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Probiotics in Human Nutrition, Health Improvement, Infection Prevention, and Disease Management - A Review

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ABSTRACT

Probiotics are Nonpathogenic microorganisms that are beneficial to one's nutritional health and are usually found in certain foods or supplements. They are typically bacteria, such as *Lactobacillus, Bifidobacterium, Streptococcus, Leuconostocmesenteroides, Pediococcus, Propionibacterium, Bacillus, and Enterococcus faecium* but can also be Yeast and molds. Probiotics help to maintain a healthy balance of gut microflora, which is important for digestion and overall health. They can also help with conditions such as irritable bowel syndrome (IBS), inflammatory bowel disease (IBD), allergies, ulcerative colitis, Crohn's disease, and even mental health issues. Probiotics may also play a role in preventing and treating other conditions such as urinary tract infections (UTIs), vaginal yeast infections, skin conditions like eczema, and even the common cold. Probiotics are involved in things like food digestion, the production of beneficial substances to eliminate harmful microbes, completing the roles of the digestive enzymes that were either not produced or had defects in their genes, maintaining the pH of the digestive system, and other things. Probiotics will improve the performance of our digestive system's biological fermenters (Ghoshal et al. 2022; Song et al 2023; Su et al. 2022). Prebiotics like FOS, GOS, XOS, inulin, and fructans are the most popular fibers that, when combined with probiotics, are known as synbiotics and can increase the viability of the probiotics. Numerous authors have discussed the development of probiotics, their history, and their various uses for them. In this review, we will primarily concentrate on three issues: health improvement, infection prevention, and disease management, all of which can be prevented by using various probiotics either directly or in foods.

Keywords: *Probiotics, Gut microflora, Prebiotics, Synbiotics,Nutritional Health Improvement, Infection, Disease management,*

Introduction

Probiotics is a term used to describe living, non-pathogenic organisms and the positive effects that result from them on hosts. It is derived from a Greek word that means "for life." When Vergin was researching the negative effects of antibiotics and other microbial substances on the gut microbial population, he first coined the term "probiotics." He noted that "probiotika" was beneficial to the gut flora. By Lilly and Stillwell, probiotics were then defined as "A product produced by one microorganism stimulating the growth of another microorganism." The term was later expanded upon by Fuller to mean "Non-pathogenic microorganisms which, when ingested, exert a positive influence on host's health or physiology." The FDA and WHO's most recent definition is “Live microorganisms which when administered in adequate amounts confer a health benefit to the host” (Kang et al. 2022).

It soon became apparent that the intestinal microflora performed metabolic tasks like fermenting indigestible dietary residues and endogenous mucus, which helped conserve energy and produced vitamin K and ions. Probiotics play a part in immune system development, immune system homeostasis, and epithelial cell differentiation and proliferation. Probiotics are not a recent discovery but have been present in many of our traditional foods for a long time, including drinks, salty fish, yogurt, various types of cheese, and so on (Shah et al 2023). These food structures include various beneficial bacterial species. It is possible that fermented milk was the first food containing probiotics to be used effectively. Humans learned that fermented milk has a good taste. Later, they figured out how to turn it into cheese, yogurt, and other foods. Before the invention of the microscope, people were able to prepare a variety of milk products with various flavors and structures. This is the result of various microbial reactions brought on by various microbes. Globally, the public has been passing along this knowledge for producing such foods from generation to generation up until the present. We really had no idea how probiotic-containing foods were first used, especially for therapeutic purposes. However, if the active microbes are beneficial and able to colonize the digestive system, probiotics collectively are a part of the fermented food. Microbe-based fermentation has been practiced since ancient times. The fungi growing inside the food were visible to the unaided eye. Since ancient times, the general populace has been able to produce bakery and alcoholic goods. They were skilled at maintaining the product's quality and testing by preserving a seed culture from the fermentation processes that were the most successful to use in the subsequent process (Patel et al. 2023).

The most significant and well-established health benefits of probiotics are their ability to prevent diarrhea, and constipation, alter the conjugation of bile salts, increase anti-bacterial activity, and act as an anti-inflammatory. However, the optimization of the process parameters needs to be taken care of for enhanced production (Roy et al. 2022; Roy and Ray 2022). Additionally, they aid in the synthesis of nutrients and increase their bioavailability. Some probiotics are also known to have antioxidant effects when they are present as whole cells or lysates. Probiotics have also proven effective at reducing the signs and symptoms of allergies, cancer, AIDS, respiratory infections, and urinary tract infections (Roy et al. 2022). Unconfirmed reports suggest that they have positive effects on aging, fatigue, autism, osteoporosis, obesity, and type 2 diabetes (Roy et al. 2023).

