REVIEW: TRENDS IN FERMENTATION TECHNOLOGY: A NUTRACEUTICAL APPROACH

Abstract

The role of fermentation technology in our lives has been established since the age of the Egyptians around 5000 BC. Fermentation technology involves harvesting the potential of microorganisms in the form of mass production of chemicals, enzymes, proteins, drugs, and biofuels using the right conditions and a specific strain of culture to obtain the desired results. With further improvements in this area, humans were able to use much of this technology to their advantage; there is still a large chunk left to explore that can improve human civilization manifold in terms of health. Continuous efforts and advancements in this field can determine the futuristic trends in biotechnology, which is a broad domain where this huge potential of technology lies. Any substance that provides therapeutic or health benefits in the prevention and treatment of disease is known as a nutraceutical. Its components either have known therapeutic activity or contribute substantially to the drug's therapeutic activity. [4] The review discusses genetically modified microorganisms as potential factories to produce desired by-products. Future trends in the nutraceutical industry have also been discussed.

Keywords: Nutraceuticals, probiotics, prebiotics, synbiotics, awareness, dietary supplements, functional foods

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I. INTRODUCTION

"Let food be thy medicine and medicine be thy food", the famous quote by Hippocrates, shows the importance of herbal products in our lives right from 400 BC. India has been the center of Ayurveda and its use has been practiced for ages. This has been observed in many other civilizations as well. The growing global population, its demands for food, and the need for proper nutrition and health awareness have led to a conscious shift in improving the quality of food production involving better technology and new trends. People are turning to probiotics, prebiotics, and Synbiotics [1] to ensure better food quality and shelf life, which translates into better health and becoming more resistant to disease or better immunity. The recent COVID pandemic has made people more health conscious. As a result, research and development with regard to nutraceuticals and their mass production has gained importance. Popular probiotics in India include Yakult, which also happens to be a nutraceutical.[5]

II. PROBIOTICS

Probiotics are live, non-pathogenic bacteria used to improve gut health through external supplementation of bacteria in suspension or in capsule form. [12] Probiotics are known to enhance health. They boost immunity and defend against both infectious and non-infectious illnesses. Probiotic traits include colonization, pathogen elimination, and host cell activation. Additionally, fiber-rich prebiotics, alter immunity and intestinal flora to improve health. [7]

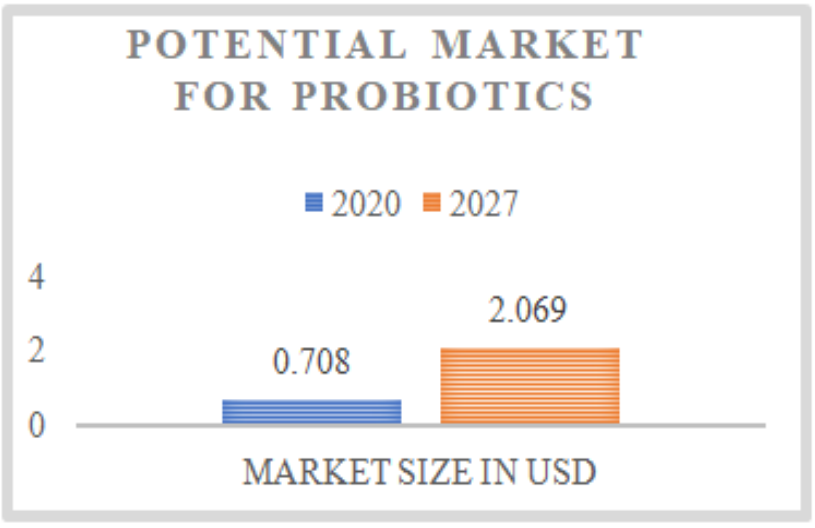

Figure 1: Potential market of Probiotics in India [11]

III. MICROORGANISMS AS PROBIOTICS

Lactobacillus, Bifidobacterium, Escherichia, Enterococcus, Bacillus, Streptococcus, and yeast like Saccharomyces are commonly used as probiotics. According to studies, probiotics are helpful for treating a variety of clinical conditions, including infantile diarrhea,

necrotizing enterocolitis, antibiotic-associated diarrhea, relapsing Clostridium colitis, Helicobacter pylori infections, inflammatory bowel disease, cancer, female urogenital infections, and surgical infections. By raising the amount of IgA in the intestinal mucosa, *Lactobacillus rhamnosus* strain GG strengthens intestinal immunity. Additionally, it promotes interferons' local release. [8]

IV. PREBIOTICS

Prebiotics are non-digestible, fiber-rich foods that have a positive impact on the host by selectively promoting the activity of one or more bacteria in the colon to enhance host health. (Roberfroid and Gibson 1995).

