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Historical Perspective of Probiotics and Role of Regulating Bodies Globally

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Abstract

Gut microbiota stimulates benefits on the health of the host and helps to prevent the diseases. Probiotics are described as "live microbes which when administered in sufficient amounts provides host with the benefit on the health." Louis Pasteur at the start of nineteen hundreds identified the microbes accountable for the fermentation process, while E. Metchnikoff related improved longevity of Bulgarian rural inhabitants by daily intake of fermented dairy products like yogurt. *Lactobacillus* are considered as probiotics by Metchnikoff as they have positive health benefits on the health of consumers. Importance in the Probiotics field has increased because of developing probiotic industry. The availability of Probiotics in medicine and food products is already present in the international markets and because of this regulatory bodies play an important role across the globe. This article will discuss the history of Probiotics, different categories of probiotics used and global regulatory bodies.

Keywords: Human-Gut; Probiotics; Probiotic Categories; Generally Recognized as Safe; Regulatory Controls

Introduction

The usages of probiotic bounce back to the earlier era before the discovery of microorganisms. The yeast and bacteria which are accountable for the process of fermentation were first identified by Louis Pasteur, but he was not able to prove any apparent connection of these microbes with health benefits [1].

Scientifically, the foundation for using live microorganism for treating and preventing the infections arose in the start of the twentieth century in 1907, with the hypothesis of Elie Metchnikoff; scientist, previously worked with Louis Pasteur in the year 1860s. His hypothesis states that by lessening or exchanging the amount of putrefactive bacteria residing in human gut with lactic acid bacteria can extend lifespan and stabilize bowel health. By the end of 20th century, the terminology probiotic was originated to reveal the concept of Metchnikoff.

Elie Metchnikoff is considered as the grandfather of probiotics. According to him when lactic acid bacteria are consistently consumed in fermented dairy products, it enhanced the longevity and health in Bulgarian populations. The reason was not only the use of

fermented products but the lactobacilli that were used in the fermentation of dairy product such as yogurt and the existence of them as gut flora [2].

The advantages of lactic acid bacteria on health were scientifically justified in Metchnikoff's book "The prolongation of life" which was printed in the year 1907. He stated that the toxic materials produced by some bacterial species in the large intestine leads to disease and aging. Additionally, he proposed that, microbes in intestine depends on the food that we intake, they take actions for the modification of intestinal flora in human body and swap the harmful microorganism into the beneficial ones. For the assessment of his hypothesis and the advantages of lactic acid bacteria on human health, Metchnikoff used to drink sour milk daily until he died in 1916 at the age of 71 years.

In 1906, Henry Tissier, A French pediatrician, who worked individually, witnessed that there was low amount of Y shape bacteria in the feces of children having diarrhea. On the other hand, "bifid" bacteria were rich in children who were healthy so he proposed that, bifid bacteria might be consumed by diarrheal patients to aid in maintaining a healthy gut flora.

In 1917, Alfred Nissle, A German scientist and physician, was fascinated by the benefits and uses of probiotics. The outbreak of shigellosis (severe diarrhea caused by the bacteria shigella), Nissle found a novel genetic variant of E.coli from the stool of the soldier during World-War I, he was affected with shigella but didn't had diarrhea. Nissle isolated that novel strain and used it to treat intestinal infections, like salmonella and shigella in the era where there were no antibiotics. Nissle gave name the novel strain as, "*Eschericia coli* Nissle 1917" [3].

Discovery of Probiotics opened up a new area of research that is involved in finding of health supporting microorganisms and their part in prevention of disease. In 1922, Lactobacillus acidophilus was used in one of the initial human studies, thirty patients with diarrhea, chronic constipation and eczema noticed improvements for all three disease conditions. After a decade, in 1932, the positive effect of *Lactobacillus acidophilus* in persons with mental disease and constipation was confirmed by a study [4].

