Recent Studies and Publications on Prebiotics

STUDIES

1. Alterations In The Gut Microbiota Of Toddlers With Cow Milk Protein Allergy Treated With A Partially Hydrolyzed Formula Containing Synbiotics: A Nonrandomized Controlled Interventional Study

Formulas containing intact cow milk protein are appropriate alternatives when human milk (HM) is not feasible. However, for babies with a physician-diagnosed cow milk protein allergy (CMPA), hydrolyzed formulas are needed.

Researchers conducted a 3-month, open-label, nonrandomized concurrent controlled trial between June 2021 and October 2022 in Qingdao City, China. In this study, CMPA toddlers were fed with a partially hydrolyzed formula containing synbiotics and compared with healthy toddlers fed a regular intact protein formula.

Scientists found that after 3 months, there were no significant group differences for length-for-age, weight-for-age, or head circumference-for-age Z scores. In the gut microbiota, pHF feeding increased its richness and diversity, similar to those of IF-fed and HM-fed healthy toddlers.

Compared with healthy toddlers, the toddlers with CMPA shows an increased abundance of phylum ***Bacteroidota, Firmicutes, class Clostridia***, and ***Bacteroidia***, and a decreased abundance of class ***Negativicutes***, while pHF feeding partly eliminated these original differences. Moreover, pHF feeding increased the abundance of short-chain fatty acid producers. Scientists also found that pHF partly simulated the beneficial effects of HM and shifted the gut microbiota of toddlers with CMPA toward that of healthy individuals. This study concluded that ***synbiotic-containing pHF might be an appropriate alternative for toddlers with CMPA.***

Source: Yanxia Wang, Hospital Of Qingdao University, 16 Jiangsu Road, Shinan District, China. Alterations In The Gut Microbiota Of Toddlers With Cow Milk Protein Allergy Treated With A Partially Hydrolyzed Formula Containing Synbiotics: A Nonrandomized Controlled Interventional Study. Food Science And Nutrition, Volume12, Issue 2, February 2024, Pages 765-775. DOI: https://doi.org/10.1002/fsn3.3801

2. Composition Of Whole Grain Dietary Fiber And Phenolics And Their Impact On Markers Of Inflammation

Inflammation is an important biological response to any tissue injury. The immune system responds to any stimulus, such as irritation, damage, or infection, by releasing pro-inflammatory cytokines. The overproduction of pro-inflammatory cytokines can lead to several diseases, e.g., cardiovascular diseases, joint disorders, cancer, and allergies. Emerging science suggests that whole grains may lower the markers of inflammation.

Whole grains are a significant source of dietary fiber and phenolic acids, which have an inverse association with the risk of inflammation. Both cereals and pseudo-cereals are rich in dietary fiber, e.g., arabinoxylan and β-glucan, and phenolic acids, e.g., hydroxycinnamic acids and hydroxybenzoic acids, which are predominantly present in the bran layer.

The purpose of this review is to discuss whole grain dietary fiber and phenolic acids and highlights their potential. Further it also examines the health benefits of these components and their impacts on subclinical inflammation markers, including the role of the gut microbiota.

Source: Kunlun Liu,College Of Food Science And Engineering And School Of Food And Strategic Reserves, Henan University Of Technology, Zhengzhou, China. Composition Of Whole Grain Dietary Fiber And Phenolics And Their Impact On Markers Of Inflammation. Nutrients, 2024 Apr 3;16(7):1047. DOI: 10.3390/nu16071047.

3. Prebiotic Selection Influencing Inflammatory Bowel Disease Treatment Outcomes: A Review Of The Preclinical And Clinical Evidence

This review explores and contrasts the efficacy of prebiotics from various sources (*β-fructans, galacto-oligosaccharides, xylo-oligosaccharides, resistant starch, pectin, β-glucans, glucomannans and arabinoxylans*) in mitigating inflammatory bowel disease (IBD) symptomatology, when used as either standalone or adjuvant therapies.

In preclinical animal colitis models, prebiotics have revealed type-dependent effects in positively modulating gut microbiota composition and subsequent attenuation of disease indicators and proinflammatory responses. While prebiotics have demonstrated therapeutic potential in animal models, clinical evidence for their precise efficacy remains limited, stressing the need for further investigation in human patients with IBD to facilitate their widespread clinical translation as microbiota-targeting IBD therapies.