As shown below several mechanisms are thought to be associated with probiotic beneficial effects:

- Production of inhibitory substances like H_2O_2, bacteriocins, organic acids, etc.
- Blocking of adhesion sites for pathogenic bacteria.
- Competition with the pathogenic bacteria for nutrients.
- Degradation of toxins as well as the blocking of toxin receptors.
- Modulation of immune responses.

Common microbes used as Probiotics

The microbes used as Probiotics represent different types such as bacteria, yeast, or mold. However, there are more common species of each such as 1 – Bacteria: (i) Lactobacillus: *acidophilus, sporogenes, plantarum, rhamnosum, delbrueck, reuteri, fermentum, lactus, cellobiosus, brevis, casei, farciminis, paracasei, gasseri, crispatus;* (ii) Bifidobacterium: *bifidum, infantis, adolescentis, longum, thermophilum, breve, lactis, animalis*; (iii) Streptococcus: lactis, cremoris, alivarius, intermedius, thermophilis, diacetylactis; (iv) *Leuconostocmesenteroides*; (v) Pediococcus; (vi) Propionibacterium; (vii) Bacillus; (viii) Enterococcus; (ix) Enterococcus faecium; 2 – Yeast and molds: *Saccharomyces cerevisiae, Saccharomyces bourlardii, Aspergillus niger, Aspergillus oryzue, Candida pintolopesii, Sacaromycesboulardii.*

The type of microbes used as Probiotics increased due to the increase in the research concerning the subject as well as by the increase of the newly discovered and identified microbes, which could be used as Probiotics. One should update his microbial flora from time to time and follow the research and the published data about Probiotics to gain more knowledge and ideas (Demin et al. 2021; Raman et al. 2022)

Mechanism of action

Probiotics' exact mechanisms of action are not well understood. However, several proposed mechanisms have been put forward to account for many of their positive effects. One of these mechanisms involves probiotics competing for cellular attachments by competing for adhesion sites. To successfully colonize, many pathogenic organisms must collaborate with the GI tract epithelium. However, some strains of bifidobacteria and lactobacilli can attach to the epithelium and function as "colonization barriers" by preventing pathogens from adhering to the mucosa (Sanders et al. 2019). The *Lactobacillus rhamnosus* strain GG and *Lactobacillus plantarum* 299v were used to demonstrate this effect. *Escherichia coli* attachment to human colon cells was demonstrated to be inhibited by both organisms. The alteration of the microbial flora through the synthesis of antimicrobial compounds is another potential mechanism of action. Bacteriocins and other antimicrobial substances are produced by numerous varieties of lactobacilli and bifidobacteria. The term "compounds produced by bacteria that have a biologically active protein moiety and a bactericidal action" is referred to as a bacteriocin. The lactic acid bacteria also produce short-chain fatty acids, hydrogen peroxide, and diacetyl, all of which are biologically active substances. Probiotic organisms release these chemicals, which alters the microflora in a positive way. However, not all strains of lactobacilli or bifidobacteria produce antimicrobial substances, and some produce substances that are rather nonspecific in their activity, which could harm both pathogenic and beneficial bacteria (Peng et al. 2020).

Probiotics have been seen to stimulate the immune system, too. This immune response may manifest as an increase in immunoglobulin-A (IgA) secretion, an increase in natural killer cell density, or an increase in macrophage phagocytic activity. The composition of the microflora may be improved by increased IgA secretion by reducing the number of pathogenic organisms in the gut. Probiotics may be beneficial for treating conditions like inflammatory bowel disease (IBD), pouchitis, and food allergies, and for use as an adjuvant to vaccination due to these immunomodulating effects, according to some researchers. Probiotics may also compete with pathogens for nutrients that they would otherwise use. This situation involves the potentially pathogenic bacterium *Clostridium difficile*, which depends on monosaccharides for growth. When there are enough probiotic organisms, they can utilize most of the available monosaccharides, which inhibits *Clostridium difficile* (Xiang et al. 2022).

Numerous microorganisms, including bacteria, archaea, viruses, fungi, and protozoa, live inside the human gastrointestinal tract. These microbes, which are collectively referred to as the gut microbiota, microbiome, or intestinal microflora, have the ability to influence human health and disease. Probiotics typically work in the GI tract, where they may have an impact on the intestinal microbiota (Parker et al. 2020). Depending on the probiotic strain, baseline microbiota, and gastrointestinal tract region, probiotics can transiently colonize the human gut mucosa in highly individualized patterns.