The word 'Probiotics' was used 1st time in 1965 by Lilly and Stillwell, in a framework to represent them as 'substances which are released by one microorganism which helps in the growth of another microorganism'. Nine years later, Parker defined probiotics as "The organisms that are used to balance the intestinal micro flora". After Fifteen years, Fuller suggested that probiotics are 'live microorganisms which affects positively to the host by improving the balance of microorganisms. Furthermore, Salminen et al., defined the term probiotic as 'Live bacteria present in the food which provides benefit to health'.

According to further advances in probiotic research, World Health Organization and United Nations Food and Agriculture Organization (WHO/FAO) in 2001 accepted a consent definition of probiotics as "live microorganisms which when administered in adequate amounts confer a health benefit on the host" [5].

Timeline of Probiotics

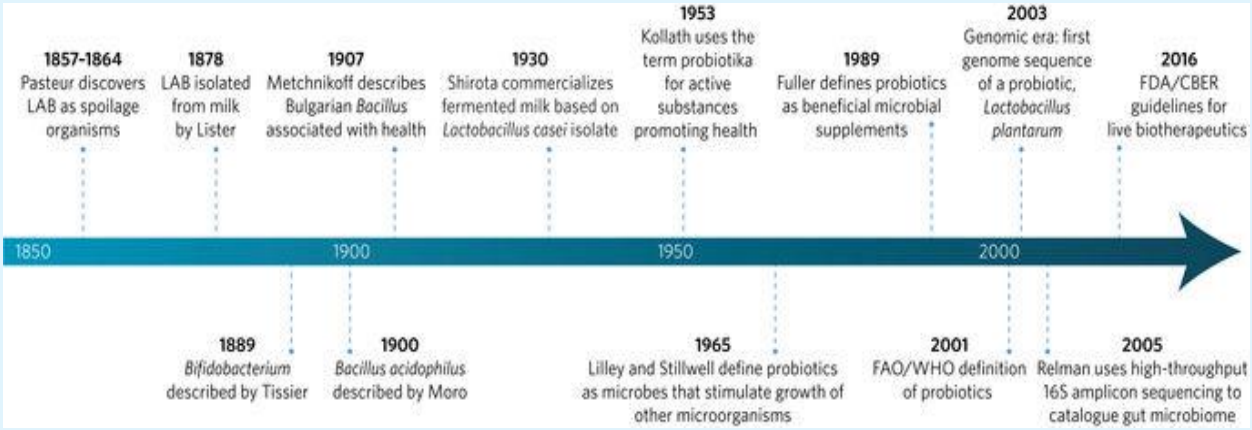

Figure 1: Timeline of Probiotics [6].

Taxonomy of Probiotic Microorganism

Lactobacillus and *Bifidobacterium* are the two most significant genera in the field of probiotics. Some other genera include *enterococcus, pediococcus* and *lactococcus. Saccharomyces, Streptococcus, Bacillus* and *Escherichia coli* also contain the interesting species that can be used as probiotics. Member of genus *Lactobacillus, Lactococcus*, and *Leuconostoc* (less commonly) that are being used as Probiotics, are called Firmicutes and are designated as lactic acid bacteria (LAB) collectively. Other probiotic microorganisms that are in use belong to the genus *Bifidobacterium*, falls in the phylum Actinobacteria. These genera entirely comprise the species that do not cause illness upon colonizationin the intestine, although exceptions do exists example includes, *Bifidobacterium dentium* that cause dental illness, otherwise they are generally the oral normal flora [7].

Lactic Acid Bacteria (LAB) are the group of microbes containing Gram positive, catalase negative Strains, and upon carbohydrate fermentation, lactic acid is produced as a main metabolic end product. Among LAB's, the genus *Lactobacillus* include a great number of GRAS (Generally Recognized as Safe) species, they are used as probiotics in food microbiology and human nutrition. According to taxonomic view, the genus Lactobacillus comprises of over 152 valid species. It includes in the family Lactobacillaceae along with its phylogenetically intermixed genus, Pediococcus [8].

