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Review article

The Importance of Probiotics in Human and Animal Life: A Review

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Abstract
Probiotics are live bacteria that, when given in sufficient quantities, help the host's health. They have attracted much interest lately. These good bacteria, which typically include Lactobacillus, Bifidobacteria, and Saccharomyces, improve the health of both animals and humans. Antibiotics alter the body's natural microbiota and result in vitamin deficiencies because they cannot distinguish between healthy and bad bacteria. They also significantly reduce the host's defenses by killing beneficial bacteria in the vaginal and intestinal tracts. Because of their positive impacts on human health, including metabolism and immune function, probiotics—a colony of bacteria that reside in our intestines—are thought of as a metabolic "organ." In therapeutic contexts, they treat and prevent diseases like autism, migraine, Helicobacter pylori infection, colon cancer, hypertension, diabetes, acute pancreatitis, diarrhea, and ventilator-associated pneumonia. By enhancing gut barrier function, modifying microbial habitat in the intestine, boosting innate and adaptive immune responses, promoting competitive adhesion to the mucosa and epithelium, and generating antimicrobial chemicals, probiotics may change immunological activity. The purpose of this study is to list the important role that probiotics play in the prevention and therapeutic use of many diseases for which there may or may not be treatment options. A thorough search was conducted using keywords like probiotics, microbiota, prophylactics, and therapeutic uses in research databases like PubMed, PubMed Central (PMC), Scopus, Web of Science, Research Gate, Google Scholar, and the Cochrane Library. The main points of this succinct narrative review essay were the selection, history, mechanism/mode of action, most recent developments in therapeutic and preventative uses, and prospective avenues for probiotic use in medicinal and preventative purposes.
Keywords. *Probiotics, Lactobacillus, Bifidobacteria, Saccharomyces, Good Bacteria.*

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Introduction

Bacteria can be classified as beneficial ("good") or harmful ("bad"). Good bacteria, also called probiotics, have roles in digestion, nutrient absorption, and immune system support. Bad bacteria, or pathogens, can cause infections and illnesses [1]. The term 'probiotic' originates from the Greek language, signifying 'for life', which provides valuable insight into its importance and relevance. An engaging and interesting approach to understanding the etymology of the word is to break it down into two components: 'pro' (meaning for) and 'bios' (meaning life), thus reflecting its foundational and essential meaning in health. More broadly and inclusively, probiotics can be defined as "live microorganisms which, when administered in adequate amounts, confer a significant health benefit on the host". This definition highlights that probiotics serve a crucial role beyond being simply characterized as "good bacteria"; rather, they are primarily defined by their remarkable ability to provide real and tangible health benefits to the consuming host. This comprehensive understanding is essential, as the overall beneficial effects of these probiotic organisms play a critical role in the continuous and ongoing development of probiotic-based functional foods and dietary supplements that aim to enhance favorable health outcomes for consumers [2].

When administered properly, probiotics, also referred to as living microorganisms or live microbial dietary supplements, may support advantageous physiological or therapeutic effects. Several studies have been conducted because of the interest in how these compounds can improve human health. They can be used to prevent many diseases, manage gastrointestinal infections, and support the immune system [3,4]. According to the authors, probiotics will soon regulate intestinal bacterial flora, but their usage must be safe and involve microorganisms with the general recognized as safe designation. Lilly and Stillwell were the first to adopt the term probiotics, which is taken from the Greek word "meaning for life." It was defined in 1965 as a chemical released by one microbe that promotes the growth of another. "Organisms and substances, which contribute to the intestinal microbial balance," including microbial culture suspension and crude microbial culture products, is how Parker (1974) referred to probiotics [5]. Probiotics are microbial

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food or feed supplements that improve the intestinal microbial balance of the host, according to Gibson and Roberfoid (1995) [6].

A form of bacteria called probiotics inhabits the intestines and is considered a metabolic 'organ' due to its positive impacts on human health, including immune function and metabolism [7]. Compared to the Homo genus, which first appeared in Africa 2.5 million years ago, microorganisms first appeared on Earth 3.8 billion years ago. Because of this, bacteria had far more time outside of humans to adapt and change, creating survival mechanisms that enabled them to endure in the most extreme conditions [8]. Human health has long been preserved and enhanced using live microbes in food, especially bacteria that create lactic acid. Ancient Greek and Roman cultures relied on fermented dairy products to maintain their health. The gut microbiome consists of three categories: Bacteroidetes (Porphyromonas, Prevotella, Bacteroides), Firmicutes (Ruminococcus, Clostridium, Lactobacillus, Eubacteria), and Actinobacteria (Bifidobacterium). The majority of the intestinal microbiome consists of Bifidobacterium and Bacteroides. The normal microbiome inhibits the colonization of pathogenic bacteria through a process termed microbial antagonism, which enhances the host's health and increases the availability of essential nutrients, such as short-chain fatty acids, vitamins, arginine, cysteine, and glutamine amino acids [9].

