

# Definition and Health Benefits of Macrobiotic, Probiotic, Prebiotic, Microbiota, Psycobiotic and Pharmabiotic with Emphasis on Postbiotic: Overview

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## ABSTRACT

Macrobiotic diet is based on perfect balance of acid, alkaline, potassium, and sodium and is suggested to maintain good human health. Macrobiotics include cereals, vegetables, beans, sea vegetables, coffee, and herbal teas, yet it is reported as an unconventional fad diet. Probiotics include group of live safe lactic acid producing bacteria as *Bifidobacterium* spp. and *Lactobacillus* spp. Prebiotics are high fiber substances used by probiotics to improve and balance the gut microbiota, by synbiotic-symbiotic effect. Psycobiotics are probiotics that have effects on the gut-brain axis. Eubiotic (eubiosis) is good balanced state of microbiota. Dysbiotic (dysbiosis) is an imbalanced state which may cause diseases, due to the decrease of beneficial bacteria, and increase of pathogens. Postbiotics are produced through probiotic fermentation or after cells lysis. Postbiotics are metabolites as enzymes, proteins, peptides, fatty acids, organic acids, polysaccharides, peptidoglycan, other bioactive compounds, and fragments of cell wall, of health benefits without live microorganisms. Postbiotics are considered as the new horizons of microbial functional bioactive compounds in food preservation industry and food safety. Pharmabiotics are bacterial cells of human gut origin, or their products, with a proven pharmacological role in health or disease.

**Keywords:** definition, benefits, macrobiotic, probiotic, prebiotic, postbiotic, pharmabiotic.

## INTRODUCTION

**Macrobiotics:** The Macrobiotic diet or macrobiotic is linked with diet and health, where macro means great and bios related to life. A book entitled *Macrobiotics: "The Art of Prolonging Human Life"*, was published in 1796, according to Simon (2005). It was recommended that the perfect balance of acid, alkaline, potassium, and sodium in macrobiotic as an unconventional diet resulted in and maintained good human health. Lerman (2010) discussed the relation of macrobiotics with some chronic human diseases. Yet, there is no clear confirmed evidence that macrobiotics help in cancer and some other diseases. Both of the American Cancer Society and Cancer Research UK do not recommend strict macrobiotics, as malnutrition and death have been reported (Bijlefeld & Zoumbaris, 2014). Macrobiotic diet is unconventional diet, based on Zen Buddhism & Yin and Yang philosophy concerned with food elements, cookware materials, reducing animal products, moderate eating locally grown natural foods in season. Cooking utensils used with macrobiotic diet should be made

of wood or glass, while plastic, copper, non-stick coatings and electric ovens should not be used. Bijlefeld & Zoumbaris (2014) reported macrobiotics in their publication about diet fads. That in spite of that the macrobiotics include cereals as brown rice, vegetables, beans and sea vegetables in proportions of 50 -60, 20 -30, and 5-10 %, respectively. Some other food items as nuts, some seeds, cereals, white fish, may be eaten, as well as beverages of herbal teas, coffee, and roasted barely.

**New terminology and definitions :** Recently in the present decades functional foods have great concern by both of the producers and the consumers of food and food products. The health benefits of functional foods are covered by many investigators (Bender, 2014 & Chaluvadi *et. al.* 2015). The health impacts of probiotics, prebiotics, and postbiotics were covered, indicating that postbiotics are now considered as the new horizons of microbial functional bioactive compounds in food preservation industry and food safety (Bishwambhar *et. al.*, 2024).

**Probiotics:** Probiotics includes group of live safe GRAS microorganisms of *Bifidobacterium* spp. and *Lactobacillus* spp., that have beneficial health effect, when they are provided at an enough concentration. Charbonneau *et. al.* (2013) investigated the health benefits of encapsulated probiotic Bifidobacterium after two months of oral supplementation. Ashraf & Shah (2014) indicated that the probiotics stimulate the immune system. Bacteria play significant roles in food spoilage, decomposition, infection, and intoxication. On the other hand probiotics and their metabolites are useful bioactive components, which can suppress some of the harmful microorganisms resulted in some benefits., according to Singh *et. al.* (2019). The role of probiotics as food and dietary supplements was covered by Binda *et. al.* (2020).

