

Recent Studies and Publications on Probiotics and Health Effects (2017-February 2020)

STUDIES

1. Lactose Maldigestion, Malabsorption, And Intolerance: A Comprehensive Review With A Focus On Current Management And Future Perspectives

Researchers review the current knowledge about lactose intolerance and discussed the potential use of specific probiotic strains such as dietary supplements in lactose-intolerant patients. Study shows that both the hydrogen breath test (HBT) and the genetic tests considered reliable and cost-effective tools to diagnose lactose intolerance condition. Researcher found that dietary restriction of lactose-containing foods is the main therapeutic intervention for lactose-intolerant people, but administration of lactase as enzymatic food supplement and of specific strains of probiotics expressing ***β-galactosidase*** activity can be of help in improving lactose tolerance and quality of life. They also found that the current evidence for the effects of probiotics on lactose intolerance are still inconclusive, more studies with a careful selection of *β-galactosidase*-expressing strains are needed in order to explore their potential in this field.

Source: Fassio F, Allergy and Clinical Immunology Unit, Azienda Usl Toscana Centro, Ospedale San Giovanni di Dio, Italy. Lactose maldigestion, malabsorption, and intolerance: a comprehensive review with a focus on current management and future perspectives. Nutrients 2018, 10(11), 1599; <https://doi.org/10.3390/nu10111599>

2. Adaptive Strategies Of The Candidate Probiotic E. Coli Nissle In The Mammalian Gut

Study show that the “good bacteria” in probiotic drinks and remedies can evolve in the body and have the potential to become harmful which calls for caution in the emerging field of treatment.

Researchers have shown that how one strain of bacteria in an anti-diarrhea probiotic can begin to attack the protective coating of the intestine. This is one factor that can increase the risk of conditions like irritable bowel syndrome (IBS).

Source: Dr Guatam Dantas, Edison Family Center for Genome Sciences & Systems Biology; Department of Biomedical Engineering; Department of Pathology and Immunology and Department of Molecular Microbiology, Washington University School of Medicine, St. Louis, USA. Adaptive strategies of the candidate probiotic e. coli nissle in the mammalian gut. Cell Host And Microbe, Volume 25, ISSUE 4, P499-512.e8, April 10, 2019. <https://doi.org/10.1016/j.chom.2019.02.005>

3. Adjunctive Probiotic Microorganisms To Prevent Rehospitalization In Patients With Acute Mania: A Randomized Controlled Trial

The study found that a probiotic supplement may reduce inflammation of the gut, which is known to exacerbate bipolar disorder. Probiotic organisms are non-pathogenic bacteria that, when present in the gut flora, are known to improve the overall health of the host.

Source: Faith Dickerson, Stanley Research Program at Sheppard Pratt, Sheppard Pratt Health System, USA. Adjunctive probiotic microorganisms to prevent rehospitalization in patients with acute mania: a randomized controlled trial. Bipolar Disord, 2018 Nov; 20(7):614-621. <https://doi.org/10.1111/bdi.12652>

4. The Microbial Metabolite Butyrate Stimulates Bone Formation Via T Regulatory Cell-Mediated Regulation Of WNT10B Expression

Researcher found that probiotics is safe and effective tool to help fight bone loss. A recent study tested the ability of a probiotic to enhance bone growth. The scientists gave laboratory mice oral ***Lactobacillus rhamnosus GG*** supplementation for a period over 4 weeks. The team revealed that the probiotic stimulated the growth of gut bacteria that produce a particular metabolite called **butyrate**. Butyrate, in turn, prompted T cells in bone marrow to produce a protein called Wnt10b, which is vital for bone growth.

Source: Roberto Pacifici, Division of Endocrinology, Metabolism and Lipids, Department of Medicine and Immunology and Molecular Pathogenesis Program, Emory University, USA. The microbial metabolite butyrate stimulates bone formation via t regulatory cell-mediated regulation of WNT10B expression. Immunity, 2018 Dec 18;49(6):1116-1131.e7. <https://doi.org/10.1016/j.immuni.2018.10.013>

5. Probiotic Supplements May Be Linked To Brain Fogginess

A study on probiotic supplements show that consuming too much of probiotics can cause brain fogginess, disorientation as well as rapid belly bloating. Researcher investigate further and found that large colonies of bacteria breeding in the patients small intestines, and high levels of D-lactic acid being produced by the bacteria *Lactobacillus* fermentation of sugars in their food.

