

# Recent Studies and Publications on Probiotics and Health Benefits

## STUDIES

### 1. Probiotics As A New Regulator For Bone Health: A Systematic Review And Meta-Analysis

This systematic review and meta-analysis indicate that probiotic supplementation improve bone health.

*Source: Hanieh-Sadat Ejtahed, Obesity And Eating Habits Research Center, Endocrinology And Metabolism Clinical Sciences Institute And Endocrinology And Metabolism Research Center, Endocrinology And Metabolism Clinical Sciences Institute, Tehran University Of Medical Sciences, Tehran, Iran. Probiotics As A New Regulator For Bone Health: A Systematic Review And Meta-Analysis. Hindawi, Evidence-Based Complementary and Alternative Medicine, Volume (2021), Article ID 3582989, 35 pages. <https://doi.org/10.1155/2021/3582989>*

### 2. The Effect Of Oral Probiotics (Streptococcus Salivarius K12) On The Salivary Level Of Secretory Immunoglobulin A, Salivation Rate, And Oral Biofilm: A Pilot Randomized Clinical Trial

This study assessed the effect of oral probiotics containing the *Streptococcus salivarius* K12 strain on the salivary level of secretory immunoglobulin A, salivation rate, and oral biofilm.

Researchers have found that there was no increase in salivary secretory immunoglobulin A levels and salivary flow rates in the probiotic group compared with placebo. Baseline and outcome salivary secretory immunoglobulin A concentrations (mg/L) were  $226 \pm 130$  and  $200 \pm 113$  for the probiotic group and  $205 \pm 92$  and  $191 \pm 97$  for the placebo group, respectively. A significant decrease in plaque accumulation was observed in the probiotic group at 4 and 6 weeks.

*Source: Ksenia Babina, Department Of Therapeutic Dentistry, I.M. Sechenov First Moscow State Medical University (Sechenov University), Moscow, Russia. The Effect Of Oral Probiotics (Streptococcus Salivarius K12) On The Salivary Level Of Secretory Immunoglobulin A, Salivation Rate, And Oral Biofilm: A Pilot Randomized Clinical Trial. Nutrients (2022), 14(5), 1124; <https://doi.org/10.3390/nu14051124>*

### 3. Prophylactic Effects Of Probiotics Or Synbiotics On Postoperative Ileus After Gastrointestinal Cancer Surgery: A Meta-Analysis Of Randomized Controlled Trials

The meta-analysis of randomized controlled trials concluded that perioperative supplementation of probiotics or synbiotics can effectively promote the recovery of gastrointestinal function after gastrointestinal cancer surgery.

*Source: Zhengqiang Wei, Department Of Gastrointestinal Surgery, The First Affiliated Hospital Of Chongqing Medical University, Chongqing, China. Prophylactic Effects Of Probiotics Or Synbiotics On Postoperative Ileus After Gastrointestinal Cancer Surgery: A Meta-Analysis Of Randomized Controlled Trials. PLOS ONE 17(3): e0264759. <https://doi.org/10.1371/journal.pone.0264759>*

### 4. Combined Berberine And Probiotic Treatment As An Effective Regimen For Improving Postprandial Hyperlipidemia (PL) In Type 2 Diabetes (T2D) Patients: A Double Blinded Placebo Controlled Randomized Study

Researchers have found that Prob+BBR (Probiotics combined with Berberine) was superior to (berberine) BBR or Prob (probiotic) alone in improving postprandial total cholesterol (pTC) and low-density lipoprotein cholesterol (pLDLc) levels with decrement of multiple species of postprandial lipidomic metabolites after 3 months follow-up.

This effect was linked to the changes of fecal *Bifidobacterium breve* level responding to BBR alone or Prob+BBR treatment. Four *fadD* genes encoding long-chain acyl-CoA synthetase were identified in the genome of this *B. breve* strain, and transcriptionally activated by BBR. In vitro BBR treatment further decreased the concentration of fatty acid (FFA) in the culture medium of *B. breve* compared to vehicle. Thus, the activation of *fadD* by BBR could enhance fatty acid (FFA) import and mobilization in *B. breve* and diminish the intraluminal lipids for absorption to mediate the effect of Prob+BBR on PL.

