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Journal of Advanced Scientific Research

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ISSN
0976-9595
Review Article

HEALTH BENEFITS OF PROBIOTIC BACTERIA FROM INDIAN FERMENTED FOODS

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ABSTRACT

Probiotics are live and beneficial bacteria that help to maintain the natural balance of the gut micro biome. The application of such probiotic bacteria will make a way for the discovery of new drugs. The main source of probiotics is edible foods. Traditionally fermented Indian foods act as a rich source for the isolation of probiotic bacteria. Each fermented food is associated with its unique microbiota along with micro and macronutrients but the importance of such traditional foods is under extinction and left unnoticed. The rate of human health hazards has been drastically increased due to emerging side effects in modern therapeutics and change in food habits. The current scenario can be overruled by employing probiotic drug isolated from traditional fermented Indian foods that majorly helps in improving human microbiome which results in subsequent relief without any adverse effects. The present deals with the benefits and utilization of probiotics as an alternative approach in human for treating various health hazards. The practice of probiotic therapy balances the natural microbiome that chiefly aids in preventing various diseases.

Keywords: Probiotic bacteria, Traditional fermented foods, Alternative approach, Health benefits.

1. INTRODUCTION

Indian traditional foods are naturally fortified foods that have been consumed through various generations with antiquity. The fermentation process increases the flavour, aroma and wholesome nutrients of foods [1]. The nature and the type of fermented foods vary regionally along with their unique micro biota [2]. Fermented foods are generally categorised as Cereal based, pulse-based, milk-based, vegetable-based, fruit-based and meat-based fermented foods [3]. The indigenous fermented food helps to satisfy the human diet which imparts huge health benefits. The change in food habits, lifestyle and adverse effects of modern therapeutics gives arise to challenging health difficulty. To overcome this scenario, during the recent decade's extensive research has been carried out to explore the traditional Indian fermented foods which act as reservoir probiotic micro biome. Probiotics are natural and live microbiome that confers health benefits to the host. Lactic Acid Bacteria (LAB) and Yeast is found to be an inhabitant of Indian fermented foods which closely resembles the human micro biome [4]. The other LAB species like *Enterococcus, Lactobacillus, Lactococcus, Leuconostoc, Pediococcus, Streptococcus, Tetragenococcus, Vagococcus* and *Weissella* strains are also considered as probiotics. Lactic acid bacteria are grouped under generally recognized as safe (GRAS) due to their non-pathogenicity [5]. The antagonistic activity of probiont eliminates the pathogens to maintain the gut micro-biome. The exploration of the probiotic organism from traditional Indian foods has become essential. The review relies on traditional Indian fermented foods as a suitable medium for the isolation of probionts through eco-friendly practice. The beneficial role of the probiotic organism in the human body against various health problems can be considered as an alternative and safe approach to reduce the burden of society.

2. TRADITIONAL INDIAN FERMENTED FOODS

Ancient Indian dietary pattern professes natural ways of attaining physical and mental health through their functional foods. The formulation of traditional Indian foods reveals originality in choosing the ingredients by implementing wholesome nutrients beyond taste. Indian cuisines loaded with flavours, aroma and taste profile for providing a balanced meal to promote digestion and well being. Inclusion of natural antimicrobials and antioxidant in spices and condiments extend a healthy lifestyle. The functional roles of foods are intensified during the fermentation process. Food processing by fermentation boosts the bioavailability of minerals by the formation of

organic acids and soluble ligands. The staple Indian fermented foods are categorized as Cereal & pulse-based, milk-based, vegetable-based and fish-based fermented foods. Each food is nourished with nutrients along with its natural unique microbiome and medicinal properties.

