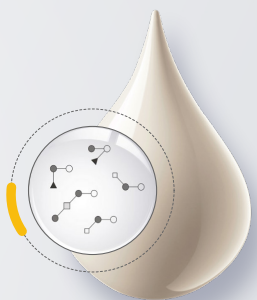


UNEXPECTED VARIATIONS OF HUMAN MILK GROUP DISTRIBUTIONS BETWEEN HUMAN MILK FROM AFRICAN AND EUROPEAN GEOGRAPHIES



Findings

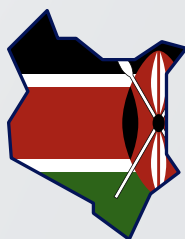
Comparing data on human milk groups from cohort studies conducted in Europe¹, Central-Africa² and Kenya³ led to interesting revelations:



Europe: human milk samples at weeks 6 (n=682), 26 (n=448) and 52 (n=73)



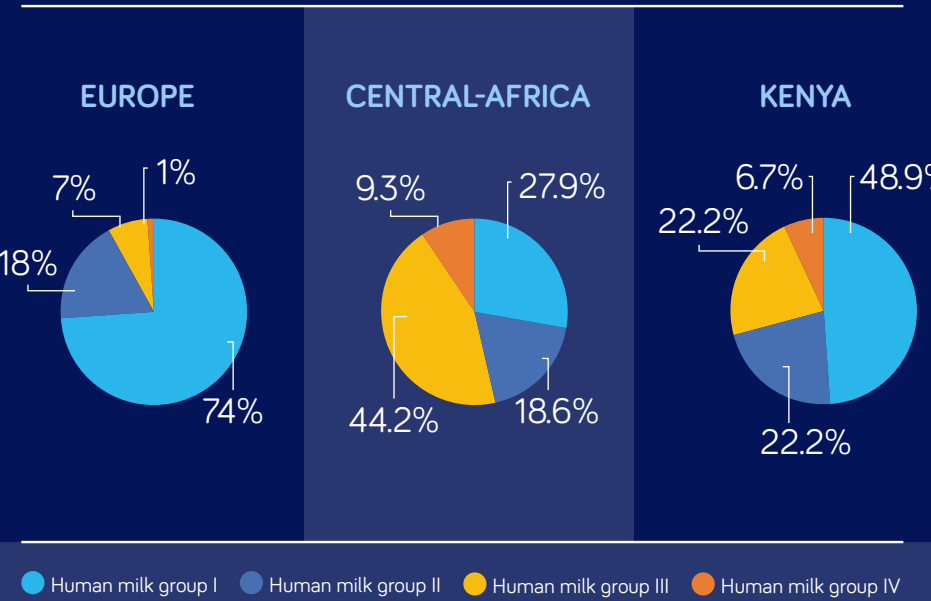
Central Africa: human milk samples at weeks 1, 4, 11, 18 and 25 (n=48)



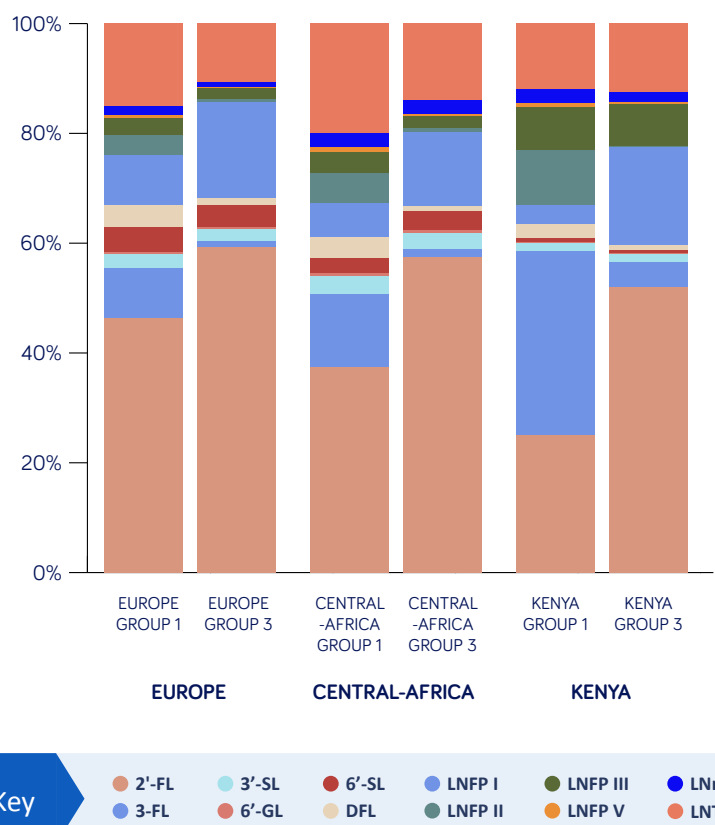
Kenya: human milk samples between weeks 24-44 (n=90)

