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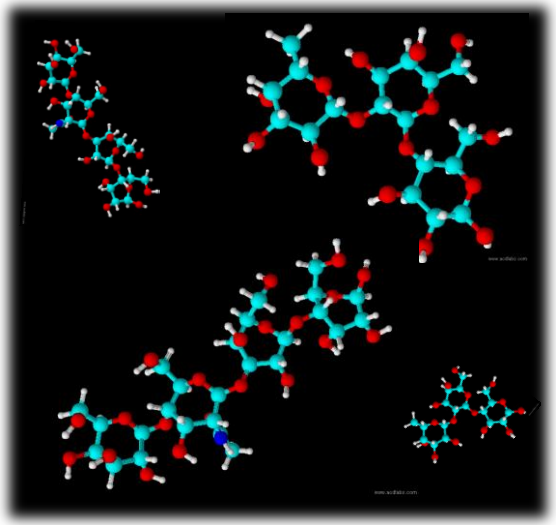
SCIENCE CENTER

Human milk oligosaccharides (HMOs) role in neurodevelopment

Jonas Hauser, PhD, Brain Health, Nestlé Research

25 March 2020

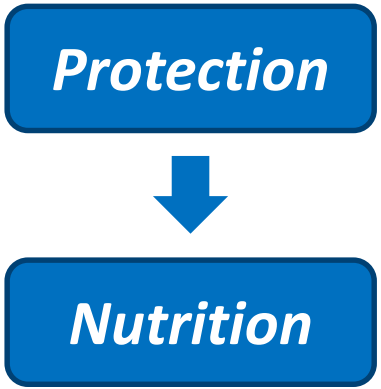


Human Milk Oligosaccharides (HMOs): Role in neurodevelopment

Jonas Hauser, PhD, Specialist in Cognition
Brain Health, Nestlé Research

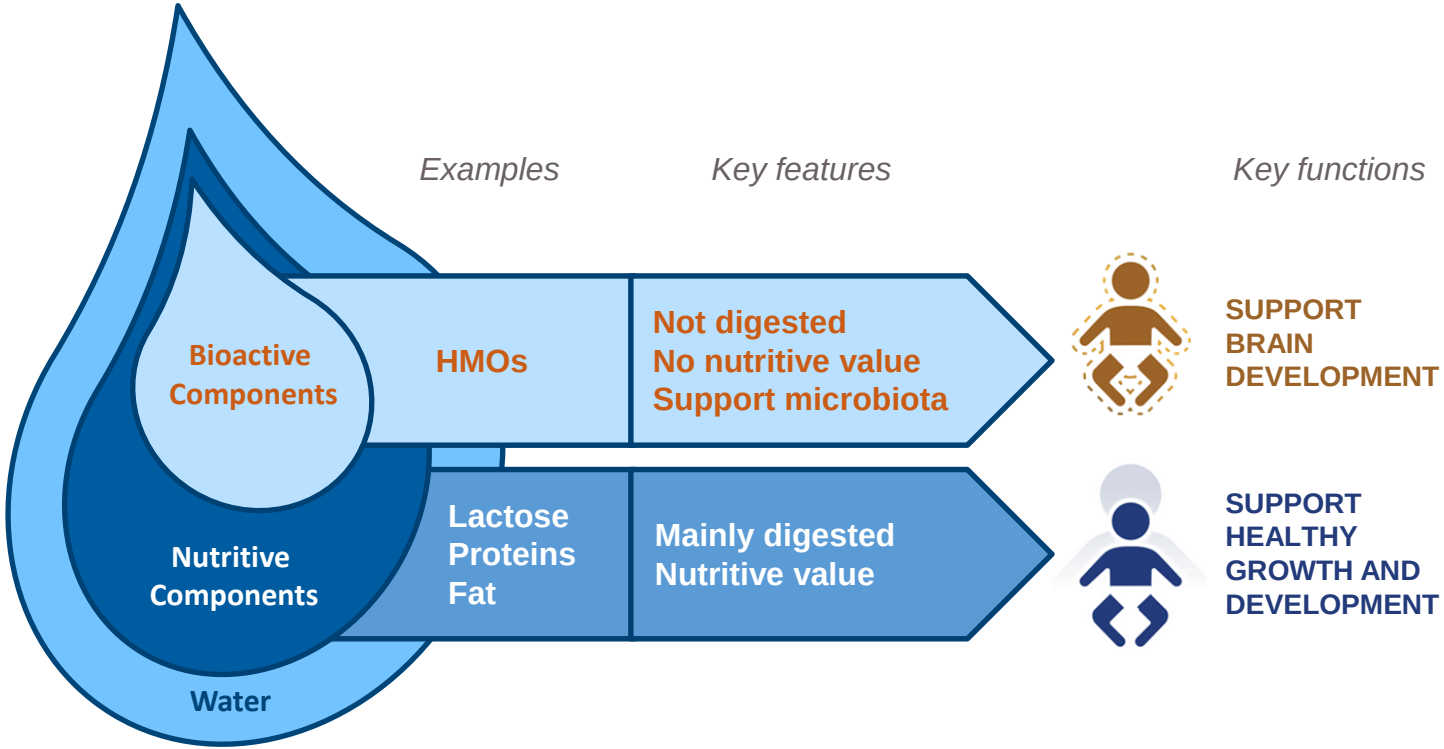
Evolution of Milk: a story 310 million years in making

