



## Probiotics and their application

Neha<sup>a</sup>, Naghma Afreen<sup>a</sup>, Abhijeeta Nandha<sup>a\*</sup>, Suchitra Kumari

Panigrahy<sup>a\*</sup>,

<sup>a</sup>Department of Biotechnology, Faculty of Science, Kalinga University, Raipur-492101, Chhattisgarh,  
INDIA.

[panigrahysuchitra@gmail.com](mailto:panigrahysuchitra@gmail.com), [suchitra.panigrahy@kalingauniversity.ac.in](mailto:suchitra.panigrahy@kalingauniversity.ac.in),

[abhijeeta.nandha@kalingauniversity.ac.in](mailto:abhijeeta.nandha@kalingauniversity.ac.in)

### ABSTRACT

Probiotics foods are those which contain micro-organisms and influence the consumer's health by regulating microbial balance in the intestine. The prebiotics are selectively utilized by host microorganisms as a substrate and significantly improve metabolic activity, enhancing digestion, nutrient absorption ability and the immune system. The term synbiotics refers to the ingredients which contain both pre and probiotics. It will enhance the viability of microorganisms against the high pH of GI tract as well as facilitate absorption of bioactive components by the body. Probiotics, prebiotics, and synbiotics supplementation maintains the optimal microflora in the gut and also helps in the prevention of numerous diseases. In this review article the isolation of probiotics, mechanism of action and health benefits are discussed briefly which will help in futuristic research.

**Keywords:** Probiotics; prebiotics; synbiotics; lactobacillus.

### 1. INTRODUCTION

The probiotics are promoted with the requisition that they provide health benefits when consumed, generally by improving or restoring the gut microbiota (Unban et al., 2021a ; Hill et al.,2014; Lee et al., 2016;Panigrahy et al. 2019). Probiotics have considered safe to consume

but bacteria-host interactions and unwanted side effects occurs in rare cases (Unban et al., 2021a; Vinderola et al., 2011; Byakika et al., 2019; Rubio et al., 2014).

Currently, there is an increasing interest in and demand for probiotics, after a long history of safe use in fermented dairy products and an increased recognition of the beneficial effects of probiotics to human gut health (Fontana et al., 2013)

People have historically consumed lactic acid bacteria (LAB) in fermented foods similar to dairy products in the product of instigated milk, the LAB strain is produced for its density and smoothness.

Some LAB strains are known to promote health benefit effect. The demand for lactic acid-producing bacteria (LAB) in food, medicinal, and chemical diligence is adding due to their capability to help food corruption, and they're made up of the product of biodegradable polymers and green detergents. The artificial product of lactic acid occurs by chemical conflation or microbial fermentation (Vijayakumar et al., 2015). LAB Lactic Acid bacteria are typically Gram-positive bacteria with rod or in cocci shape and non-sporing.

In this, the major end product is the lactic acid They are able of converting carbohydrates into different organic acids. Lactic acid bacteria are a bacterial group that's wide in the dairy product or in fermented food. LAB is extensively used for the starter culture and for the Probiotic. Some common Strains are

Lactobacillus (2) (Dahroud et al., 2016; Edalati et al., 2019a)

Enterococcus (3) (Ogier & Serror, 2008; Edalati et al., 2019a) and

Bifidobacterium (4) are the most generally studied and most extensively used probiotic bacteria. (Edalati et al., 2019a)

Some of the e.g., lactic acid, are Lactobacillus Lactococcus, Enterococcus (Taye et al., 2021)

## **2. PROBIOTICS, PREBIOTICS, SYNBIOTICS**

Probiotics are defined as live microorganisms that when administered in acceptable quantities confer health benefits as a host. Probiotics are also defined as the live bacteria or provocations that's which when given in sufficient proportions, give a health benefit to the host or an organism now a day people are more conscious towards their physical body due to their

changing cultures with the growing interest in health knowledge, the conception of probiotic foods has gotten a lot further attention in the recent generation. A large number of probiotic species and strains belong to the genera of *Lactobacillus* and *Bifidobacterium*. (Taye et al., 2021)

The probiotics are promoted with the requisition that they provide health benefits when consumed, generally by improving or restoring the gut microbiota. (Unban et al., 2021a; Hill et al., 2014; Lee et al., 2016) Probiotics have considered generally it is safe to consume but may cause bacteria-host interactions and unwanted side effects in rare cases, (Unban et al., 2021a; Vinderola et al., 2011; Byakika et al., 2019; Rubio et al., 2014)

Prebiotics can be used as comestible food constituents (special factory fibre) that help healthy bacteria to grow in the gut; it helps the digestive system to work better (Upasana., 2022; Collins, J. Prebiotics)