Different distributions of human milk groups

- The percentages of human milk group III in Africa seem to be **noticeably higher** than in Europe
- In Africa, a different level of 2'-FL was identified at ~6 months post-partum in human milk group III relative to Europe

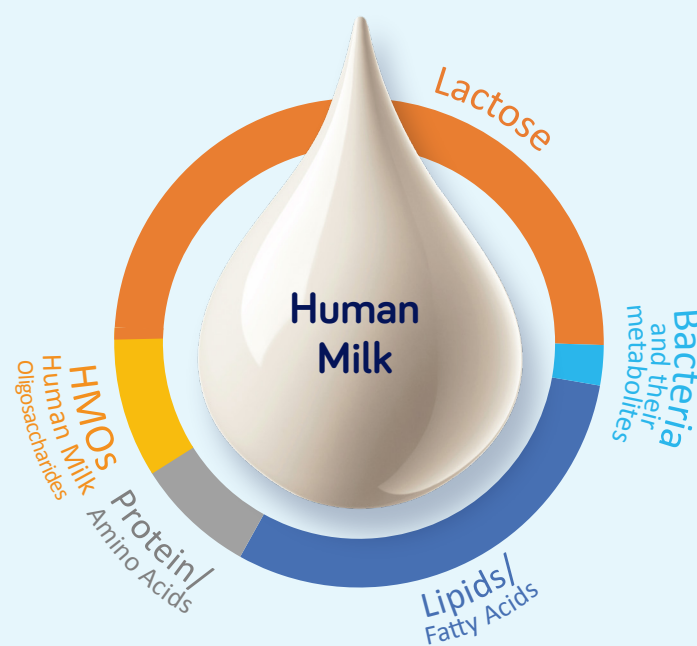


HUMAN MILK GROUPS 1&3 EUROPE / CENTRAL-AFRICA / KENYA



Background

Human milk, recognised as the optimal nutrition for all infants, contains human milk oligosaccharides (HMOs), that constitute the third most abundant fraction of its biomolecules.^{4,5}



✓ Human milk has over 1000 different HMOs, more than 160 of which have been identified.^{6,7} The most prevalent HMO among majority of women is 2'-Fucosyllactose (2'-FL), thought to play a key role in the gut and immune system of the developing infant.⁸⁻¹²

✓ HMO concentrations exhibit considerable variability among mothers and undergo changes throughout the course of lactation.⁶

✓ Maternal genetics (expression of Secretor and Lewis genes) leads to different HMO profiles, allowing for the assignment of individual milks to one of 4 different human milk groups: HM-type I, II, III and IV.^{13,14}

Conclusion



Food insecurity and maternal diet has a significant influence on human milk composition, including HMOs.



We need to better understand the factors driving the rare predominance of HM-group III in African milks, which have elevated 2'-FL and LNFP I, as well as decreased 3'-FL levels compared to HM-group I. Additionally, the differences in HMO expressions between HM-group I and III are more pronounced in African than in European milks. Therefore, exploring the bio-functional relationships of these geographically specific HMO profiles requires more comprehensive research.



These results possibly indicate a unique evolutionary pressure in rural regions of Africa, which selects for HM type-III with increased concentrations of 2'-FL.

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References



1. Siziba LP, Mank M, Stahl B, Gonsalves J, Blijenberg B, Rothenbacher D, Genuneit J. Human Milk Oligosaccharide Profiles over 12 Months of Lactation: The Ulm SPATZ Health Study. *Nutrients*. 2021 Jun 8;13(6):1973. doi: 10.3390/nu13061973. PMID: 34201331; PMCID: PMC8228739.



2. Moya-Alvarez V, Eussen SRBM, Mank M, Koyembi JJ, Nyasenu YT, Ngaya G, Mad-Bondo D, Kongoma JB, Stahl B, Sansonetti PJ, Bourdet-Sicard R. Human milk nutritional composition across lactational stages in Central Africa. *Front Nutr*. 2022 Nov 16;9:1033005. doi: 10.3389/fnut.2022.1033005. PMID: 36466422; PMCID: PMC9709887.