- Earliest indication in the Pennsylvanian period, approximately 310 million years ago
- Ancestors of mammals laid eggs with parchment-like shells intolerant to desiccation and therefore dependent on glandular skin secretions for moisture
- Today few egg laying mammals still exist
- This skin secretion (intended for moisture and antimicrobial properties) evolved into a nutrient-rich milk long before mammals, taking a role of vehicle of nutrients to the new-borns

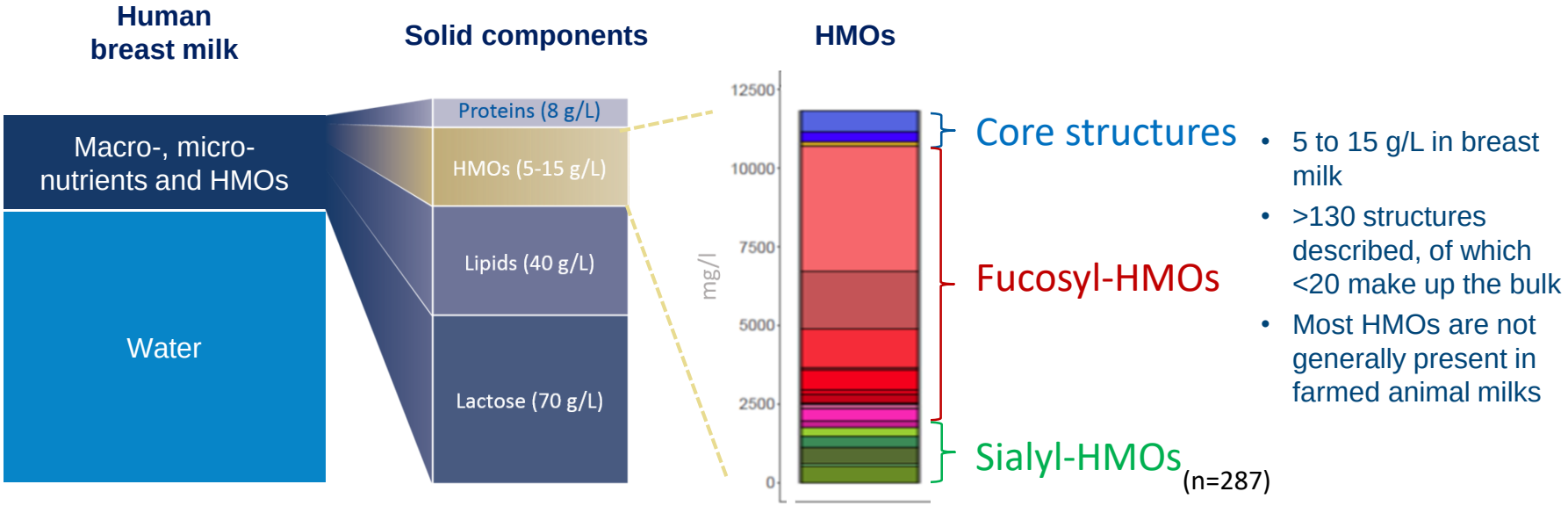


Oftedal, O. T. (2012). The evolution of milk secretion and its ancient origins. Animal, 6(3), 355-368.