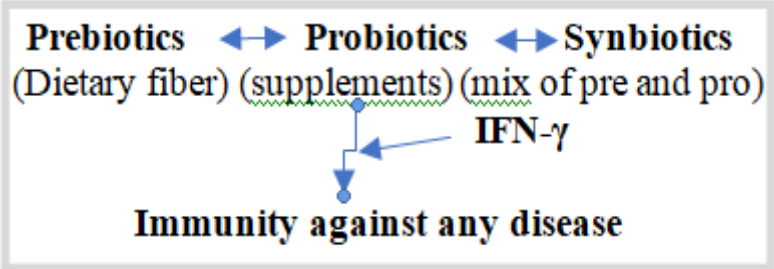

Figure 2: Flowchart of the potential role of pre, pro, and synbiotic molecules in immune modulation

V. SYNBIOTICS

They are a mix of fibre-rich foods and gut-friendly microflora or probiotics as seen in the flowchart. Figure 2.

VI. SPIRULINA

Spirulina, a microalga, is a great nutritional supplement for the brain. Numerous animal studies have demonstrated the role of spirulina in improving neural health by focusing on antioxidant, anti-inflammatory, and neuroprotective functions. According to certain studies, spirulina may assist in alleviating cerebrovascular diseases by reducing mental tiredness, preventing damage to brain vessels, and regulating internal pressure. Spirulina appears to improve brain functions in malnourished children, pointing to a potential developmental role as a supplement. [6]

Many enterprises are utilizing the spirulina microalgae's potential as a "superfood," growing it on a huge scale and purifying it to create spirulina pills. [10]

VII. NUTRACEUTICALS

The concentrated forms of nutraceuticals are sold as tablets, capsules, and powders, either alone or in combination form. Nutraceuticals lower the risk of cancer and heart disease as well as prevent or treat other conditions such as high blood pressure, high cholesterol,

obesity, osteoporosis, diabetes, cataracts, menopausal symptoms, insomnia, memory and concentration problems, digestive upsets, and constipation. Supplements often contain nutraceuticals including silymarin, curcumin, vitamin E, docosahexaenoic acid, choline, and phosphatidylcholine. Numerous nutritional supplements, including gallic acid, caffeine, curcumin, and others, have antioxidant and anti-aging properties. Omega-3 fish oils high in PUFA1 lower the risk of coronary heart disease and improve mental performance. Ingredients in nutraceuticals, like pomegranate, curcumin, and epigallocatechin gallate, treat a variety of cancers, such as breast cancer, prostate cancer, and other types of cancer. Nutraceutical products provide growth opportunities for the agri-food industry, both domestically and internationally. The potential market is the aging population, rising healthcare costs, advances in food technology and nutrition, as well as a growing consumer understanding of the link between diet and health. [4]

VIII. TYPES OF NUTRACEUTICALS [4]

1. Based on Product Categories

- Functional foods e.g., Omega-3, probiotic yoghurt
- Functional beverages e.g., energy drinks, soy beverages
- Dietary supplements e.g., vitamins, minerals

2. Based on Types

- Traditional pro and prebiotics
- Non-traditional fortified and recombinant varieties

Table 1: Nutraceutical manufacturers in India

Number	Company Names
1	Dabur India
2	GlaxoSmithKline
3	Consumer Healthcare
4	Cadila Healthcare
5	Zandu Pharmaceuticals
6	EID Parrys
7	Amway
8	Himalaya Herbal Healthcare
9	Baidyanath
10	Patanjali
11	Herbalife
12	Sami Labs
13	Ranbaxy
14	Elder Pharmaceuticals

IX. DISADVANTAGES OF NUTRACEUTICALS

The possibility of probiotics infecting the host due to their viable nature needs to be studied further, especially in immunocompromised patients. It is extremely important to understand and balance the beneficial aspect of probiotic bacteria with the likelihood of sepsis caused by different pathological bacteria and the morbidity factor of diseases for which probiotic bacteria are now being employed as therapeutic agents.

X. FUTURE OF NUTRITION THERAPY

It is extremely important to screen and establish strains of genetically modified microorganisms. Further research is needed to improve the targeted distribution of synbiotics to the stomach.

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