It's well known that prebiotics is generally deduced from shops used as food adjuncts, similar as inulin, fructose oligosaccharides, lactulose, salutary fibre, and gums (Upasana., 2022; Rao & Rao, 2016). Prebiotics substantially correspond of oligosaccharides promoting salutary bacterial growth within the gastrointestinal tract of advanced invertebrates. In different studies from last ten times, numerous substances have been delivered as prebiotics

Any foodstuff that reaches the colon (e.g. non-digestible carbohydrates, some peptides and proteins, as well as certain lipids) is a seeker prebiotic. still, utmost studies have concentrated on non-digestible carbohydrates, substantially oligosaccharides. According to Gibson et al. only three oligosaccharides were classified as prebiotics inulin, transgalactooligosaccharide (TOS) and lactulose. A more recent study includes fructooligosaccharides (FOS) in the list of prebiotics (19). (Das et al., n.d.)

Prebiotics mainly correspond of oligosaccharides promoting salutary bacterial growth within the gastrointestinal tract of advanced pets. In different studies from last ten times, multitudinous substances have been excavated as prebiotics predicated on the studies of Mahious and Ollevier, Fooks et al and Gibson et al any foodstuff that reaches the colon (e.g. On- digestible carbohydrates, some peptides and proteins, as well as certain lipids) is a candidate prebiotic (18). Still, utmost studies have concentrated on non- digestible carbohydrates, mainly oligosaccharides. According to Gibson et al., only three oligosaccharides were classified as prebiotics inulin, transgalactooligosaccharide (TOS) and lactulose. A more recent study includes fructooligosaccharides (FOS) in the list of prebiotics (Das et al., n.d.)

**Synbiotic** defines as nutritive supplements combining probiotics and prebiotics in the form of mutualism thus perfecting salutary goods of individual probiotics. (Upsana,2022)

Synbiotics are considered to have further salutary goods on mortal health as compared to prebiotics and probiotics as depicted in Figure 4. It's used not only for enhancing the survival of salutary microorganisms added to the food but also for the stimulation of the proliferation of specific native bacterial strains present in the gastrointestinal tract, 17 ..( Upsana, 2022;Markowiak, 2017; Goubeyre et al., 2011)

Before exploration reported that synbiotics ameliorate the gut microflora and spark host vulnerable function, leading to the forestalment of bacterial translocation<sup>1</sup>(Upasana, 2022; Bandyopadhyay & Mandal, 2014). Some exemplifications of synbiotics are Bifidobacteria in confluence with fructooligosaccharides (FOS), Lactobacillus rhamnosus in confluence with inulins, and so on

### **3. MODE OF ACTION**

#### **Prebiotics**

It's well known that prebiotics passes through the digestive system without being broken down by the digestive enzymes i.e., reach the large intestine in a complete form. Once these non-digestible carbohydrates do towards the bowel, they serve as a feast for the probiotic bacteria that live there.

Prebiotics has the effectiveness to modulate the gut microbiota by stimulating indigenous salutary foliage while inhibiting the growth of pathogenic bacteria therein<sup>1</sup>. (Upasana., 2022; Rao and Rao, 2016) The species belonging to the Lactobacillus and Bifidobacterium rubrics are the favoured target organisms for prebiotics<sup>1</sup>(Upasana., 2022; Rao and Rao, 2016). Above all, prebiotics should be resistant to the conduct of acids in the stomach, corrosiveness mariners and other hydrolyzing enzymes in the intestine, shouldn't be absorbed in the upper gastrointestinal tract, and fluently fermentable by the salutary intestinal microflora ( upsana, 2022; Bezkorovainy, 2001; Dworzański et al., 2016).

**SYNBIOTICS** -As the word synbiotics ” reflects the “ cooperative gest ”; so the term can be defined for the products in which prebiotic factors appreciatively supports the growth of probiotic microorganism. It's well known that probiotics are active in the small and large intestine and the goods of prebiotics are generally observed in the large intestine thus, the

combination of two has a synergistic effect (Upsana, 2022; Markowiak, 2017; Hamasalim, 2016)

Before studies stated that for the development of synbiotic products; selection of applicable probiotics and prebiotics is important that can act independently on the host's health. (Upasana., 2022; Solís- Oviedo & Pech- Canul, 2019). The prebiotic composites should widely stimulate the growth of probiotics, with a salutary effect on mortal health and not be suitable to stimulate other microorganisms. (Upasana., 2022; Solís- Oviedo & Pech- Canul, 2019).

