she was told by her neurologist to take 400mg of vitamin B-2 (riboflavin) each day to prevent migraines. (The RDA is 1.3 mg) Now that she is breastfeeding, she is wondering if this is safe. The neurologist told her to ask a lactation consultant.

You advise:

- No, because the amount is too high for the infant
- Yes it is safe because the amount in breastmilk is not excessively high



### Maternal Vitamin/Mineral Intake and Breastmilk Levels

Increased Intake Increases BM Levels	Increased Intake Does Not Change BM Levels
<ul style="list-style-type: none"> <li>Vitamins:                             <ul style="list-style-type: none"> <li>- A, C, D, E</li> <li>- B-1, B-2, B-6, B-12</li> </ul> </li> <li>Selenium</li> </ul>	<ul style="list-style-type: none"> <li>Zinc</li> <li>Copper</li> <li>Iron</li> <li>Chromium</li> <li>Cadmium</li> <li>Calcium</li> </ul>

Breastfeeding Med 12(9) 2017; Matern Child Nutr 2018; 14(S3)

TABLE 2. HIGH-DOSE ORAL VITAMIN USES

Vitamin	Use <sup>a</sup>	Daily high dose <sup>b</sup>
B <sub>2</sub>	Migraine	400 mg
B <sub>6</sub>	Neuritis	200–600 mg
B <sub>12</sub>	Anemia, CV health, vegetarianism	250–5,000 mcg
Biotin	Skin and hair health	2.5 mg
C	Common cold	250–1,000 mg
D	Bone health, cancer prevention	2,000–6,000 IU
K	Bone health, CV health	1–5 mg

<sup>a</sup>Reported benefits in the mother, not necessarily endorsed by the author. See NIH.<sup>9</sup> for more information.  
<sup>b</sup>Typical doses likely to be encountered, see text and NIH.<sup>9</sup> CV, cardiovascular.

Breastfeeding Med 14(5) 2019

### High Dose Vitamins During Lactation

Breastfeeding Med 14(5) 2019

- Vit C- highest dose of 4,000mg- infant dose safe, limit of transmission into BM
- B-2 (riboflavin)- High doses (400mg) for HA prevention- wide margin of safety. High doses used for neonates with hyperbilia
- B-6- high doses markedly increase BM level. Best to avoid megadoses (over 200mg/day). Effect on infant not known
- B-12- supplements of up to 5000mcg a day is considered safe, based on BM levels. Wide margin of safety
- Vit K- mat doses of 1-5mg are safe for infant, similar to levels in formula
- Biotin- high mat doses of 2500mcg assumed safe, wide margin of safety

### Vegetarian/Vegan Diets and Breastmilk

- 5% of adults in the USA in 2012 were vegetarian
  - 1.4-2% are vegan
- Vegetarian diets differ between individuals and cultures/populations.
- Low B-12 intake during lactation => low breastmilk B-12 content
- Lower DHA in breastmilk unless eating fish or supplementing with DHA
- Fewer saturated fats and trans fats in breastmilk
- Lower vit D levels in breastmilk without supplementation
  - Vit D is found in fish, liver oils, egg yolks. Less in beans, broccoli, leafy greens

Nutrients 2019, 11, 557

The amount of vitamin D that a breastfeeding mother needs in order to provide sufficient vitamin D in her breastmilk depends on her BMI.

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### Vitamin D During Breastfeeding

- All infants require 400-1000 units of vitamin D each day
  - Responsible for bone metabolism and calcium homeostasis
    - Increases calcium absorption from the gut
  - Sources are UVB radiation, oily fish, fortified milks, or vitamins
- Nutritional rickets in USA 1986-2003
  - 83% AA, 96% breastfed, only 5% were supplementing with Vit D
- Vitamin D levels in breastmilk are based on maternal serum Vit D level
- Maternal dosing of 6400u of vit D-3 daily may bring BM levels to sufficiency
  - Mat Vit D dosing converts to 25 (OH) D in maternal liver within 24 hrs
  - 25 (OH) D does not pass into breastmilk, just D3
  - D3 needs to be taken EVERYDAY for adequate D in BM

Best Practice & Research Clin Endocrin & Metab 32 (2018) 39-45  
Pediatrics 136 (4) Oct 2015 p. 625- 634

### Effect of Obesity on Vitamin D Level

Mean 25(OH)D concentrations and bone mineral densities in all participants and by BMI subgroup at V1, V4 and V7