3. Derrien M, Mikulic N, Uyoga MA, Chenoll E, Climent E, Howard-Varona A, Nyilima S, Stoffel NU, Karanja S, Kottler R, Stahl B, Zimmermann MB, Bourdet-Sicard R. Gut microbiome function and composition in infants from rural Kenya and association with human milk oligosaccharides. *Gut Microbes*. 2023 Jan-Dec;15(1):2178793. doi: 10.1080/19490976.2023.2178793. PMID: 36794816; PMCID: PMC9980514.



4. ESPGHAN Committee on Nutrition; Agostoni C, Braegger C, Decsi T, Kolacek S, Koletzko B, Michaelsen KF, Mihatsch W, Moreno LA, Puntis J, Shamir R, Szajewska H, Turck D, van Goudoever J. Breast-feeding: A commentary by the ESPGHAN Committee on Nutrition. *J Pediatr Gastroenterol Nutr*. 2009 Jul;49(1):112-25. doi: 10.1097/MPG.0b013e31819f1e05. PMID: 19502997.



5. Boehm G, Stahl B. Oligosaccharides from milk. *J Nutr*. 2007 Mar;137(3 Suppl 2):847S-9S. doi: 10.1093/jn/137.3.847S. PMID: 17311985.



6. Thurl S, Munzert M, Boehm G, Matthews C, Stahl B. Systematic review of the concentrations of oligosaccharides in human milk. *Nutr Rev*. 2017 Nov 1;75(11):920-933. doi: 10.1093/nutrit/nux044. PMID: 29053807; PMCID: PMC5914348.



7. Urashima, T., J. Hirabayashi, S. Sato and A. Kobata (2018). "Human Milk Oligosaccharides as Essential Tools for Basic and Application Studies on Galectins." *Trends in Glycoscience and Glycotechnology* 30(172): SE51-SE65.



8. Jantscher-Krenn E, Bode L. Human milk oligosaccharides and their potential benefits for the breast-fed neonate. *Minerva Pediatr*. 2012 Feb;64(1):83-99. PMID: 22350049.



9. Ayechu-Muruzabal V, van Stigt AH, Mank M, Willemsen LEM, Stahl B, Garssen J, Van't Land B. Diversity of Human Milk Oligosaccharides and Effects on Early Life Immune Development. *Front Pediatr*. 2018 Sep 10;6:239. doi: 10.3389/fped.2018.00239. PMID: 30250836; PMCID: PMC6140589.



10. Erney RM, Malone WT, Skelding MB, Marcon AA, Kleman-Leyer KM, O'Ryan ML, Ruiz-Palacios G, Hilty MD, Pickering LK, Prieto PA. Variability of human milk neutral oligosaccharides in a diverse population. *J Pediatr Gastroenterol Nutr*. 2000 Feb;30(2):181-92. doi: 10.1097/00005176-200002000-00016. PMID: 10697138.



11. Orczyk-Pawitowicz M, Lis-Kuberka J. The Impact of Dietary Fucosylated Oligosaccharides and Glycoproteins of Human Milk on Infant Well-Being. *Nutrients*. 2020 Apr 16;12(4):1105. doi: 10.3390/nu12041105. PMID: 32316160; PMCID: PMC7230487.



12. Hundshammer C, Minge O. In Love with Shaping You-Influential Factors on the Breast Milk Content of Human Milk Oligosaccharides and Their Decisive Roles for Neonatal Development. *Nutrients*. 2020 Nov 20;12(11):3568. doi: 10.3390/nu12113568. PMID: 33233832; PMCID: PMC7699834.



13. Eussen SRBM, Mank M, Kottler R, Hoffmann XK, Behne A, Rapp E, Stahl B, Mearin ML, Koletzko B. Presence and Levels of Galactosyllactoses and Other Oligosaccharides in Human Milk and Their Variation during Lactation and According to Maternal Phenotype. *Nutrients*. 2021 Jul 6;13(7):2324. doi: 10.3390/nu13072324. PMID: 34371833; PMCID: PMC8308909.



14. Mank M, Hauner H, Heck AJR, Stahl B. Targeted LC-ESI-MS2 characterization of human milk oligosaccharide diversity at 6 to 16 weeks post-partum reveals clear staging effects and distinctive milk groups. *Anal Bioanal Chem*. 2020 Oct;412(25):6887-6907. doi: 10.1007/s00216-020-02819-x. Epub 2020 Aug 14. PMID: 32794008; PMCID: PMC7496073.