Source: Satish Rao, Division of Gastroenterology/Hepatology, Department of Internal Medicine, Medical College of Georgia, Augusta University, USA. Probiotic supplements may be linked to brain foginess. Clinical and Translational Gastroenterology. 9(6):e162, JUNE 2018. DOI: 10.1038/s41424-018-0030-7

6. Immunization With Mycobacterium Vaccae Induces An Anti-Inflammatory Milieu In The CNS: Attenuation Of Stress-Induced Microglial Priming, Alarmins And Anxiety-Like Behavior

A new probiotic-based immunization treatment to protect against post-traumatic stress disorder (PTSD), anxiety, and depression may be on the horizon. According to researchers, immunization with beneficial bacteria can have long-lasting anti-inflammatory effects on the brain, making it more resilient to the physical and behavioral effects of stress. Researchers found that in rodents this particular bacterium, *Mycobacterium vaccae*, actually shifts the environment in the brain towards an anti-inflammatory state.

Source: Matthew G Frank, Department of Psychology and Neuroscience and Center for Neuroscience, University of Colorado Boulder, USA. Immunization with mycobacterium vaccae induces an anti-inflammatory milieu in the cns: attenuation of stress-induced microglial priming, alarmins and anxiety-like behavior. Brain, Behavior, and Immunity, Volume 73, October 2018, Pages 352-363. <https://doi.org/10.1016/j.bbi.2018.05.020>

7. The Anxiolytic Effect Of Probiotics: A Systematic Review And Meta-Analysis Of The Clinical And Preclinical Literature

Researcher concluded that consuming probiotics may be good for the digestive system; it may not be effective in decreasing anxiety levels. Study shows that probiotics in yogurt and supplements can reduce anxiety in rodents, but not in humans.

Source: Daniel J. Reis, Department of Psychology, University of Kansas, United States of America. The anxiolytic effect of probiotics: A systematic review and meta-analysis of the clinical and preclinical literature. PLoS ONE 13(6): e0199041. <https://doi.org/10.1371/journal.pone.0199041>

8. Probiotic Treatment Reduces Depressive-Like Behaviour In Rats Independently Of Diet

A study on rates has shown that besides keeping the gut healthy, consuming a diet rich in probiotics – also called as “good” or “helpful” bacteria — may help protect against depression. Probiotics are live bacteria and yeasts that are good for health, especially the digestive system.

Source: Anders Abildgaard, Translational Neuropsychiatry Unit and Department of Clinical Biochemistry, Aarhus University Hospital, Denmark. Psychoneuroendocrinology, Volume 79, May 2017, Pages 40-48. <https://doi.org/10.1016/j.psyneuen.2017.02.014>

9. Yogurt And Other Fermented Foods As Sources Of Health-Promoting Bacteria

Epidemiological studies have shown that the consumption of fermented foods is associated with reduced risks of type 2 diabetes, metabolic syndrome, and heart disease, along with improved weight management. The microorganisms present in these foods are suggested to contribute to these health benefits. Among these are the yogurt starter culture organisms *Streptococcus thermophilus* and *Lactobacillus delbrueckii subsp bulgaricus* as well as *Bifidobacterium* and *Lactobacillus* strains that are added for their probiotic properties. In contrast, for other fermented foods, such as sauerkraut, kimchi, and miso, fermentation is initiated by autochthonous microbes present in the raw material.

Several studies have shown that consumption of yogurt and other fermented foods may improve intestinal and extra-intestinal health and might be useful in improving lactose mal-absorption, treating infectious diarrhea, reducing the duration and incidence of respiratory infections, and enhancing immune and anti-inflammatory responses.

Source: Robert Hutkins, Department of Food Science and Technology, University of Nebraska, USA. Yogurt and other fermented foods as sources of health-promoting bacteria. Nutrition Reviews, Volume 76, Issue Supplement_1, December 2018, Pages 4-15, <https://doi.org/10.1093/nutrit/nuy056>

10. Isolation And Characterization Of *L. Parafarraginis* (Ku495926) Inhibiting Multidrug-Resistant And **Extended Spectrum Beta**-Lactamase Gram-Negative Bacteria

Study shows that a *Lactobacillus* isolate from commercial yogurt, identified as *Lactobacillus parafarraginis*, inhibited the growth of several multidrug-resistant/extended spectrum ***β-lactamase bacteria***.