In the contemporary landscape of complementary medicine, probiotics and prebiotics are increasingly recognized as therapeutic food components due to their potential to alleviate various ailments, including reducing lactose intolerance symptoms, improving intestinal health and nutrient bioavailability, and diminishing susceptibility to allergies. They may also function as functional foods to reduce the risk of certain cancer types and manage diarrhea-predominant irritable bowel syndrome. Moreover, by obstructing the activity of dietary carcinogens (nitrosamines), probiotics significantly influence enterocyte development. Consequently, the therapeutic value of food products is enhanced with the incorporation of probiotic bacteria [10]. Consequently, competitive probiotic bacteria-based dietary products are essential for developing effective therapeutics that protect the epithelial barrier against gastrointestinal discomfort and associated factors, such as mucosa-associated E. coli. The microbe that regulates bacteria must not adversely affect the host or disrupt the natural microbiome of the human stomach [11].

Probiotics increase certain intestinal microbiome but not the total number of bacteria. The generation of organic acids, ethanol, hydrogen peroxide, or protein-containing substances (bacteriocins) is associated with the antibacterial activity of probiotics [12,13]. After antibiotics lose their effectiveness due to antibiotic resistance, probiotics become the second most crucial immune defense mechanism. The mammalian gastrointestinal tract's defenses against bacterial colonization are incredibly intricate. An imbalance between commensal and pathogenic bacteria in the gut microbiome leads to intestinal inflammation, which thins or eliminates the mucus layer. This makes it possible for bacteria and their metabolites to penetrate the mucus layer and infiltrate intestinal epithelial cells, which lowers the function of the intestinal mechanical barrier [14]. Two kinds of bacteria, native microbiome and invasive pathogenic germs, colonize the gastrointestinal tracts of many mammals. A healthy gut microbiota is necessary to maintain intestinal immunity and balance. A change in this balance may have detrimental pathophysiological effects [15].

Definition and Types of Probiotics

Probiotics are live microorganisms that, when administered in adequate amounts, confer health benefits. Strains of probiotics have been specifically isolated from the human and animal gastrointestinal microbiota. Probiotics have been grouped into several different strains based on i) source of origin, e.g., human, animal, plant fermentations, or soil; ii) degree of domestication, and have classically been termed “Lactic Acid Bacteria” (LAB) or not (non-LAB) on the ability to grow at low pH; or sequence analysis (where possible). Two of the most well-described groups of probiotics are Bifidobacterium and Lactobacillus, but there are many others. From a nomenclature and taxonomic standpoint, organisms or strains are named according to prefixes, species determined using the species name that may be followed by the strain code [16].

It is important to remember that probiotic activities are strain-specific. Several large commercial strains, such as Lactobacillus rhamnosus, Lactobacillus acidophilus, Lactobacillus casei, Bifidobacterium infantis, and Lactobacillus plantarum, have been extensively studied. Good clinical studies take a considerable amount of time and patience to do, and often, this work needs to be replicated to generate rigorous scientific evidence. It is also important to differentiate between “probiotics” and other complementary gut health-enhancing products like “prebiotics,” which are defined as non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of beneficial bacteria. For a consumer, understanding the differences between these products

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is crucial. In addition to strains, the product can also contain other ingredients such as vitamins, minerals, fiber, and other additives. In poorly regulated markets, manufacturers of probiotic products may not have the legislative approval, nor should there be any clinical trial substantiation regarding their functional effects [17].

Benefits of Probiotics

Probiotics provide various health benefits primarily because they function to maintain a balanced microbiota in the gut. Once delivered, they modulate the natural gut microbiome and support the growth of a diverse group of microorganisms in the gut. Probiotics have been shown to mitigate diarrhea and aid lactose digestion. Some evidence suggests that these beneficial microorganisms may also enhance immune function, improve mineral absorption, and maintain enzyme activity in relation to some cancers. In addition to their roles in the gut, potential benefits for skin and mental health are supported.

One of the most common benefits of probiotics is the maintenance of gut health. The lining of the intestines is covered in a perfect, healthy garden of bacteria, also known as a microbiota, that totals about 39 trillion cells. When things get out of balance or if bad bacteria take over, the result is poor or suboptimal digestive health. Probiotics help to keep the beneficial bacteria at higher levels and the harmful bacteria significantly lower. Consuming various strains of probiotics can help repopulate the microbiota with beneficial bacteria, which can help keep one in good health [18]. Probiotics have been shown to help increase the amount of IgA-producing cells, which can enhance the overall immune function. IgA is a very important immune system-friendly protein produced by the body to ensure that harmful pathogens are eliminated. The use of probiotics can stop this process and lead to the reduction of pathogenic bacteria linked to various disorders, such as irritable bowel syndrome. By reinforcing the gut microbiome, one can lower the risk of infections, food allergies, and intolerances. Additionally, probiotics have been shown to kill harmful bacteria by producing substances that inhibit their growth; probiotics can also have a major impact when it comes to keeping humans regular. Scientific research has documented a connection between probiotics and a reduction in diarrhea symptoms, with decreased virus shedding also influencing disease progression [19]. One can consume probiotics from several dietary sources, such as Lactobacillus acidophilus, found in yogurt and other dairy products. Dairy-free options are available, too. Although probiotics can also be taken in supplement form, it is important to use safety-confirmed products [20].