This study confirmed that BBR and Prob (*B. breve*) could exert a synergistic hypolipidemic effect on PL, acting as a gut lipid sink to achieve better lipidemia and CVD risk control in T2D.

*Source: Weiqing Wang, Department Of Endocrine And Metabolic Diseases, Shanghai Institute Of Endocrine And Metabolic Diseases, Ruijin Hospital, Shanghai Jiao Tong University School Of Medicine; Shanghai National Clinical Research Center For Metabolic Diseases, Key Laboratory For Endocrine And Metabolic Diseases Of The National Health Commission Of The Pr And Shanghai National Center For Translational Medicine, Ruijin Hospital, Shanghai Jiao Tong University School Of Medicine, Shanghai, China. Combined Berberine And Probiotic Treatment As An Effective Regimen For Improving Postprandial Hyperlipidemia (PL) In Type 2 Diabetes (T2D) Patients: A Double Blinded Placebo Controlled Randomized Study. Gut Microbes, Gut Microbes Volume 14, (2022) - Issue 1, 14:1. <https://doi.org/10.1080/19490976.2021.2003176>*

## **5. Clinical, Gut Microbial And Neural Effects Of A Probiotic Add-On Therapy In Depressed Patients: A Randomized Controlled Trial**

A promising new treatment approach for *major depressive disorder (MDD)* targets the *microbiota-gut-brain (MGB) axis*, which is linked to physiological and behavioral functions affected in MDD.

This randomized controlled trial determines whether short-term, high-dose probiotic supplementation reduces depressive symptoms along with gut microbial and neural changes in depressed patients.

Researchers have found that *Hamilton Depression Rating Scale HAM-D scores* were decreased over time and interactions between time and group indicated a stronger decrease in the probiotics relative to the placebo group. Probiotics maintained microbial diversity and increased the abundance of the genus *Lactobacillus*, indicating the effectivity of the probiotics to increase specific taxa. The increase of the *Lactobacillus* was associated with decreased depressive symptoms in the probiotics group. Finally, putamen activation in response to neutral faces was significantly decreased after the probiotic intervention.

Further, an add-on probiotic treatment ameliorates depressive symptoms (HAM-D) along with changes in the gut microbiota and brain, which highlights the role of the MGB axis in MDD and emphasizes the potential of microbiota-related treatment approaches as accessible, pragmatic, and non-stigmatizing therapies in MDD.

*Source: André Schmidt, University Of Basel, Department Of Psychiatry (UPK), Basel, Switzerland. Clinical, Gut Microbial And Neural Effects Of A Probiotic Add-On Therapy In Depressed Patients: A Randomized Controlled Trial. Transl Psychiatry 12, 227 (2022). <https://doi.org/10.1038/s41398-022-01977-z>*

## **6. Daily Lactobacillus Probiotic Versus Placebo In COVID-19-Exposed Household Contacts (PROTECT-EHC): A Randomized Clinical Trial**

The objective of this study was to determine whether daily probiotic *Lactobacillus rhamnosus GG (LGG)* is effective in preventing development of symptoms of illness within 28 days of Covid-19 exposure.

Study result suggests that *LGG* is well-tolerated and is associated with prolonged time to development of Covid-19 infection, reduced incidence of symptoms, and changes to gut microbiome structure when used as post-exposure prophylaxis within 7 days after exposure. This preliminary work may inform the approach to prevention of Covid-19, particularly in underdeveloped nations where *Lactobacillus* probiotics have already been utilized to reduce non-Covid sepsis and infectious-morbidity. Further, studies are required.

