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1. Prebiotics and Probiotics in Health

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Abstract:

A complex microbiome develops colonised the human gastrointestinal tract. In virtue to being commensal, intestinal bacteria co-evolve with their host in a technique labelled as synbiotic co-evolution. Beneficial intestinal bacteria accomplish a variety of essential key activities for their host, including trying to make various nutrients, preventing infections driven on by intestinal pathogens, and directing a healthy immune response. Therefore, changing the intestinal microbiota to achieve, restore, and maintain a favourable ecosystem balance as well as the activity of microorganisms present in the gastrointestinal tract are essential for the host's improved health. The intestinal microbiota profits from the insertion of probiotics, prebiotics, or synbiotics to the human diet. They can be eaten as raw fruits and vegetables, pickles that have survived fermentation, or dairy products. Pharmaceutical dosage formulations and functional foods could be another resource. This essay reviews the information that is now accessible and summarises what is known about how probiotics, prebiotics, and synbiotics affect human health. The mechanism of such substances' beneficial effect is discussed, and confirmed study findings demonstrating their effectiveness in human nutrition are discussed.

1.1 Introduction:

The problem of food poisoning, obesity, allergies, cardiovascular illnesses, and cancer—the disease of the twenty-first century—make food quality crucial. Scientific studies support the use of probiotics and prebiotics in human diet as having positive effects on health. Greek is the origin of the word "probiotic," which means "for life." By contrasting the negative effects of antibiotics and other antibacterial drugs on the intestinal microbiota with the positive effects ("probiotika") of some helpful bacteria, Ferdinand Vergin most likely coined the word "probiotic" in his 1954 article "Anti-und Probiotika." [1]. Probiotics have undergone extensive modification and change. According to Fuller (1989), probiotics must have living microorganisms and have a positive impact on their host in order to emphasise their microbial origin [2]. Probiotics are explained primarily as "live strains of strictly selected microorganisms that, when administered in adequate amounts, confer a health benefit on the host" according to the definition formed in 2002 by experts from the FAO (Food and Agriculture Organization of the United Nations) and WHO (World Health Organization) working group [3]. In 2013, the International Scientific Association for Probiotics and Prebiotics (ISAPP) maintained the definition [4]. By stimulating the growth and/or activity of a single type or a small number of bacteria existing in the gastrointestinal

system, prebiotics were described by Gibson and Roberfroid in 1995 as non-digested food components that enhance the health of a host [5]. Prebiotics are components that have been selectively fermented to allow for certain changes in the composition and/or activity of bacteria in the gastrointestinal system, changes that are advantageous to the host's health and welfare. This definition was modified in 2004 [6]. Prebiotics are a nonviable dietary component that offers health benefits on the host related with regulation of the microbiota, according to FAO/WHO scientists in 2007 [7]. In the last few decades, a lot of study has been done on the health benefits that probiotics, prebiotics, and synbiotics confer. Functional foods are food supplements that have been shown to change, adapt, and restore the body's natural gut flora. They also support the intestinal environment's efficient operations. The probiotic strains Bifidobacterium, Lactobacilli, S. boulardii, and B. coagulans that are most frequently utilised [7]. The most widely utilised prebiotics include fructans, inulin, GOS, and XOS. These fibres are known as synbiotics when they are combined with probiotics to increase the viability of the probiotics. We will now learn more particularly about prebiotics and probiotics.

1.2 Definition of Prebiotics:

Glenn Gibson and Marcel Roberfroid [5] initially introduced the idea of prebiotics in 1995. According to definitions, prebiotics are "a non-digestible food element that advantageously impacts the host by selectively encouraging the growth and/or activity of one or a restricted number of bacteria in the colon, and so enhances host health." For more than 15 years, this definition remained largely constant. Only a small number of molecules belonging to the carbohydrate class, including lactulose, GOS, and short and long chain fructans [FOS and inulin], can be categorised as prebiotics by this criterion "Dietary prebiotics" are defined as "selectively fermented ingredients that result in specific changes in the composition and/or activity of the gastrointestinal microbiota, thus conferring benefit(s) upon host health" in 2008 at the 6th Meeting of the International Scientific Association of Probiotics and Prebiotics (ISAPP).

1.2.1 Prebiotics in Human Health:

Prebiotics are crucial for maintaining human health. Asparagus, sugar beet, garlic, chicory, onion, Jerusalem artichoke, wheat, honey, banana, barley, tomato, rye, soybean, human and cow's milk, peas, beans, etc., as well as, more recently, seaweeds and microalgae, naturally occur in various nutritional food products. They are produced on an industrial basis due to their low concentration in foods. The basic materials lactose, sucrose, and starch are used to make some prebiotics. Since the majority of prebiotics fall under the GOS and FOS categories on an industrial scale [8].