Probiotics not only affect gut health but also regulate the immune response in the intestines, referred to as gut-associated lymphoid tissue (GALT). While the specifics of this connection remain somewhat ambiguous, probiotics can augment nonspecific immune function by elevating mucosal and systemic synthesis of immunoglobulin A (IgA), platelets, phagocytosis, T lymphocyte activation, and natural killer cell activity. Their function is contingent upon the host's type, quantity, duration, and pre-existing functional immunological status. Besides influencing the immune response, evidence indicates that dietary probiotics can diminish inflammation by obstructing pathogens from penetrating the intestinal barrier and activating cyclic lipopeptides that enhance the synthesis of anti-inflammatory cytokines rather than pro-inflammatory cytokines [21].

The immune system serves as the primary defense against invading microorganisms and allergens. The immune system combats intruders such as bacteria, viruses, and poisons, while also aiding in the elimination of possible allergens from our bodies. Research indicates that some strains of probiotics may prevent acute respiratory infections and appetite loss. A study indicated that probiotic intake may improve immunological function, hence reducing the likelihood of upper respiratory infections and allergies in children. Probiotics also affect adaptive immunity, encompassing allergen-specific responses and various T-cell, B-cell, and antigen-presenting cell activities. Furthermore, research indicates that probiotics can influence immune cell activity by enhancing cytokine release [22]. It is uncertain whether these clinical consequences are exclusively contingent upon interactions within the stomach or if they also involve interactions in other tissues, such as the skin and lungs. Research on human disorders associated with gastrointestinal immunology substantiates the notion of a correlation between the gut and the skin, as well as between the gut and the lungs. Significant evidence indicates that changes in the gut microbiota are closely associated with immunological dysfunction and likely precede allergy and autoimmune disorders.

It is also plausible that probiotics ingested via the oral route could indirectly stimulate mucosal immune system function and protection in other immunologically sensitive sites such as the skin. The gut microbiome is interconnected with the health of the whole body. The gut microbiome has a significant impact on ancillary systems such as the immune system and other body sites. The potential of probiotics in the treatment of such conditions is increasingly feasible as the health of the immune system and overall health are inextricably linked. Given the growing amount of data linking the gut

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microbiome to other parts of the body, the use of probiotics as a preventive therapy for other body sites with a functional relationship to the gut is probable [23].

Applying probiotics to skin health can open a host of possibilities in sub-healthcare sectors, as conditions like eczema, acne, or allergic conditions cause a loss of work that has a tangible impact on the severity of the condition. Researchers have been studying and debating the effects of probiotics in skincare more and more recently, as we have grown more aware of their potent effects in many different fields. There are several ways that probiotics can work (Figure 1).