Researcher found that the inhibitory substance is a unique, bacteriocin-like peptide which is heat stable up to 121°C and these antimicrobial peptides produced by bacteria are released to kill other related bacteria that are not immune to their action. Findings from the study may hold promise for possible therapeutic application.

Source: Rachele Allen-Mcfarlane, Howard University, Department of Biology, Washington D.C. Isolation and characterization of L. parafarraginis (ku495926) inhibiting multidrug-resistant and extended spectrum β-lactamase gram-negative bacteria. Journal of Microbiology, Biotechnology and Food Sciences, February - March, 2019, VOL. 8, NO. 4, Pages 970-978.

DOI: [10.15414/jmbfs.2019.8.4.970-978](https://doi.org/10.15414/jmbfs.2019.8.4.970-978)

11. A pH-Responsive Gel Macrosphere Based On Sodium Alginate And Cellulose Nanofiber For Potential Intestinal Delivery Of Probiotics

Prebiotics (fermentable fibers) and probiotics (beneficial microbes) are key to establishing a healthy gut microbiome. While most dietary prebiotics can successfully traverse the digestive system, most dietary probiotics cannot survive digestion. Chinese Scientists have developed a gel to help probiotics reach their destination: the colon.

Source: Hao Zhang, Oil Crops Research Institute of the Chinese Academy of Agricultural Sciences, Oil Crops and Lipids Process Technology National & Local Joint Engineering Laboratory, Key Laboratory of Oilseeds Processing, Ministry of Agriculture, Hubei Key Laboratory of Lipid Chemistry and Nutrition, China. A pH-responsive gel macrosphere based on sodium alginate and cellulose nanofiber for potential intestinal delivery of probiotics. ACS Sustainable Chem. Eng. 2018, 6, 11, 13924-1393.

<https://doi.org/10.1021/acssuschemeng.8b02237>

12. Probiotics Biofilm-Integrated Electrospun Nanofiber Membranes: A New Starter Culture For Fermented Milk Production

Researcher found that growing biofilms on thin sheets of nano-fibres can be a mechanism for producing probiotic-delivering fermented milk products. The researchers successfully grew the bacteria *Lactobacillus plantarum*, which is associated with the health benefits provided by fermented foods, on nano-fibre membranes.

Study show that a large surface area of the nanofiber membranes provides a scaffold for the bacteria, allowing it to form colonies and then biofilms, which were used to ferment milk. They also found that the useful *L. plantarum* bacteria in biofilms were more resistant to simulated digestion than free-floating *L. plantarum* and survived better over the course of the milk's shelf life.

Source: Meng-Xin Hu, School of Food Science and Biotechnology, Zhejiang Gongshang University, China. Probiotics biofilm-integrated electrospun nanofiber membranes: a new starter culture for fermented milk production. Agric. Food Chem. 2019, 67, 11, 3198-3208.

<https://doi.org/10.1021/acs.jafc.8b05024>

13. Use Of A Potential Probiotic, *Lactobacillus Casei* L4, In The Preparation Of Fermented Coconut Water Beverage

Researcher has produce a fermented coconut water beverage with the potential probiotic *Lactobacillus casei* L4 and they found that the fermentation of coconut water with probiotic lactobacilli increased the cell viability count with vitamin B12 and total phenolic content.

They also noticed that fermentation did not changed the levels of most minerals, except calcium, manganese, phosphorus and sodium and the culture supernatant from fermented coconut water was found to inhibit the growth of foodborne pathogens such as *Bacillus cereus*, *Listeria monocytogenes*, *Staphylococcus aureus*, and *Salmonella typhi*. The coconut water fermented with *L. casei* L4 act as a novel functional beverage that contains both probiotics and electrolytes, and they are suitable vehicle for preparing a wider range of novel functional products.

Source: Sib S. Giri, Department of Biotechnology, Periyar Maniammai University, Thanjavur; Laboratory of Aquatic Biomedicine, College of Veterinary Medicine and Research Institute for Veterinary Science, Seoul National University, Seoul, South Korea and School of Life Sciences, Jawaharlal Nehru University, New Delhi, India. Use of a potential probiotic, lactobacillus casei l4, in the preparation of fermented coconut water beverage. Front Microbiol. 2018 Aug 22;9:1976. <https://doi.org/10.3389/fmicb.2018.01976>

14. Next-Generation Probiotics: The Spectrum From Probiotics To Live Biotherapeutics

Study shows that the leading probiotics currently available to consumers are generally drawn from a narrow range of organisms and the knowledge of the gut microbiota and its constituent actors is changing particularly given the phylogenetic range and relatively unknown characteristics of the organisms under investigation as novel therapeutics.