*Source: Neeraj K. Surana, Department of Molecular Genetics and Microbiology, Duke University, Department of Immunology, Duke University Medical Center, Division of Infectious Diseases, Department of Pediatrics, Duke University Medical Center Durham, North Carolina, United States. Daily Lactobacillus Probiotic Versus Placebo In COVID-19-Exposed Household Contacts (PROTECT-EHC): A Randomized Clinical Trial. Medrxiv (2022) .01.04.21268275. DOI: <https://doi.org/10.1101/2022.01.04.21268275>*

## **7. Next-Generation Probiotics As A Therapeutic Strategy For The Treatment Of Phenylketonuria: A Review**

Phenylketonuria (PKU) is a rare genetic disease that causes brain toxicity due to the inability of the body to convert dietary phenylalanine to tyrosine by the action of phenylalanine hydroxylase. The only treatment for PKU so far is lifelong dietary intervention to ensure normal human growth and neurodevelopment. Genetically modified probiotics designed as live biotherapeutic agents for the treatment of specific diseases are sophisticated alternative therapeutic strategies.

**This systematic review** highlights the use of next-generation probiotics as a therapeutic strategy in the treatment of individuals with PKU. The results described in the literature are encouraging, showing efficacy - both in vitro and in vivo- of use of genetically modified engineered probiotics. Further, these probiotics appear to be suitable for meeting the unmet need for new drugs for PKU.

*Source: Mariana Buranelo Egea, Goiano Federal Institute Of Education, Science, And Technology, Rio Verde, Goiás, Brazil. Next-Generation Probiotics As A Therapeutic Strategy For The Treatment Of Phenylketonuria: A Review. Nutrition Reviews, Volume 80, Issue 10, October (2022), Pages 2100-2112. <https://doi.org/10.1093/nutrit/nuac024>*

## 8. The Contribution Of Diet Therapy And Probiotics In The Treatment Of Sarcopenia Induced By Prolonged Immobilization Caused By The Covid-19 Pandemic

This study shows that diet therapy, consisting of increased protein intake and specific probiotics and specific physical therapy, demonstrated superiority in improving the functional status of patients with recent Covid-19 infection.

Source: Delia Mirela Tit, Doctoral School Of Biological And Biomedical Sciences And Department Of Pharmacy, Faculty Of Medicine And Pharmacy, University Of Oradea, Romania. *The Contribution Of Diet Therapy And Probiotics In The Treatment Of Sarcopenia Induced By Prolonged Immobilization Caused By The Covid-19 Pandemic. Nutrients* (2022), 14(21), 4701. <https://doi.org/10.3390/nu14214701>

## 9. Efficacy Of Probiotics In The Management Of Halitosis: A Systematic Review And Meta-Analysis

Halitosis is defined as a foul odour emitted from the oral cavity. Volatile sulphuric compounds are the main cause of persistent bad breath. These compounds are produced by mouth bacteria as a result of bacterial mixing and food debris associated with poor gum and dental hygiene.

This systematic review and meta-analysis indicates that probiotics (e.g., *Lactobacillus salivarius*, *Lactobacillus reuteri*, *Streptococcus salivarius* and *Weissella cibaria*) may inhibit the decomposition of amino acids and proteins by anaerobic bacteria in the mouth, so curbing the production of smelly by-products and bad breath in the short term ( $\leq 4$  weeks).

Source: Longjiang Li, State Key Laboratory Of Oral Diseases, National Clinical Research Center For Oral Diseases, Department Of Head And Neck Oncology, West China Hospital Of Stomatology, Sichuan University, Chengdu, China. *Efficacy Of Probiotics In The Management Of Halitosis: A Systematic Review And Meta-Analysis. BMJ Open* (2022);12:e060753, DOI: 10.1136/bmjopen-2022-060753.

## 10. Supplementation With A Probiotic Mixture Accelerates Gut Microbiome Maturation And Reduces Intestinal Inflammation In Extremely Preterm Infants

In this study researchers have investigated the effects of a probiotic product containing four strains of *Bifidobacterium species* autochthonous to the infant gut and one *Lactocaseibacillus strain* on the compositional and functional trajectory of microbiome.

Scientists have found that daily administration of the mixture accelerated the transition into a mature, term-like microbiome with higher stability and species interconnectivity. Besides infant age, *Bifidobacterium* strains and stool metabolites were the best predictors of microbiome maturation, and structural equation modeling confirmed probiotics as a major determinant for the trajectory of microbiome assembly. *Bifidobacterium*-driven microbiome maturation was also linked to an anti-inflammatory intestinal immune milieu. This demonstrates that *Bifidobacterium strains* are ecosystem engineers that lead to an acceleration of microbiome maturation and immunological consequences in extremely premature infants.

