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# A Holistic Review on Synbiotics

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

The human health depends on various factors and various useful bacteria present in the body. The beneficial intestine bacteria have numerous and important functions, e.g., they produce various nutrients for their host, prevent infections caused by intestinal pathogens and modulate a normal immunological response. The synbiotics are the combination of prebiotics and probiotics which enhances the growth of the action of the beneficial bacteria. This review highlights the synbiotics, and role of synbiotics in various disease.

*Keywords: Synbiotics; prebiotics; probiotics.*

## 1. INTRODUCTION

In the present era, nutrition plays a vital role for the growth and development of the organism. The world is full of highly processed food, particular attention is drawn to the composition and safety of the consumed products. The quality and purity of the food taken in the day-to-day life plays a crucial role for maintaining of the health of the individual because of the problem of food

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poisoning, obesity, allergy, cardiovascular diseases. Many of recent scientific reports are pointing towards the probiotics and prebiotics due to their benefits and protein effect on the host cell. The word “probiotics” is derived from Greek which means “for life”. The Probiotics was coined by Ferdinand Vergin in the year 1954 in his article named as “Anti-und Probiotika”. “He compared the harmful effects of antibiotics and other antibacterial agents on the intestinal microbiota with beneficial effects of some useful bacteria” [1]. “After then, in 1965, Lilly and Stillwell described that probiotics are the living microorganism enhancing the growth of the other microorganisms” [2]. Fuller stated that “probiotics may be viable microorganisms which shows beneficial effect on their host” [3]. The definition of the probiotics has been modified many times based on the developments or the different studies. The current definition formulated in 2002 by FAO (Food and Agriculture Organization of United Nations) and WHO (World Health Organization) states that probiotics are’ live strains of strictly selected microorganism which when administered in adequate amounts, confer a health benefit on the host’ [4]. “This definition was maintained by the International scientific association for Probiotics and Prebiotics (ISAPP) in 2013” [5].

“In 1995, Gibson and Roberfroid invented prebiotics and defined as non- digested food components, that through the stimulation of growth and activity of a single type or a limited amount of microorganism residing in the gastrointestinal tract, improve the health condition of a host” [6]. “In 2007 FAO/WHO experts described prebiotics are the nonviable food components that confers a health benefit of the host cell or the human body” [7].

“Prebiotics and probiotics both have a positive effect and enhance or stimulate the growth of the indigenous gut bacteria. Prebiotics have the capacity to modify the gut bacteria. There are several scientific reports on the usage of probiotics and prebiotics. For the simultaneous use of probiotics and prebiotics, the Gibson and Roberfroid introduced the word “synbiotic” which means the combination of prebiotics and probiotics” [8]. “Thus, introducing the selective component into the gastrointestinal tract exhibiting or stimulating the growth of the intestinal microbiota for the benefit of host” [9].

## 2. SYNBIOTICS

“Synbiotics consists of the properties of both prebiotics and probiotics [10]. The synbiotics are introduced to overcome the problems regarding the survival of probiotics in the gastrointestinal tract” [10]. “Synbiotics are of two types complementary and synergistic. A complementary synbiotic consists of a probiotic and prebiotic that together confers one or more health benefits but do not require co-dependent functions. A synergistic synbiotic contains a substrate that is selectively utilized by co-administered microorganism” [31].

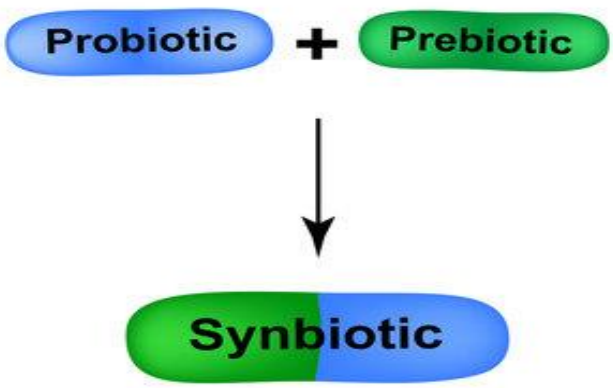


**Fig. 1. Composition of Synbiotics**

## 3. FORMULATION OF SYNBIOTICS

"The scientific basis for combining a given probiotic with a specific prebiotic is either complicated or vague. So, if in general when a statement is passed, links are selected based either on the independent properties of every single component or the suggested ability of the prebiotic substrate to encourage the growth of the host" [11]. "To satisfy the relevant for each and every single of these categories should be a transparent process" [12]. However, many of the clinical studies described in the literature.

In addition to the particular guidelines provided by the ISAPP are to be followed for the designing studies to test the synbiotics. The synbiotics being tested are may be synergistic or complementary. The study pattern to formulate the complementary synbiotics are far easier to satisfy and test than the synergistic synbiotics.

### 3.1 Formulation of the Complementary Synbiotics

"Postulate a synbiotic was formulated such that the dose of single/ combined components was below the active range. A clinical trial would also be issued based on stated doses on the labels, so many commercial synbiotic products are used in clinical studies. Probably, it consists of prebiotics doses well further down that would be expected to provide a health benefit" [13]. "Likely, the most flourishing synbiotic trail described in the compositing was for a complementary synbiotic to decrease the infection in a population of children" [14].