2.1. Cereal & Pulse Based Traditional Fermented Foods

Cereal-based fermented foods are one of the major dietary foods consumed in India. The foods include idli, dosa, dhokla, koozhu, nan, parotta, ambali and pazhaiyasoru. Cereals such as rice (*Oryza sativum*), ragi flour (*Eleusine coracana*), wheat flour (*Triticum* sp.), barley flour (*Hordeum vulgare*) and pulses such as black gram dhal, red gram, green gram dhals are widely used for food preparation and fermentation. The foods are loaded with water-soluble fibres such as b-glucan, arabinoxylan, galactooligosaccharides and fructooligosaccharides [6]. The cereals based functional foods are considered as an essential substrate to activate the growth of *Lactobacilli and Bifidobacteria*. LAB leads to the production of secondary metabolites such as lactic acid and acetoin, which imparts a sour taste and a pleasant flavour [7]. The microorganisms involved in the fermentation process include *Weissella paramesenteroides, Lactobacillus fermentum, L. plantarum, Enterococcus faecalis, Pediococcus acidilactici, P.Cerevisiae* and *L. mesenteroides*. More attention is needed to explore the natural microbiome of Indian fermented foods.

2.2. Milk-Based Traditional Fermented Foods

Milk and milk-based products are consumed popularly to satisfy nutritional need. Dahi or curd is the most popular and commonly consumed traditional Indian fermented food. The curd is made from cow's milk and fermentation was carried out by inoculating curd as a starter culture. The curd can be consumed directly or it can be churned into buttermilk. *Streptococcus cremoris, S. lactis, S. thermophilus, Lactobacillus bulgaricus, L. acidophilus, L. helveticus, L. cremoris, L. plantarum, L. curvatus, L. fermentum, L. paracasei subsp. pseudoplantarum, L. alimentarius, L. kefir, L. hilgardii, Enterococcus faecium, L. mesenteroides, L. farciminis, L. brevis, L. lactis subsp. cremoris, L. casei subsp. Casei* and *L. Bifermentans* have isolated from milk-based fermented foods [3].

2.3. Vegetable Based Traditional Fermented Foods

Fermented vegetable like gundruk, sinki, khalpi and inziangsang are consumed as a traditional food by ethnic people of the North-eastern states of India. *Pediococcus pentasaceous, L. cellubiosus, L. plantarum, L. fermentum, L. brevis, L. mesenteroides, L. lactis, E. Faecium* and *P. acidilactici* are isolated from fermented vegetable products.

2.4. Fish Based Traditional Fermented Foods

Tungtap and hentak are made of fermented fish paste consumed in the North-eastern state of India. Fermentation is done by autocatalytic enzymes from fish [8]. *Lactobacillus lactis subsp. cremoris, Lactococcus plantarum, E. faecium, Lactobacillus fructosus, L. Amylophilus, Lactobacillus sake, L. curvatus, L. divergens, L. carnis, L. sanfrancisco, L. mesenteroides, E. faecium, L.plantarum, L. brevis* and *Pediococcus pentosaceous* are isolated from fermented fish products.

3. HEALTH BENEFITS ASSOCIATED WITH PROBIOTIC MICROBIOME FROM TRADITIONAL INDIAN FERMENTED FOODS

Indian fermented foods loaded with an enormous medicinal value which makes a way for discoveries. The fermented foods are nourished with beneficial bacteria that aids in healing and prevention from various diseases. The uses of the probiotic micro biome against various diseases are shown in the chart below.

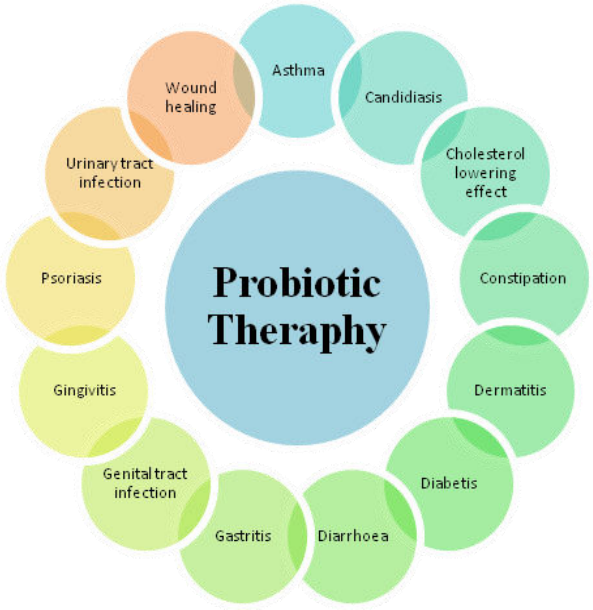

Fig. 1: Uses of Probiotic micro biome

3.1. Asthma

Asthma is a chronic inflammatory lower airway disorder that leads to the frequent and severe development of wheezing, shortness of breath, chest tightness and cough. Gut micro biota triggers an immune response against