Additionally, probiotics have a variety of general, species-, and strain-specific health effects. The non-specific mechanisms differ significantly between probiotic supplement strains, species, and even genera. These mechanisms include the production of bioactive metabolites (such as short-chain fatty acids), the reduction of luminal pH in the colon, and the inhibition of the growth of pathogenic microorganisms in the gastrointestinal tract (by fostering colonization resistance, enhancing intestinal transit, or aiding in the normalization of a perturbed microbiota). Vitamin synthesis, gut barrier reinforcement, bile salt metabolism, enzymatic activity, and toxin neutralization are a few examples of species-specific mechanisms. Cytokine production, immunomodulation, and effects on the endocrine and nervous systems are examples of strain-specific mechanisms, which are uncommon and used by only a few strains of a given species. Through all these mechanisms, probiotics might have wide-ranging impacts on human health and disease (Tan et al. 2019).

It is necessary to make recommendations for the use of probiotics in research studies and clinical settings that are strain and species-specific. This is because probiotic effects can vary depending on the probiotic species and strain used. Additionally, combining information from studies on various probiotic types can lead to inaccurate conclusions about their efficacy and safety.

Sources of Probiotics

Food

A variety of live microbial cultures grow and engage in metabolic activity to produce fermented foods. Numerous of these foods are abundant in live, potentially helpful microbes. Some fermented foods, like most commercial pickles and sourdough bread, are processed after they are fermented and do not contain live cultures in the form that is intended for consumption. Probiotic microorganisms like *Lactobacillus bulgaricus* and *Streptococcus thermophilus* are commonly found in commercial yogurt, another kind of fermented food (Patel et al. 2023).

Many fermented foods, including yogurt, contain live microorganisms that typically remain viable throughout the product's shelf life. However, they frequently do not survive passage through the stomach and may not be able to withstand hydrolytic enzyme and bile salt degradation in the small intestine, which may prevent them from reaching the distal gut. On the other hand, genuine probiotic strains present in yogurt or other foods do survive intestinal transit (Vipparla et al. 2022).

Numerous kinds of cheese, kimchi (a Korean dish made from fermented cabbage), kombucha (a fermented tea), sauerkraut (fermented cabbage), miso (a fermented soybean-based paste), pickles, and raw unfiltered apple cider vinegar made from fermented apple sugars are examples of foods that are fermented but do not typically contain proven probiotic microorganisms (Akhtar et al. 2021).

Milk, juices, smoothies, cereals, nutrition bars, and infant and toddler formulas are examples of unfermented foods that have additional microorganisms. The number of microorganisms in these foods when consumed, whether they survive intestinal transit, and whether the particular species and strains have any negative health effects determine whether or not they are truly probiotics (Thakur et al. 2023).

Dietary supplements

A wide range of probiotic strains and doses are also offered as dietary supplements (in the form of capsules, powders, liquids, and other substances). Instead of just one strain, these products frequently contain mixed cultures of live microorganisms. It is challenging for people who are not familiar with probiotic research to determine which products are supported by evidence because the effects of many commercial products containing "probiotics" have not been investigated in research studies. However, some organizations have thoroughly examined the available data and created recommendations on probiotics—including the best brand, dosage, and formulation—to use for preventing or treating a variety of illnesses (Wang et al. 2022).

Probiotics are measured in colony-forming units (CFU), which indicate the number of viable cells. Amounts may be written on product labels as, for example, 1×10^9 for 1 billion CFU or 1×10^{10} for 10 billion CFU. Many probiotic supplements contain 1 to 10 billion CFU per dose, but some products contain up to 50 billion CFU or more. However, higher CFU counts do not necessarily improve the product’s health effects (Angulo et al. 2023).

The supplement facts label for probiotic products must currently only include the total weight of the microorganisms; this weight can include both live and dead microorganisms and has no bearing on the number of viable microorganisms in the product. In addition to total microorganism weight, manufacturers may now voluntarily list the CFUs in a product on the Supplement Facts label. Users should look for products labeled with the number of CFU at the end of the product's shelf life, not at the time of manufacture, as probiotics can die during their shelf life and must be consumed alive to have health (Angulo et al. 2023).

Commercial forms of Probiotics

Probiotic organisms can be consumed in two main ways: through supplements and fermented foods. Both dairy and vegetable products can be fermented, and yogurt and sauerkraut are the most well-known examples of each. Freeze-dried (lyophilized) bacteria are used as probiotic supplements in powder, capsule, and tablet forms. No matter how the microorganisms are consumed, products containing probiotic organisms must deliver enough live organisms to have a therapeutic impact in order to be clinically effective. This is true for both categories of fermented foods and nutritional supplements. The advantages and disadvantages of popular probiotic delivery methods are contrasted (Shah et al. 2023).