Probiotics shows healthy effects on the host as production of vitamin B, stimulating immunity, reduce cholesterol level, and have antibacterial activity. On the other hand probiotics have some slight adverse effects on the metabolic and bacterial virulence of the host Bishwambhar *et. al.* (2024).

**Psychobiotics:** The probiotics which show benefits on the mental health of the host, when ingested in a proper quantity with an interaction with the gut bacteria, are known as psychobiotics. The psychobiotic potential of gut- brain axis has not yet completely investigated. Generally, it was reported that psychobiotics showed an effect on neurotransmitters production, enhancing signals, reducing inflammation, improving mental health, and alleviating symptoms of neurological disorders, This highlights their potential as a therapeutic tool for maintaining a healthy gut-brain connection, as an important subject which is under present and future investigations (Sylvie *et. al.*, 2024 & Wall *et. al.*, 2014).

**Prebiotics:** Prebiotics are high fiber organic substances used by the present living probiotic microorganisms of human microflora. Prebiotics are used to improve the gut microbial balance. Good health is associated with balanced gut microbiome. According to Hutkins (2016), almonds, cashews, chicory roots, leeks, Jerusalem artichokes, legumes. asparagus, onions, garlic, barely, oats, flax seeds seaweeds, bananas, apples and vegetables are of the good sources of prebiotics. Prebiotics can improve both of digestion, metabolism, and bowel movement. Binda *et. al.* (2020) defined prebiotic as the substrate used

by beneficial bacteria, with improved microbiota, resulted in good health, Prebiotics increase bone density, by the improvement of calcium absorption. Prebiotics have numerous health benefits as they regulate the level of blood sugar, lower body inflammation, help in suppressing appetite, support the immune system, reduce the risk of colon cancer, and showed many other health impacts, as indicated and recommended by Brown University Health Team (2022).

**Synbiotics and Symbiotics:** The mixes of probiotics and prebiotics (synbiotics) have frequent synergistic activity to the beneficial bacteria in the gut, Roberfroid (1998). Synbiotics modify and enhance the microbial metabolites, resulting in good health impacts, targeting gut microbiota. Li *et. al.* (2021). On the other hand, the food supplements and ingredients compining the probiotics and prebiotics compining as symbiotics are important mixes which play a very important role in reducing and preventing many diseases of humans and animals, according to Supriya &, Suneela (2023).

**Microbiota and microbiome:** The microbiota (mico flora of the gut) represents and consists of millions but trillions varieties of microorganisms, as bacteria, fungi, viruses, and others that are present in an environment. The gut microbiota represents the microorganisms present in the human gut in a symbiotic live, Chaluvadi *et. al.* (2015). The human micobiota could exide one thousand of different species, in different parts of the body. On the other hand the microbiome is the environment where the microbiota live in. The balanced gut microbiota has many beneficial health effects as protection against harmful pathogens, controlling immunity, with many other health impacts (Hou, 2022 & Cynthia, 2023).

**Eubiotic and dysbiotic:** Euobiotic state ( eubiosis) is a good state, due to balanced microbiota, Clemente *et. al.* (2012), while the dysbiotic is an imbalanced state which may cause diseases. Dysbiotic according to Arianna *et. al.* (2016) is the condition indicating imbalanced bacterial composition, known as dysbiosis. That is accompanied with changed metabolite or different bacterial distribution in the gut. Accordingly, dysbiosis may result in decrease in the count of beneficial bacteria, with an increase of pathogens, and loss of diversity of present bacteria.

**Pharmabiotics:** Pharmabiotics are bacterial

cells of human origin, or their products, with a proven pharmacological role in health or disease. Shanahan & Collins (2010) & Chaluvadi *et. al.* (2015) stated that the fact of pharmabiotic effects on the microbiota in gastrointestinal disorders, is now a reality. Thi Thanh *et. al.* (2017) reported that the application of pharmabiotics is a recent approach in the treatment for metabolic syndrome and diseases. Many medical investigations were carried out in the area of microbiota and gastrointestinal disorders (Fanny & Eamonn, 2019). Individual microbiomes show different respond to the postbiotics present in their environment. This accelerates the investigation for paving tailored dietary supplements. According to Wiktionary (2024) pharmabiotic (s) covered any material that shows health benefit from host microbe dietary interaction in the gut.