List of Probiotic Microorganism Being Used in the Present Era

Lactic Acid Bacteria

Lactobacillus	***Lactococcus***	***Enterococcus***	***Leuconostoc***	***Pediococcus***
L. acidophilus	*Lactococcus lactis subsp. Lactis*	*Enterococcus faecium*	*Le. citreum*	*Pd. acidilactici*
L. casei/paracasei		*Enterococcus durans*	*Le. mesenteroides subsp. cremoris*	*Pd. pentosaceus*
L. gallinarum				
L. plantarum				
L. crispatus				
L. gasseri				
L. reuteri				
L. fermentum				
L. johnsonii				
L. rhamnosus				
L. salivarius				
L. sakei				

Table 1: Lactic Acid Bacteria.

Other Species

Bifidobacterium	***Saccharomyces***	***Streptococcus***	***Bacillus***	***Escherichia***	***Propionibacterium***
B. infantis	*Saccharomyces cerevisiae*	*Streptococcus thermophilus*	*B. subtilis*	*Escherichia coli Nissle 1917 (EcN).*	*Pr. acidipropionici*
B. adolescentis	*Saccharomyces bayanus*		*B. coagulans*		*Pr. freudenreichii subsp. shermanii*
B.animalis subsp lactis.	*Saccharomyces boulardii*		*B. cereus.*		*Pr. jensenii*
B.animalis subsp animalis			*B. clausii*		
B. bifidum			*B.pumilus*		
B. longum					
B. breve					

Table 2: List of the Probiotics used in current era [9,10].

Whole Genome Sequences of Probiotics for Human Applications

Strain	NCBI Ref Seq Number	GenBank Accession Number
B. Animalis subsp. Lactis AD011	NC_011835.1	CP001213.1
B. Animalis subsp. Lactis B420	NC_017866.1	CP003497.1
B. Adolescentis ATCC 15703	NC_008618.1	AP009256.1
B. Animalis subsp. Lactis BB-12e)		CP001853
B. Animalis subsp. Lactis BLC1	NC_017216.1	CP003039.1
B. Animalis subsp. Lactis DSM 10140	NC_012815.1	CP001606.1
B. Animalis subsp. Lactis CNCM I-2494	NC_017215.1	CP002915.1
B. Animalis subsp. Lactis B1-04	NC_012814.1	CP001515.1
B. Animalis subsp. Lactis Bi-07	NC_017867.1	CP003498.1
B. Animalis subsp. Lactis V9		CP001892
B. Bifidum BGN4	NC_017999.1	CP001361.1
B. Bifidum PRL2010	NC_014638.1	CP001840.1
B. Bifidum S17	NC_014616.1	CP002220.1
B. Breve ACS-071-V-Sch8b	NC_017218.1	CP002743.1
B. Breve UCC2003		CP000303.1
B. Longum NCC2705	NC_004307.2	AE014295.3
B. Longum DJO10A	NC_010816.1	CP000605.1
B. Longum subsp. Infantis 157F	NC_015052.1	AP010890.1
B. Longum subsp. Infantis ATCC 15697	NC_011593.1	CP001095.1
B. Longum subsp. Longum JCM 1217	NC_015067.1	AP010888.1
B. Longum subsp. Longum BBMN68	NC_014656.1	CP002286.1
B. Longum subsp. Longum F8		FP929034
B. Longum subsp. Longum JDM301	NC_014169.1	CP002010.1
B. Longum subsp. Longum KACC 91563	NC_017221.1	CP002794.1
L. acidophilus 30SC	NC_015214.1	CP002559.1
L. acidophilus NCFM	NC_006814.3	CP000033.3
L. amylovorus GRL 1112		CP002338
L. amylovorus GRL1118	NC_017470.1	CP002609.1
L. casei ATCC 334	NC_008526.1	CP000423.1
L. casei BL23	NC_010999.1	FM177140.1
L. casei BD-II	NC_017474.1	CP002618.1
L. casei LC2W	NC_017473.1	CP002616.1
L. casei str. Zhang	NC_014334.1	CP001084.1
L. crispatus ST1	NC_014106.1	FN692037.1
L. delbrueckii subsp. Bulgaricus ATCC 11842	NC_008054.1	CR954253.1
L. delbrueckii subsp. Bulgaricus ND02	NC_014727.1	CP002341.1
L.delbrueckii subsp. Bulgaricus 2038	NC_017469.1	CP000156.1
L. delbrueckii subsp.Bulgaricus ATCC BAA-365	NC_008529.1	CP000412.1
L. fermentum IFO 3956	NC_010610.1	AP008937.1
L. fermentum CECT 5716		CP002033
L. gasseri ATCC 33323	NC_008530.1	CP000413.1
L. johnsonii DPC 6026	NC_017477.1	CP002464.1
L. johnsonii FI9785	NC_013504.1	FN298497.1
L. johnsonii NCC 533	NC_005362.1	AE017198.1
L. plantarum JDM1	NC_012984.1	CP001617.1
L. plantarum WCFS1	NC_004567.1	AL935263.1