Researcher found that development is likely to be more amenable to a pharmaceutical than a food delivery route; these organisms are often operationally referred to as next-generation probiotics, a concept that overlaps with the emerging concept of live biotherapeutic products. They also found that the latter is a class of organisms developed exclusively for pharmaceutical application.

Source: O'Toole PW, School of Microbiology & APC Microbiome Institute, University College Cork, Ireland. Next-generation probiotics: the spectrum from probiotics to live biotherapeutics. Nat Microbiol 2, 17057 (2017). <https://doi.org/10.1038/nmicrobiol.2017.57>

15. Probiotics In Human Health And Disease: From Nutriotics To Pharmabiotics

Study shows that probiotics are the most useful tools for balancing the gut microbiota which influencing human health and disease and have a range of effects from those on nutritional status to medical conditions throughout the body from the gut to non-intestinal body sites such as the brain and skin. Researcher found that the concept of pharmabiotics emerged only two decades ago, and the recent research suggest the new categorization of probiotics to nutriotics and pharmabiotics which are under the different regulation depending on whether they are food or drug. They also found that information on the gut microbiome has been continuously accumulating, which will make possible the gut microbiome-based healthcare in the future, when nutriotics show potential for maintaining health while pharmabiotics are effective therapeutic tools for human diseases.

Source: Lee ES, Research Group of Healthcare, Korea Food Research Institute, Republic of Korea. Probiotics in human health and disease: from nutriotics to pharmabiotics. J Microbiol. 56, 773-782 (2018). <https://doi.org/10.1007/s12275-018-8293-y>

16. The Effects Of Probiotics In Lactose Intolerance: A Systematic Review

Study shows that the effectiveness of probiotics in the treatment of **LI (Lactose Intolerance)** using 15 randomized double-blind studies. Eight probiotic strains with the greatest number of proven benefits were studied. Researcher found that there is varying degrees of efficacy but an overall positive relationship between probiotics and lactose intolerance.

Source: Oak SJ, Department of Human Nutrition , Food and Animal Sciences, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, USA. The effects of probiotics in lactose intolerance: A systematic review, Critical Reviews in Food Science and Nutrition, 59:11, 1675-1683, 2019. <https://doi.org/10.1080/10408398.2018.1425977>

17. Status Paper On Role Of Probiotics In Promoting Healthy Microbiome For Health And Immunity

This paper clearly brings out the importance of Microbiome and role of Probiotics in promoting health and the mode of action. Overview of current research on Probiotics by research organizations in the country in India, Probiotics in India traditional diets and national and international regulatory framework for Probiotics are also included.

Source: ILSI India, Status paper on role of probiotics in promoting healthy microbiome for health and immunity (2019).

<http://www.ilsi->

[india.org/PDF/Status_Paper_On_Role_of_Probiotics_In_Promoting_Healthy_Microbiome_For_Health_And_Immunity/Status_Paper_On_Role_of_Probiotics_In_Promoting_Healthy_Microbiome_For_Health_And_Immunity.pdf](http://www.ilsi-india.org/PDF/Status_Paper_On_Role_of_Probiotics_In_Promoting_Healthy_Microbiome_For_Health_And_Immunity/Status_Paper_On_Role_of_Probiotics_In_Promoting_Healthy_Microbiome_For_Health_And_Immunity.pdf)

18. A Systematic Evaluation of the Immunomodulatory and Functional Properties of Probiotic Bifidobacterium Breve BR03 (DSM 16604) Lactobacillus Plantarum LP01 (LMG P-21021)

This study was conducted to evaluate the capability of the bacterial strains *Bifidobacterium breve* BR03 (DSM 16604) and *Lactobacillus plantarum* LP01 (LMG P-21021) which induce an in vitro immune response in the peripheral blood mononuclear cells (PBMCs) of healthy adult volunteers and to modify the state of oxidative stress and intestinal permeability of in vitro cell models. It was found that the species Bifidobacterium breve could be fruitfully employed in both IBS and chronic gut dysbiosis associated with impaired mucosal permeability like in coeliac disease and thus potentially contrasting the progression of irritable bowel diseases in predisposed patients.

