

Raising Awareness about Breast Milk Composition among Women in Latvia

Liva Aumeistere^{1,2,*}, Dace Zavadska³

¹Institute of Food Safety, Animal Health and Environment BIOR, Riga, Latvia

²Latvia University of Agriculture, Jelgava, Latvia

³Department of Pediatrics, Riga Stradins University, Riga, Latvia

Abstract

Background: Breast milk is the ideal food source that contains all components an infant needs. Infants are at risk of receiving possible pollutants and high levels of trans fatty acids through breast milk that may affect their cardiovascular health and cognitive development. Statistics indicate that the proportion of children who are breastfed up to one year of age shows an annual increase in Latvia.

Objectives:

- To review studies conducted among the Latvian population regarding breast milk composition.
- To evaluate the necessary future studies emphasizing the importance of the trans fatty acid content in a mother's diet and correspondingly in breast milk and taking into consideration the new changes in Latvian legislation setting the maximum trans fat content in foodstuffs.

Conclusions: There is very little research done about the human milk composition in Latvia that could be referable to a general population. It is known that the exposure of breast milk to persistent organic pollutants in Latvia corresponds to the lowest levels detected in the European countries and is not a cause of health disorders. Taking into consideration the adverse effect trans fatty acids have on human's health regardless of the age, consumption should be as low as possible. Latvia has become the latest European Union country to set the maximum amount of trans fats in foodstuffs, yet there is no information about trans fatty acids content in human milk among women in Latvia. This problem needs to be addressed and set in motion. Therefore, it would be a novel idea to study if the TFA content also declines in milk among Latvian women after the introduction of the new legislation.

Corresponding author: Liva Aumeistere, Institute of Food Safety, Animal Health and Environment BIOR, Riga, Latvia, Email: liva.aumeistere@bior.lv

Running title: Breast milk composition among women in Latvia.

Keywords: Breastfeeding; Human milk composition; Contaminants; Diet; Persistent organic pollutants; Trans fatty acids; Latvia.

Received: Aug 07, 2016

Accepted: Nov 06, 2016

Published: Nov 13, 2016

Introduction

For nearly all infants, breast milk is the ideal food source that contains all the nutrients that a young one needs for growing. It also contains a wide range of biologically active substances, including immunoglobulins, hormones, growth factors and at least 60 enzymes, ensuring immunological and anti-inflammatory properties against many diseases [1-6]. Since breastfeeding attributes health benefits to both infant and mother, the World Health Organization (WHO) recommends that all children should be exclusively breastfed for the first 6 months after birth and breastfeeding should be continued up to 2 years of age and beyond [7].

Nutritional requirements during lactation are greater than during pregnancy. Breast milk may sometimes contain considerable amounts of toxic chemicals because of maternal dietary exposure. Accordingly, a woman's diet is a major factor greatly affecting an infant's future life [1, 4, 7, 8-12].

Breastfeeding is not only the cornerstone of a child's healthy development; it is also the foundation of a country's development. Supporting breastfeeding is one of the smartest investments a country can make in the wellbeing of their citizens, and thus, in their own long-term strength [13]. Hence, responsible authorities need to encourage mothers to choose breastfeeding over formula feeding and to nurse as long as possible. Moreover, it is critical to educate mothers about the diet's impact on the breast milk composition to ensure the best possible outcome for offspring.

World Breastfeeding Week is celebrated every year from 1th to 7th August to encourage breastfeeding and improve the health of babies around the world [14], also in Latvia.

The Republic of Latvia is one of the Baltic countries and forms part of the eastern border of the European Union. It is a sparsely populated country with about 2 million inhabitants and with slightly more women than men (54% female in 2010) [15].