Source: Marie-Claire Arrieta, Department Of Physiology And Pharmacology, Snyder Institute For Chronic Diseases; Department Of Pediatrics, Alberta Children's Hospital Research Institute And International Microbiome Centre, University Of Calgary, Calgary, AB, Canada. *Supplementation With A Probiotic Mixture Accelerates Gut Microbiome Maturation And Reduces Intestinal Inflammation In Extremely Preterm Infants. Cell Host And Microbe*, Volume 30, Issue 5, P696-711.E5, May 11, (2022). DOI: <https://doi.org/10.1016/j.chom.2022.04.005>

## 11. Efficacy Of i3.1 Probiotic On Improvement Of Lactose Intolerance Symptoms A Randomized, Placebo-Controlled Clinical Trial

This study shows that the i3.1 probiotic was safe and efficacious in reducing lactose intolerance symptoms in patients with lactose intolerance.

Source: Ana D. Cano-Contreras, Gastroenterology Department, Hospital Juarez De Mexico, Av Instituto Politécnico Nacional, Ciudad De México, México. *Efficacy Of i3.1 Probiotic On Improvement Of Lactose Intolerance Symptoms A Randomized, Placebo-Controlled Clinical Trial. Journal of Clinical Gastroenterology* 56(2):p 141-147, February (2022). DOI: 10.1097/MCG.0000000000001456

## 12. Microbial Communities In Home-Made And Commercial Kefir And Their Hypoglycemic Properties

Kefir is a popular traditional fermented dairy product in many countries. It has a complex and symbiotic culture made up of species of the *genera Leuconostoc, Lactococcus, and Acetobacter*, as well as *Lactobacilluskefiranofaciens* and *Lentilactobacillus kefiri*.

This systematic review aims to explain the microbial composition of commercial and home-made kefir and its possible effects on Type 2 diabetes mellitus (T2DM). Based on animal and human studies, it has been shown that consumption of kefir reduces blood glucose, improves insulin signaling, controls oxidative stress, and decreases progression of diabetic nephropathy. Moreover, probiotic bacteria such as *lactic-acid bacteria* and *Bifidobacterium spp.* and their end-metabolites in turn directly or indirectly help in controlling many gut disorders, which are also the main biomarkers in the T2DM condition and its possible treatment.

Source: Jyoti Prakash Tamang, Department Of Microbiology, School Of Life Sciences, Sikkim University, Tadong, Gangtok, Sikkim, India. *Microbial Communities In Home-Made And Commercial Kefir And Their Hypoglycemic Properties. Fermentation (2022), 8(11), 590. <https://doi.org/10.3390/fermentation8110590>*

## 13. An Open-Label, Multicenter Study To Assess The Efficacy And Safety Of A Novel Probiotic Blend In Patients With Functional Gastrointestinal Symptoms

A novel 5-strain (*BI-04, Bi-07, HNo19, NCFM, and Lpc-37*) probiotic blend was developed and its safety and efficacy were evaluated in patients with functional gastrointestinal (GI) symptoms.

Researchers have found that at day 30, 85.1% of patients achieved the primary endpoint, a positive response signifying improvement in overall GI well-being. Improvements from baseline were reported at day 30 in diarrhea frequency (baseline frequency  $\geq 3$  to 4 day/week) and severity (baseline severity  $\geq 5/10$ ) for 75.8% and 87.3% of patients, respectively. Over the same time period, constipation frequency (baseline frequency  $\geq 3$  to 4 day/week) and severity (baseline severity  $\geq 5/10$ ) improved in 73.6% and 80.4% of patients, respectively. Most patients reported improvements at day 30 in frequency and severity of straining, urgency, abdominal pain/discomfort, bloating, and distention. Improvements reported at day 30 were generally observable at day 14.

