

FUTURE OF PROBIOTICS AND PREBIOTICS

Abstract

Probiotics and prebiotics are the emerging topics in today's world. Traditionally probiotics were used in protecting the gut flora but there are various research that proves that probiotics can show other beneficial effects too. Prebiotics are those foods that helps in growth and activity of the beneficial bacteria and fungi. In this chapter, the author will elaborate on the various kinds of probiotics and prebiotics which will help the food and pharmacological market to grow in the world. However, the interested reader is also referred to the references listed at the end of this chapter for developing a more holistic notion of this subject.

Keywords: Next generation Probiotics, Emerging prebiotics, β -hydroxybutyrate, genetically modified bacteria, Next-generation sequencing

Author

Poulamee Ghosh
Student
Department of Applied Nutrition
All India Institute Of Hygiene and Public
Health
Nagerbazar, Kolkata, India
poulameeg@gmail.com

I. INTRODUCTION

- 1. Probiotics:** The term Probiotics is derived from a Greek word meaning “for life” and used to define living micro-organism beneficial for the body. The definition for probiotics by FDA and WHO jointly is “Live microorganisms which when administered in adequate amounts confer a health benefit to the host”.

The widely use probiotics are *Lactobacillus rhamnosus*, *Lactobacillus reuteri*, bifidobacteria and certain strains of *Lactobacillus casei*, *Lactobacillus acidophilus*-group, *Bacillus coagulans*, *Escherichia coli* strain Nissle 1917, certain enterococci, especially *Enterococcus faecium*SF68, and the yeast *Saccharomyces boulardii*. Fermented foods like kimchi, sauerkraut, miso and some other Indian foods like idli, dosa also contains probiotics. Advanced research shows that there are many emerging probiotics that are found today.

- 2. Future of Probiotics:** Probiotics are traditionally used for development of beneficial microorganisms at gut microbiota but today there are numerous probiotics undergoing various mechanisms that can be used in the future in our foods as well as in our medical sciences. Hereby elaborating the various mechanisms with the newly found probiotics in the recent studies.

- **Stress Management:** Sedentary lifestyle has been the major cause for stress in today’s scenario. Stress is a response to individual’s emotional and physical tension. Stress can arise from various reasons varying from individual to individual. Probiotics species belonging to *Lactobacillus fermentum* NMCC-14 and spores of *Bacillus clausii* were used for treating acute and subacute restraint-stressed mice in one of the study. Though it showed a positive result on mice but the role of those probiotics on human is yet to be studied.
- **Skin Treatment:** In recent times, probiotics has shift their beneficial effects from the gut microbiome to skin microbiome. Certain inflammatory skin diseases, most commonly acne can be treated using probiotics. One such probiotic is *Bifidobacterium animalis* subsp. *lactis* MG741 that showed a negative effect on skin photo-aging induced by UV radiation.
- **Managing Allergy:** Cow’s milk allergy is a vital issue specially in infants and children. We know that breastmilk contains *Bifidobacteria* spp that protects the infant’s gut. But sometimes cow’s milk is introduced at early age which shows allergic reactions in the infants. To bridge that gap, researchers has found new probiotic bacteria from human milk – *L. rhamnosus* SL42 strain that has reduced the allergic response in rats against casein found in cow’s milk. Though the study was conducted in rats, it showed a positive response with lowering histamine and IgE levels and subsequently increase the beneficial bacteria in the gut.
- **Treating Gastrointestinal Problems:** Nowadays probiotics are also showing promising role in treating colitis. The new probiotic named *Escherichia coli* Nissle was engineered for synthesizing one of the ketone body named 3-hydroxybutyrate

(3HB). 3HB has act as a stimulating factor for increase of *Akkermansia* spp in the gut in mice that can reduce the incidence of colitis.

Advancement of microbiology has open the door for the next generation probiotics especially *Akkermansia muciniphila* which showed positive results on mice for treating IBD(Inflammatory Bowel Disease).

- **Weight Management:** Obesity is one of the leading cause for various diseases. A body mass index (BMI) over 25 is considered overweight, and **over 30** is obese suggested by WHO. Most of the studies have shown that individuals who are obese can develop insulin resistance in later years.