Main categories of human milk components



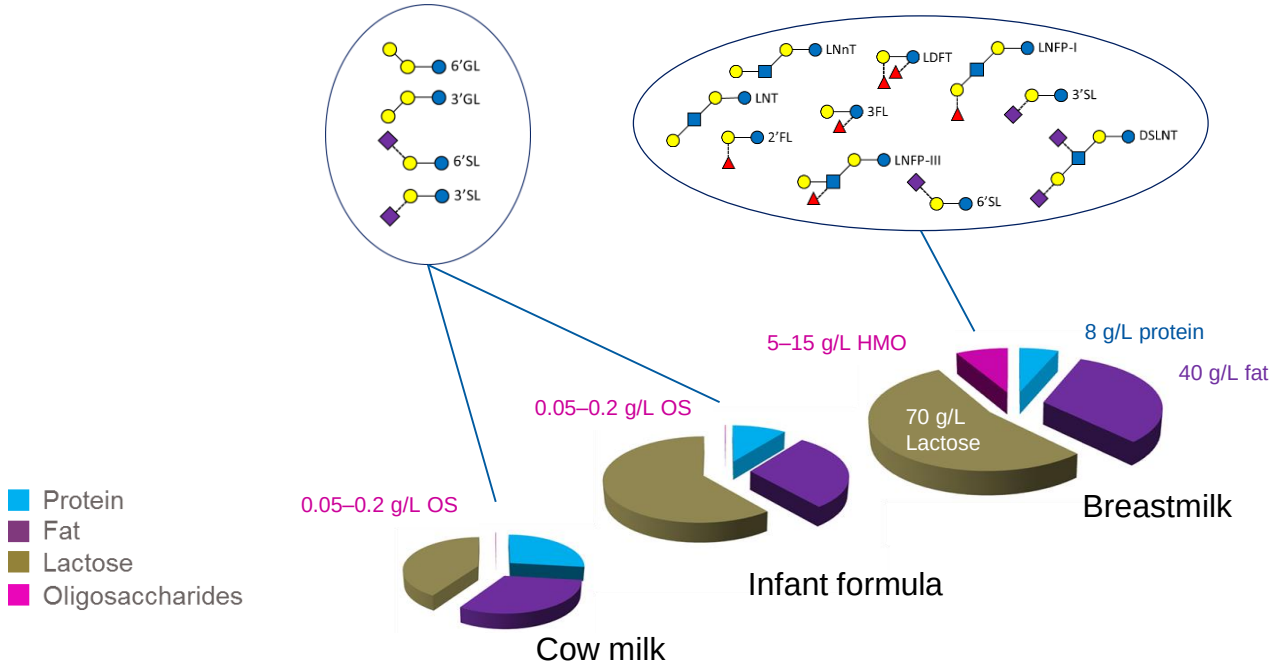
Gross composition of breast milk



- 5 to 15 g/L in breast milk
- >130 structures described, of which <20 make up the bulk
- Most HMOs are not generally present in farmed animal milks

Adapted from Anna Petherick, Nature volume 468, pages S5–S7 (23 December 2010); Zivkovic AM, et al. Proc Natl Acad Sci USA. 2011;108(Suppl. 1):4653–8; Austin S, et al. Nutrients 2016;8:pii: E346; Sprenger N, et al. PLoS One 2017;12:e0171814; Kunz C, et al. J Pediatr Gastroenterol Nutr 2017;64:789–98; Bode L. Glycobiology 2012;22:1147–1162, Samuel and Binia et al., 2019, Scientific Reports in revision

Gross compositional comparison to bovine and formula milk



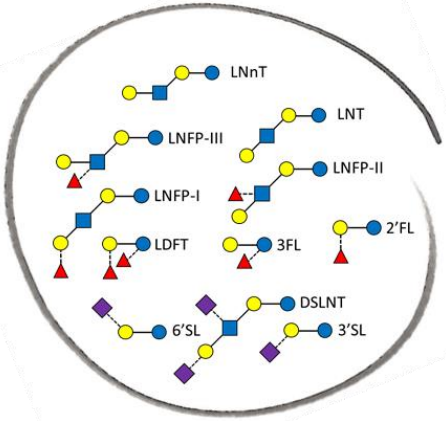
Adapted from Anna Petherick, Nature volume 468, pages S5–S7 (23 December 2010); Samuel and Binia et al., 2019, Scientific Reports

Which factors influence breastmilk HMO composition ?

Maternal parameters

- Genetics (Secretor-, Lewis gene)
- Lactation stage
- Physiological status
- Mode of delivery
- Infant gestational age
- Diet

HMO composition



Important to understand for observational association studies of HMOs with breastfed infant clinical parameters.