#### **4. SOURCES**

##### 4.1. Conventional sources

Dairy and dairy- related products are a good source of probiotics (Fontana et al., 2013; Liong, 2011). Lactic acid bacteria (LAB), bifidobacterial and other microorganisms attained from fermented milks have been used for centuries. The use of salutary microorganisms in fermented dairy products has been rehearsed for numerous generations (Fontana et al., 2013; Yu et al., 2011) These traditional fermented milks contain complex compositions of LAB species and thus give a useful source of probiotic strains. therefore, it isn't surprising that in a recent work, 148 LAB strains were insulated from Kurut, a traditional naturally fermented yak milk from China in which *L. delbrueckii* subsp *bulgaricus* and *Streptococcus thermophilus* are the predominant microbial populations (Fontana et al., 2013; Sun et al., 2010)

Cheese is a dairy product with eventuality for the delivery of probiotic microorganisms into the mortal intestine. *L. plantarum* strains have been insulated from Italian, Argentinean and Bulgarian crapola (Fontana et al., 2013; Zago et al., 2011; Georgieva et al., 2008)

#### **YOGHURT**

Yoghurt is generally produced by using mixed starter culture comprised of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* (Xu et al., 2014; S.S. Zhang et al., 2020; Ayivi & Ibrahim, 2022) The US Food and medicines Administration lately streamlined the legal description of yoghurt, low- fat yoghurt and non-fat yoghurt as substantiated in the US law of Federal Regulations in 21CFR131.200(CFR (Code of Federal Regulations, 2022). In this description, yoghurt was credited to food made from dressed dairy voluntary constituents (similar as skim milk, cream, milk or their reconstituted performances)

of which these constituents could be employed either as a stage-alone or in combination with each other. (S.S. Zhang et al., 2020; Ayivi & Ibrahim, 2022)

Yoghurt is an implicit source of probiotic lactobacilli. Yoghurt is a nutrient- thick, fermented dairy product that's primarily consumed due to its expansive health benefits as opposed to its introductory nutritive value (Weerathilake et al., 2014; Ayivi & Ibrahim, 2022)

## **CAMEL MILK**

Lactic acid bacteria (LAB) are exhaustively dispersed in nature and do typically as indigenous microflora in raw milk that assumes an essential part in several food and feed restlessness. LAB is a group of non – spore- forming Gram-positive bacteria that produce lactic acid as the main end product among the turmoil of carbohydrates and are employed as starter culture (Edalati et al., 2019b)

Camel's milk, which has a high probiotic eventuality, is a source from which LAB can be insulated. In vitro exertion of camel's milk against Gram-positive and-negative bacteria has been astronomically reported (Edalati et al., 2019b)

Interestingly, it was observed that bone milk isn't sterile, indeed when collected aseptically, which raises the possibility that boost milk harbours a natural bacterial inoculum( Reference West, Hewitt and Murphy( Fontana et al., 2013;West et al., 1979) also, it was reported that two Lactobacillus strains insulated from mortal bone milk enhanced natural and acquired vulnerable responses through the activation of the natural killer and T- cell subsets and the expansion of nonsupervisory T cells( Fontana et al., 2013; Pérez- Cano et al., 2010)

## **Human Gastrointestinal tract**

Another source of probiotics is the human GIT. More than 500 different bacterial species reside in the adult human gut. In fact, many of the probiotic strains used today have been isolated from this source, such as *L. gasseri* and *L. reuteri* (Ryan et al., 2008; Fontana et al., 2013)

In addition, it has been reported that *L. fermentum*, isolated from human colonic mucosal biopsy samples, possesses antimicrobial activities against food-borne pathogens(Fontana et al., 2013; Varma et al., 2010)

## **TEA LEAVES**

Miang is a traditional fermented food product made of tea leaves (*Camellia sinensis* var. *assamica*) which is commonly produced and consumed in northern Thailand and neighbouring countries. (Unban et al., 2021; Khanongnuch et al., 2017)

The manufacturing process of Miang includes many steps following the inherited protocol depending on local communities, and the most important step of Miang production process is the natural fermentation for a few weeks or up to one year without the use of any preservatives (Unban et al., 2021; Kanpiengjai et al., 2016; Unban et al., 2019)

LAB is a key group of microorganisms having an important role in Miang fermentation. Various strains of LAB, including *Lactobacillus* sp., *Pediococcus* sp. and an *Enterococcus* sp., have been isolated from Miang (Gharaei-Fathabad & Eslamifar, 2011; Unban et al., 2021)

Recent studies exploring the microbial community during Miang fermentation by non-filamentous growth-based fermentation (NFP process) (Unban et al., 2021; Unban et al., 2020) and filamentous growth-based fermentation (FFP process) (Kodchasee et al., 2021; Unban et al., 2021) have confirmed the important role of LAB and their diversity in Miang samples. This indicates the relevance of Miang as potential source of probiotic bacteria

#### 4.1. Commercial Sources

**PROBIOTICS**---Variety of probiotics are available in marketable forms. Commercially probiotic microorganisms are generally set up in two forms i.e., fermented foods and supplements.