Similar to many other European countries, the main causes of deaths in Latvia are the diseases of the circulatory system [15] and there is strong evidence for a relationship between the trans fatty acid (TFA) content

and cardiovascular diseases [16]. The policy is a way to restrict and regulate the intake of TFA. The Latvian health system is regulated through a mix of legislative (laws, regulations), administrative (licences, permissions) and market mechanisms (contractual relationships) [15, 17]. Latvia has recently adopted regulatory approaches [18] to control the presence of TFA in domestic and imported food setting the maximum allowed amount.

It is known that TFA passes from the mother into the breast milk [17, 19]. Statistics show that there is an annual increase of Latvian children who are breastfed up to one year of age (from 21.7% in 2010 to 26.2% in 2014) which is higher than in most European countries for which data are available [15]. Increase is also observed for Latvian infants breastfed till 6 months (from 52.5% in 2010 to 57% in 2014) [20].

There is practically very little research done about human milk composition in Latvia [21-22]; therefore, due to increasing number of women breastfeeding in Latvia, research examining breast milk for potential pollutants and levels of TFA is needed.

Breast Milk Composition

Generally, 100 ml of mature breast milk consist of 90 g water and contain 0.8 – 1.3 grams of protein, 6.9 – 7.4 grams of carbohydrate, 3.0 – 5.0 grams of fat. In total, mature breast milk provides 60 – 75 kcal per 100 ml [3, 9, 23]. Nevertheless, the composition of human milk is still being studied since it differs among mothers and populations as well as during different times of lactation [22, 24-25].

There is little research done about breast milk composition among lactating women in Latvia [21-22]. Research [22] is only a recent study conducted in Latvia about breast milk composition. However, samples were taken from mothers, whose children were not full term healthy infants. In research [22], breast milk samples were obtained from the mothers (on the 5th–7th and 11th–28th day of lactation), whose neonates were treated in the Neonatal Care Unit, Children's Clinical University Hospital, Riga. Protein, fat and lactose content as well as pH and density were determined from the milk samples. Study [21] was done according to the National Implementation Plan on Persistent Organic Pollutants (POPs) for the years 2004–2020. Mothers

were selected from a presumably polluted area in Latvia (Olaine) to assess the contamination of breast milk with polychlorinated biphenyls, polychlorinated dibenzodioxins, dibenzofurans and some pesticides.

The previously mentioned studies [21-22] were conducted in particular areas so it is difficult to judge if the human milk of Latvian women differs from other populations and what are the factors that mostly affect it.

Proteins

Human milk proteins contribute to the optimal growing and development of an infant and also secure against infections [26]. Proteins provide ~8% of the exclusively breastfed infant's energy requirements; however, the concentration of protein changes as lactation progresses.

Higher concentration of protein was noticed in the milk among Latvian women in comparison to the samples from the USA and the UK, but it can be explained by sampling period which was from 5th to 7th day of lactation representing the transitory milk [22].

The total protein content decreases as lactation progresses mainly due to the diminution in whey protein concentration. However, it seems that, in general, concentration of protein in human milk is not affected by the protein content in a mother's diet [23, 26].

Carbohydrates

100 ml of mature breast milk contains 6.9 – 7.4 grams of carbohydrates, which mostly consist of disaccharide lactose (90 – 95%) and count for approximately 40% of the total breast milk energy content. The lactose content remains constant during the colostrum transition to mature milk [3, 9].

Study done in Latvia [22] suggests that the concentration of lactose is higher for mothers who had a neonate with low birth weight (<2.5 kg), which could be explained by lactose positive effect on gastrointestinal microflora [27]. However, since the studied samples represent the milk composition from the mothers with unhealthy young ones, the results cannot be used as a reference for the general Latvian population [22].

Fats

Fat is the most variable macronutrient and the main source of energy in human milk contributing ~50%

of the total energy [3]. Some researchers conclude that the quantity of the total fat in breast milk is quite stable and does not correlate to the fat intake of a mother [9, 25, 28-30]. Others, among them Latvian researchers as well, observe a large variability between milk samples [12, 22, 24, 31] and suggest that fat content could depend on mother's nutrition [12, 22, 31].