L. plantarum subsp. Plantarum ST-III	NC_014554.1	CP002222.1
L. rhamnosus ATCC 8530	NC_017491.1	CP003094.1
L. rhamnosus GGe)	NC_013198.1	FM179322.1
L. rhamnosus Lc 705	NC_013199.1	FM179323.1
L. rhamnosus GGe)		AP011548
L. reuteri DSM 20016	NC_009513.1	CP000705.1
L. reuteri JCM 1112	NC_010609.1	AP007281.1
L. reuteri SD2112	NC_015697.1	CP002844.1
L. salivarius CECT 5713		CP002034
L. salivarius UCC118	NC_007929.1	CP000233.1
L. Lactis subsp. Cremoris SK11	NC_008527.1	CP000425.1
L. Lactis subsp. Cremoris MG1363	NC_009004.1	AM406671.1
L. Lactis subsp. Cremoris A76	NC_017492.1	CP003132.1
L. Lactis subsp. Cremoris NZ9000		CP002094
L. Lactis subsp. Lactis CV56	NC_017486.1	CP002365.1
L. Lactis subsp. Lactis Il1403	NC_002662.1	AE005176.1
L. Lactis subsp. Lactis KF147	NC_013656.1	CP001834.1
L. Citreum KM20	NC_010471.1	DQ489736.1
L.Mesenteroides subsp.Mesenteroides ATCC 8293	NC_008531.1	CP000414.1
L.Mesenteroides subsp.Mesenteroides J18	NC_016805.1	CP003101.1
O. oeni PSU-1	NC_008528.1	CP000411.1
P. Pentosaceus ATCC 25745	NC_008525.1	CP000422.1
S. thermophiles LMD-9	NC_008532.1	CP000419.1
S. thermophiles JIM 8232	NC_017581.1	FR875178.1
S. thermophiles LMG 18311	NC_006448.1	CP000023.1
S. thermophiles MN-ZLW-002	NC_017927.1	CP003499.1
S. thermophiles CNRZ1066	NC_006449.1	CP000024.1
S. thermophiles ND03		CP002340

Table 3: List of whole genome sequences of Lactic Acid Bacteria and of Bifidobacterium species used as probiotics for human applications [9].

Role of Regulating Bodies for Approval of Novel Probiotic Strain

Probiotics are now considered as a commercial product because of its need and significance in global market and healthcare settings. As the demand of Probiotics is growing rapidly across the globe, they are grouped under diverse categories in the different countries. The probiotic category must be validated for commercial products in order to guarantee consumer assurance. Probiotics are traded under different categories in different countries. Table shows the categories and legal regulatory bodies across the globe for the products.

Category of Probiotics and Global Regulatory Bodies

Country	Category	Regulatory Body
Japan	Probiotics	FAO/WHO
	Functional food and neutraceuticals	MHLU, FOSHU
Europe	Functional food	FUFOSE
China	Functional food	SFDA
Brazil	Functional food	ANVISA
Newzealand and Australia	Functional food	FSANZ
USA	Dietary supplements	DSHEA

	Drugs	FDA
	Biological product	BLA
	Medical food	FDA
	Live Biotherapeutic agent	FDA
India	Functional food, drugs	FSSA, PFA, FDA
Canada	Natural health products	Natural Health Products Regulations
Malaysia	Functional food	FSQD, The Drug Control Authority, NPCB and Committee for the Classification of Food-Drug Interface Products