		Maternal BMI category			
		Total	<25 kg/m <sup>2</sup>	25 - <30	≥30 kg/m <sup>2</sup>
V1	Mean (SD) maternal 25(OH)D concentration, ng/ml	34.1 (13.1)	37.2 (14.4)	34.7 (13.8)	34.1 (12.9)
	Mean (SD) maternal bone mineral density, g/cm <sup>2</sup>	1.01 (0.13)	0.97 (0.13)	1.04 (0.13)	1.00 (0.13)
	Mean (SD) infant 25(OH)D concentration, ng/ml	14.2 (8.4)	13.3 (8.4)	13.1 (8.2)	14.3 (8.6)
V4	Mean (SD) maternal 25(OH)D concentration, ng/ml	32.1 (12.5)	37.4 (14.2)	34.2 (13.5)	32.9 (12.8)
	Mean (SD) maternal bone mineral density, g/cm <sup>2</sup>	1.00 (0.12)	0.98 (0.12)	1.01 (0.12)	1.01 (0.12)
	Mean (SD) infant 25(OH)D concentration, ng/ml	14.2 (8.4)	13.3 (8.4)	13.1 (8.2)	14.3 (8.6)
V7	Mean (SD) maternal 25(OH)D concentration, ng/ml	32.1 (12.5)	37.4 (14.2)	34.2 (13.5)	32.9 (12.8)
	Mean (SD) maternal bone mineral density, g/cm <sup>2</sup>	1.00 (0.12)	0.98 (0.12)	1.01 (0.12)	1.01 (0.12)
	Mean (SD) infant 25(OH)D concentration, ng/ml	14.2 (8.4)	13.3 (8.4)	13.1 (8.2)	14.3 (8.6)

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- All mother given 6400 units of vitamin D supplementation
  - Lower vit D level in infants of high BMI moms
  - Higher bone density with higher BMI

J Pediatr 2017 Aug; 187: 147-152

### Breastfeeding mothers have a higher calcium requirement than non-breastfeeding mothers

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### Do Breastfeeding Women Need More Calcium?

- 99% of calcium in a mother's body is in her bones
- Maternal PTH removes Ca from the bones into blood stream
- Calcium in BM comes from maternal bones (decrease in bone density)
- Mammary glands secrete PTH-related protein (PTHrP)
  - Liberates calcium from mother's bones
- High PRL inhibits estrogen/progesterone, allowing bone resorption
- When Ca in BM falls, PTHrP increases

### Bone Density Changes During Lactation

- Lumbar spine density decreases 5-10% during lactation (1-3%/month)
  - Hip, forearm and other sites much less bone loss
  - Less bone density loss for higher BMI
    - Higher estrogen level from body fat
- Greater milk output, greater bone density loss

J Bone Min Res 2017 Apr; 32(4)

## Do Breastfeeding Women Need More Calcium?

- Recommendations for calcium intake are 1000mg for non-pregnant, pregnant, and lactating women
- Increasing mat calcium during lactation does not increase BM calcium level
  - Tight control by PTHrP
  - No increase in calcium from the gut during lactation
- Increasing mat dietary calcium does not decrease bone resorption
- Breastmilk calcium levels ~ 260mg/liter
- The higher the milk produced, the greater the maternal calcium loss from bones

## Sweeteners in Breastmilk



Artificial sweeteners are considered unsafe during breastfeeding

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## Artificial Sweeteners

- Acesulfame- found in diet sodas and artificial sweetener packets
  - Level in BM related to maternal dose, lasts in BM at least 18 hours
- Aspartame- breaks down in maternal GI tract to aspartic acid and phenylalanine
  - Only results in a slight rise in BM phenylalanine level
- Saccharin
  - Level in BM related to maternal dose
  - 4 cans of diet soda with saccharin daily for 2 days=> level in BM safe according to FDA (under recommended daily limit as mg/kg/day)
- Sucralose
  - Transmits into breastmilk, little else known about safety, but levels are low
- No info on stevia or xylitol
- Mannitol, sorbitol considered safe (e-lactancia.org)

Breastfeeding Med 14 (1) 2019 p. 15-16

## Natural Sugars

- Fructose- metabolized in the liver to triglycerides. Commonly used are agave and high-fructose corn syrup
  - Increased maternal dietary intake increases BM levels within 3 hours
    - Fructose concentration remains elevated for 5 hours
  - One study showed that for 1mg/L increase in BM fructose is associated with a 257 gram increase in infant body weight, 170g increase in lean mass, 131g increase in fat mass and 5g increase in bone mineral content (Nutrients 2017; 9; 146)
  - Sucrose- table sugar=> fructose and glucose
  - Hyperglycemia in mothers associated with higher BM glucose levels (J Pediatr 1987 Nov-Dec;6(6):936-41)