Table 1 Different forms of the probiotic delivery system.

Delivery system	Pros	Cons
Fermented dairy	-Affordability and easy availability -Ease of incorporation into daily patterns -Additional nutritional benefits survival -Enhanced bacterial through the upper GI tract (100× fewer bacteria can be given per dose) -Effective in the upper GI tract	-Contains dairy proteins and lactose -Taste can be an issue -Not suitable when traveling -Not suitable for vegans
Capsules	-Ease of administration -Contain no binders	-Not therapeutic in the upper GI tract (unless opened or chewed) -May contain allergenic excipients -Higher cost
Tablets	-Ease of administration -Effective in the upper GI tract	-May contain allergenic or otherwise problematic binders and excipients (e.g., gluten) -Higher cost
Powders	-Effective in the upper GI tract -Dosages can be easily adjusted -Can be incorporated into foods or drinks -Contain no binders	

Probiotics in Human Nutrition

Good and bad microbes in the digestive system

A variety of functions are carried out by groups of microbes in our bodies. The ones found in our digestive system are the most significant. They facilitate better food consumption and digestion. They can fill in a variety of gaps in our digestive system. They reduce the number of steps our bodies must take to convert complex food structures to simple ones. Alternately, many undesirable variations of various microbes will take over and improperly digest our food. Even worse, when our food is being digested, they will add some toxins to it (Singh et al. 2021). Consequently, each food cycle will cause a real decline in our health. Many illnesses are misdiagnosed when their primary cause of elevation is the presence of harmful microbes in the digestive system, primarily as a result of leaks in the feeding processes, lifestyle choices, or even illnesses that will tip the balance in favor of the harmful microbes. Humans are affected because they did not take the proper precautions to prevent themselves from losing beneficial strains and gaining harmful ones. Probiotics must be administered in higher dosages in these circumstances (Albury et al. 2020).

Probiotic, the good against the bad microbes

Incorrect food fermentation and the potential production of toxins that could be harmful to our health could result from harmful microbes colonizing our digestive system. What could probiotics accomplish? Probiotics have the power to replenish our digestive system with beneficial microbes that will combat harmful ones. Our health will be improved by beneficial microbes that properly ferment our food. Why do we need to use probiotics? Throughout our lives, we are exposed to a variety of microbes that are harmful to our health. Our beneficial microflora might be destroyed by antibiotic treatment. Probiotics ought to be used in such circumstances to restore our microflora (Tewari et al. 2019). The best and most affordable way to restore any losses in the microflora of our digestive system and enhance our health is if our daily food contains probiotics. People used to consume probiotic-containing foods daily in earlier civilizations. However, probiotics should be given in large doses as tablets or in any other appropriate forms when our microflora has been severely affected for any reason. Lactobacilli, streptococci, clostridia, coliforms, and Bacteroides all maintain a significant balance in a healthy intestine. The balance of our intestinal flora can be affected by a variety of conditions, including stress, excessive alcohol use, high-fat diets, meat, sugar, genetic disorders, chlorine and fluoride in drinking water, antibiotics, inadequate nutrition, exposure to environmental toxins, and many others (Roy and Ray 2019; Roy and Ray 2020; Roy et al. 2022). The truth is that our health is affected by a wide range of exogenous and endogenous factors that may change the makeup of our microflora (Roy et al. 2022). Health is ensured by useful microflora (Banik et al. 2023; Li and Roy 2013; Parveen et al. 2023). The daily battles between the beneficial and harmful microbes in our bodies cannot be seen or heard, nor can it be observed how they enter our bodies with each inhaled breath, spoken word, or bite of food. They play a vital role in maintaining our health. Our immune system is gradually strengthened so that it will be prepared for pathogens. People who live far from such a lifestyle are more prone to infections and illnesses. Another angle on the matter is that these microbes, especially the non-pathogenic ones, work in our bodies like employees of a large company, performing a variety of tasks to help and support us constantly (Liu et al. 2022). They typically act in such a way on impulse. By performing such work, they either save us energy and power or accomplish tasks that we are unable to complete. An illustration of this would be lactose digestion deficiencies. The presence of harmful bacteria could lead to the development of resistance in the body, which would delay the appearance of their harmful effects. Instead, they are not scarce but are produced in large quantities, and at this point, they will be seriously harmful. Despite appearing to be nonexistent in a healthy person, bad microbes do in fact exist, but they are greatly limited in their ability to harm due to the presence of good bacteria. They are constantly being pressed by beneficial bacteria. In our bodies, good bacteria fill in any gaps, preventing the growth of harmful bacteria. However, we alter the environment frequently to the advantage of bad bacteria because of our mishandling and misinterpretation of their behavior. We will begin to experience problems and experience a decline in our health as the ratio of harmful microbes shifts in our favor. Keeping the undesirable microbes under control will help to prevent that. Therefore, there is no better option than letting good ones compete with them, take their places, and in some cases, omit them or reduce them to the absolute minimum safe amount. The intestinal tract is home to 100 trillion different kinds of microbes (Kitamoto et al. 2020). Our stomach is acidic to kill most of the harmful microbes before they enter the long intestine because many of them prefer to live in an alkaline or natural environment. Ammonia produced by unfavorable microbes causes the intestinal tract's pH to increase in alkalinity. One might notice that after consuming mildly acidic fermented milk, he feels good and at ease. This is due to two factors: first, fermented milk contains acids that kill pathogenic bacteria, and second, it also contains good bacteria that will immediately occupy the spaces left by the pathogenic bacteria that have just been killed. It also still has proteins that can lessen any excess acidity. Lactobacillus is one of the most significant strains found naturally in milk products. The microflora in our digestive system performs important tasks, such as filling in empty spaces in the digestive system, breaking down food, killing pathogens, and secreting vitamins (such as vitamin B) and some essential amino acids. Enzymes aid in the breakdown of complex food fibers, and acids (such as lactic acid) help to keep pathogenic microflora from growing too large. Probiotic strains in the colon also aid in the digestion of some types of fiber. The ability of probiotics to partially activate the immune system should be emphasized (Ghosh et al. 2019).