Source: Luca Mogna, Research and Development, Probiological Research Ltd, Italy. A systematic evaluation of the immunomodulatory and functional properties of probiotic Bifidobacterium breve BR03 (DSM 16604) Lactobacillus plantarum LP01 (LMG P-21021). J Prob Health. 7:214. DOI: 10.35248/2329-8901.19.7.214

19. Probiotics To Prevent Staphylococcus Aureus Disease?

According to this study Bacillus colonization of the human intestine is negatively correlated with that of the human pathogen, Staphylococcus aureus. Further, colonization resistance is achieved by secretion of a class of lipopeptides by Bacillus species that inhibits S. aureus quorum-sensing signaling, which is crucial for *S. aureus* intestinal colonization.

Source: Michael Otto, Pathogen Molecular Genetics Section, National Institute of Allergy and Infectious Diseases, The National Institutes of Health, USA. Probiotics to prevent Staphylococcus aureus disease? Gut Microbes, 11:1, 94-101, 2019. <https://doi.org/10.1080/19490976.2019.1591137>

20. Online Information on Probiotics: Does It Match Scientific Evidence?

The present study was undertaken to assess the information quality of webpages referring to probiotics and to compare the recommendations available online with the information collected from trusted scientific sources. In the study, 150 webpages were evaluated returned by Google searching "probiotics" in terms of typology of website, health information quality based on the JAMA score and the HONcode certification, as well as completeness of the information based on the presence of four criteria: (1) links to scientific references supporting health claims, (2) cautionary notes about level of evidence for alleged benefits, (3) safety considerations, and (4) regulatory status.

It was found that HON-certified websites were significantly more frequent in the top 10 websites than in the remaining websites. In terms of completeness of information, only **10% of webpages met all four criteria, 40% had a cautionary note on benefits, 35% referred to scientific literature, and only 25% mentioned potential side effects.**

The results of the content analysis led to conclusion that: **(1) the most frequent typologies of webpages returned by Google are commercial and news, (2) commercial websites on average provide the least reliable information, and (3) significant numbers of claimed benefits of probiotics are not supported by scientific evidence.** This study highlight the important biases in the probiotics information available online, underlining the need to improve the quality and objectivity of information provided to the public.

Source: Michel Goldman, Institute for Interdisciplinary Innovation in Healthcare, Université Libre de Bruxelles, Belgium. 20. Online information on probiotics: does it match scientific evidence? Front Med (Lausanne). 2019; 6: 296. <https://doi.org/10.3389/fmed.2019.00296>

21. Probiotics In The Next-Generation Sequencing Era

This study demonstrates that even during probiotic supplementation, resident gut bacteria in a subset of individuals resist the mucosal presence of probiotic strains, limiting their modulatory effect on the microbiome and on the host gut transcriptional landscape. It was found that resistance was partly alleviated by antibiotics treatment, which enables probiotics to interact with the host at the gut mucosal interface, although rather than promoting reconstitution of the indigenous microbiome and of the host transcriptional profile, they inhibit these components from returning to their naïve pre-antibiotic configurations.

Source: Eran Elinav, Immunology Department, Weizmann Institute of Science, Israel and Cancer Microbiome Research Division, DKFZ, Heidelberg, Germany. Probiotics in the next-generation sequencing era, Gut Microbes, 11:1, 77-93, 2019. <https://doi.org/10.1080/19490976.2019.1586039>

22. Probiotic Bacteria As Modulators Of Cellular Senescence: Emerging Concepts And Opportunities

Studies have shown that probiotic supplementation is useful in mitigating age-associated oxi-inflammatory stress, immunosenescence, and gut dysbiosis thereby promoting health and longevity. Current understanding of the process of aging suggests a strong interrelationship between the accumulation of senescent cells and the development of aging phenotype, including the predisposition to age-related disorders. The present review studies the documented pro-longevity effects of probiotics and highlights how these beneficial attribute of probiotics could be related to the mitigation of cellular senescence.