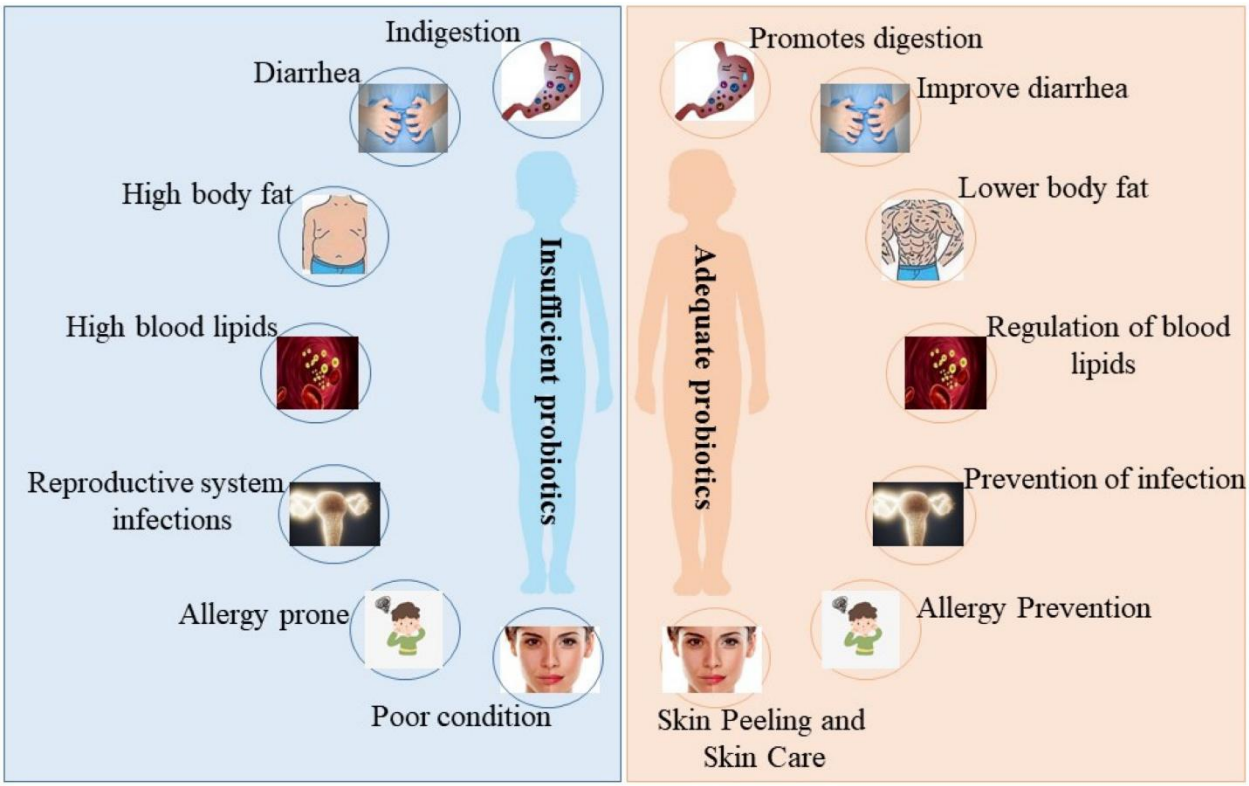

Figure 1: The beneficial effects of probiotics on the organism [24].

Acne is a good example of how the role of sebaceous glands, the integument barrier, and systemic inflammation are all factors in considering long-term treatment options. The research building on the role of the gut-skin axis can lead to some now common claims that the skin is a "window" into wider health. This is true in the context of autoimmune and mental health, where probiotics have been claimed to reduce oxidative stress primarily in these two areas [25]. Since the growth in interest, topical probiotics' role in skin health has indeed been more powerful and observable immediately than oral probiotics, which seem more restricted to their perceived immunological and longer-term effects. Studies have demonstrated that probiotics can influence the speed at which skin can repair itself and have the potential to soothe discomfort and reduce inflammation [26,27]. Initial studies have reported that the effect of probiotics may be to reduce interleukin levels and oxidative stress; however, so far, there have been no widespread literature review reports on the effect that probiotics have on stimulating their own receptor profile and the interaction of Nrf2 antagonists in the skin [24]. Furthermore, the epidermal thickening effect of internal probiotics was found to vary according to gender, with no additional influences based on dosage, highlighting the current paucity of data [28].

A new and intriguing aspect of probiotics focuses on their relationship to mental health and emotional well-being, a field known as psychobiotics. This observation is based on the well-established gut-brain axis, through which the gut microbiome and its probiotics, or changes due to various diseases, affect mood, feelings, and even cognitive function. A common example is how emotions such as fear or excitement can cause "butterflies in the stomach." This is because the intestines contain an intrinsic, separate nervous system, often called the "second brain," with neurons that communicate directly with the brain. This relationship is bidirectional; this means that when the brain is stressed emotionally, the gut can be simultaneously affected. On the other hand, a healthy digestive system and a balanced stomach are crucial for optimal brain health [29].

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The production of neurotransmitters is also attributed to gut bacteria, which are often considered crucial in directly regulating the mood. Consequently, consuming a probiotic formula can be speculated to rebalance brain-gut communication. This is consistent with an increasing body of literature that has shown, for example, that probiotic supplementation can improve anxiety and depression and generally enhance well-being. According to the mechanisms that have been learned, such mental health benefits are thought to be most or only prevalent in times of increased psychological vulnerability, such as during the treatment of people suffering from anxiety, depression, autism, post-traumatic stress, and other problems [30] (Figure 2).

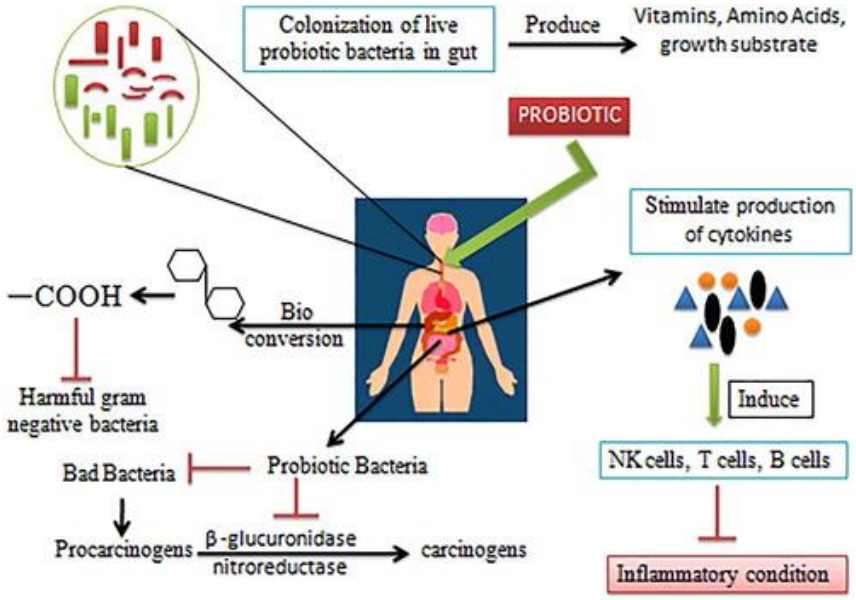

Figure 2: The applications of probiotics originated from different organisms [31].