Breastfeeding Med 14 (1) 2019 p. 15-16

## Fructose and Infant Brain Development

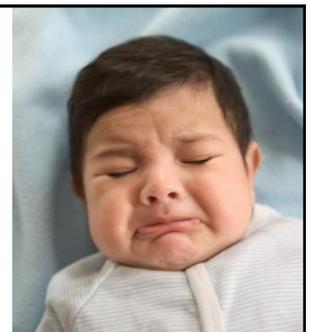
- A study of 88 Hispanic lactating dyads performed a 24 h dietary recall at 1 and 6 mo (well controlled for many other confounders)
  - Sugar sweetened beverages and juices (SSB + J) at 1 mo pp correlated with poorer Bayley-III neurodevelopment scores at 24 months of age
    - Maternal whole fruit intake didn't matter
  - Maternal SSB + J intake at 6 months pp didn't have an impact
  - Infant fructose and SSB + J at 24 mo didn't have an impact
- Exposure to fructose at critical times may impair infant brain development
  - Decreased antioxidant enzymes in frontal cortex
  - Decreased brain-derived neurotrophic factor (a protein that supports brain development)

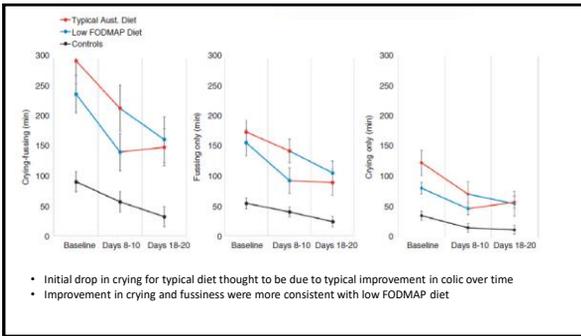
Am J Clin Nutr 112 (6) Dec 2020

## Effect of Maternal FODMAP Diet on Infant Colic

- FODMAP= fermentable oligosaccharides, disaccharides, monosaccharides and polyols
- Colic = > 3hrs/day, >3 days/wk, >3wks
- Dyads with colic randomized to a low FODMAP vs typical Australian diet
  - Blinded, with all foods brought to dyad
  - Control group didn't have colic, and kept their regular diet

Aliment Pharmacol Ther 2018; 1-13





### Keto Diet During Lactation

- Lactation requires glucose
  - To make lactose
  - For general functioning of glandular tissue
- Keto diet is high in fat, adequate in protein, and low in carb (glucose)
  - Energy comes from fat broken down into fatty acids
  - People become ketotic
- Lactating women often try to lose preg weight gain
- Ketoacidosis is the risk of the Keto diet for anyone
  - Blood becomes acidic => life-threatening
  - Bodily stress increases risk of ketoacidosis

Table 1. Literature review of existing case reports and their precipitating factor.

Case Report	Precipitating Factor
A case of lactation "bovine" ketoacidosis [14]	Breastfeeding twins in the setting of a "selected diet"
A severe case of atrogenic lactation ketoacidosis [15]	Nil per oral for 3 days to treat a bowel obstruction
"Bovine ketosis" in a nondiabetic postpartum woman [16]	Urinary tract infection in the setting of a weight reduction diet
Severe spontaneous "bovine" ketoacidosis in a lactating woman [17]	Urinary tract infection in the setting of a high protein, carbohydrate-free reduction diet
A case of bovine ketoacidosis in a lactating woman [18]	2-day nausea & vomiting in the setting of several small high-protein carbohydrate-free meals
Ketoacidosis associated with low-carbohydrate diet in a non-diabetic lactating woman [19]	Low carbohydrate, high fat diet for 10 days
Starvation ketosis in a breastfeeding woman [20]	Bariatric surgery during lactation
Severe ketoacidosis in breastfeeding woman with low energy and carbohydrate intake [21]	Illness while on a low carbohydrate diet
Ketoacidosis in a non-diabetic woman who was fasting during lactation [22]	Starvation during lactation due to abdominal pain
Lactation ketoacidosis: an unusual entity and a review of the literature [23]	No precipitating factor except for lactation
Life-threatening lactation or Bovine ketoacidosis [24]	Frequent skipping of meals while on a high protein, low carbohydrate diet
A rare cause of metabolic acidosis: ketoacidosis in a non-diabetic lactating woman [25]	Gastroenteritis in the setting of a low carbohydrate diet

Case Reports in Nephrology 2019

### Maternal Egg Consumption During Lactation

Matern Child Nutr 2018; 14(S3)