Source: Rohit Sharma, Pharmacology and Toxicology Laboratory, Food and Nutraceutical Division, CSIR- Institute of Himalayan Bioresource Technology, Palampur, India. Probiotic bacteria as modulators of cellular senescence: emerging concepts and opportunities. *Gut Microbes*, 2019. <https://doi.org/10.1080/19490976.2019.1697148>

23. Assessment of Probiotic Properties of Some Bacteria Isolated from Dairy Products

This study was undertaken to isolate bacteria from fermented dairy products and evaluate their probiotic potential. It found that among the tested isolates, P3 has maximum antimicrobial activity against *Staphylococcus aureus* and P8 has maximum antimicrobial activity against *Salmonella enteritidis*, *Listeria monocytogenes* and *Escherichia coli*. The isolate P8 has highest cholesterol assimilation capability (41.91%) which was followed by isolate P3 (35.95%). Further, based on the morphological, biochemical and physiological characteristics the isolate P3 and P8 were identified as *Lactococcus lactis* and *Streptococcus thermophilus*, respectively. This study reveals that fermented dairy products available in Bangladesh contain adequate number of lactic acid bacteria and some of the bacterial isolates possess appreciable probiotic properties.

Source: Rahman MR, Department of Botany, Jahangirnagar University, Bangladesh. Assessment of probiotic properties of some bacteria isolated from dairy products. *J Prob Health*. 7:207. doi: 10.35248/2329-8901.19.7.207

24. Gut Microbiota Profile Autism Spectrum Disorder Relationship: Diversity and Imbalance in Probiotics

According to this study probiotic-based diet supplementations are among potential treatments of Autism Spectrum Disorders (ASDs) because of the existing gut microbiota profile-mental health. It found that there are less microbiota diversity and an uncommon higher *Streptococcus/Lactobacillus* abundance ratio in the autistic adult.

Source: Razafindralambo H, Gembloux Agro-Bio Tech, Belgium. Gut microbiota profile autism spectrum disorder relationship: diversity and imbalance in probiotics. *J Prob Health*. 7:209. doi: 10.35248/2329-8901.19.7.209

Note: Only lead author's names and their affiliations are given. Please see the articles for full details.
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1. Effects Of Low FODMAP Diet On Symptoms, Fecal Microbiome, And Markers Of Inflammation In Patients With Quiescent Inflammatory Bowel Disease In A Randomized Trial

Researchers from the UK and France have found that a diet low in fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAP) improved some gut symptoms and improved health-related quality of life for sufferers of inflammatory bowel disease (IBD).

The researchers also discovered that the low FODMAP diet reduces certain gut bacteria, such as *Bifidobacteria*, that may be beneficial to health and may reduce inflammation. Despite the changes in beneficial bacteria, gut inflammation did not appear to increase after the low FODMAP diet in patients with IBD.

Source: Kevin Whelan, Department of Nutritional Sciences, King's College London, London, United Kingdom. 1. Effects of low FODMAP diet on symptoms, fecal microbiome, and markers of inflammation in patients with quiescent inflammatory bowel disease in a randomized trial. Gastroenterology. 2020 Jan;158(1):176-188.e7. <https://doi.org/10.1053/j.gastro.2019.09.024>

2. Efficacy Of An Anthocyanin And Prebiotic Blend On Intestinal Environment In Obese Male And Female Subjects

New study shows that combination of anthocyanins and prebiotics may improve the composition of the gut microflora and reduce bloating and abdominal pain in obese adults. It was found that the supplementation with the anthocyanin-prebiotic blend will bring significant decrease in the phylum Firmicutes, a significant increase in the phylum Bacteroidetes, and a significant decrease in the ratio of Firmicutes to Bacteroidetes.

The *Firmicutes/Bacteroidetes* ratio is reportedly a good biomarker for obesity, with data from a 2005 study by indicating that obese mice had lower levels of Bacteroidetes and higher levels of Firmicutes, compared with lean mice. Researchers found that consumption of a supplement containing a blend of anthocyanins and prebiotics positively modulated the intestinal ecosystem, including the microbiome, and provided insights into the mechanisms of action of the anthocyanin prebiotic formulation and its impact on health benefits.