Source: Lucinda A. Harris, Division Of Gastroenterology And Hepatology, Mayo Clinic, Alix School Of Medicine, Scottsdale. *An Open-Label, Multicenter Study To Assess The Efficacy And Safety Of A Novel Probiotic Blend In Patients With Functional Gastrointestinal Symptoms. Journal of Clinical Gastroenterology 56(5):p 444-451, May/June (2022). DOI: 10.1097/MCG.0000000000001567*

## 14. Preventive Effect Of Probiotics On Oral Mucositis Induced By Cancer Treatment: A Systematic Review And Meta-Analysis

This systematic review and meta-analysis demonstrated the effectiveness of probiotics in the prevention and mitigation of cancer therapy-induced oral mucositis. Researchers have recommended the use of probiotics to prevent and treat oral mucositis during cancer therapy.

Source: Tsai-Wei Huang, School Of Nursing, College Of Nursing, Taipei Medical University; Center For Nursing And Healthcare Research In Clinical Practice Application, Wan Fang Hospital, Taipei Medical University And Cochrane Taiwan, Taipei Medical University, Taipei, Taiwan. *Preventive Effect Of Probiotics On Oral Mucositis Induced By Cancer Treatment: A Systematic Review And Meta-Analysis. Int. J. Mol. Sci. 2022, 23(21), 13268. <https://doi.org/10.3390/ijms232113268>*

## 15. Randomized, Double-Blind, Placebo-Controlled Study To Assess The Effect Of Two Probiotics On The Preterms' Gut Microbiota

The objective of this study was to evaluate the effect of a new probiotic strain combination, *Ligilactobacillus salivarius subsp infantis PS11603* and *Bifidobacterium longum PS10402*, on gut bacterial colonization of preterm infants.

Researchers have concluded that Probiotic supplementation with *L salivarius PS11603* and *B longum subsp. infantis PS10402* enhanced an earlier colonization of *Lactobacillus* and *Bifidobacterium* in preterm infants' guts in 5 and 1 week, respectively. A higher number of infants were colonized by *Lactobacilli* with the probiotics' intake at the end of the study.

Source: Esther Jiménez, ProbiSearch, SLU, C/Santiago Grisolia, Tres Cantos, Spain. *Randomized, Double-Blind, Placebo-Controlled Study To Assess The Effect Of Two Probiotics On The Preterms' Gut Microbiota. Journal Of Pediatric Gastroenterology And Nutrition 74(6):p e153-e159, June (2022). DOI: 10.1097/MPG.00000000000003427*

## 16. Effects Of Probiotic Supplementation On Hormonal And Clinical Outcomes Of Women Diagnosed With Polycystic Ovary Syndrome: A Double-Blind, Randomized, Placebo-Controlled Clinical Trial

The present study revealed that probiotic supplementation in *Polycystic Ovary Syndrome (PCOS)* women for 12 weeks had a beneficial effect on *sex hormone-binding globulin (SHBG)* but did not affect other clinical and hormonal parameters. Further, *Random Clinical Trials (RCTs)* with longer duration, other probiotic strains, other prebiotics, and higher dosages, respectively, may improve knowledge regarding the role of gut microbiota in PCOS.

Source: Elham Karimi, Research Development Center, Arash Women's Hospital, Tehran University Of Medical Sciences And Department Of Clinical Nutrition, School Of Nutrition And Food Science, Food Security Research Center, Isfahan University Of Medical Sciences, Isfahan, Iran. *Effects Of Probiotic Supplementation On Hormonal And Clinical Outcomes Of Women Diagnosed With Polycystic Ovary Syndrome: A Double-Blind, Randomized, Placebo-Controlled Clinical Trial. Journal of Functional Foods, Volume 96, (2022), 105203, ISSN 1756-4646. <https://doi.org/10.1016/j.jff.2022.105203>*

## 17. Fermented Natural Product Targeting Gut Microbiota Regulate Immunity And Anti-Inflammatory Activity: A Possible Way To Prevent Covid-19 In Daily Diet

This systematic review presents the modulating effects of probiotics and their fermented natural products on the body, including immunity-enhancing and anti-inflammatory activities by modulating gut microbiota. The current molecular mechanism associated with it is also presented. Further, it may become a possible way to prevent Covid-19 through consuming natural products fermented by probiotic in daily diet.