The study about the milk composition among lactating women in Latvia showed a large variability in the fat content (1.605-5.470 and 2.427-4.560 on the 5th – 7th and 11th – 28th lactation day respectively). The concentration of fat on the the 11th – 28th day of lactation among Latvian women was also significantly higher than among British women [22]. However, samples were taken from the mothers of infants treated at hospital during the study so results cannot be attributed to a general population. There is also no mention if the samples were taken on a specific time of the day (for instance, in the morning) and if the milk samples were expressed in the beginning or in the end of the feeding. This information is important because the milk composition (especially the fat content) differs not only during a day but also during a feeding [9, 23]. Authors [22] emphasize that it would be advisable to perform an individual milk analysis among the infants with poor weight gain to evaluate if it is influenced by the fat content in milk and therefore by the fat content in a mother's diet. The studies conducted to determine relations between the infant feeding practices and antropometrical traits in Latvia [32, 33] reveal that the breastfed infants tend to have a higher body weight in the first month of life in comparison with the formula fed ones. Yet, the formula fed infants have a higher weight starting from 2 months of age. However, in those studies no effort was made to analyse the impact of the composition of human milk on infant's weight gain. Therefore, a mother's low fat diet could affect the weight gain of an infant [12, 22, 31].

A lot of attention in recent years is drawn to the trans fat content in different foodstuffs, including milk. Humans do not synthesize trans isomers of fatty acids but accumulate them via diet [34-40]. The trans fatty acid content of human milk reflects the mother's trans dietary intake from the previous day [38]. The content of TFA in milk among women from different countries varies from ~1% to ~11% of the total

fatty acids [6, 17, 35-36, 38-39, 41-43]. Although dairy and meat fats are a natural source of TFA, intake of foods that contain greater concentrations of trans fat such as processed foodstuffs made with partially hydrogenated vegetable oils leads to greater intakes of trans fatty acids, which are then incorporated into milk fat. Therefore, the total amount and composition of trans fatty acids in milk may be attributed to the differences in women's diet [6, 36-39, 41, 44-45].

Knowing that TFA in breast milk leads to possible adverse effects on the infant's growth and development, their level in breast milk should be kept as low as possible [6, 17, 19, 44, 46]. Legislation is a way to reduce the negative influence of TFA. The TFA content in human milk in Canada has declined with the introduction of the trans fat declaration in food labelling [46]. However, the mandatory declaration of the TFA content had no effect on reducing the content of TFA amount in a lactating woman's diet in Brazil [42]. Latvia has become the latest European Union country to set the maximum amount of trans fats in foodstuffs. The new regulations entered into force on May 20, 2016. However, there is a transition period until June 1, 2018 [18]. The new requirements will cause food industries to produce foods with lower levels of TFA and might result in lower maternal consumption and concentration in milk [42]. The ceilings of TFA in foodstuffs is a more rigorous approach of legislation than mandatory labelling; therefore, it would be a novel idea to study if the TFA content also declines in milk among Latvian women after the introduction of the new Cabinet Regulation [18].

Persistent Organic Pollutants In Breast Milk

Persistent organic pollutants (POPs) are chemicals that accumulate in the food chain and are toxic to humans. Due to their high stability and lipophilic properties, they accumulate in fat-containing foodstuffs [1, 47-48]. For most people, exposure to POPs comes from the ingestion of food such as fish, meat, and dairy products [48]. WHO has considered human milk as an important matrix for monitoring POPs because high levels of POPs have resulted in serious adverse health effects for children. Breastfed infants developed pink sore, weakness, seizures and an annular rash because their mothers' ingested bread was

prepared from grains treated with high dose of fungicides. There was also an extremely high rate of mortality [49]. Fortunately, the assessment of the exposure of breast milk to POPs in Latvia corresponds to the lowest levels detected in the European countries and is not a cause of health disorders [21, 49].

Conclusion

There is little research done to determine the milk composition among lactating women in Latvia. The conducted studies represent results from the milk samples taken only from local places [21-22] and cannot be used as a reference for the general population of Latvia.