A combinations of strains mainly *Lactobacillus rhamnosus, plantarum, curvatus or gasseri* have reduced weight along with visceral fat in obese rats, with reduction of other triggering factors like LDL, insulin resistance and triglyceride levels. Other strains of bacteria like *L. gasseri* BNR17 and *L. rhamnosus* CGMCC1.3724 strain have control weight in humans. Combinations of various strains of bacteria is better than using only one strain of bacteria. Polymerase chain reaction (PCR) of the 16 S rRNA gene and next-generation sequencing (NGS) like *Akkermansia muciniphila, Parabacteroides goldsteinii Faecalibacterium prausnitzii, Parabacteroides distasonis, Eubacterium hallii* and many more are showing potential beneficial effect for treating obesity.

Let's discuss about the evolving and emerging prebiotics in the recent market of food and agriculture.

II. PREBIOTICS

Prebiotics are non-digestible food ingredients that enhance the growth and/or activity of some microorganisms in the colon, generally *lactobacilli and bifidobacteria* spp. Probiotics along with the prebiotics show amazing results in our body.

1. **Future of Prebiotics:** One of the recent prebiotics find was Poly-hydroxybutyrate (PHB) that can increase 3-hydroxybutyrate (3HB) in the large intestinal lumen which showed various effects on different aspects.

2. Age Related Diseases

- **Cancer:** Researchers are still indulge in finding the proper treatment of cancer. Recently some prebiotics have shown promising role in treating colorectal cancer.

Some of the listed prebiotics which promote growth of beneficial bacteria are:

- **Fructans:** They promote the growth of *Bifidobacteria* in the colon that help in production of Short chain fatty acids(SCFAs).
- **Galactans:** They help in growth of *Bifidobacteria* as well as *Lactobacillus* bacteria in the gut.

- **Human milk oligosaccharides (HMOs):** They promote growth of *Bifidobacteria* (*B. infantis*) and *Lactobacillus* that produce SCFAs. They also inhibit growth of *Campylobacter*, *Vibrio cholera*, *Shigella*, *Salmonella*, *E. coli* toxins, and caliciviruses
- Propionic acid and Butyric acid

All these above mentioned prebiotics show anti-inflammatory and provides immunity to the body. They also protect the gut by avoiding any attachment of pathogens in the gut.

- **Neurological Disorders:** β -HB have shown some promising role in treating neurodegenerative diseases. Though patients suffering from neurodegenerative diseases show reduced mitochondrial metabolism but use of β -HB as prebiotic has shown reduction in the toxicity of neurotoxins, reduction in the oxidative stress, as well as shown resistance to neuro-inflammation.
- **Cardiovascular Diseases (CVD):** Short chain fatty acids such as acetate, propionate, and butyrate are important for the body. Studies are showing that including prebiotics increases SCFA in body that will lower the glycaemic levels, help to manage weight and also will improve the gut of CVD patients. It will also regulate the leptin-ghrelin function, thereby controlling the appetite and improve the insulin sensitivity in the CVD suffering individuals. SCFAs will also act as an antioxidant and show provide immunity to the persons.
- **Muscle Dysfunction:** Muscle dysfunction is very common in elderly persons. Use of prebiotics like β -HB will slow down the muscle loss and catabolic effect in the muscles. Enhancing anabolism, muscle regeneration and treating sarcopenia are some of the beneficial effects of β -HB.
- **Inflammation:** As already discussed in above points, β -HB can be administered as anti-inflammatory substances by inhibiting inflammation, reducing oxidative stress and lipid accumulation. Liver functions is often affected in elderly persons, so administration of β -HB can restore the liver function at old-age.

III.DISCUSSION

Many new prebiotics and probiotics are coming up in the medical science and microbiology field. Researchers and scientists need to keep themselves updated continuously of these new prebiotics and probiotics. With the emerging study in the pre and probiotics, it can navigate a pathway for cost effective treatment in numerous diseases which is the need of the hour. In the recent time, more new novel prebiotics and probiotics will emerge in the world.

IV. CONCLUDING REMARKS

New tests on human are the need of the hour as in most cases the experiments are conducted over mice or rats. Though they are showing promising results on mice but the microbiota of mice is different compare to human microbiota. Laboratory scientists need to

research more on various mechanisms in vivo and in vitro for new probiotics and prebiotics in food technology, microbiology and medical sciences.

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