Recent Studies & Publications on Prebiotics and Health Effects

(September 2020)

STUDIES

1. Dynamics Of Structural And Functional Changes In Gut Microbiota During Treatment With A Microalgal Β-Glucan, Paramylon And The Impact On Gut Inflammation

This study shows the potential of a microalgae derived β-1,3-D-glucan, paramylon (PM), in shaping the gut microbiota and modulating the susceptibility to colitis. The community structure within the gut microbiota showed progressive changes including selective enrichment of specific communities and lowered community richness and diversity during prolonged oral treatment with PM. Compared to control mice, the gut microbiota of PM-treated mice had significantly higher abundance of Verrucomicrobia and lower abundance of Firmicutes. Specific taxa that were significantly more abundant in PM-treated mice include *Akkermansia muciniphila* and several *Bacteroides* members. Predictive functional analysis revealed over-representation of carbohydrate metabolism function in the fecal microbiota of PM recipients compared to controls, and this function was linked to *Bacteroides* spp. ***Prolonged pretreatment with PM not only diminished susceptibility to dextran sulfate sodium induced colitis severity, but also caused enhanced immune regulation. Overall, this study demonstrates the prebiotic properties of PM and the potential benefits of its prolonged oral consumption to gut health***.

Source: Harrison B. Taylor, Department Of Microbiology And Immunology, College Of Medicine, Medical University Of South Carolina, Charleston, USA. Dynamics Of Structural And Functional Changes In Gut Microbiota During Treatment With A Microalgal Β-Glucan, Paramylon And The Impact On Gut Inflammation. Nutrients 2020, 12(8), 2193; https://doi.org/10.3390/nu12082193

2. Intestinal Permeability In Children With Celiac Disease After The Administration Of Oligofructose-Enriched Inulin Into A Gluten-Free Diet—Results Of A Randomized, Placebo-Controlled, Pilot Trial

Researchers have evaluated the effect of twelve-week supplementation of a gluten-free diet (GFD) with prebiotic oligofructose-enriched inulin (10 g per day) on the intestinal permeability in children with celiac disease (CD) treated with a GFD.

Scientists have found that the supplementation with prebiotic did not have a substantial effect on barrier integrity. Prebiotic intake increased excretion of mannitol, which may suggest an increase in the epithelial surface. For individuals with elevated values, improvement in calprotectin and sugar absorption test (SAT) was observed after the prebiotic intake. **This preliminary study suggests that prebiotics may have an impact on the intestinal barrier** and it requires further studies.

Source: Elżbieta Jarocka-Cyrta, Department of Pediatrics, Gastroenterology, and Nutrition, Collegium Medicum, University of Warmia & Mazury, Poland. Intestinal Permeability In Children With Celiac Disease After The Administration Of Oligofructose-Enriched Inulin Into A Gluten-Free Diet—Results Of A Randomized, Placebo-Controlled, Pilot Trial. Nutrients 2020, 12(6), 1736; https://doi.org/10.3390/nu12061736

3. Immune Boosting Functional Foods And Their Mechanisms: A Critical Evaluation Of Probiotics And Prebiotics

Probiotics and prebiotics play crucial roles in managing the intestinal microbiota in order to improve host health, even though their influences on other body sites are being investigated. Different colonic bacteria metabolize dietary prebiotics to produce beneficial metabolites, especially short chain fatty acids (SCFAs) that improve luminal contents and intestinal performance, while positively affecting overall host physiology. This review provides a general perspective of the immune system, the gut immune system and its microbiota. The review also evaluates functional foods with critical but comprehensive perspectives into probiotics and prebiotics, their immune boosting and mechanisms of action. It is recommended that further mechanistic and translational studies are conducted to promote health, social life and also empower poverty-stricken communities.

Source: Tolulope Joshua Ashaolu, Smart Agriculture Research And Application Team And Faculty Of Applied Sciences, Ton Duc Thang University, Ho Chi Minh City, Viet Nam. Immune Boosting Functional Foods And Their Mechanisms: A Critical Evaluation Of Probiotics And Prebiotics. Biomedicine & Pharmacotherapy, Volume 130, October 2020, 110625, https://doi.org/10.1016/j.biopha.2020.110625

4. Dietary Prebiotics Alter Novel Microbial Dependent Fecal Metabolites That Improve Sleep

Dietary prebiotics produce favorable changes in the commensal gut microbiome and reduce host vulnerability to stress-induced disruptions in complex behaviors such as sleep. This study tested if stress and/or dietary prebiotics (Test diet) alter the fecal metabolome; and also explored if these changes were related to sleep and/or gut microbial alpha diversity.