Source: Feng Zeng, College Of Food Science, Fujian Agriculture And Forestry University And National Engineering Research Center Of JUNCAO Technology, Fujian Agriculture And Forestry University, Fuzhou, China. *34.Fermented Natural Product Targeting Gut Microbiota Regulate Immunity And Anti-Inflammatory Activity: A Possible Way To Prevent Covid-19 In Daily Diet. Journal of Functional Foods Volume 97, October (2022), 105229. <https://doi.org/10.1016/j.jff.2022.105229>*

## 18. Bifidobacterium Animalis Subsp. Lactis Bi-07 Supports Lactose Digestion In Vitro And In Randomized, Placebo- And Lactase-Controlled Clinical Trials

The objective of this study was to select a probiotic with high *lactase activity* and compare it with *lactase and placebo* in clinical trials. Two crossover clinical trials, *Booster Alpha and Booster Omega*, were performed in participants with lactose intolerance, where  $2 \times 10^{12}$  CFUs *Bi-07*, 4662 FCC (Food Chemicals Codex) *lactase*, or placebo was consumed simultaneously with a lactose challenge, with 1-week washouts between challenges.

*Study result shows that Bi-07 was superior to placebo in reducing Breath hydrogen concentration (BHC) [iAUC (incremental area under the curve), parts per million (ppm) · h] in both trials. Lactase was superior to placebo in Booster Alpha but not Booster Omega. Noninferiority of Bi-07 compared with lactase was observed in Booster Omega. Odds of abdominal pain and flatulence were lower with lactase in Booster Alpha. Increased odds of nausea were seen with Bi-07 in Booster Omega.*

Source: Pia Rasinkangas, Health & Biosciences, International Flavors & Fragrances Inc. (Iff), Kantvik, Finland. *Bifidobacterium Animalis Subsp. Lactis Bi-07 Supports Lactose Digestion In Vitro And In Randomized, Placebo- And Lactase-Controlled Clinical Trials. The American Journal Of Clinical Nutrition, Volume 116, Issue 6, December 2022, Pages 1580-1594. <https://doi.org/10.1093/ajcn/nqac264>*

## 19. Effectiveness Of Two Probiotics In Preventing Necrotising Enterocolitis In A Cohort Of Very-Low-Birth-Weight Premature New-Borns

This prospective observational study was conducted in a cohort of 245 *very-low-birth-weight (VLBW)* new-borns to assess the prevalence of *Necrotising Enterocolitis (NEC)* after supplementation with the probiotic Inforan® (Berna Biotech, Madrid, Spain) 250 mg capsules containing  $10^9$  cfu of *Lactobacillus acidophilus (ATCC 4356)* and  $10^9$  cfu of *Bifidobacterium bifidum (ATCC 15696)*; or with Bivos® (Ferring, Madrid, Spain) containing *Lacticaseibacillus (formerly Lactobacillus) rhamnosus (LGG) (ATCC 53103)* ( $10^9$  cfu); or with no probiotic supplementation.

Researchers found that there is a significant association between a reduced presence of NEC Stage  $\geq 2$  and probiotic supplementation. The odds risk (OR) obtained was 0.174 for Inforan and 0.196 for Bivos. Therefore, both probiotics are associated with a lower prevalence of NEC in VLBW new-borns, with no significant differences.

Source: J. Uberos, Neonatal Intensive Care Unit, San Cecilio Clinical Hospital, Avda, Dr. Oloriz And Medicine Faculty, University Of Granada, Granada, Spain. *Effectiveness Of Two Probiotics In Preventing Necrotising Enterocolitis In A Cohort Of Very-Low-Birth-Weight Premature New- Borns. Beneficial Microbes: 13 (1)-Pages: 25 - 31, (2022). <https://doi.org/10.3920/BM2021.0088>*

## **20. Probiotics' Effect On Visceral And Subcutaneous Adipose Tissue: A Systematic Review Of Randomized Controlled Trials**

This systematic review found that probiotics have a beneficial and specific effect on central adiposity. **Single Lactobacillus-based probiotics** reduced visceral and subcutaneous adiposity (VAT and SAT), whereas **Bifidobacterium-based probiotics** reduced visceral adiposity.