2’-Fucosyllactose breast milk levels at 1 month of age is associated with cognitive development at 24 months

RESEARCH ARTICLE

Human milk oligosaccharide 2’-fucosyllactose links feedings at 1 month to cognitive development at 24 months in infants of normal and overweight mothers

Paige K. Berger[1], Jasmine F. Plows[1], Roshonda B. Jones[1], Tanya L. Alderete[2], Chloe Yonemitsu[3], Marie Poulsen[4], Ji Hoon Ryoo[1], Bradley S. Peterson[1], Lars Bode[3], Michael I. Goran[1]*

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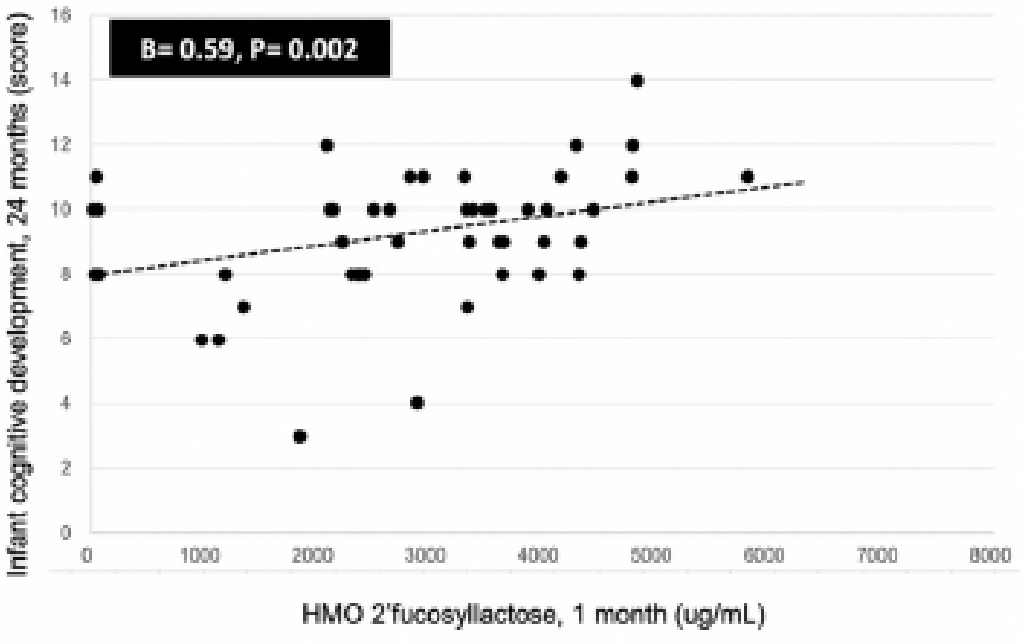


Berger et al. PlosOne Feb 2020

Early life supplementation with 2'-Fucosyllactose improves long-term potentiation (LTP) via the Gut-Brain Axis in preclinical model

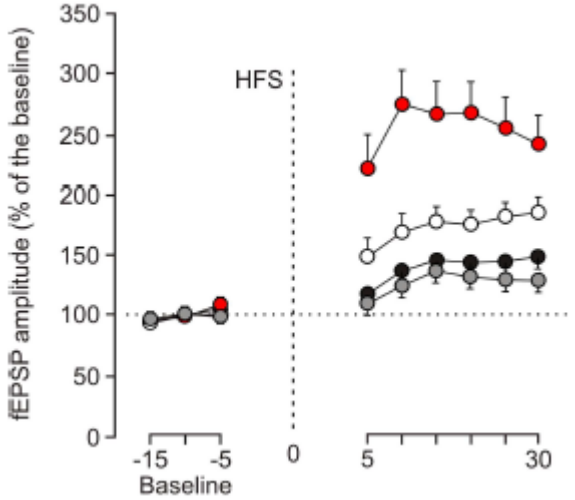
RESEARCH ARTICLE

Dietary 2'-Fucosyllactose Enhances Operant Conditioning and Long-Term Potentiation via Gut-Brain Communication through the Vagus Nerve in Rodents

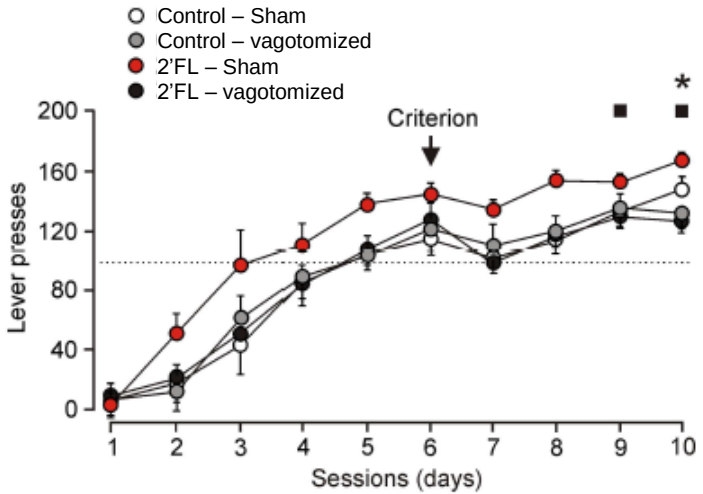
Enrique Vazquez[1]+, Alejandro Barranco[1], Maria Ramirez[1], Agnes Gruart[3], Jose M. Delgado-Garcia[3], Maria L. Jimenez[1], Rachael Buck[2], Ricardo Rueda[1]