Source: Steven M. Wood, Pharmanex Research, NSE Products Inc., USA. Efficacy of an anthocyanin and prebiotic blend on intestinal environment in obese male and female subjects. J Nutr Metab. 2018 Sep 13; 2018:7497260. <https://doi.org/10.1155/2018/7497260>

3. Prebiotic Effects Of White Button Mushroom (*Agaricus Bisporus*) Feeding On Succinate And Intestinal Gluconeogenesis In C57BL/6 Mice

In a mouse model, the scientists have been able to map out how white button mushrooms modify the gut microbiota, ultimately leading to improved glucose regulation in the mice's systems. The findings suggest that white button mushrooms, as a prebiotic food, could be used in the future to manage diabetes, due to the role that they seem to play in gluconeogenesis.

*Source: Margherita T. Cantorna, Department of Veterinary and Biomedical Sciences, The Pennsylvania State University, United States. Prebiotic effects of white button mushroom (*Agaricus Bisporus*) feeding on succinate and intestinal gluconeogenesis in C57BL/6 mice. Journal of Functional Foods, Volume 45, June 2018, Pages 223-232. <https://doi.org/10.1016/j.jff.2018.04.008>*

4. Prebiotics In Foods And Their Beneficial Effects

The monograph includes information on sources of prebiotics in Indian food and explains the beneficial effects of Oligosaccharides as prebiotics and positive impact on gut health by regulating the lipid metabolism and immune modulation.

Source: ILSI India, Prebiotics In Foods And Their Beneficial Effects. http://www.ilsa-india.org/PDF/Monograph_on_Prebiotics_In_Foods_And_Their_Beneficial_Effects.pdf

5. Dietary Polydextrose And Galactooligosaccharide Increase Exploratory Behavior, Improve Recognition Memory, And Alter Neurochemistry In The Young Pig

New mothers often hear the slogan "breast milk is best" and are encouraged to offer breast milk to their newborn babies and that's because it contains natural sources of prebiotics, the small indigestible fiber molecules that promote the growth of good bacteria in the infant's gut. However, many families find breastfeeding completely impossible in some cases and turn to infant formulas and now infant formulas are getting even closer to the real thing. In a recent study, scientists found that prebiotics included in infant formula may enhance memory and exploratory behavior.

Source: Ryan Dilger, Piglet Nutrition and Cognition Laboratory, Department Of Animal Sciences, Division Of Nutritional Sciences, And Neuroscience Program, University Of Illinois, USA. Dietary polydextrose and galactooligosaccharide increase exploratory behavior, improve recognition memory, and alter neurochemistry in the young pig, Nutritional Neuroscience, 22:7, 499-512. <https://doi.org/10.1080/1028415X.2017.1415280>

6. Effect Of Functional Foods (Prebiotics) Incorporated Chikkis For HIV Positive Adults In Madurai District, Tamil Nadu, India

This study focuses on the organoleptic evaluation of formulated Prebiotics incorporated chikkis and the impact of supplementation among HIV infected subjects.

It was found that there was a significant **improvement in the hemoglobin content** in the experimental group than the placebo and control group at five per cent level of significance. The mean initial CD4 count of the experimental group was 562, placebo group was 376 and control group was 453 but at the end of the supplementation of prebiotics incorporated chikkies, mean final CD4 count of the experimental group was 759, placebo group was 399 and control group was 479.

Result of the study shows that supplementation of prebiotics incorporated chikkis to the HIV adults of Madurai District had a significant impact on the hemoglobin levels and the CD4 count of selected HIV subjects.

Source: Vasantha Esther Rani, Research Center of Home Science with Food Biotechnology at Fatima College (Autonomous), Madurai, Tamil Nadu, India. Effect of functional foods (prebiotics) incorporated chikkis for HIV positive adults in Madurai district, Tamil Nadu, India. J Prob Health 2018, Volume 6. DOI: 10.4172/2329-8901-C2-028

7. Potential For Enriching Next-Generation Health-Promoting Gut Bacteria Through Prebiotics And Other Dietary Components

The newly identified health-associated bacteria include: ***Faecalibacterium prausnitzii***, ***Akkermansia muciniphila***, ***Ruminococcus bromii*** and ***Roseburia species***, have. The abundance of many of these bacteria are inversely correlated to several disease states. Technological and regulatory hurdles may limit the use of strains from these taxa as probiotics, however, it should be possible to utilize prebiotics and other dietary components to selectively enhance their growth in situ. Dietary components of potential relevance include well-established prebiotics, such as galacto-oligosaccharides, fructo-oligosaccharides and inulin, while other putative prebiotics, such as other oligosaccharides, polyphenols, resistant starch, algae and seaweed as well as host gut metabolites such as lactate and acetate, may also be applied with the aim of selectively and/or differentially affecting the beneficial bacterial community within the gastrointestinal environment.