Chemical contaminants like POPs should not be a reason for a mother to choose against breastfeeding but constant vigilance is needed to reduce the contaminant content in human milk as low as possible [1].

TFA may have a negative effect on offspring, and for now there are no studies conducted in Latvia to evaluate their content in a mother's diet and, therefore, excretion in milk. Taking into account that after the mid of 2018, according to the legislation of the Republic of Latvia, the maximum level of TFA for food products produced in Latvia as well as from other EU or third countries is set [18], it would be a novelty to do a research to determine if the change in the legislation contributes to TFA decrease in human milk among lactating women in Latvia.

References

1. Landrigan, P.J., Sonawane, B., Mattison, D., McCally, M., Garg A. (2002) Chemical Contaminants in Breast Milk and Their Impacts on Children's Health: An Overview. *Environ. Health. Perspect.*, 110(6), A 313-5.
2. U.S. Department of Health and Human Services. The Surgeon General's Call Action to Support Breastfeeding (2011). Available at: <http://www.surgeongeneral.gov/library/calls/breastfeeding/calltoactiontosupportbreastfeeding.pdf>. Accessed 19 September 2016.
3. Park, Y.W., Haenlein G.F.W. (2013) Milk and Dairy Products in Human Nutrition. Production,

- Composition and Health. Wiley-Blackwell, USA, 728 pages.
- WHO. Infant and young child feeding. Model Chapter for textbooks for medical students and allied health professionals (2009). Available at: http://apps.who.int/iris/bitstream/10665/44117/1/9789241597494_eng.pdf?ua=1&ua=1. Accessed 19 September 2016.
 - Miller, E.M., Aiello, M.O., Fujita, M., Hinde, M., Millian, L., et al. (2013) Field and Laboratory Methods in Human Milk Research. *Am. J. Hum. Biol.* 25, 1-11.
 - Mosley, E.E., Wright, A.L., McGuire, M.K., McGuire, M.A. (2005) trans Fatty acids in milk produced by women in the United States. *Am. J. Clin. Nutr.* 82, 1292-7.
 - WHO, UNICEF. Protecting, promoting and supporting breast-feeding. The special role of maternity services (1989). Available at: <http://apps.who.int/iris/bitstream/10665/39679/1/9241561300.pdf?ua=1&ua=1>. Accessed 19 September 2016.
 - Brown, J. (2006) What to Eat Before, During and After Pregnancy. McGraw-Hill Companies, USA, 288 pages.
 - Dahl, L. (2015) Clinician's Guide to Breastfeeding. Evidenced-based Evaluation and Management. Springer International Publishing, Switzerland, 168 pages.
 - Institute of Medicine (US) Committee on Nutritional Status During Pregnancy and Lactation (1991) Nutrition During Lactation. National Academies Press, Washington, 326 pages.