The following facts and points could serve as a summary of how probiotics relate to our health.

1. Probiotics are useful and friendly microbes.
2. They can compete with the bad microbes and colonize our digestive system.
3. They can ferment our food into simpler byproducts and could promote our health through many different mechanisms.
4. Their amount could be deteriorated due to many factors, such as incorrect diet, alcohol, age, and so on. This is why they should be taken through our regular diet.
5. In Cases such as after antibiotic treatments, where they are expected to be affected severely, they should be taken orally in considerable amounts or with food.
6. Probiotics promote health while they:

a. Remove the side effect of the pathogens or the harmful microbes.

b. Supply the body with useful byproducts.

c. Reduce the jobs of our digestive system.

d. Reduce the effect of the first attack of harmful compounds, instead of our cells, by their biofilm, which protects our digestive system.

e. Reduce the amount of food needed by our bodies due to the correct digestion and metabolism of any amount of food.

f. Probiotics in some cases could complement the deficiency in our genetic materials by helping us to borrow the products of their genes (such as in case of the lactose fermentation deficiency). Here we should highlight that Probiotics or anything in our lives should not exceed a certain limit and should be used wisely to give the best-expected results.

Probiotics for Infection control

There are still many unsolved questions in the field of probiotic research, including the mechanisms by which they work. But probiotics are also involved in altering gut pH, combating pathogens by producing antimicrobial compounds, vying for pathogen binding and receptor sites as well as for available nutrients and growth factors, activating immunomodulatory cells, and producing lactase (Palai et al. 2020). The fact that probiotics have been shown to be both safe and cost-effective, as well as having the potential to interfere with microbial infections, is their most crucial feature. Probiotics were recognized as the second-most crucial immune defense system by the World Health Organization in 1994 when antibiotic resistance rendered common prescription antibiotics useless. Microbial interference therapy refers to the use of probiotics in the treatment of antibiotic resistance (Kumar et al. 2019).

Table 2. Different types of Probiotic microbial strains, and their usage.