Mechanisms of Action

Probiotics act through several mechanisms to confer health benefits to both the host and the non-infected host or alternative animals. They can interact with the host immune system, enhancing immune responses while promoting tolerance to normally non-harmful commensals as necessary (Figure 3).

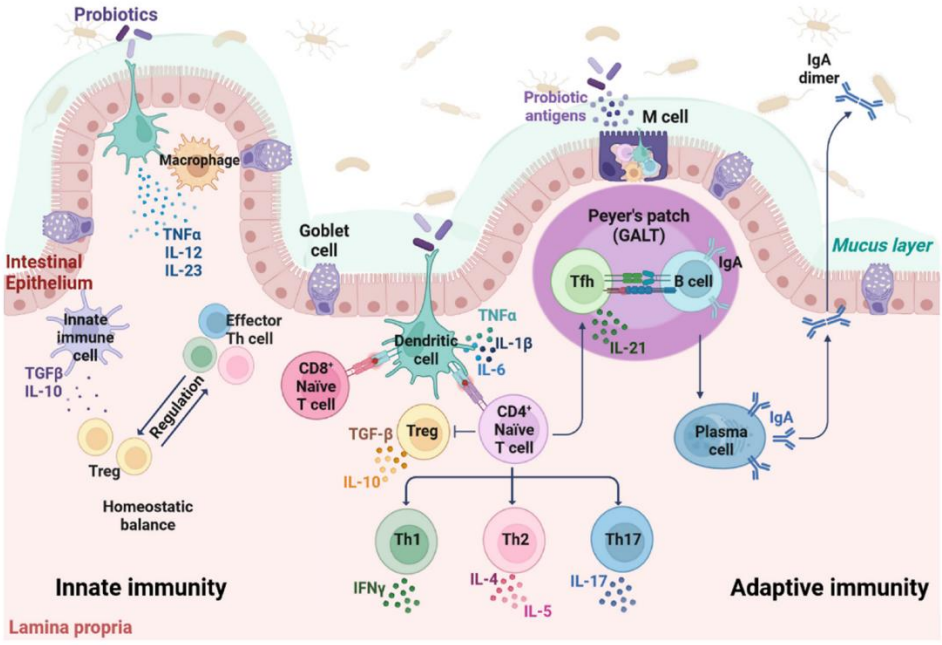

Figure 3: Probiotics mechanism of action on Immune cells [21].

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They can also produce beneficial short-chain fatty acids and vitamins, reduce potential pathogenic bacteria via competitive exclusion, enhance the gut-brain axis, and affect the composition of the commensal microbiome. Gut health and its stability are crucial for a wide variety of physiological processes in both animals and humans [32]. Up to 1 × 1014 bacteria reside within the mammalian large gut, the majority of which are beneficial to their host. The commensal bacteria, such as Bifidobacterium spp. and Lactobacillus spp., as well as the host, can derive considerable benefits from their mutualistic relationships. The gut microbiome mix can also include confounders and pathogens. In many animals and humans, gut microbiome plays a significant role in the process of metabolic entropy and contributes greatly to the maintenance of the immune steady state contributes greatly to the maintenance of the immune steady-state. The large and small intestines, colon, and other gut samples contain phylogenetically diverse populations that include a variety of species of facultatively anaerobic bacteria. The use of antimicrobial agents, including probiotics, prebiotics, and synbiotics, for the control of pathogenic organisms in the gut, including E. coli, as well as for enhancing host growth and performance, isolating beneficial symbiotic bacteria is known as the competitive exclusion principle (Figure 4). It offers human and animal communities a robust method of preventing diseases. In addition, there has been increasing concern over the ecological implications of the transfer of living microbiome across the food chain, particularly when commensals and pathogens are involved [21].