**Postbiotics definition:** Postbiotics are unviable components which are produced through probiotic fermentation activity or after cells lysis. Collado *et. al.* (2019) reported some facts about postbiotics definition and benefits. Postbiotics components are metabolites as enzymes, proteins, peptides, lipids, fatty acids, organic acids, polysaccharides, peptidoglycan, other bioactive compounds, and fragments of cell wall, without live microorganisms, indicating no risk. Postbiotics can be classified according to various factors as the present bacteria of the microbiota, intracellular or extracellular compounds, chemical structure, and their functional effects. The preparation, chemical components, and safety use of postbiotics were covered by Moradi *et. al.* (2019), (2020) & (2021).

**Postbiotics food sources:** Investigations are concerned recently with forming postbiotic components in food, Wegh *et. al.* (2019) & Fiore *et. al.* (2020). Postbiotics can be found in yogurt, Kefir, tempeh, miso, kimchi, pickles, sauerkraut, buttermilk, soft cheese, sourdough bread, and some fermented foods or as dietary supplements, where they play an important role in supporting certain health aspects and well-being (Ahnann-Winaro *et. al.*, 2021, Bourebaba *et. al.*, 2022, Vinderola *et. al.*, 2022, Sangiliyandi *et. al.*, 2023).

**Postbiotics application in foods:** Biofilm is a complex matrix of carbohydrates or protein containing different microorganisms as bacteria and fungi of one or many types, that differ in their rate of growth and activity resistance to antibacterial and antifungal agents. Urish *et. al.* (2016) indicated that postbiotics can play an important role

for the removal of biofilms in food industry and biopreservation of foods. Probiotics and postbiotics found their promising applications in edible films, coatings and active food packaging for functional purposes, Pavli *et. al.* (2018). Biobiotics can play important roles in the biopreservation of foods. Silva *et. al.* (2018) & Motaleb *et. al.* (2020) applied bacteriocins and probiotics for bio-preservation of some dairy products, due to many economic and safety aspects. Moradi *et. al.* (2020), Aguilar-Toalá *et. al.* (2018) & (2021) reported that postbiotic is a novel term which showed a functional effect in the foods safety. Postbiotics are available at economic costs, and have safe effective effect with broad spectrum activity when used at low concentrations. Abdulhussain & Razavi (2020) found that antimicrobial peptide can be used as a bacteriocin in food preservation. Postbiotics can resist temperature and pH, without affecting the chemical, physical, and sensory quality of foods. Chang *et. al.* (2021) investigated the antioxidant and inhibitory effects of postbiotic components produced by *Lactiplantibacillus plantarum* used as a probiotic. The food industry and consumers generally focus on the use of natural preservatives to enhance both of the quality and the shelf life of fresh and processed food and food products. Recently artificial additives can be replaced by natural antimicrobial agents. Now the postbiotic substances of several lactic acid producing bacteria are in use.

**Postbiotics health benefits:** Chaluvadi *et. al.* (2015) and Wegh *et. al.* (2019) recommended that postbiotics reduce allergic reactions and can be effective nutrition agent in early life and over that. Postbiotics play many important metabolic and health effects. Balaguer *et. al.* (2022) investigated a novel postbiotic that is effective in reducing fat deposition. Dini and Mancusi (2023) indicated that postbiotics supplements can add a weight loss effect. Postbiotics are more stable dietary supplements as compared with either probiotics or prebiotics and they have some applications in food biopreservation and food safety. Postbiotics contain bacteriocins, effective organic acids, and some other antibacterial substances, which have bioactive effects in reducing the biofilm which can be developed on foods. They also have a role in influencing the immune response, proper blood sugar level, reducing inflammation, aid in management of weight, and result in balance of good gut micro-biome and gut health. The intestinal barrier function is improved