Disease name	Strain
Eczema	*Escherichia coli, Bifidobacterium bifidum, Bifidobacterium lactis, Lactococcus lactis.*
Food allergies	*Escherichia coli.*
Immunity	*Bacillus circulans PB7, Lactobacillus plantarum DSMZ 12028.*
Antibiotic effect removal	*Enterococcus mundtii ST4SA Lactobacillus plantarum 423, Lactobacillus brevis KB290, Lactobacillus strains, Bifidobacterium strains.*
Gastroenteritis Therapeutics	*Lactobacillus casei.*
Intestinal hyperpermeability	*Lactobacillus plantarum species 299 (LP299).*
Vaginal candidiasis (thrush)	*Lactobacillus rhamnosus GR-1 Lactobacillus reuteri RC-14.*
Urinary tract infection	*Lactobacillus rhamnosus GR-1 Lactobacillus reuteri RC-14.*
Lactose intolerance	*Lactobacillus acidophulus.*
Non-steroidal anti-inflammatory drug	*Escherichia coli strain Nissle 1917.*
Intestinal dysbiosis	*Lactobacillus johnsonii La1, Lactobacillus strain, Lactobacillus GG.*
Irritable bowel syndrome	*Bifidobacterium infantis 35624, Escherichia coli DSM17252, Bifidobacterium infantis 35624.*
Traveler’s diarrhea	*Lactobacillus GG, Lactobacillus plantarum.*
Radiation-induced diarrhea	*Lactobacillus casei DN-114 001.*
Crohn’s disease	*Escherichia coli strain Nissle 1917.*
Prevention of colon cancer	*Enterococcus faecium M-74.*
Urinary tract infection	*Lactobacillus acidophilus, Escherichia coli Nissle 1917, Bifidobacterium.*
Hypercholesterolemiaand cardiovascular diseases	*Enterococcus faecium M-74, Lactobacillus plantarum Propionibacterium freudenreichii, Lactobacillus plantarum PH04.*
Peptic ulcer disease	*Lactobacillus acidophulus.*

The role of Probiotics in disease treatment:

Probiotics have the potential to treat and manage real diseases in addition to enhancing our health and reducing pathogenic infections. The same ideas about probiotic functions that are discussed in the sections serve as a foundation for some of these tasks. But how could probiotics aid in the management and treatment of diseases. Understanding the behavior of the disease and its underlying causes is crucial. For instance, conditions like lactose intolerance that are linked to genetic disorders will result in certain types of deficiencies (Allen et al. 2013). Probiotics will play a role in these types of cases by helping to address these deficiencies through a variety of mechanisms, such as (i) supplying our bodies with the products of the missed gene products, (ii) supplying our bodies with suitable alternative products, (iii) supplying our bodies with the final products of a complete pathway which will be the best choice and in the case that none of the defective pathways metabolic intermediates will be accumulated in our cells in the case of a single or multiple gene deficiency which could block a certain pathway, (iv) Probiotics could support a weak (rather than a completely defected pathway) pathway which might be due to a defect in a single allele rather than the defect in both alleles. Exactly like in the case of those who have retinoblastoma. In such a case the critical basis for the Knudson hypnosis will be completely interfered with while a single gene will not be subject to excessive stress that could lead to a mutation, (v) Probiotics will be the best support for us when we become old. It will reduce the load on our biological system and will enable us to do extra activities, especially those that will enhance our ability to utilize food (Begum et al. 2017).

Conclusion:

The first species to colonize the child's body and have an impact on his health throughout his life are determined by the mother's health and the environment in which he or she is born. Our health will improve and we will receive various benefits from having healthy microbial strain colonies of microflora. Exo-sources should be used when the beneficial microflora in our bodies is disturbed by one of the many factors that make up daily life. Foods like fermented foods, milk, and milk products can all contain such exo-sources, also known as probiotics, which are beneficial microbes. Probiotics come in a variety of forms to treat various illnesses, thanks to science, researchers, and contemporary businesses.

Early human observations, research, and the various applications for probiotics in their various forms highlight how much these wonderful microbes could do to ensure our treatment or management of diseases, as well as to promote our health. The fact that probiotics are available in natural forms and carry out safe, natural functions may be their most important quality. This review provides a concise list of the various probiotic strains, types, applications, some of the companies involved in these fields, as well as the names of the same categories of foods high in probiotics. In the future, probiotics, promising microbes, will attract more and more attention.

References

Akhtar, G., Bhat, N. A., Masoodi, F. A., &Gani, A. (2021). Small-and Large-Scale Production of Probiotic Foods, Probiotic Potential and Nutritional Benefits. In Advances in Probiotics (pp. 365-395). Academic Press.

Albury, C., Strain, W. D., Le Brocq, S., Logue, J., Lloyd, C., &Tahrani, A. (2020). The importance of language in engagement between health-care professionals and people living with obesity: a joint consensus statement. The Lancet Diabetes & Endocrinology, 8(5), 447-455.

Allen, H. K., Levine, U. Y., Looft, T., Bandrick, M., & Casey, T. A. (2013). Treatment, promotion, commotion: antibiotic alternatives in food-producing animals. Trends in microbiology, 21(3), 114-119.

Angulo, M., Ramos, A., Reyes-Becerril, M., Guerra, K., Monreal-Escalante, E., & Angulo, C. (2023). Probiotic *Debaryomyceshansenii* CBS 8339 yeast enhanced immune responses in mice. 3 Biotech, 13(1), 1-12.