Source: Paul Joyce, Centre For Pharmaceutical Innovation, Unisa Clinical & Health Sciences, University Of South Australia, Adelaide, South Australia, Australia. Prebiotic Selection Influencing Inflammatory Bowel Disease Treatment Outcomes: A Review Of The Preclinical And Clinical Evidence. eGastroenterology 2024;2:e100055. DOI: https://doi.org/10.1136/egastro-2023-100055

4. Human Milk Oligosaccharides And Respiratory Syncytial Virus Infection In Infants

In infants worldwide, respiratory syncytial virus (RSV) is the leading cause of lower respiratory infections, including bronchiolitis, which is a major source of infant mortality. Bronchiolitis is the most common lower respiratory infection and the major cause of hospitalization in the first 6 months of life.

This review shows the current evidence on the role of human milk oligosaccharides (hMOSs) with regard to RSV infection and disease, attending to knowledge gaps and future research directions.

Source: David S Newburg, Department Of Environmental Health And Public Health Sciences, University Of Cincinnati College Of Medicine, Cincinnati, OH, United States. Human Milk Oligosaccharides And Respiratory Syncytial Virus Infection In Infants. Adv Nutr, 2024 Jun;15(6):100218. DOI: 10.1016/j.advnut.2024.100218.

5. Microbial Colonization Programs Are Structured By Breastfeeding And Guide Healthy Respiratory Development

Breastfeeding and microbial colonization during infancy occur within a critical time window for development, and both are thought to influence the risk of respiratory illness. **Researchers profiled the nasal and gut microbiomes, breastfeeding characteristics, and maternal milk composition of 2,227 children from the CHILD Cohort Study.**

They identified robust colonization patterns that, together with milk components, predict preschool asthma and mediate the protective effects of breastfeeding. Scientists found that early cessation of breastfeeding (before 3 months) leads to the premature acquisition of microbial species and functions, including *Ruminococcus gnavus* and tryptophan biosynthesis, which were previously linked to immune modulation and asthma. Conversely, longer exclusive breastfeeding supports a paced microbial development, protecting against asthma. **These findings underscore the importance of extended breastfeeding for respiratory health and highlight potential microbial targets for intervention.**

Source: Padmaja Subbarao, Department Of Pediatrics, Hospital For Sick Children, University Of Toronto, Toronto, ON, Canada. Microbial Colonization Programs Are Structured By Breastfeeding And Guide Healthy Respiratory Development. Cell, Volume 187, Issue 19p5431-5452.e20. DOI: 10.1016/j.cell.2024.07.022

6. Mother's Milk Microbiota Is Associated With The Developing Gut Microbial Consortia In Very-Low-Birth-Weight Infants

Mother's milk contains diverse bacterial communities, although their impact on microbial colonization in very-low-birth-weight (VLBW, <1,500 g) infants remains unknown. This study examines relationships between the microbiota in preterm mother's milk and the VLBW infant gut across initial hospitalization (n = 94 mother-infant dyads, 422 milk-stool pairs). Shared zero-radius operational taxonomic units (zOTUs) between milk-stool pairs account for 30%–40% of zOTUs in the VLBW infant's gut. **Ninety-four mother-infant dyads from the OptiMoM fortifier trial (NCT02137473) were included**

Scientists show dose-response relationships between intakes of several genera from milk and their concentrations in the infant's gut. These relationships and those related to microbial sharing change temporally and are modified by in-hospital feeding practices (especially direct breastfeeding) and maternal-infant antibiotic use. Correlations also exist between milk and stool microbial consortia, suggesting that multiple milk microbes may influence overall gut communities together. **These results highlight that the mother's milk microbiota may shape the gut colonization of VLBW infants by delivering specific bacteria and through intricate microbial interactions.**

Source: Deborah L. O'Connor, Department Of Nutritional Sciences, University Of Toronto, Toronto, ON, Canada. Mother's Milk Microbiota Is Associated With The Developing Gut Microbial Consortia In Very-Low-Birth-Weight Infants. Cell Reports Medicine, Volume 5, Issue 9, 101729. DOI: 10.1016/j.xcrm.2024.101729.