Fermented foods can be of both origins i.e., vegetable as well as dairy. Sauerkraut, kimchi, some kinds of pickles, tempeh, yogurt, soft rubbish, lassi, buttermilk, kefir, and other kinds are the most popular and beloved ones to eat. Freeze-dried (lyophilized) microorganisms in powder, pill, or tablet form make up probiotic supplements or tablet form make up probiotic supplements. (Upasana.,2022; Rao & Rao, 2016)

**PREBIOTICS**- The sources of prebiotics include bone milk, soybeans, inulin sources (like Jerusalem artichoke, chicory roots, etc.), raw oats, unrefined wheat, unrefined barley, yacon roots, comestible carbohydrates and in particular non-digestible oligosaccharides<sup>14</sup>(Upasana, 2022; Bezkorovainy, 2001). From prebiotics, only bifidogenic, non-digestible oligosaccharides particularly inulin, its hydrolysis product oligofructose and(trans) galactooligosaccharides (GOS), fulfil all the criteria for prebiotic classification. (Upasana, 2022; Sela et al., 2010)

Generally, prebiotics is set up from natural sources like fruits, vegetables and grains that are consumed daily in our diet. But, are also set up in artificial forms like lactulose, fructooligosaccharide and galacto oligosaccharides, maltooligo saccharides, cyclodextrins and lactosaccharose<sup>12</sup>. (Upasana, 2022; Markowiak, 2017)

SYNBIOTICS- Lactobacillispp., Bifidobacteria spp, S. boulardii, B. coagulans, etc., probiotic strains The prebiotics that are used for making synbiotic strains are oligosaccharides i.e., fructooligosaccharides (FOS), galactooligosaccharides (GOS) and xylo oligosaccharides (XOS) and from inulin i.e., available in the natural sources from chicory and yacon roots, etc (Upasana., 2022)

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## **5. Health benefits of probiotics**

Probiotics and Synbiotics are allowed to help your body in several ways.

**Inflammatory bowel disease (IBD).** Scientists believe synbiotics may reduce gut inflammation and help relieve symptoms in people with IBD.

**Travellers' diarrhea.** You get this when you eat or drink defiled food and water, generally when you visit a place with a different aseptic practice. It causes cramps and diarrhea. Synbiotics may help to help it.

**Lactose intolerance.** People with this condition have symptoms like bloating, diarrhea, stomach pain, and gas after eating or drinking dairy products. That is because they cannot duly digest a sugar set up in milk called lactose. Studies have shown that synbiotics could reduce these symptoms.

**Immune function.** The combination of prebiotics and probiotics may profit your vulnerable system. We need further exploration on this, but studies have set up that synbiotics bettered the vulnerable function of rats.

**Obesity and hyperglycaemia** In one study, people with rotundity who ate synbiotic pasta once a day for 12 weeks had smaller signs of inflammation and better cholesterol position. And study actors with high blood sugar had lower situations of a hormone linked to insulin resistance, type 2 diabetes and rotundity (Panigrahy et al. 2017).

The consumption of synbiotics and probiotics has also the following benefits It increased the situations of lactobacilli and bifidobacterial and balanced gut microbiota, forestallment of bacterial translocation, reduced frequentness of nosocomial infections in surgical cases, enhancement of liver function in cirrhotic cases and enhancement of immunomodulating ability<sup>19- 20</sup> which is well depicted in. (Upasana., 2022; Solís- Oviedo & Pech- Canul, 2019; M.-M. Zhang et al., 2010)

Before studies showed that prebiotics has the following parcels and functions maintaining good gut bacteria, helping in the immersion of calcium and magnesium, changing the rate at which foods causes harpoons in blood sugar (the glycaemic indicator), helping in stirring the food briskly; so that they spend lower time in the digestive tract that helps them free from

constipation. At last, prebiotics also keeps the cells healthy. (Upasana., 2022; Collins., Prebiotics)