Banik, S., Nath, P. C., & Roy, R. Microbiome and gut-brain axis affecting stress behavior. American Journal of Applied Biotechnology Research, 17-33.

Begum, P. S., Madhavi, G., Rajagopal, S., Viswanath, B., Razak, M. A., &Venkataratnamma, V. (2017). Probiotics as functional foods: potential effects on human health and its impact on neurological diseases. International Journal of Nutrition, Pharmacology, Neurological Diseases, 7(2), 23-33.

Demin, K. A., Refeld, A. G., Bogdanova, A. A., Prazdnova, E. V., Popov, I. V., Kutsevalova, O. Y., ... &Chikindas, M. L. (2021). Mechanisms of Candida resistance to antimycotics and promising ways to overcome it: the role of probiotics. Probiotics and Antimicrobial Proteins, 13(4), 926-948.

Dey, P., Roy, R., Mukherjee, A., Krishna, P. S., Koijam, R., & Ray, S. (2022). Valorization of Waste Biomass as a Strategy to Alleviate Ecological Deficit: A Case Study on Waste Biomass Derived Stable Carbon. Advanced Microscopy, 167-196.

Ghosal, A., Roy, R., Sharma, K., Mitra, P., & Vora, K. (2022). Antibiofilm activity of Phytocompounds against of *Staphylococcus aureus* Biofilm forming Protein-In silicostudy. American Journal of Applied Bio-Technology Research, 3(1), 27-29.

Ghosh, T., Beniwal, A., Semwal, A., &Navani, N. K. (2019). Mechanistic insights into probiotic properties of lactic acid bacteria associated with ethnic fermented dairy products. Frontiers in microbiology, 10, 502.

Kang, S. R., Nguyen, D. H., Yoo, S. W., & Min, J. J. (2022). Bacteria and bacterial derivatives as delivery carriers for immunotherapy. Advanced Drug Delivery Reviews, 181, 114085.

Kitamoto, S., Nagao-Kitamoto, H., Hein, R., Schmidt, T. M., &Kamada, N. (2020). The bacterial connection between the oral cavity and the gut diseases. Journal of dental research, 99(9), 1021-1029.

Kumar, D., Pornsukarom, S., & Thakur, S. (2019). Antibiotic usage in poultry production and antimicrobial-resistant Salmonella in poultry. Food Safety in Poultry Meat Production, 47-66.

Li, R., & Roy, R. (2023). Gut Microbiota and Its Role in Anti-aging Phenomenon: Evidence-Based Review. Applied Biochemistry and Biotechnology, 1-15.

Liu, L., Huh, J. R., & Shah, K. (2022). Microbiota and the gut-brain-axis: Implications for new therapeutic design in the CNS. EBioMedicine, 77, 103908.

Palai, S., Derecho, C. M. P., Kesh, S. S., Egbuna, C., &Onyeike, P. C. (2020). Prebiotics, probiotics, synbiotics and its importance in the management of diseases. Functional Foods and Nutraceuticals: Bioactive Components, Formulations and Innovations, 173-196.

Parker, A., Fonseca, S., & Carding, S. R. (2020). Gut microbes and metabolites as modulators of blood-brain barrier integrity and brain health. Gut Microbes, 11(2), 135-157.

Parveen, S., Sur, T., Sarkar, S., & Roy, R. (2023). Antagonist Impact of Selenium-Based Nanoparticles Against Mycobacterium tuberculosis. Applied Biochemistry and Biotechnology, 1-9.

Patel, P., Butani, K., Kumar, A., Singh, S., & Prajapati, B. G. (2023). Effects of Fermented Food Consumption on Non-Communicable Diseases. Foods, 12(4), 687.

Peng, M., Tabashsum, Z., Anderson, M., Truong, A., Houser, A. K., Padilla, J., ... & Biswas, D. (2020). Effectiveness of probiotics, prebiotics, and prebiotic- like components in common functional foods. Comprehensive reviews in food science and food safety, 19(4), 1908-1933.

Raman, J., Kim, J. S., Choi, K. R., Eun, H., Yang, D., Ko, Y. J., & Kim, S. J. (2022). Application of lactic acid bacteria (LAB) in sustainable agriculture: Advantages and limitations. International Journal of Molecular Sciences, 23(14), 7784.

Roy, R., Debnath, D., & Ray, S. (2022). Comprehensive Assessment of Various Lignocellulosic Biomasses for Energy Recovery in a Hybrid Energy System. Arabian Journal for Science and Engineering, 47(5), 5935-5948.