7. Human Milk Oligosaccharides and Their Pivotal Role in Gut–Brain Axis Modulation and Neurologic Development: A Narrative Review to Decipher the Multifaceted Interplay

Human milk oligosaccharides (HMOs), which are unique bioactive components in human milk, are increasingly recognized for their multifaceted roles in infant health. A deeper understanding of the nexus between HMOs and the gut–brain axis can revolutionize neonatal nutrition and neurodevelopmental strategies.

This review shows that HMOs significantly influence the neonatal gut–brain axis. HMOs are shown to influence gut microbiota composition and enhance neurotransmitter production, which are crucial for brain development. For instance, 2-fucosyllactose has been demonstrated to support cognitive development by fostering beneficial gut bacteria that produce essential short-chain fatty acids.

Source: Raffaele Falsaperla, Neonatal Intensive Care Unit And Neonatal Accompaniment Unit, University Of Catania, Catania And Department Of Medical Science-Pediatrics, University Of Ferrara, Ferrara, Italy. Human Milk Oligosaccharides and Their Pivotal Role in Gut–Brain Axis Modulation and Neurologic Development: A Narrative Review to Decipher the Multifaceted Interplay. Nutrients, 2024 Sep 5;16(17):3009. DOI: 10.3390/nu16173009.

8. Prebiotics Beyond The Gut: Omics Insights, Artificial Intelligence, And Clinical Trials In Organ-Specific Applications

Prebiotics, traditionally linked to gut health, are increasingly recognized for their systemic benefits, influencing multiple organ systems through interactions with the gut microbiota. Compounds like inulin, fructooligosaccharides (FOS), and galactooligosaccharides (GOS) enhance short-chain fatty acid (SCFA) production, benefiting neurocognitive health, cardiovascular function, immune modulation, and skin integrity.

Advances in biotechnology, including deep eutectic solvents (DES) for extraction and machine learning (ML) for personalized formulations, have expanded prebiotic applications. Integrating these innovations with "omics" technologies enables precise microbial modulation, fostering personalized nutrition and precision therapies.

This review examines organ-specific effects of prebiotics, highlights findings from clinical trials, and explores biotechnological innovations that enhance prebiotic efficacy, laying the groundwork for future personalized therapeutic strategies.

Source: Phillip J. Collier, Faculty Of Pharmacy And Medical Sciences, University Of Petra, Jordan. Prebiotics Beyond The Gut: Omics Insights, Artificial Intelligence, And Clinical Trials In Organ-Specific Applications. Probiotics & Antimicro. Prot. (2025). DOI: https://doi.org/10.1007/s12602-025-10465-x

9. Galacto-Oligosaccharides And The Elderly Gut: Implications For Immune Restoration And Health

The increasing prevalence of non-communicable diseases in the aging population has been correlated with a decline in innate and adaptive immune responses; hence, it is imperative to identify approaches to improve immune function, prevent related disorders, and reduce or treat age-associated health complications. Prebiotic supplementation is a promising approach to modulate the gut microbiome and immune system, offering a potential strategy to maintain the integrity of immune function in older individuals.

This review summarizes the current research on prebiotic galacto-oligosaccharide (GOS) immunomodulatory mechanisms mediated by bacterial-derived metabolites, including short-chain fatty acids and secondary bile acids, to maintain immune homeostasis. **The potential applications of GOS as immunotherapy for age-related disease prevention in older individuals are also highlighted.** This aligns with the global shift toward proactive healthcare and emphasizes the significance of early intervention in directing an individual's health trajectory.

Source: Maria Andrea Azcarate-Peril, Department Of Nutrition, Gillings School Of Global Public Health And UNC Microbiome Core, Center For Gastrointestinal Biology And Disease (CGIBD), School Of Medicine, University Of North Carolina, Chapel Hill, NC, United States. Galacto-Oligosaccharides And The Elderly Gut: Implications For Immune Restoration And Health. Advances In Nutrition, Volume 15, Issue 8, August 2024, 100263.
DOI: https://doi.org/10.1016/j.advnut.2024.100263

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