1 Strategic R&D Department, Abbott Nutrition, Granada, 18004, Spain, **2** Strategic R&D Department, Abbott Nutrition, Columbus, OH, United States of America, **3** Division of Neurosciences, Pablo de Olavide University, Seville, 41013, Spain

Long-term potentiation



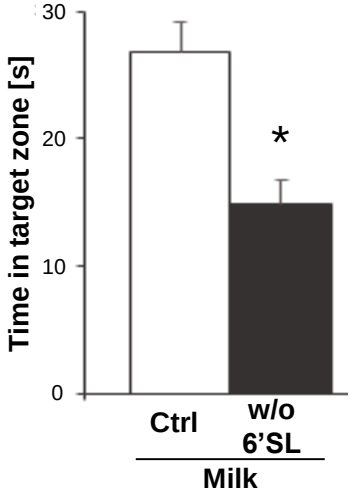
Fixed ratio schedule reinforcement



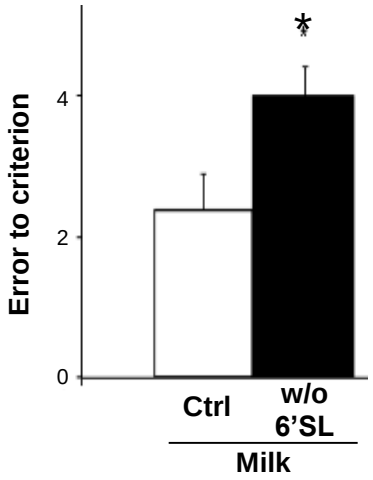
Vazquez et al. PlosOne Nov 2016

Presence of 6‘Sialyllactose during lactation promotes attention and memory in preclinical model

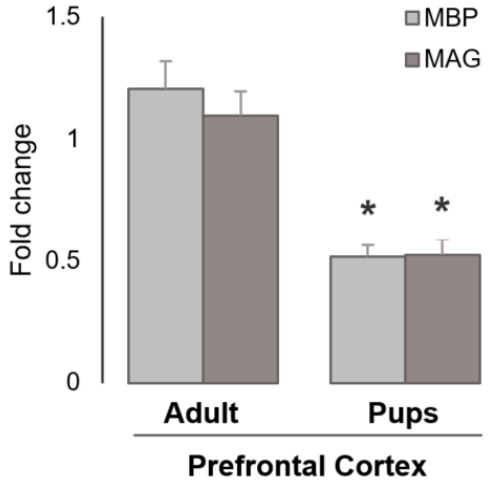
Spatial memory
(Barnes maze)



Attention
(attention set shifting task)



Myelination
(gene expression relative to control)



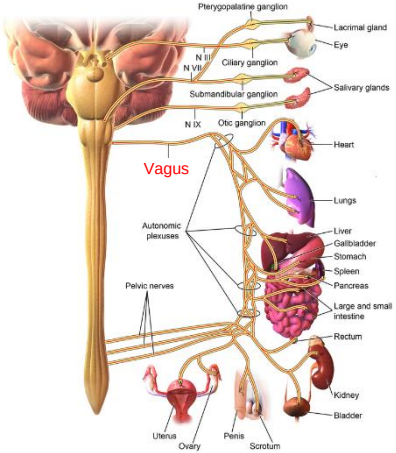
Hauser et al. ESPGHAN 2019 and unpublished results

HMOs modulation of neurodeveolpment: Mode of actions

Microbiota

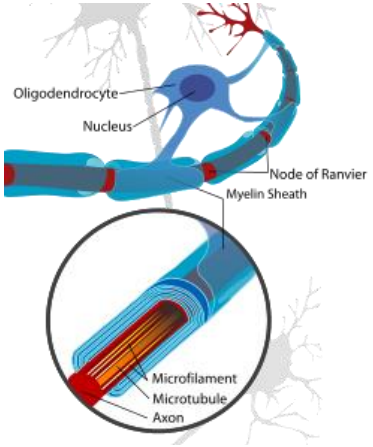
Modulation of microbiota composition

Vagus Nerve



Modulation of vagal tone by HMOs

Myelination



Modulation of myelination by sialyllated HMOs

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Thank you for your attention