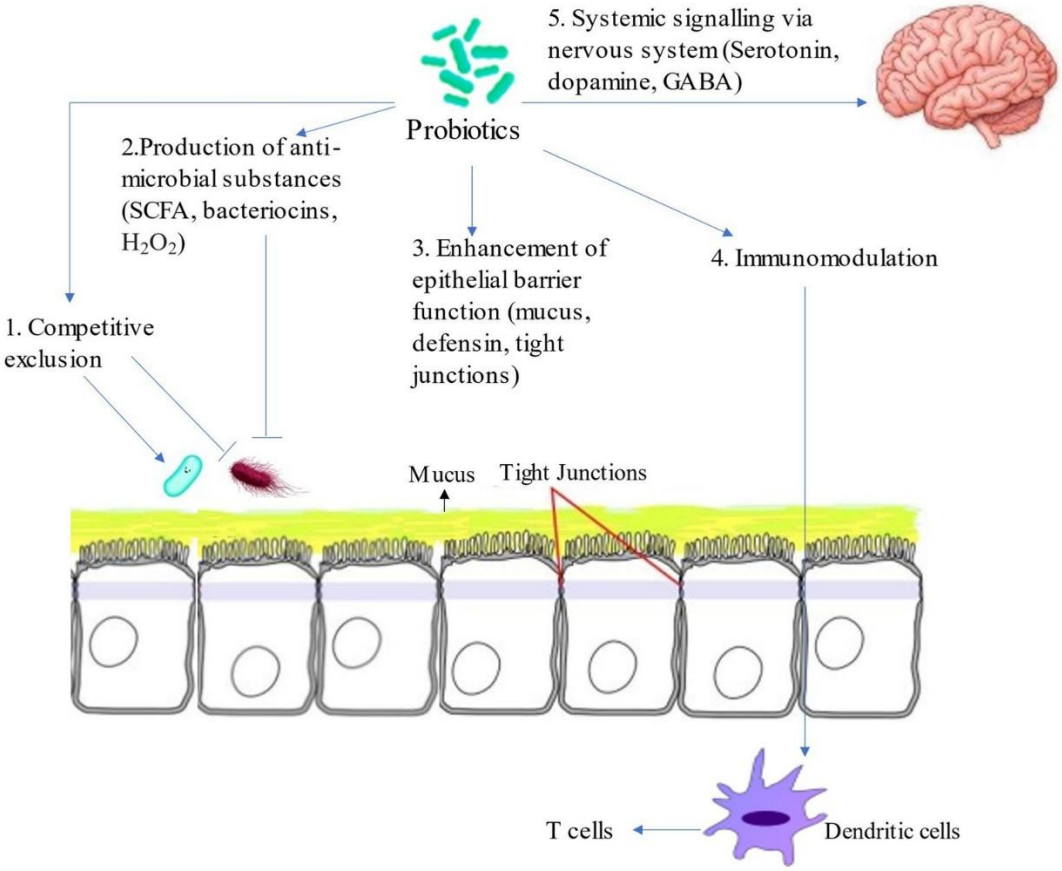

Figure 4. Mechanism of action of probiotics [32].

Probiotics in Animal Health

Probiotics have emerged and established themselves as important factors for the management of animal health and well-being, with potential health benefits in organic systems. They increase livestock production and reproduction by enhancing the cow's growth rates and feed conversion efficiency. At present, probiotics in animal feed have looked promising since they have been able to improve productivity and livestock health. In animal production systems, antibiotics have been used for treatment and growth promotion. Nevertheless, the use of antibiotics in animal husbandry, which can lead to antibiotic residues in animal products, consequently disrupts the quality of animal-derived food and has become a rising concern for the public [33,34].

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Probiotics can be used as a natural alternative to antibiotics in controlling or preventing infections in animals. Furthermore, the food market has been evolving, and consumer choices for their pets have shifted towards an interest in more natural and nutrition-based products to improve the health and well-being of these animals (Figure 5). Thus, pet animals' diets have been subjected to an important level of scrutiny, and the search for naturally trustworthy ingredients, apart from nutrient content, is still ongoing. Consequently, the use of probiotics for companion animals has also increased. They have shown promising results in modulating the alimentary behavior and health of animals and assisting in the immune response against specific antigens. In addition, there have been some scientific proofs based on controlled trials and case studies for the practical application of probiotics and their products in veterinary practices. Proper administration and dose consideration are critical for the promise offered by probiotics. Thus, the beneficial application of probiotics in both livestock and companion animals, along with their advantages, has gained broader attention over the last few years [35].