Eggs are one of the best sources of choline

### Maternal Egg Consumption During Lactation

- Excellent source of DHA, choline, lutein, zeaxanthin, riboflavin, B-12
- Choline
  - Precursor for neurotransmitters acetylcholine and sphingomyelin (forms white matter)
  - Promotes long term memory and cognition
  - Eggs are the most concentrated source of choline
    - 2 eggs provide 53% of maternal daily choline requirement during lactation
  - Other sources are meat, poultry, fish (animal-food sources)

Nutrients 2018, 10; 1513

### Foods Rich in Choline (mg/100g)

- Salmon – smoked – 220mg/100g
- Chicken – roasted – 79mg/100g
- Salmon – cooked – 91mg/100g
- Tilapia – 83mg/100g
- Soy protein powder – 86mg/100g
- Peanut Butter – 66mg/100g
- Cocoa powder – 115mg/100g
- Skim Milk – 38mg/cup





Institute of Medicine recommends 550mg/day during breastfeeding, 450mg/day during pregnancy

- Fried egg – 270/100g
- Hard-boiled egg – 230/100g
- Large Egg (one) – 120mg
- Beef Liver – 350mg/100g
- Chicken Liver – 330mg/100g
- Almonds – 52mg/100g
- Broccoli – 40mg/100g
- Brussels sprouts – 41mg/100g
- Cauliflower – 39mg/100g

USDA Database for Choline in Common Foods, Release To: US DAAERS, Jan 2008.

### Carotenoids During Lactation



Nutrients 2017 Aug 4;9 (8)

### Carotenoids and Breastfeeding

- Antioxidants
  - 95% are beta-carotene, alpha-carotene, lycopene, beta-cryptoxanthin, lutein, zeaxanthin
  - Yellow, orange, red colors of produce
  - Also found in egg yolk, trout, salmon
- Highest level is in the brain

Nutrients 2017 Aug 4;9 (8)

### Breastfeeding mothers should avoid excessive orange vegetables during lactation to prevent carotenemia

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• ~~F~~

Nutrients 2017 Aug 4;9 (8)

### Carotenoids in Breastmilk

- Increased intake of carotenoids associated with increased levels in breastmilk
- Highest concentration in colostrum
- Highest in the fat content
- FDA does not require carotenoids in formula

Nutrients 2017 Aug 4;9 (8)

### Role of Carotenoids in Breastmilk

- Anti-oxidants, prevent oxidative stress
  - Prevents decreased blood flow to fetus
  - Prevents inflammatory illnesses such as NEC, Respiratory Distress Syndrome and Bronchopulmonary Dysplasia
  - Evidence of reducing risk of pre-eclampsia
- Promote optimal retinal development
- Lutein may protect the retina from blue light exposure
  - Blue light exposure over time => macular degeneration

Nutrients 2017 Aug 4;9 (8)



## Odor of Refrigerated EBM

- Caused by fat oxidation (rancid)
  - After lipolysis
- 7 pooled samples, each from 4-5 mothers
  - Each sample + 3, 1 fresh, 1 in frig for 1 day, 1 in frig for 3 days
  - 12 trained noses
- Pooled samples differ less than individual
- Increased odor over time
- Not terrible
  - Similar to odors of eggs, cheese
  - Odors from formula are similar in strength/quality



Clinical Nutrition 32 (2013) 1036–1042

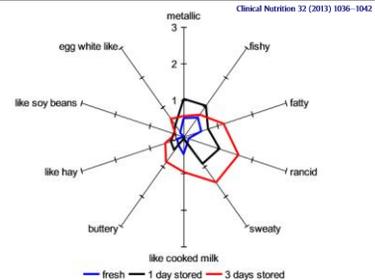


Fig. 1. Comparative sensory evaluation of the orthonasal aroma profile of fresh human milk and human milk stored in the refrigerator at -4 °C for one day and for three days respectively (mean data of two different samples each).

## Odor of Frozen EBM Due to Oxidation

- Fatty acids are oxidized
- Triglycerides may be more available from frozen milk micelles
- Off-odor is worse in frozen milk than refrigerated milk
  - More time in freezer to oxidize
- Limit oxygen exposure during storage



Spitzner J, Baumert A. Characterization of aroma changes in human milk during storage at -18 degrees C. Food Chem 2010;120:249-54.  
Spitzner J, Dueser S, Baumert A. The influence of storage conditions on flavor changes in human milk. Food Qual Prefer 2010;23:568-580.