Roy, R., Chakraborty, A., Jana, K., Sarkar, B., Biswas, P., & Madhu, N. R. (2023). The Broader Aspects of Treating Diabetes with the Application of Nanobiotechnology. In Advances in Diabetes Research and Management (pp. 137-162). Singapore: Springer Nature Singapore.

Roy, R., & Ray, S. (2019). Effect of various pretreatments on energy recovery from waste biomass. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 1-13.

Roy, R., & Ray, S. (2020). Development of a non-linear model for prediction of higher heating value from the proximate composition of lignocellulosic biomass. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 1-14.

Roy, R., & Ray, S. (2022). Upgradation of an Agro-residue by Acid Pretreatment into a Solid Fuel with Improved Energy Recovery Potential: An Optimization Study. Arabian Journal for Science and Engineering, 47(5), 6311-6323.

Roy, R., Sarkar, S., Kotak, R., Nandi, D., Shil, S., Singha, S., ... &Tarafdar, S. (2022). Evaluation of the Water Quality Parameters from Different Point Sources: A Case Study of West Bengal. American Journal of Applied Bio-Technology Research, 3(3), 18-28.

Roy, R., Shil, S., Choudhary, D. K., Mondal, P., Adhikary, P., Manna, U., ... & Maji, M. (2022). Conversion of glucose into calcium gluconate and determining the process feasibility for further scaling-up: An optimization approach. Int. J. Exp. Res. Rev, 27, 1-10.

Roy, R., Srinivasan, A., Bardhan, S., & Paul, T. (2022). Evaluation of the Expression of CD-4 and CD-45 Count among Patients Having Non-Small Cell Lung Cancer. Journal homepage: www. ijrpr. com ISSN, 2582, 7421.

Sanders, M. E., Merenstein, D. J., Reid, G., Gibson, G. R., &Rastall, R. A. (2019). Probiotics and prebiotics in intestinal health and disease: from biology to the clinic. Nature reviews Gastroenterology & hepatology, 16(10), 605-616.

Shah, A. M., Tarfeen, N., Mohamed, H., & Song, Y. (2023). Fermented Foods: Their Health-Promoting Components and Potential Effects on Gut Microbiota. Fermentation, 9(2), 118.

Singh, R., Zogg, H., Wei, L., Bartlett, A., Ghoshal, U. C., Rajender, S., & Ro, S. (2021). Gut microbial dysbiosis in the pathogenesis of gastrointestinal dysmotility and metabolic disorders. Journal of Neurogastroenterology and Motility, 27(1), 19.

Song, B., Liu, X., Dong, H., & Roy, R. (2023). miR-140-3P Induces Chemotherapy Resistance in Esophageal Carcinoma by Targeting the NFYA-MDR1 Axis. Applied Biochemistry and Biotechnology, 195(2), 973-991.

Su, Q., Dong, J., Zhang, D., Yang, L., & Roy, R. (2022). Protective effects of the bilobalide on retinal oxidative stress and inflammation in streptozotocin-induced diabetic rats. Applied Biochemistry and Biotechnology, 194(12), 6407-6422.

Tan, H. Y., Chen, S. W., & Hu, S. Y. (2019). Improvements in the growth performance, immunity, disease resistance, and gut microbiota by the probiotic *Rummeliibacillusstabekisii* in Nile tilapia (Oreochromis niloticus). Fish & shellfish immunology, 92, 265-275.

Tewari, S., David, J., & Gautam, A. (2019). A review on probiotic dairy products and digestive health. Journal of Pharmacognosy and Phytochemistry, 8(3), 368-372.

Thakur, M., Verma, D. K., Billoria, S., Deshpande, H. W., Patel, A. R., & Kaushik, G. (2023). Probiotics in Fruits and Vegetables: Challenges, Legislation Issues, and Potential Health Benefits. In Microbial Biotechnology in Food Processing and Health (pp. 81-127). Apple Academic Press.

Vipparla, C., Sarkar, S., Manasa, B., Pattela, T., Nagari, D. C., Aradhyula, T. V., & Roy, R. (2022). Enzyme Technology in Biofuel Production. In Bio-Clean Energy Technologies Volume 2 (pp. 239-257). Singapore: Springer Nature Singapore.

Wang, G., Chen, Y., Xia, Y., Song, X., & Ai, L. (2022). Characteristics of probiotic preparations and their applications. Foods, 11(16), 2472.

Xiang, Q., Yan, X., Shi, W., Li, H., & Zhou, K. (2022). Early Gut Microbiota Intervention in Premature Infants: Application perspectives. Journal of Advanced Research.