### 3.2 Formulation of the Synergistic Synbiotics

"Assumption of comparing both the formulations of synbiotics (complementary and synergistic), the synergistic synbiotics are more difficult to formulate. So, as mentioned earlier some reports are there in the literature that gives particular strategy for how these synergistic synbiotics could be formulated [15]. So, without any plan of action one cannot assume the combining of probiotic with a prebiotic for the final report in synergism. So, there should be either metabolic or functional and other scientific basis for expecting the two components to provide a synergistic effect. This is in divergence with the oversimplified notion that every single drive can be a single nutrient can drive pioneering of a comrade microbe [16]. The pattern of the later case was described in an in vitro study" [17]. However, a clinical trial should be compulsory to identify whether the given formulation is strongly matched to the synergistic effect on the health of the host.

## 4. APPLICATIONS OF SYNBIOTICS

In this section, we mainly focus on how the synbiotic combinations can improve the human health. We can study various types of diseases which are cured by the usage of synbiotics. Synbiotics which are the combination of prebiotics and probiotics for enhancing the positive effect on the host. The effectiveness of the synbiotic treatment on a series of diseases phenotypes has been summarized by the meta-analysis and systematic reviews. The various therapeutic potentials and health benefits are mentioned in Table 1.

### 4.1 Metabolic Syndrome

This type of syndrome is referred to the metabolic aberrancies strongly associated with cholesterol that collectively contribute to the risk of coronary artery diseases and type-2 diabetes mellitus [18]. Here, some of the risk factors are involved like, obesity, dyslipidaemia, difficult to glucose and hypertension [19]. Number of synbiotic formulations have been used in the clinical trials to provide the improvement in reducing the metabolic disorders [20]. Example: The combination of FOSs(3g) with lactobacillus plantarum or bifidobacterium.

### 4.2 Irritable Bowel Syndrome

It is an intestinal disorder which is characterised by the pain in the abdomen bloating, diarrhoea, constipation etc. It is unknown to the people till illness but visceral hypersensitivity, genetics of the gut microbiota, constant of low-grade inflammation, and also environment are contributing factors [21].

### 4.3 Colon Cancer

It is the third most common cancer in population. So; in addition to the genetic factors, environmental factors like radiation, chemical carcinogens, and also influence of diet to tumours [22]. Current treatments are associated with a high risk of complications and low success rate. Investigators have suggested that by maintaining a healthy weight, diet and physical activity, up to one-third of colon cancers may be prevented.

**Table 1. Therapeutic potential and health benefits of synbiotics**

| Sources | Diseases | Health effects | Mechanism of action | Reference |
|---|---|---|---|---|
| Oral synbiotic preparation containing L. plantarum and Fructooligosaccaride [FOS] | Sepsis in early infancy | Significant reduction in sepsis and lower respiratory tract infections | Promotes the growth of L. plantarum ATCC202195 | [26] |
| Synbiotic with L. rhamnosus CGMCC1.3724 | Obesity | Weight loss | Reduction in leptin and increase in lachnospiraceae | [27] |
| Acidophilus, L. rhamnosus, B. bifidum, B. longum, E. faecium and FOS | Obesity | Changes in anthropometric measurements | Decrease in TC, LDL-C and total oxidative stress serum levels | [28] |
| L.plantarum La-5, B. animalis subsp. lactisBB-12 and dietary fibres | Irritable bowel syndrome | Improvement in the IBS score and satisfaction in bowel movement reported | Data not available | [29] |
| L. rhamnous GG, B. lactis Bb12 and inulin | Cancer | Increase in probiotics in stools | Increased in production of interferon | [30] |

### 4.4 Kidney and Liver Diseases

They are approximately 6-10% of youngsters suffer from varying stages of the chronic kidney diseases [23]. So, recently several synbiotic clinical trails for kidney and liver diseases have been reported. A mixture consists of a nine-strain cocktail (bifidobacterium, lactobacilli streptococci) and a FOS/GOS. It was provided for those who are suffered with chronic kidney diseases patients [24]. Similarly, A combination of B. longum with FOSS was also treat the liver diseases [25]. So, these are about the various diseases are mentioned above for applications.

## 5. SYNBIOTICS IN MARKET PLACE

Synbiotics refer to products that contain both probiotics and prebiotics. Probiotics are live beneficial bacteria, while prebiotics are nondigestible fibres that nourish these bacteria. Together, they support the growth and activity of beneficial microorganisms in the gut, promoting digestive health and potentially offering other health benefits.

In the market place, synbiotics are available in various forms, including:

- **Supplements:** Synbiotic supplements are available in the form of capsules, tablets, powders, and liquids. These products typically contain a combination of specific probiotic strains along with prebiotic fibres.
- **Food and Beverages:** Some food and beverage products are fortified with both probiotics and prebiotics. These may include yogurt, kefir, fermented food, energy bars, and even certain juices.
- **Functional foods:** Certain food products are formulated to provide specific health benefits beyond basic nutrition. Synbiotic functional foods fall into this category, offering consumers a convenient way to incorporate probiotics and prebiotics into their diet.
- **Medical feed:** In some cases, synbiotics are used in medical foods designed to manage specific health conditions, such as irritable bowel syndrome (IBS) or inflammatory bowel disease (IBD).

## 6. CONCLUSION

We could see the effect of probiotics in maintaining the balance between human health and human intestinal microbiota. This has been studied and proven by many scientific reports. Probiotics are helpful in treating various diseases like irritable bowel syndrome, colon cancer, bacterial infections kidney and liver diseases and various metabolic disorders. Prebiotics are used as a support or alternate for the probiotics. The development of studies lead to the invention of

"synbiotics", means the combination of prebiotics and prebiotics which is helpful in enhancing or stimulating the growth of several intestinal flora and useful of treatment of various diseases. In future studies we could see the mechanism of action and also beneficial effects on human health.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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