1.2.2 Action of Prebiotics:

The vast genetic potential of the gut microbiota population, which is engaged in numerous metabolic processes, can be modulated to benefit the host's health. Prebiotics, which are short-chain carbohydrates with a degree of polymerization between two and sixty and are indigestible by human or animal digestive enzymes, can be used to modulate this process. The ability to selectively utilise prebiotics sets them apart from other undigested dietary

components and compounds, such antibiotics, minerals, and vitamins, since prebiotics are not the only substances having the capacity to modify the gut environment. Prebiotics, which are typically present in fruits and vegetables, may have a number of positive health effects when included in the diet. Among the benefits of those prebiotics, it is important to emphasise the decrease in blood density lipoprotein levels, the stimulation of the immune system, the enhanced calcium absorbability, the maintenance of the proper intestinal pH value, and the low caloric value [9].

Studies have suggested that the microbial metabolic products, including SCFAs, the promotion of ion and trace element absorption, such as that of calcium, iron, and magnesium, and the regulation of the immune system, increasing IgA production and modulating cytokine production, are the mechanisms by which prebiotics confer benefits to the host. Prebiotics, which are typically present in fruits and vegetables, may have a number of positive health effects when included in the diet. Among the benefits of those prebiotics, it is important to mention the decrease in blood low density lipoprotein levels, activation of the immune system, higher calcium absorbability, preservation of the proper intestinal pH value, and low calorie value [10].

1.2.3 Beneficiary Prebiotics:

Prebiotics have an extraordinary impact on human health, making them tempting and desirable treatments for cancer, vascular disease, obesity, and mental problems. There is numerous research on the beneficial benefits of prebiotics on human health; however, to substantiate the health claims, carefully planned long-term clinical trials and genomics studies are required. In order to improve human health, scientists will be able to create better food supplements by figuring out the basic workings of prebiotics. Prebiotic food components have the potential to normalise the makeup of the gut microbiota, which is an appealing method in the management and recovery of several serious illnesses [11].

1.3 Definition of Probiotics:

The word "probiotics," generally refers to live, non-pathogenic organisms and their potential benefits on hosts, is derived from a Greek word that indicates "for life." Vergin initially used the word "probiotics" when he was investigating the harmful effects of antibiotics and other microbial agents on the population of bacteria in the gut.

Probiotika, he saw, was beneficial to the gut flora. After that, Lilly and Stillwell [10] redefined probiotic as "A substance produced by one microbe encouraging the growth of another microorganism. Eventually, the concept was further defined by Fuller as Non-pathogenic microorganisms that, when consumed, have a positive influence on the host's health or physiology [12]. According to the most recent definition proposed jointly by FDA and WHO, living microorganisms when given to a host in adequate amounts improve their health. The following actions must be taken in accordance with the rules:

- Recognition of the strain.
- The strain(s) functional characterization for probiotic benefits and safety.
- Human investigations that verify the health benefits.

- Labelling of efficacy claims and content that is truthful and not deceptive throughout the whole shelf life.

1.3.1 Food Products in Probiotic:

The variety of dietary items that involve probiotic strains is substantial and continues to expand. Dairy-based goods such as fermented milks, cheese, ice cream, buttermilk, milk powder, and yoghurt make up the majority of the market's offerings. Yogurt sales account for the greatest percentage of total sales. Soy-based goods, nutrition bars, cereals, and a range of juices are examples of non-dairy food applications that are appropriate for providing probiotics to customers [13].

1.3.2 Types of Microorganisms in Probiotics:

A number of bacteria may be present in probiotics. Bacteria from the families Lactobacillus and Bifidobacterium are the most prevalent. As probiotics, other bacteria as well as yeasts such Saccharomyces boulardii may be employed.

Microorganisms considered as probiotics Lactobacillus species, Bifidobacterium species, L. acidophilus, B. adolescentis, L. casei, B. animalis, L. crispatus, B. breve, L. *g*allinarum, B. *l*actis, L. gasseri, B. longum, L. johnsonii, B. bifidum, L. paracasei, B. infantis, L. plantarum, L. reuteri, L. rhamnosus, Other lactic acid bacteria Non-lactic acid bacteria Enterococcus aecium, Escherichia coli, strain nissle Streptococcus thermophilus, Saccharomyces cerevisiae, Lactococcus *l*actis, S. boulardii [14].

1.3.3 Beneficiary Probiotics:

The assertions that probiotics have positive effects, such as improving intestinal health, enhancing the immune system, lowering blood cholesterol, and preventing cancer, are being supported by more and more research. These strain-specific health characteristics are influenced by the numerous processes discussed above. Although some of the medical advantages have a strong body of evidence, others need more research to be confirmed. Probiotics have been shown to be effective in treating acute diarrheal illnesses, preventing antibiotic-associated diarrhoea, and improving lactose metabolism, but there is not enough data to support its use in treating other clinical problems [15].

Prebiotics encourage the development and spread of healthy bacteria in the gastrointestinal tract. Live microorganisms that, when given in sufficient quantities, boost the host's health are known as probiotics. Prebiotics, as opposed to probiotics, which are living organisms, are parts of food that are ordinarily difficult for humans to digest. They effectively act as food for the good bacteria in your stomach [16].