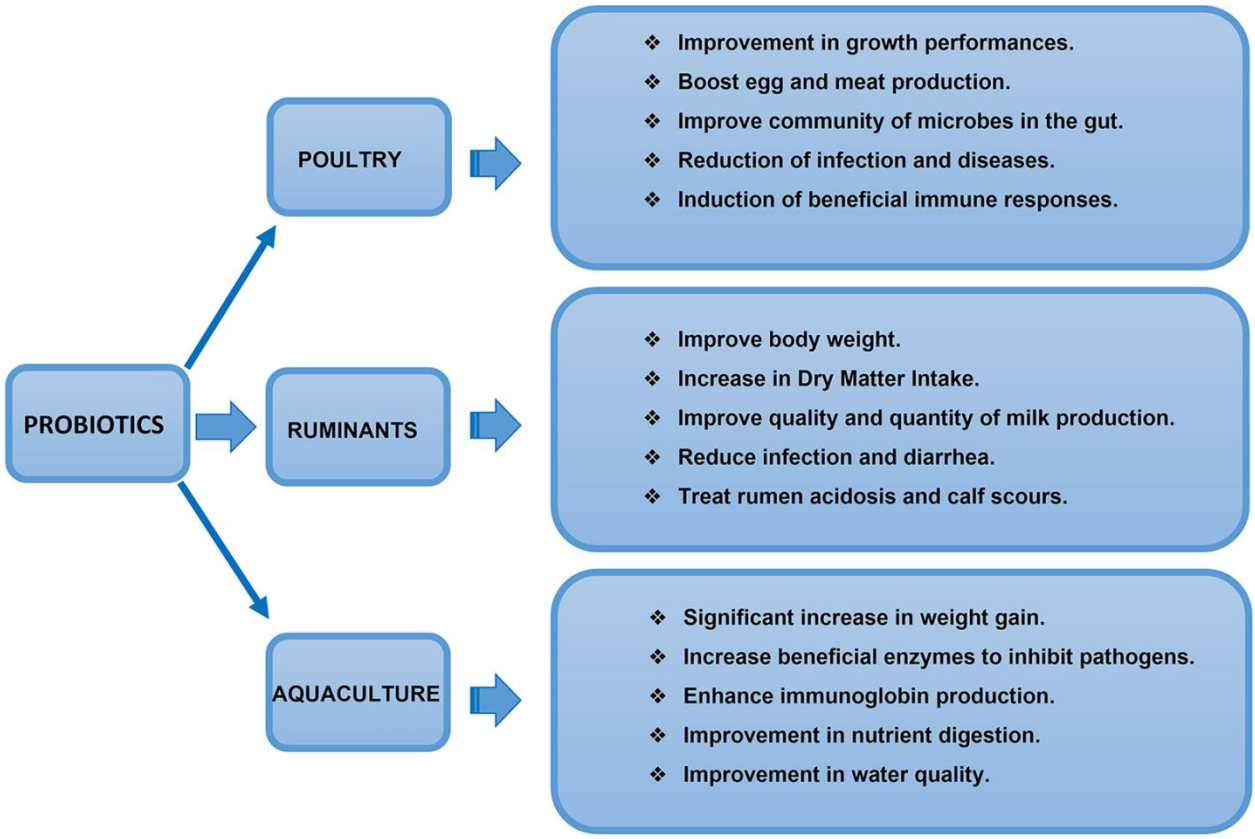

Figure 5. A flowchart containing an informative summary of the beneficial effects of probiotics in animals (poultry, ruminants, and aquaculture) [35].

Livestock and Poultry

Benefiting mankind from probiotics can be credited to many aspects; a few such aspects are discussed in the following subsections: Livestock and Poultry Modern farming practices in livestock and poultry greatly depend on the application of non-specific antimicrobials, such as growth promoters, to promote gut health, immune stimulants, anticoccidials, and other immunomodulation molecules [36]. A few beneficial effects of probiotics in poultry are to enhance growth and performance and reduce the incidence of caecal colonization by zoonotic and food-borne pathogens. Using a strain-specific probiotic in the modern broiler breeder industry can yield substantial beneficial effects.

Lactobacilli and bifidobacteria are important beneficial human probiotics. There are a few animal-specific strains of L. salivarius, L. reuteri, and other strains of L. acidophilus used as probiotics for poultry. The genera Enterococcus, Pediococcus, and vegetative forms of Bacillus are a few other suitable probiotics for poultry production. Regular large consumption of non-absorbed prebiotics can increase the growth of these beneficial bacterial strains in the human colon. A probiotic at a 0.1% inclusion level can improve the weight gain of a broiler. The Lactobacillus strains present in the

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probiotic preparation are isolated from the crops of healthy adult birds and are suitable for GMP application for poultry production [37].

Probiotics are used after extensive research and finding suitable beneficial strains or strains of bacteria suited for their host animal species. Human-specific strains of probiotics, when applied to farm animals, did not yield satisfactory results. Livestock probiotics are not only for enhancing performance but also for the health of the animal. In extensive and free-range husbandry systems, where the birds have contact with potential zoonotic pathogens, probiotics are suitable for application. The use of probiotics in dairy calf feeds increased weight gain. Adding a specific Bacillus improved fat-corrected milk yield and the cow conformation score [38,39]. The use of another Bacillus strain in pigs during the period from 30 to 80 kg also showed reduced excretion of E. coli. Feeding L. rhamnosus cells in piglet feed increased the preventive effect on E. coli infections by improving intestinal cell functions and may supply a non-antibiotic way to combat E. coli-related infections in mammals [40]. The beneficial effects of probiotic intervention on human health are dealt with in the next section. Consumers in industrialized countries are moving away from antibiotics to prevent and treat young livestock against infections and thus are shifting to the setup of natural defenses like regular historic feed consumption of probiotics, phytonutrients, and other immune promoters. Probiotics fit perfectly in the trend of modern natural livestock and poultry farming.

Pets

Probably the most obvious and important moment when everyone thinks of probiotics is the diet and health of their pets. Every person who has a dog, cat, or any other pet is worried about their health, growth, and appearance. The health improvement of pets and gut regulation in many gastrointestinal pathologies make pets the second target for the sale of probiotics. Many times, pet owners may have problems managing their pets' behavior, where anxious and aggressive behavior is associated with an altered gut microbiome, so the use of probiotics in pets can also improve their behavior [41].