 - Dietitians Association of Australia (2013) Nutrition for the breastfeeding woman. *Nutr. Diet.* 70(3), 255-9.
 - Shi, Y., Sun, G., Zhang, Z., Deng, X., Kang, X. et al. (2011) The chemical composition of human milk from Inner Mongolia of China. *Food Chem.* 127, 1193-8.
 - UNICEF/WHO. Breastfeeding: A Key to Sustainable Development (2016). Available at: <http://worldbreastfeedingweek.org/pdf/wbw2016-los-unicef.pdf> Accessed 19 September 2016.
 - WHO. World Breastfeeding Week (2016). Available at: <http://who.int/mediacentre/events/2016/world-breastfeeding-week/en/>. Accessed 19 September 2016.
 - Latvia. Health system review (2012). Available at: http://www.euro.who.int/__data/assets/pdf_file/0006/186072/e96822.pdf. Accessed 19 September 2016.
 - Mozaffarian, D., Katan, M.B., Ascherio, A., Stampfer, M.J., Willett, W.C. (2006) Trans Fatty Acids and Cardiovascular Disease. *N. Engl. J. Med.* 354(15), 1601-13.
 - European Parliament. Policy Department Economic and Scientific Policy (2008) Trans Fatty Acids and Health: A Review of Health Hazards and Existing Legislation. Available at: [http://www.europarl.europa.eu/RegData/etudes/etudes/join/2008/408584/IPOL-JOIN_ET\(2008\)408584_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/etudes/join/2008/408584/IPOL-JOIN_ET(2008)408584_EN.pdf). Accessed 19 September 2016.
 - Republic of Latvia. Cabinet Regulation No. 301 (2016) Regulations on the maximum amount of trans fats in foods. Available at: <http://likumi.lv/ta/id/282210-noteikumi-par-maksimali-pielaujamo-transtaukskabju-daudzumu-partikas-produktos>. Accessed 19 September 2016.
 - Innis, S.M. (2006) Trans fatty intakes during pregnancy, infancy and early childhood. *Atherosclerosis Supp.* 7, 17-20.
 - The Centre for Disease Prevention and Control (CDPC) of Latvia (2014) Yearbook of health case statistics in Latvia. Report on the state of health of children. Available at: <http://www.spkc.gov.lv/statistics/>. Accessed 19 September 2016.
 - Bake, M.A., Linnika, Z., Sudmalis, P., Kočan, A., Jursa, S., et al. (2007) Assessment of the exposure of breast milk to persistent organic pollutants in Latvia. *Int. J. Hyg. Environ.-Health.* 210(3-4), 483-9.
 - Broka, L., Daugule, I., Ciproviča, I., Kviļūna, D., Rumba-Rozenfelde I. (2016) Comparison of breast Milk Composition Among Lactating Woman in Latvia. *Proc. Latvian Acad. Sci., Section B.* 70(2), 47-50.
 - Ballard, O. , Morrow, A.L. (2013) Human Milk Composition: Nutrients and Bioactive Factors. *Pediatr. Clin. North. Am.* 60(1), 49-74.