After 5 weeks on diet, rats were either stressed or remained in home cages. Based on untargeted mass spectrometry and 16S rRNA gene sequencing, both stress and Test diet altered the fecal metabolome/microbiome. In addition, Test diet prevented the stress-induced reduction in microbial alpha diversity based on PD_Whole_Tree. Network propagation analysis revealed that stress increased members of the neuroactive steroidal pregnane molecular family; and that Test diet reduced this effect. Researchers have also discovered links between sleep, alpha diversity, and pyrimidine, secondary bile acid, and neuroactive glucocorticoid/pregnanolone-type steroidal metabolites. These results reveal novel microbial-dependent metabolites that may modulate stress physiology and sleep.

Source: Monika Fleshner, Department Of Integrative Physiology And Center For Neuroscience, University Of Colorado At Boulder, Boulder, USA. Dietary Prebiotics Alter Novel Microbial Dependent Fecal Metabolites That Improve Sleep. Sci Rep 10, 3848 (2020). https://doi.org/10.1038/s41598-020-60679-y

5. 3′-Sialyllactose Prebiotics Prevents Skin Inflammation Via Regulatory T Cell Differentiation In Atopic Dermatitis Mouse Models

3'-Sialyllactose (3'-SL), a natural prebiotic, maintains immune homeostasis and exerts anti-inflammatory and anti-arthritic effects. Researchers investigated the effect of 3'-SL on regulatory T cells (Treg) responses in atopic dermatitis (AD) pathogenesis.

Scientists found that oral administration of 3'-SL reduced AD-like symptoms such as ear, epidermal, and dermal thickness in repeated topical application of house dust mites (HDM) and 2,4-dinitrochlorobenzene (DNCB). 3'-SL inhibited IgE, IL-1β, IL-6, and TNF-α secretion and markedly downregulated AD-related cytokines including IL-4, IL-5, IL-6, IL-13, IL-17, IFN-γ, TNF-α, and Tslp through regulation of NF-κB in ear tissue. Additionally, *in vitro* assessment of Treg differentiation revealed that 3'-SL directly induced TGF-β-mediated Treg differentiation. Furthermore, 3'-SL administration also ameliorated sensitization and elicitation of AD pathogenesis by suppressing mast cell infiltration and production of IgE and pro-inflammatory cytokines in mouse serum by mediating the Treg response. Furthermore, *Bifidobacterium* population was also increased by 3'-SL administration as prebiotics. Study data collectively shows that ***3'-SL has therapeutic effects against AD progression by inducing Treg differentiation, downregulating AD-related cytokines, and increasing the Bifidobacterium population.***

Source: Siyoung Yang, CIRNO, Sungkyunkwan University, Suwon; Department Of Biomedical Sciences And Department Of Pharmacology, Ajou University School Of Medicine, Suwon, Republic Of Korea. 3′-Sialyllactose Prebiotics Prevents Skin Inflammation Via Regulatory T Cell Differentiation In Atopic Dermatitis Mouse Models. Sci Rep 10, 5603 (2020). https://doi.org/10.1038/s41598-020-62527-5

6. Human Milk And Mucosa-Associated Disaccharides Impact On Cultured Infant Fecal Microbiota

Human milk oligosaccharides (HMOs) are a mixture of structurally diverse carbohydrates that contribute to shape a healthy gut microbiota composition. The great diversity of the HMOs structures does not allow the attribution of specific prebiotic characteristics to single milk oligosaccharides. Scientists analyzed the utilization of ***four disaccharides, lacto-N-biose (LNB), galacto-N-biose (GNB), fucosyl-α1,3-GlcNAc (3FN) and fucosyl-α1,6-GlcNAc (6FN), that form part of HMOs and glycoprotein structures***, by the infant fecal microbiota.

Researchers found that LNB significantly increased the total levels of ***bifidobacteria*** and the species ***Bifidobacterium breve*** and ***Bifidobacterium bifidum***. The ***Lactobacillus genus*** levels were increased by 3FN fermentation and *B. breve* by GNB and 3FN. There was a significant reduction of ***Blautia coccoides*** group with LNB and 3FN. In addition, 6FN significantly reduced the levels of ***Enterobacteriaceae*** family members. Significantly higher concentrations of ***lactate, formate*** and ***acetate*** were produced in cultures containing either LNB or GNB in comparison with control cultures. Additionally, after fermentation of the ***oligosaccharides*** by the fecal microbiota, several *Bifidobacterium* strains were isolated and identified. ***The results indicated that each, LNB, GNB and 3FN disaccharide, might have a specific beneficial effect in the infant gut microbiota and they are potential prebiotics for application in infant foods.***

Source: María J. Yebra, Laboratorio De Bacterias Lácticas Y Probióticos, Departamento De Biotecnología De Alimentos, IATA-CSIC, Valencia, Spain. Human Milk And Mucosa-Associated Disaccharides Impact On Cultured Infant Fecal Microbiota. Sci Rep 10, 11845 (2020). https://doi.org/10.1038/s41598-020-68718-4