Source: Paul D. Cotter, Teagasc Food Research Centre; APC Microbiome and University College Cork, Ireland. Potential for enriching next-generation health-promoting gut bacteria through prebiotics and other dietary components. Gut Microbes, 11:1, 1-20, 2019. <https://doi.org/10.1080/19490976.2019.1613124>

8. Potential For Using Of Ulvan Polysaccharide From Ulva Lactuca As A Prebiotic In Synbiotic Yogurt Production

This study demonstrates that addition of 1-2% of the ulvan polysaccharide to synbiotic yogurt provide good chemical and physical properties, as well as stimulates the growth and activity of probiotic bacteria. It was found that the addition of high percentage (4%) of the ulvan polysaccharide will gave opposite results in terms of flavor, delayed fermentation and weak texture with syneresis. Ulvan polysaccharide is extracted from **Ulva lactuca**. Ulva lactuca is a widespread macroalga and highly consumed by humans and livestock because of its great nutritional values.

Source: Samah Shalaby M, Food Science Department, Faculty of Agriculture, Ain Shams University, Egypt. Potential Using of Ulvan Polysaccharide from Ulva lactuca as a Prebiotic on Synbiotic Yogurt Production. J Prob Health 7: 208. doi: 10.35248/2329-

9. Effect Of Wheat Bran Derived Prebiotic Supplementation On Gastrointestinal Transit, Gut Microbiota, And Metabolic Health: A Randomized Controlled Trial In Healthy Adults With A Slow Gut Transit

Acute intake of the wheat bran extract *Arabinoxylan-Oligosaccharide (AXOS)* modulates the gut microbiota, improves stool characteristics and postprandial glycemia in healthy humans. Yet, little is known on how long-term AXOS intake influences gastrointestinal (GI) functioning gut microbiota, and metabolic health. In this randomized, placebo-controlled, double-blind study, scientists evaluated the effects of AXOS intake on GI function and metabolic health in adults with slow GI transit without constipation.

It was found that WGTT (whole-gut transit time) was unchanged, but stool consistency softened after AXOS. 12-wks of AXOS intake significantly changed the microbiota by increasing Bifidobacterium and decreasing microbial alpha-diversity. The incretin hormone Glucagon-like protein 1 was reduced after AXOS compared to placebo whereas energy expenditure, plasma metabolites, AT (adipose tissue) parameters, SCFA (short-chain fatty acids), and gut permeability were unchanged. Further, the intake of wheat bran extract increases fecal *Bifidobacterium* and softens stool consistency without major effects on energy metabolism in healthy humans with a slow GI transit.

Source: Ellen E. Blaak, Department of Human Biology, NUTRIM School of Nutrition and Translational Research in Metabolism, Maastricht University Medical Centre, Maastricht, The Netherlands. Effect of wheat bran derived prebiotic supplementation on gastrointestinal transit, gut microbiota, and metabolic health: a randomized controlled trial in healthy adults with a slow gut transit. Gut Microbes, 2020. <https://doi.org/10.1080/19490976.2019.1704141>

Other Studies

1. Expert Consensus Document: The International Scientific Association For Probiotics And Prebiotics (ISAPP) Consensus Statement On The Definition And Scope Of Prebiotics

In December 2016, a panel of experts in microbiology, nutrition and clinical research was convened by the International Scientific Association for Probiotics and Prebiotics to review the definition and scope of prebiotics. The panel updated the definition of a prebiotic: a substrate that is selectively utilized by host microorganisms conferring a health benefit and it expands the concept of prebiotics to possibly include non-carbohydrate substances, applications to body sites other than the gastrointestinal tract, and diverse categories other than food. Beneficial health effects must be documented for a substance to be considered a prebiotic. The consensus definition applies also to prebiotics for use by animals, in which microbiota-focused strategies to maintain health and prevent disease is as relevant as for humans.

Source: Gibson GR, Department of Food and Nutritional Sciences, The University of Reading, UK. Expert consensus document: The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics. Nat Rev Gastroenterol Hepatol 14, 491-502 (2017). <https://doi.org/10.1038/nrgastro.2017.75>

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