decreasing the permeability of the harmful components. Sangiliyandi *et. al.* (2023) reported postbiotics and their food sources as therapeutic agents. Postbiotics can help in health impacts due to their functions in supporting immunity, lowering blood sugar, having antimicrobial effect, treating diarrhea, helping in case of eczema, suppressing appetite, and improving metabolic disorders. Postbiotics content include antibacterial substances as peptides, organic acids, bacteriocins, vitamins, and hydrogen peroxide, Dini and Mancusi (2023). Park *et. al.* (2023) reported that postbiotics play a role against obesity. The clinical applications of postbiotics, as promising evolving fields, are reviewed by Anand *et. al.* (2024). Postbiotics can have a promising application in feeding animals when used under proper controlled conditions. Tao *et. al.* (2024) investigated the potential effect of using postbiotics as a promising feed additive.

**Postbiotics preparation:** Generally, postbiotics components are heterogeneous. Postbiotics are stable to a wide temperature range. Postbiotics have health importance in food supplementation and some pharmacological preparations, Wegh *et. al.* (2019). Some suggested methods were investigated to be applied with the aim of producing homogenized postbiotics preparation for further controlled applications. Mechanical or chemical methods can achieve that goal. The bacterial cells can be lysed by various methods including heating, extracting, using sonication, and enzymes, Fiore *et. al.* (2020). The best suitable method for producing postbiotics is chosen according to the yield, required components, and safety. Postbiotics biomolecules have a promising impact in health and food safety, Rad *et. al.* (2021). Accordingly, combining postbiotics with probiotics and prebiotics in active formulations represents promising health benefits. Mehran *et. al.* (2021) indicated that the chemical components of postbiotics are markedly differed according to many effective factors, mainly the used lactic acid bacteria, and the cultural conditions. Standard biochemical assays should be developed. That is to ensure safety and consistency of postbiotic preparations for further use in functional foods and dietary supplement preparations.

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## التعريف والمزايا الصحية لوجبات الميكروبيوتيك، البكتيريا الحية، مكونات النمو، الفلورا المعوية، البكتيريا الحية المؤثرة على المخ، التأثيرات الدوائية، مع التركيز على مخلفات نمو وتحلل البكتيريا الحية؛ تغطية موجزة

عصمت صابر الزلاقي

قسم علوم وتقنية الأغذية كلية الزراعة (الشاطبي) جامعة الإسكندرية

وجبات الميكروبيوتيك تعتمد على توازن مقنن من الحموضة، القلوية، البوتاسيوم، الصوديوم بهدف التمتع بصحة جيدة. تتضمن الوجبات الغلال، الخضراوات، الفول، نباتات بحرية، القهوة، شاي الأعشاب. رغم ذلك تعتبر تلك الوجبات غير تقليدية وغير مفيدة. البكتيريا الحية المفيدة تشمل بكتيريا حية آمنة منتجة لحمض اللاكتيك مثل *Lactobacillus spp.* & *Bifidobacterium spp.* و التي يلزم لنموها المواد الغنية بالألياف. هذا يتحقق التوازن المنشود وتحسن الفلورا المعوية بالتعايش التكافلي. البكتيريا الحية التي مجال نشاطها يربط بين المخ والنظام المعوي يطلق عليها مسمى *Psychobiotics*. التوازن الميكروبي الجيد بين البكتيريا المفيدة *Eubiotic* والبكتيريا الضارة *Dysbiotic* ينتج عنه صحة جيدة، بينما عدم التوازن قد يؤدي الى حدوث أمراض، نظرا لنقص عد البكتيريا المفيدة مع زيادة البكتيريا الممرضة. تتضمن نواتج التخمر بالبكتيريا الحية المفيدة إنزيمات، بروتينات، ببتيدات، أحماض دهنية، أحماض عضوية، سكريات عديدة طويلة السلسلة، ببتيدات الجليكان، مكونات حيوية أخرى، مع جدر الخلايا البكتيرية ومكونات موت وتحلل الخلايا ويطلق عليها *Postbiotics*. تلك النواتج الحيوية الآمنة الخالية من الخلايا الحية تشق طريقها الآن للتطبيق في صناعة حفظ الأغذية وفي سلامة الأغذية لخلوها من الخلايا الحية مع مالها من مزايا صحية مع بعض التطبيقات العلاجية الحيوية *Pharmabiotics*.