1.4 Types of Prebiotics:

Anything that contains sugar qualifies as a prebiotic. Inulin About 36,000 different plants contain inulin, including:

- Chicory root, burdock root, and dandelion root are examples of herbs.
- Apples and bananas are examples of fruits.
- Mother's milk for infants
- sweet vegetables including onions, garlic, asparagus, leeks, and Jerusalem artichokes; raw apple cider vinegar
- Eco Bloom, a prebiotic dietary fibre supplement from Body Ecology
- Fructooligosaccharides (FOS), a subgroup of inulin, is also a prebiotic and is often added to dairy foods and baked goods. It improves the taste and stimulates the growth of the beneficial bacteria, bifidobacterial

1.4.1 Heart Health:

Prebiotics have been found to reduce triglyceride and cholesterol levels, two markers of heart disease. One study specifically demonstrates that inulin can prevent artery hardening, or artherosclerosis, by 30%. New techniques to therapy and treatment that do not use pharmaceuticals are showing to be beneficial as heart disease grows more common among both men and women. They also have the extra advantage of being side impact free, unless you regard enhanced health as a negative effect [17].

1.4.2 Immunity:

Prebiotics appear to increase white blood cells and killer T cells and may even enhance the immune system's response to vaccinations, according to early study. Children in one study who consumed yoghurt with inulin missed fewer days of daycare, went to the doctor less frequently, and required fewer antibiotics [18].

1.4.3 Chronic Illness and Digestion:

Prebiotics have a significant impact on the pathogens and harmful bacteria in the system that can lead to disease. They act in the human intestines. Prebiotics are used to treat Crohn's disease and irritable bowel syndrome, and they may also be effective in the treatment of cancer, osteoporosis, and diabetes [18].

1.5 Probiotics in Health:

Probiotics are food items or nutritional supplements that contain friendly, helpful, and good microbes or yeasts that are typically found in the human body.

1.5.1 Benefits of Probiotics:

A. Immune System:

- Continue to live a healthy and happy life.
- Give your body a natural defence or immune system.
- Stop the spread of dangerous microorganisms.
- Boost your immune system's resistance to autoimmune illnesses and allergies.

- Assist the body in producing vitamins.

B. Digestion System:

- Encourage sound digestion.
- Increase bowel movements and decrease constipation.
- Assist in keeping the germs that cause disease in your intestines under control.
- Lessen the consequences of a Candida infection.
- Help those individuals who are lactose intolerant better digest lactose.
- Decreased cholesterol levels.
- Blood pressure reduction.
- Increasing your body's capacity to absorb nutrients, particularly calcium.
- Reducing oral bacteria that cause dental caries.

C. Probiotics to Prevent Disease:

- Treat yeast infections in the vagina.
- Infections of the urinary tract.
- Prevent diarrhoea following the administration of specific medications.
- Prevent Salmonella- or virus-induced diarrhoea
- Irritable bowel syndrome symptoms and signs should be managed (IBS).
- Boost immunological function to fight off allergies and other immune-related illnesses.
- Reduce the quantity of chemicals in your intestine that cause cancer.
- Diminish a Candida infection's negative effects.
- Eliminate or lessen colon cancer.
- Stop the kids from developing allergies.
- Lower inflammation and infections.
- Combating eczema

1.5.2 Probiotics Products:

Miso, cheese, and kefir are all well-known dairy products that have undergone fermentation and are loaded with health advantages. One of them is a probiotic.

Sauerkraut; pickles; chocolate; tofu; and tempeh, an Indonesian fermented soybean snack with a nutty flavour that has gained popularity as a probiotic food source.

Probiotics have a solid body of research supporting their use in the treatment and treatment of gastrointestinal illnesses such traveler's diarrhoea, diarrhoea brought on by antibiotic use, and diarrhoea due to Clostridium difficile. With less evidence of efficacy in Crohn's disease, other bowel disorders where they have a visible clinical impact comprise ulcerative colitis, particularly in relapse rather than maintenance. Additionally, they have been reported to help with some IBS, lactose intolerance, and constipation symptoms. Probiotics, whether consumed by the pregnant or nursing mother or the child, have also been shown to be effective in avoiding eczema in kids [19]. Prebiotics have been demonstrated to be good for the wellness of the gastrointestinal system, suppressing infections and boosting immune function, despite the fact that their impacts on health are still being studied. With data from

RCTs and systematic reviews indicating benefits in dementia, depression, Parkinson's disease, cardiometabolic health and obesity, as well as in lung diseases, reducing the risk of upper respiratory tract infection, asthma, bronchitis, and chronic obstructive pulmonary disease, there is growing evidence that probiotics have a positive impact on brain health [20].

Probiotics may be taken into consideration for the purpose of preserving a healthy gut microbiota in individuals with gut dysbiosis who have acquired COVID-19 since they appear to be at an increased risk of more serious illness and mortality. This interaction between the gut microbiota and these organs via immune cells, proinflammatory mediators, neurotransmitters, and hormones is what causes these impacts on distant organs. These results offer promising prospects for the future of both probiotics and prebiotics, even if much more research is need to determine the effects on human health.

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