7. Effects Of Prebiotic Dietary Fibers And Probiotics On Human Health: With Special Focus On Recent Advancement In Their Encapsulated Formulations

Dietary fibers (DFs) are known as potential formulations in human health due to their beneficial effects in control of life-threatening chronic diseases including cardiovascular disease (CVD), diabetes mellitus, obesity and cancer. In recent decades scientists around the globe have shown tremendous interest to evaluate the interplay between DFs and gastrointestinal (GIT) microbiota. Evidences from various epidemiological and clinical trials have revealed that DFs modulate formation and metabolic activities of the microbial communities residing in the human GIT which in turn play significant roles in maintaining health and well-being. Furthermore, interestingly, a rapidly growing literature indicates success of DFs being prebiotics in immunomodulation, namely the stimulation of innate, cellular and humoral immune response, which could also be linked with their significant roles in modulation of the probiotics (live beneficial microorganisms). The main focus of the current review is to expressively highlight the importance of DFs being prebiotics in human health in association with their influence on gut microbiota. Now in order to significantly achieve the promising health benefits from these prebiotics, it is aimed to develop novel formulations to enhance and scale up their efficacy. ***This article highlighted different kinds of prebiotic and probiotic formulations which are being regarded as hot research topics among the scientific community now a days.***

Source: Bakht Ramin Shah, Faculty Of Fisheries And Protection Of Waters, South Bohemian Research Center Of Aquaculture And Biodiversity Of Hydrocenoses, Institute Of Aquaculture And Protection Of Waters, České Budějovice, Czech Republic. Effects Of Prebiotic Dietary Fibers And Probiotics On Human Health: With Special Focus On Recent Advancement In Their Encapsulated Formulations. Trends in Food Science & Technology. 2020 Aug; 102:178-192. DOI: 10.1016/j.tifs.2020.06.010

8. Use Of Prebiotic Sources To Increase Probiotic Viability In Pectin Microparticles Obtained By Emulsification/Internal Gelation Followed By Freeze-Drying

This present study investigates the influence of hi-maize, inulin, and rice bran in the survival of *Lactobacillus acidophilus* LA-5 in pectin microparticles obtained by internal gelation and subjected to freeze-drying.

Study results indicated that the pectin + inulin encapsulation matrix presented the highest encapsulation efficiency (68.1%) compared to the other treatments. Microparticle sizes ranged from 166 ± 2 μm (pectin + hi-maize) to 345 ± 9 μm (pectin + inulin). The microparticles added from the different prebiotics shows better microorganism protection when compared to treatment without prebiotics, which presented greater viability in the gastrointestinal simulation. Under storage conditions of 25 °C and −18 °C, the microparticles containing hi-maize, inulin, and rice bran maintained the probiotic microorganisms viable for longer periods than the pectin microparticles. At 7 °C, the pectin + rice bran treatment stood out from the other treatments, as it was able to maintain probiotic stability during 120 days of storage.

Source: Cristiano Ragagnin de Menezes, Department Of Food Science And Technology, Federal University Of Santa Maria, Rio Grande Do Sul, Brazil. Use Of Prebiotic Sources To Increase Probiotic Viability In Pectin Microparticles Obtained By Emulsification/Internal Gelation Followed By Freeze-Drying. Food Research International, Volume 130, April 2020, 108902. https://doi.org/10.1016/j.foodres.2019.108902

9. Enhancing The Prebiotic Effect Of Cellulose Biopolymer In The Gut By Physical Structuring Via Particle Size Manipulation

Cellulose is generally recognized as dietary fiber with no limit of permissible quantity in food, and its consumption may modulate digesta content and impact positively on the gastrointestinal physiology and gut microflora. However, cellulose in its native form possesses inherent undesirable physical properties, making it unattractive for food applications. The present study investigated whether by changing cellulose size to nanometric scale, its prebiotic effect would be altered and also fermenting differently in contrast with micro size cellulose by the gut microbiome would promote the yield of metabolites such as short chain fatty acids (SCFAs). Study results show that the increase in production of acetate (194%), butyrate (224%) and propionate (211%) after 24 h of fermentation was significantly promoted by the size reduction and revealed size-dependent relationship as exemplified R^2 values >0.83. Consequently, gavaging rats with nanometric size cellulose (125 nm) significantly increased these SCFAs yields as well as *Bifidobacterium* counts in contrast with both control and the micro scale size cellulose. Therefore, ***engineered nanocellulose might have beneficial physiological impact on the gut with improved prebiotic effect.***

Source: Fang Zhong, State Key Laboratory Of Food Science And Technology, School Of Food Science And Technology, Jiangnan University, Wuxi, PR China. Enhancing The Prebiotic Effect Of Cellulose Biopolymer In The Gut By Physical Structuring Via Particle Size Manipulation. Food Research International, Volume 131, May 2020, 108935. https://doi.org/10.1016/j.foodres.2019.108935