Probiotics have shown very positive effects in enhancing the health and longevity of pets. Pet owners also notice shinier coats, more vitality, and energy in their animals due to the use of these beneficial products. They also showed treatment for diarrhea in pets due to the use of antibiotics, immune-deficient conditions, and other problems associated with poor digestion and nutrient absorption. These beneficial microorganisms also showed a fast recovery of gut barrier function in dogs' intestines. Probiotics are available in several formulations for dogs, cats, etc., that can be used as food supplements. Some formulations specifically targeting dogs are produced [42]. If blends are not specifically marketed for one or more pets, owners have the option of dividing the suitable dosage for human supplements to give their dogs according to their weight. Also, fermented products are commercially available and made with canine and feline starter cultures that include various strains [43]. It is recommended to start taking these products, if possible, when the animals are in the breastfeeding period. In probiotics, the quantity of viable probiotics that are sold will be less than the starting quantity of viable probiotics, and some will degrade or not be viable over time. Discussing the use of these supplements with the veterinarian or an animal nutritionist is important. In the same animal species, up to four different probiotics may be clinically justifiable. For different species of animals, veterinarians choose from among various probiotics. In birds, certain species are used almost as frequently as lactobacilli [44]. The ability of a probiotic to perform the required function in a particular animal is important when attempting to select a probiotic for use, and is a significant factor. Through such product efficacy, veterinarians can evaluate efficacy related to strain-specific saturation levels of the target site, bioavailability, and the effect of survivability, growth, and metabolic activities on the delivery and establishment of beneficial strains within the GI tract [45].

Future Directions and Research Opportunities

The field of probiotic research is relatively new despite probiotic applications in human and animal healthcare for thousands of years. While impressive progress has been made in these two domains, various gaps remain in our understanding of the experimental outputs and safety profiles of these bacteria. Research and development activities for probiotic marketing and over-the-counter products have only recently piqued the interest of food companies and food technicians. In the future, innovative products containing probiotics will exert immense effects and provide human health benefits.

Based on real-time applications of these treatments, some areas currently need exploration. It is anticipated that these areas will provide direction to researchers and practitioners alike. It is recommended that the concept of personalized

probiotics receive the most attention alongside gene and nutritional reports. Personalized probiotics are supposed to have greater success rates than non-personalized probiotics. Pulling together results from different clinical trials is going to be a bit tricky since a lot of the variation we see can't just be chalked up to the treatment or the dose used in the meta-analysis. We really need better studies to tackle issues like publication bias and varying responses. We must come up with criteria to figure out which studies are unbiased and which aren't. There's also an expectation that genomic research looking into the regulations around development and metabolism will ramp up. Plus, we could see some clinical trials in livestock models being conducted using lab techniques.

Over the next 5-10 years, our ability to investigate these things will improve significantly. Regarding probiotics, how much people take is likely to depend a lot on what strain it is, how long it stays in the gut, how dominant it is, and what it does. So, personalized treatments to boost digestion and absorption look promising. But, because testing a one-size-fits-all method is super costly, we'll still need a hefty chunk of funding. Collaborative projects that involve multiple departments are the way to go. Studies examining things like high obesity rates or fast growth in kids help encourage teamwork. Even though dietary preferences can vary a lot from culture to culture, we could still mix everyone's probiotic formulas by adding one of four custom probiotics to what people already use.

Conclusion

The present century has been marked by great challenges from the point of view of public health, in which bacterial resistance to antibiotics stands out against the lack of emergence of new antimicrobial molecules that can guarantee the safety of millions of human and animal patients. It is noted that so-called probiotic microorganisms, acting when ingested in a defined amount and for a defined time on health and well-being, have been occupying a relevant place in both the interest of researchers and the requests for their registration, in the human and veterinarian fields. Their mode of action is intense, crossing areas such as nutrition and metabolism, when microorganisms can synthesize molecules that are of interest in the nutrient supply and growth of organisms; the production of structuring molecules for an ecological niche through exopolysaccharides and bacteriocins; the stabilization of microbial communities or the modulation of the gut, demonstrating immunomodulatory capacity with consequent action in pathologies inherent in dysbioses; finally, the availability of microbial space has permitted the control of important zoonotic pathogens from the ingestion of probiotics. It is demonstrated how many microorganisms are available for possible inclusion in probiotics, the number of regulatory aspects that govern their marketing, and the possibility of acting on some of them such as the production of metabolites appropriate for health, food merit, and food safety, the importance of this concept to prevent and eliminate biofilms associated with gut bacterial pathogens, among others, about the gut environment and recommendations related to the use of probiotics as a therapy for gut health in general and diseases associated with the consumption of anti-microbial molecules. Finally, we found that the use of prebiotic molecules presents, in many cases, advantages concerning the administration of probiotics, in that, in addition to avoiding the ability of some microorganisms to colonize certain patients, pharmacological issues of interest are raised, given that many probiotics have deleterious effects on the bioavailability of drugs.

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Conflict of interest.

The authors confirm that there is no conflict of interest to declare.

Author contributions

Conceptualization: Alaa and Lana; methodology: investigation: Alaa and Lana; data curation: writing—original draft preparation: Lana and Alaa; writing—review and editing: Alaa and Sarmad; visualization, supervision, project administration, Funding acquisition: All, Alaa, Lana, and Sarmad. All authors have read and agreed to the published version of the manuscript.

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