respiratory influenza in mice [9]. The mice fed with *Lactobacilluacaesi* before the inoculation of influenza virus showed a significant increase in pulmonary natural killer cell activity by tripling the survival rate [10]. Oral administration of *Lactobacillus rhamnosus* to mice triggers an antiviral immune response against pulmonary infections [11]. *L. johnsonii* was fed to mice showed protection against allergic and inflammation of the lung. Administration of *Lactobacillus acidophilus* and *Bifidobacterium animalis* to 3 to 5-year-old children showed a significant reduction in fever, rhinorrhoea, cough which lead to the loss of antibiotic therapy.

3.2. Candidiasis

Candidiasis is the opportunistic infection caused by *Candida albicans* a natural commensal in the oral cavity. Oral Candidiasis is clinically characterized by a patchy white tongue in immunocompromised individuals. *Lactobacillus paracaesi, Lactobacillus fermentum, Lactobacillus rhamonus* reduces the number of *Candida albicans* by inhibiting hyphal formation by the production of acids. The *lactobacillus* strains can be used as potential probiotics against oral candidiasis in the oral cavity [12].

3.3. Cholesterol-Lowering Effect

Cholesterol is an essential lipid molecule for human. The increase in the level of cholesterol leads to the development of coronary artery disease. Probiotics are employed to reduce the level of cholesterol [13]. Administration of *Lactobacillus plantarum* to hyperglycaemic mice for 14 days reduced level of total cholesterol. *Lactobacillus acidophilus* showed a significant reduction in LDL (Low- Density lipoprotein) and HDL (High- Density Lipoprotein) cholesterol level.

3.4. Constipation

Constipation refers to the irregular bowel moment which makes the stool hard. Generally, laxatives are prescribed to increase bowel movement and soften the stool. Nowadays probiotics are used to treat constipation. Studies involving the administration of *Bifidobacterium lactis* showed improved colonic transit times, both in a healthy population [14] and in constipated patients by lowering the pH in the colon [15]. *Lactobacillus casei* gradually increased the frequency and consistency of hard stools without any adverse effect.

3.5. Dermatitis

Dermatitis is the inflammation of the skin followed by itching, redness etc. Administration of *Lactobacillus rhamnosus* and *Lactobacillus reuteri* to children with dermatitis showed clinical improvement. *In vitro* study of *Lactobacillus rhamnosus* inhibited antigen-induced IgE (Immunoglobulin E) production in murine lymphocytes [16].

3.6. Diabetes

Diabetes is caused due to the insufficient or excessive production of insulin which makes a way for other dangerous diseases. Intake of *Lactobacillus acidophilus, Lactobacillus casei* and *Bifidobacterium bifidum* for 6 weeks showed a significant reduction in glucose [17]. The study reported that consumption of *Lactobacillus alivarius, Lactobacillus casei, Lactobacillus plantarum, Lactobacillus acidophilus, Bifidobacterium breve* and *Bacillus coagulans* twice a day for 90 days lead to a decrease in blood glucose level.

3.7. Diarrhoea

Diarrhoea is the frequent and urgent occurrence of loose bowel movements which lead to loss of appetite and energy. Probiotics can be prescribed as adjunctive therapy in the treatment of diarrhoea [18]. A combination of *Streptococcus thermophilus* and *Bifidobacterium bifidum*is highly effective against chronic diarrhoea in children. Several microorganisms like *Lactobacillus rhamnosus Lactobacillus casei, Lactobacillus plantarum*, *Bifidobacteria, Enterococcus faecium* and the yeast *Saccharomyces boulardii* are effective in reducing the severity and duration of acute diarrhoea in children [19].