24. Kent, J.C., Mitoulas, L.R., Cregan, M.D., Ramsay, D.T., Doherty, D.A., Hartmann, P.E. (2006) Volume and Frequency of Breastfeeding and Fat Content of Breast Milk Throughout the Day. *Pediatrics*, 117(3), e387-95.
25. Quinn, E.A., Largado, F., Power, M., Kuzawa C.W. (2012) Predictors of Breast Milk Macronutrient Composition in Filipino Mothers. *Am. J. Hum. Biol.* 24(4), 533-40.
26. Lönnerdal, B. (2003) Nutritional and physiologic significance of human milk proteins. *Am. J. Clin. Nutr.* 77 (suppl), 1537S-43S.
27. Cederlund, A., Kai-Larsen, Y., Printz, G., Yoshio, H., Alvelius, G., et al. (2013) Lactose in Human Breast Milk an Inducer of Innate Immunity with Implications for a Role in Intestinal Homeostasis. *PLoS ONE* 8(1), e53876.
28. Andreas, N.J., Kampmann, B., Le-Doare, K.M. (2015) Human breast milk: A review on its composition and bioactivity. *Early Hum. Dev.* 91, 629-35.
29. Innis, S.M. (2014) Impact of maternal diet on human milk composition and neurological development of infants. *Am. J. Clin. Nutr.* 1S-S8.
30. Innis, S.M. (2007) Human milk: maternal dietary lipids and infant development. *Proc. Nutr. Soc.* 66, 397-404.
31. Caballero, B. (2003) *Encyclopedia of Food Sciences and Nutrition*. 2nd Ed. Academic Press, USA, 6000 pages.
32. Oginska, A., Vētra, J., Pilmane, M. (2008) Relations between infant feeding practices and anthropometrical traits in Latvia. *Acta Med. Litu.* 15 (1), 61-6.
33. Šulce, D., Šlisere, E. (2015) Growth of exclusively breast-fed and formula fed infants during the first 6 months of life. Conference thesis. Riga Stradiņš University International Student Conference. Available at: <http://www.rsu.lv/eng/images/isc2015-health-abstracts.pdf>. Accessed 19 September 2016.
34. Larqué, E., Zamora, S., Gil, A. (2000) Dietary trans fatty acids affect the essential fatty-acid concentration of rat milk. *J. Nutr.* 130(4), 847-51.
35. Larqué, E., Zamora, S., Gil, A. (2001) Dietary trans fatty acids in early life: a review. *Early Hum. Dev.* 65 (suppl), S31-S41.
36. Mojska, H., Socha, P., Soplińska, E., Jaroszewska-Balicka, W., Szponar, L. (2003) Trans fatty acids in human milk Poland and their association with breastfeeding mothers' diets. *Acta Paediatr.* 92, 1381-7.
37. Craig-Schmidt, M.C. (2006) World-wide consumption of trans fatty acids. *Atheroscler. Suppl.* 7(2), 1-4.
38. Craig-Schmidt, M.C., Weete, J.D., Faircloth, S.A., Wickwire, M.A., Livant, E.J. (1984) The effect of hydrogenated fat in the diet of nursing mothers on lipid composition and prostaglandin content of human milk. *Am. J. Clin. Nutr.* 39, 778-86.
39. Bahrami, G., Rahimi, Z. (2005) Fatty acid composition of human milk in Western Iran. *Eur. J. Clin. Nutr.* 59, 494-7.
40. Precht, D., Molkentin, J. (1999) C18:1, C18:2 and C18:3 trans and cis fatty acid isomers including conjugated cis D9, trans D11 linoleic acid (CLA) as well as total fat composition of German human milk lipids. *Nahrung* 43 (suppl), 233-44.
41. Silva, M.H.L., Silva, M.T.C., Brandão, S.C.C., Gomes, J.C., Peternelli, L.A., Franceschini, S.C.C. (2004) Fatty acid composition of mature breast milk in Brazilian women. *Food Chem.* 94, 297-303.
42. Nishimura, R.Y., de Castro, G.S.F., Jordão Junior, A.A., Sartorelli, D.S. (2013) Breast milk fatty acid composition of women living far from the coastal area in Brazil. *J. Pediatr. (Rio J.)*. 89(3), 263-8.
43. Boatella, J., Rafecas, M., Codony, R., Gibert, A., Rivero, M. et al. (1993) Trans Fatty Acid Content of Human Milk in Spain. *J. Pediatr. Gastroenterol. Nutr.* 16, 432-4.
44. Innis, S.M., King, D.J. (1999) trans Fatty acids in human milk are inversely associated with concentrations of essential all-cis n-6 and n-3 fatty acids and determine trans, but not n-6 and n-3, fatty acids in plasma lipids of breast-fed infants. *Am. J. Clin. Nutr.* 70, 383-90.

45. Przybylski R. and McDonald B. E. (2006) Development and Processing of Vegetable Oils for Human Nutrition. AOCS Press, Illinois, 133 pages.
46. Friesen, R., Innis, S.M. (2006) Trans Fatty Acids in Human Milk in Canada Declined with the Introduction of Trans Fat Food Labeling. J. Nutr. 136, 2558-61.
47. Colles, A., Koppen, G., Hanot, V., Nelen, V., Dewolf, M.C. et al. (2008) Fourth WHO-coordinated survey of human milk for persistent organic pollutants (POPs): Belgian results. Chemosphere 73(6), 907-14.
48. Sonawane, B.R. (1995) Chemical Contaminants in Human Milk: An Overview. Environ. Health. Perspect. 103 (Suppl 6), 197-205.
49. WHO. Persistent Organic Pollutants: Impact on Child Health (2010). Available at: http://apps.who.int/iris/bitstream/10665/44525/1/9789241501101_eng.pdf. Accessed 19 September 2016.