*Source: M. Elba Gonzalez-Mejia, Facultad De Medicina, Benemérita Universidad Autónoma De Puebla. Calle 13 Sur 2901, Colonia Volcanes, Puebla, Puebla, México. Probiotics' Effect On Visceral And Subcutaneous Adipose Tissue: A Systematic Review Of Randomized Controlled Trials. Eur J Clin Nutr 76, 1646–1656 (2022). <https://doi.org/10.1038/s41430-022-01135-0>*

## **21. An Overview Of The Challenges Associated With The Use Of Fruit And Cereal-Based Probiotic Carriers And Their Recently Developed Solutions**

*This systematic review* reports that transferring health benefits and maintaining bacterial cell viability for longer storage have been a major shortfall in the plant-based probiotic products for industry due to challenges, such as easy loss of cell viability and sensory attributes as a result of fermentation activities by probiotic bacteria.

Hence, for reducing these problems, the review suggests that the adoption of techniques, such as selection of resistant probiotic bacteria, prebiotics, encapsulation, and use of appropriate packaging and storage conditions, would improve probiotic bacteria cell viability and maintain the sensory attributes in plant-based probiotic products, thus increasing consumer acceptance.

*Source: Samuel Kumi Okyere, Key Laboratory Of Animal Diseases And Environmental Hazards Of Sichuan Province, College Of Veterinary Medicine, Sichuan Agricultural University, Chengdu, Sichuan, China. 19. An Overview Of The Challenges Associated With The Use Of Fruit And Cereal-Based Probiotic Carriers And Their Recently Developed Solutions. Current Functional Foods (2023); 1(1) : e070122200102 . <https://dx.doi.org/10.2174/2666862901666220107152746>*

## **22. Probiotic Cultures As A Potential Protective Strategy Against The Toxicity Of Environmentally Relevant Chemicals: State-Of-The-Art Knowledge**

This systematic review summarized the state-of-the-art knowledge regarding the potential protective effects of different probiotic strains against environmentally relevant toxic substances (**Mycotoxins, Polycyclic Aromatic Hydrocarbons, Pesticides, Perfluoroalkyl and Polyfluoroalkyl Substances, Phthalates, Bisphenol A and Toxic Metals**).

*Source: Katarina Baralić, Department Of Toxicology "Akademik Danilo Soldatović", University Of Belgrade, Faculty Of Pharmacy, Vojvode Stepe, Belgrade, Serbia. Probiotic Cultures As A Potential Protective Strategy Against The Toxicity Of Environmentally Relevant Chemicals: State-Of-The-Art Knowledge. Food and Chemical Toxicology, Volume 172, February (2023), 113582. <https://doi.org/10.1016/j.fct.2022.113582>*

## **23. Synbiotics Improve Clinical Indicators Of Ulcerative Colitis: Systematic Review With Meta-Analysis**

The aim of this systematic review and meta-analysis was to gather and analyze data from randomized controlled trials to provide more information to increase the current evidence level about the safety and efficacy of synbiotic use as a supplemental treatment for ulcerative colitis.

The results demonstrated that synbiotics significantly improved colonic endoscopic and histologic scores, the Clinical Activity Index, serum C-reactive protein levels, intestinal microbiota, Bowel Habits Index, and levels of messenger RNAs, tumor necrosis factor- $\alpha$ , interleukin- $1\alpha$ , interleukin- $10$ , and myeloperoxidase in the patients. In addition, the use of synbiotics increased probiotic microorganisms, reduced proinflammatory colonic cytokines, and elevated anti-inflammatory cytokines.