Table 4: FAO/WHO=Food and Agricultural Organization/World Health Organization, MHLW=Ministry of Health and Welfare, FOSHU=Food for Specified Health Use, FUFOSE=Functional Food Science in Europe, SFDA=State Food and Drug Administration, ANVISA=National Health Surveillance Agency Brazil, FSANZ=Food Standards Australia and New Zealand, DSHEA=Dietary Supplement Health and Education Act, BLA=Biologic License Application, PFA=Prevention of Food Adulteration Act, FSQD=Food Safety and Quality Division, NPCB=National Pharmaceutical Control Bureau [11].

Japan

Japan is considered as a leader of global market till date where the probiotics are present as both drugs and foods. Japan was the first global authority for applying a regulatory system in 1991 for neutraceuticals and functional foods. According to Japanese regulations, probiotic products lie in category of foods and Foods for Specific Health Uses (FOSHU). For the food products of probiotic, the approval from the Ministry of Health and Welfare (MHLW) must be obtained for the probiotic product to be counted in the category of FOSHU, which requires safety and confirmation of efficacy as a mandatory [12].

Europe

In 1995, Europe was the second for creating the functional food's definition and applying a regulatory instruction on functional food science in Europe (FUFOSE). European market for probiotic has been developed with rapid development as functional foods, the largest section of whose comprise of food products of probiotic, which includes dairy products, example; fermented milks and yogurts [13]. According to the laws in Europe, the culture of microbes exist in food also needs to fulfill the legal necessities. European food safety authority (EFSA) for the first time inducted Qualified presumption of safety (QPS) to make sure the premarket assessment of safety in food supplements and food. The registered drug finally covers under the Drug Law (65/65/EC, amended) [14,15].

China

China has a strong market for probiotics products which are used as the functional foods. They are built on traditional nutritional culture and have demanding performance along with prompt economic growth [16]. All health foods including all types of nutraceuticals and functional foods are presently monitored by State Food and Drug Administration (SFDA) in China.

Brazil

Brazil (Among American countries) is hypothetically the first country to ensure regulation regarding the safety of functional food. Probiotics are called functional foods in Brazil. The safety of food products is approved by registered health authority named as National Health Surveillance Agency Brazil (ANVISA) [17].

Australia and New Zealand

Food Standards Australia and New Zealand (FSANZ) is a joint regulatory agency of Australia and New Zealand for approval of probiotics as functional foods [18].

USA

Dietary Supplement Health and Education Act (DSHEA) and Food and Drug administration (FDA) are current regulatory bodies in USA. Food and Drug Administration (FDA) legalize the labeling, health claims, and safety of products of dietary supplement and food. The advertisement is regulated by Federal Trade Commission (FTC). FDA reviews and approves all the statements that relate the probiotic product to the diagnosis, cure, prevention, treatment, or mitigation of disease [19].

India

In India, at present the regulatory bodies for food and drugs are FDA and Prevention of Food Adulteration Act (PFA). Probiotics in India are used in pharmaceuticals and as food. Currently, probiotics are considered as functional food in India.

Malaysia

Probiotics are used as functional foods in Malaysia. The Drug Control Authority, Food Safety and Quality Division (FSQD), the Committee for the Classification of Food-Drug Interface Products and the National Pharmaceutical Control Bureau (NPCB) are the major regulatory bodies for food and drug regulation in Malaysia [20].

Canada

Canada contains a complex regulatory authority for industry of functional foods. Probiotics are categorized as natural health products in Canada. The packaging and approval of these products is regulated under Natural Health Products Regulations (NHPR) by Canadian Food and Drugs Act (CFDA) [21].