Table 1: Source of probiotics with their beneficial effect

PRODUCT NAME	ORIGIN	STRAIN CULTURE	FUNCTIONAL BENEFITS	REFFERENCES
Yoghurt	UK, TRUKISH , US	<i>Lactobacillus</i> spp, <i>Lactococcus</i> , <i>streptococcus</i> <i>spp. Pediococcus</i>	High protein content, boost the health	Hoque et al.,2010
<b>Cheese</b> (Swiss, gouda, Xinjiang cheese)	France, Germany	<i>Enterococcus</i> , <i>Lactococcus rhamnosus</i>	Protein Vitamin A Vitamin B12 Vitamin K	Azat et al.,2016
Butter (butter milk)	German, France,	<i>Lactobacillus</i> , <i>Lactococcus</i> , <i>Enterococci</i>	reduce the risk of heart disease	Bettache et al.,2012
Curd	India	<i>Lactobacillus</i> , <i>Lactococcus</i> , <i>Enterococci</i> <i>Pediococcus</i>	Vitamin B12	Patil et al.,2010
Raw milk (camel, cow, buffalo)	Kerman	, <i>Lactobacillus plantarum</i> , <i>Weissella parames enteroides</i>	Probiotics	Edalati et al., 2019
Kimchi	Korea	<i>Weissella leuconostoc</i> , <i>Lactobacillus</i> ,	Stroke, cancer	Chang et al., 2010

Soya milk (sofit drink)	China	Lactobacillus, Acetobacter	Healthy muscles	Djadouni et al.,2012
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## 6. Antagonists effect

**Yoghurt-** It was observed that isolated *Lactobacillus* spp. were resistance to inhibitory substances like phenol (0.4%), NaCl (1-9%) and bile acid (0.05-0.3%). Additionally, it was observed that a good growth is shown in the presence of 1% NaCl and 0.3% bile acid. The isolated *Lactobacillus* spp. Also show good survival abilities in acidic (pH 2.5) and alkaline (pH 8.5) conditions, while, their maximum growth was observed at pH 5.0 for lactobacilli isolated from Bogra yoghurt and at pH 6.5 for lactobacilli isolated from yoghurt of Khulna region of Bangladesh. . (Billah et al., 2010)

The MICs results showed that, *Lactobacillus* spp. isolated from Bogra yoghurt were sensitive to amoxicillin, moderately sensitive to gentamycin, clindamycin, azithromycin and resistant to kanamycin, nalidixic acid, metronidazole, cefradine and tetracycline.

In conclusion, most of the results from the present experiments showed that, there were variations in probiotic properties of the isolated *Lactobacillus* spp. from different regions . (Billah et al., 2010)

**Camel milk-** A total of 32 isolates were randomly picked, eight of which were analyzed in this study. On the basis of phenotypic and genotypic methods, isolated LAB was *Lactobacillus plantarum* *Weissella paramesenteroides* and *Weissella confuse aureus* (Edalati et al., 2019b)

Antagonistic activity of isolated LAB against two pathogenic bacteria showed that they had more inhibitory activity against *S. aureus* subsp. *aureus* PTCC 1431 than *E. coli* ATCC 25922. This study discovered that raw camel's milk obtained from three districts of Kerman province contain LAB bacteria that have antagonistic properties on *S. aureus* (Edalati et al., 2019b)

**Dairy product-** The study of Boris et al. showed that lactobacilli strains isolated from dairy products were able to inhibit the growth of *P. aeruginosa*, *E. coli*, *Salmonella typhimurium*, and *S. aureus*, the latter was in the highest inhibitory effect.[30] (Karami et al., 2017; Boris et al., 2001)

Seventy percent of isolated lactobacilli showed antimicrobial effects on selected pathogens, but inhibitory effects of three strains were more considerable than others. ] (Karami et al., 2017),

Antagonistic activity of three selected isolated lactobacilli of some dairy products was evaluated in this study. The obtained results that have been showed that all three isolates had moderate activity (inhibition zone <15 mm) except *L. collinoides* and *L. alimentarius* that had relatively strong activity (inhibition zone  $\geq$ 15 mm) against *P. aeruginosa* and *B. subtilis*, respectively. ] (Karami et al., 2017),

## **7. Conclusion**

In recent years, probiotics, prebiotics as well as synbiotics have become an essential part of our day-to-day life, work and environment and also in the dairy product and in aquaculture practices for improving the growth performance and disease resistance. Probiotics play an important role in feed conversion, growth rates, weight gain, immune response and disease resistance of fish. On the other hand, prebiotics also have various beneficial effects mainly in disease resistance and nutrient availability of fish. Synbiotics, the combined application of probiotics and prebiotics, which improve the survival and establishment of the live microbial dietary supplement in the gastrointestinal tract of the host. The use of synbiotics confirm greater benefits than the application of individual probiotics.

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