*Source: Hermann Bremer-Neto, Department Of Functional Sciences, Faculty Of Medicine, Universidade Do Oeste Paulista, Presidente Prudente, Sao Paulo, Brazil. Synbiotics Improve Clinical Indicators Of Ulcerative Colitis: Systematic Review With Meta-Analysis. Nutrition Reviews, Volume 80, Issue 2, February (2022), Pages 157–164. <https://doi.org/10.1093/nutri/nuab017>*

## 24. Effect Of Synbiotic (*L. Plantarum* Dad-13 And Fructo-Oligosaccharide) Powder On Gut Microbiota (*L. Plantarum*, *Bifidobacterium* And *Enterobacteriaceae*) On Stunting Children In Yogyakarta, Indonesia

The aim of this study was to determine the effect of synbiotics (*L. plantarum* Dad-13 and fructo-oligosaccharide) on gut microbiota composition (*L. plantarum*, *Bifidobacterium* and *Enterobacteriaceae*) in stunting children under five in Yogyakarta, Indonesia.

Study result showed that there were significant differences in synbiotic group on gut microbiota (increased in *L. plantarum* and *Bifidobacterium*, while decreased in *Enterobacteriaceae*). Protein and carbohydrate were significantly increasing in synbiotic group compared to placebo group. Body weight and height were significantly different in both groups. Body weight and height of children on synbiotic group was increasing 1.02 and 1.6 times higher than placebo group. Neither morbidity nor weight loss was recorded throughout consumption period. Synbiotic powder had significantly positive effect on gut microbiota that could induce nutrient intake, height and weight gain of stunting children.

*Source: Endang Sutriswati Rahayu, Department Of Food And Agricultural Product Technology, Faculty Of Agricultural Technology, Universitas Gadjah Mada, Center For Food And Nutrition Studies, Universitas Gadjah Mada And Center Of Excellence For Probiotics, Universitas Gadjah Mada, Jl. Teknika Utara Berek, Yogyakarta, Indonesia. Effect Of Synbiotic (L. Plantarum Dad-13 And Fructo-Oligosaccharide) Powder On Gut Microbiota (L. Plantarum, Bifidobacterium And Enterobacteriaceae) On Stunting Children In Yogyakarta, Indonesia. Curr Res Nutr Food Sci (2022); 10(1). DOI : <http://dx.doi.org/10.12944/CRNFSJ.10.1.31>*

## 25. Opportunities For Growth In The Growing Field Of Psychobiotics

This systematic review discusses the *three domains within psychobiotics research* -sex (and gender) representation, fungi and the mycobiome, and vagus nerve activity), why they are of particular relevance for psychobiotics research, and how psychobiotics research can easily integrate their perspectives. In this study scientists have also given recommendations for future psychobiotic studies i.e. include *equal sex representation at all phases of research (human and animal studies), investigating the relationship between psychobiotics and commensal fungi, and measuring the activity of the vagus nerve in psychobiotics studies* etc.

*Source: L. Tipton, School Of Natural Sciences And Mathematics, Chaminade University Of Honolulu, USA. 39. Opportunities For Growth In The Growing Field Of Psychobiotics. Beneficial Microbes, (2022) ; 13(06): 445-452. <https://doi.org/10.3920/BM2022.0051>*

## 26. Gut Microbiome Modulation By Probiotics, Prebiotics, Synbiotics And Postbiotics: A Novel Strategy In Food Allergy Prevention And Treatment

Changes in gut microbial compositions are strongly associated with increases in food allergy. Altering microbial composition is crucial in modulating food antigens' immunogenicity.

This systematic review article briefly summarizes the mechanisms of food allergy and discusses the role of the gut microbiota and the use of probiotics, prebiotics, synbiotics, and postbiotics as novel therapies for the prevention and treatment of food allergy. The perspective studies on the development of novel immunotherapy in food allergy are also described.

*Source: Jin Wang, Key Laboratory Of Environmental Medicine And Engineering, Ministry Of Education, And Department Of Nutrition And Food Hygiene, School Of Public Health, Southeast University, Nanjing, China. Gut Microbiome Modulation By Probiotics, Prebiotics, Synbiotics And Postbiotics: A Novel Strategy In Food Allergy Prevention And Treatment. Critical Reviews In Food Science And Nutrition. DOI: 10.1080/10408398.2022.2160962*

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