Conclusion

The products of Probiotic have been popularized and gained their significance in past fifty years. The novel strains of Probiotic are constantly reporting due to their novel benefits on human health, safety aspects of these strains must be addressed before their utilization by consumers. Today, the healthy utilization, design and selection of probiotics are a significant task for scientists, keeping the safety factors in concern. The importance of functional food and their significant impact on humans has been recognized worldwide by the leading countries. Each of the nations is involved in addressing the problems for functional foods, due to which different regulatory bodies are involved in different countries worldwide. Because of the separate regulations running in different countries, certain challenges and confusions arise for the food scientists, developers and consumers about the probiotic associated claims which needs to be looked up and resolved for the successful usage and marketing of functional foods. To determine the concerns related to Probiotics a mutual regulatory frame is required to address the global status of Probiotic. Common framework of regulations will be able to solve the problems, exchange information and products for the success of global Probiotic market. Harmony among the regulatory bodies must be taken in consideration for future success of Probiotics.

References

1. Barnett JA (2000) A history of research on yeasts 2: Louis Pasteur and his con- temporaries, 1850-1880. Yeast 16(8): 755-771.

2. Metchnikoff E, Chapter V (1908) Lactic acid as inhibiting intestinal putrefaction. In: The prolongation of life. Optimistic studies. New York, pp: 161-183.

3. Goldin BR, Gorbach SL (2008) Clinical indications for probiotics: an overview. Clinical Infectious Disase 46(Suppl 2): 5096-5100.

4. Lynne V, McFarland (2015) From Yaks to Yogurt: The History, Development, and Current Use of Probiotics 60(S2): S85-S90.

5. Anukam KC, Reid G (2007) Probiotics: 100 years (1907-2007) after ElieMetchnikoff"s Observation.

6. O'Toole PW, Marchesi JR, Hill C (2017) Next-generation probiotics: the spectrum from probiotics to live biotherapeutics. Nat Microbiol 2: 17057.

7. Lukjancenko O, Ussery DW, Wassenaar TM (2012) Comparative Genomics of Bifidobacterium, Lactobacillus and Related Probiotic Genera 63(3): 651-673.

8. Salvetti E, Torriani S, Giovanna E, Felis GE (2012) The Genus Lactobacillus: A Taxonomic Update. New York 4(4): 217-226.

9. Huys G, Botteldoorn N, Delvigne F, Vuyst LD, Heyndrickx M, et al. (2013) Microbial characterization of probiotics-Advisory report of the Working Group "8651 Probiotics" of the Belgian Superior Health Council (SHC). Mol Nutr Food Res 57(8): 1479-1504.

10. Sabina Fijan (2014) Microorganisms with Claimed Probiotic Properties: An Overview of Recent Literature. Int J Environ Res Public Health 11(5): 4745-4767.

11. M Arora, A Baldi (2015) Regulatory categories of probiotics across the globe: A review representing existing and recommended categorization. Indian Journal of Medical Microbiology 33(1): 2-10.

12. Amagase H (2008) Current marketplace for probiotics: A Japanese perspective. Clin Infect Dis 46: S73-s75.

13. Stanton C, Gardiner G, Meehan H, Collins K, Fitzgerald G, et al. (2001) Market potential for probiotics. Am J ClinNutr 73(Suppl): 476-483S.

14. Coppens P, da Silva MF, Pettman S (2006) European regulations on nutraceuticals, dietary supplements and functional foods: A framework based on safety. Toxicology 221(1): 59-74.

15. Hilliam M (1998) Functional foods in Europe. World Ingred 7: 40-45.

16. Patel D, Dufour Y, Domigan N (2008) Functional food and nutraceutical registration process in japan and china: A diffusion of innovation perspective. J Pharm PharmSci 11(4): 1-11.

17. Danielle Freitas (2008) Nutraceuticals in Latin America: Brazil and Beyond at Latin America: Nutraceutical Boom or Bust.

18. FSANZ (2018) Food Standards Australia New Zealand. Health and related claims.

19. Jon A Vanderho (2008) Clinical Infectious Diseases 46(2): S67-S72.

20. Stanton, Emms, Sia (2011) Malaysia's markets for functional foods, nutraceuticals and organic foods: An introduction for Canadian producers and exporters.

21. Canada Gazette (2011) Regulations Amending the Food and Drug Regulations (1220 - Enhanced Labeling for Food Allergen and Gluten Sources and Added Sulphites). Food And Drugs Act 145(4).