## Flavors and Odors Detected in BM



- Those detected by chemical analysis:
  - Garlic
  - Alcohol
  - Vanilla
  - Carrots
  - Tobacco
- Several not detected
  - Mothers' Milk Tea (fennel, anise, caraway)
  - Fish oil
- Possible variation in transmission of [and metabolism of] odorants in BM

Physiol & Behavior 199 (2019) 88-99

## Maternal BMI and Macronutrient Breastmilk Composition

- 40 mothers from Warsaw Poland
  - Healthy, term infants, exclusive breastfeeding, nonsmokers, all highly educated
- BM composition measured during 1<sup>st</sup>, 3<sup>rd</sup>, and 6<sup>th</sup> months
- Higher protein content with higher BMI (higher fat mass)
- No association between protein, fat, carb intake in mat diet and BM levels
- Low carb diet does not change lactose content of BM
  - Lactose is the most stable macronutrient, since it drives milk volume
- Milk composition is stable during Ramadan
- Fat concentration is independent of fat intake



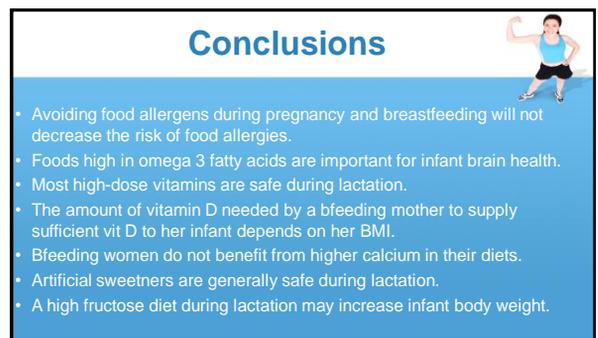
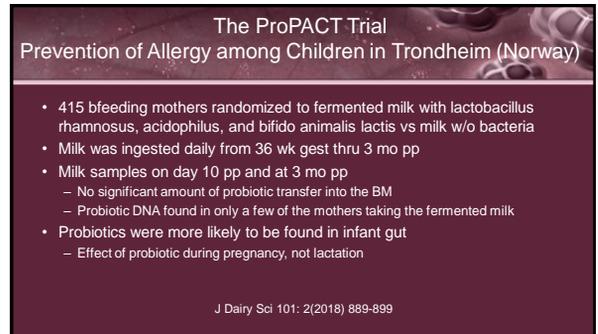
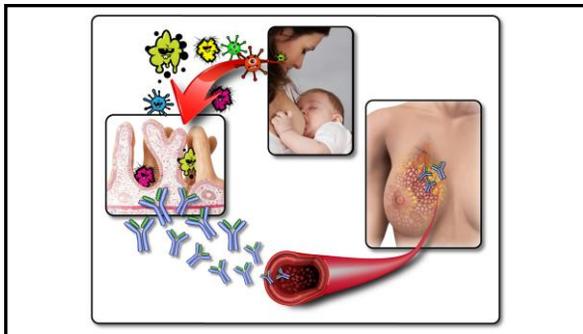
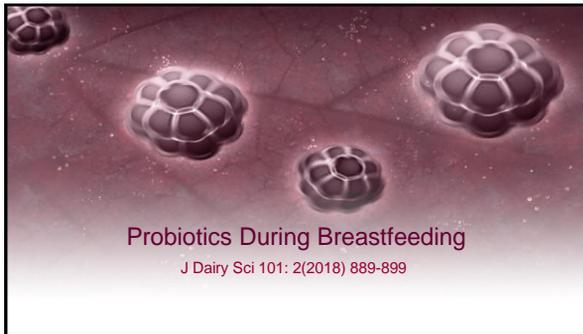
Nutrients 2018, 10, 1379

## Maternal Intake of Fiber During Breastfeeding



- Dietary fiber are 'microbiota-accessible carbohydrates' (MACs)
  - Whole grains, fruits, vegetables, legumes
- Fibers reduce risk of death and chronic disease
  - Reduced inflammatory markers
- Fiber-rich foods during pregnancy found to decrease allergic diseases in infants
- Gut bacteria are required to break down fibers
  - Humans don't make the enzymes themselves, rely on gut bacteria
  - Wide range of bacteria are needed, since bacteria vary in what enzymes they have
- A wide variety of bacteria are supported with 30g of varied fibers in mat diet
- Healthier gut bacteria transmitted to infant

Nutrition and Metabolic Insights 12(1-10) 2019



## Conclusions



- Carotenoids are important during lactation for infant brain and eye development.
- Breastfeeding mothers are encouraged to avoid trans-fats in their diet.
- An off-odor to stored breastmilk is related to oxidation of fatty acids, not the level of lipase.
- Probiotic treatment for breast health during lactation is not ready for prime time.