3.8. Gastritis

The inflammation of the stomach lining is called gastritis. *Helicobacter pylori* cause inflammation in the gut region. The strains of *Lactobacilli* interferes and compete with *Helicobacter pylori* at the adhesion sites which aids in the increase in intestinal mucin that gradually reduce the level of infection [20]. *Lactobacillus johnsonii* produces secondary metabolite shows antibacterial activity [21]. The production of Bacteriocin by certain probiotic organism reduced the growth of *Helicobacter pylori* [22]. Animal studies revealed the use of *Lactobacillus johnsonii* could provoke immune responses like pro-inflammatory and anti-inflammatory cytokines which aid in decreasing the inflammation [23].

3.9. Genital Tract Infection

Sexually transmitted disease (STD) and non-Sexually Transmitted Disease (non-STD) are the major cause of genital tract infection throughout the world. Bacteria,

viruses or protozoa provoke vaginosis, vaginitis, cervicitis, endometritis, genital ulcers, or pelvic inflammatory disease. The probiotic bacteria are attached to the host mucosa and participate in the prevention of UGT (Urinary Genital Tract) [24]. Zárate *et al.*, [25] demonstrated that, the inoculation of *Lactobacillus paracasei* significantly decreased inflammation and structural alteration in vaginal mucosa infected with *Staphylococcus aureus.* The clinical test was in infected women conducted by oral and vaginal administration of *Lactobacillus rhamnosus* and *Lactobacillus fermentum* showed a reduction in the level of infection [26].

3.10. Gingivitis

The inflammation, itching, redness and bleeding of gums are called gingivitis. Probiotics can be used for the benefit of oral health [27]. Regular consumption of *lactobacillus* and *Bifidobacterium* showed a significant reduction of carcinogenic *streptococci* in saliva and dental plaque [28]. Several studies showed that the use of *Lactobacillus* strains decreased gingival inflammation [29] by improving periodontal health [30] and decreases the concentration of black-pigmented rods including *Porphyromonas gingivalis* in saliva and subgingival plaque [31]. Twetman *et al.*, [29] reported that the use of *Lactobacillus reuteri* chewing gum for two weeks reduced the clinical symptoms of gingivitis.

3.11. Psoriasis

Psoriasis is an autoimmune and long-lasting disease that is characterized by red, dry, itchy and scaly patches on the skin. Probiotics can be employed as an alternative therapy for the treatment of psoriasis. The patient administered with one sachet of Lactobacillus sporogens with 10mg of biotin thrice a day for about 4 weeks by stopping the intake of all the other drugs. After 15 days of treatment fever subsided, lesion involutes and further no new lesion was developed [32]. Simultaneously there was a significant drop in the blood glucose level. Another study revealed that the use of *Lactobacillus rhamnosus* and *Lactobacillus reuteri* in children with chronic atopic dermatitis showed better development in clinical symptoms.

3.12. Urinary Tract Infection

The main cause of UTI (Urinary Tract Infection) is a bacterial infection which shows the clinical manifestation of perennial pain, back pain, fever and chills. *Escherichia coli* are the major cause of UTI. Other pathogenic strains like *Staphylococcus saprophyticus, Enterococcus faecalis* and, occasionally, *Klebsiella pneumoniae* and *Proteus mirabilis* are also responsible for causing UTI [33]. In the field of UTI, the *lactobacillus* sp undergoes intravaginal completion against uropathogens to offer protection against UTI infections which can be used as an alternative drug against UTI [26]. The use of *L. Casei* against *E. coli* in a murine UTI model reduced the level of infection [34]. Uehara *et al.,* [35] also showed that the administration of *Lactobacillus crispatus* showed a reduction in the number of pathogens without any adverse effects. The probiotics also aid in wound healing by inhibiting the pathogenic organism. *Pseudomonas aeruginosa* was inhibited completely by *Lactobacillus plantarum* which resulted in 97% inhibition of infected cells. The cells culture of *Lactobacillus plantarum can* interfere with *Pseudomonas aeruginosa* cells by inhibiting the excessive PMN (Polymorph nuclear Leukocytes) influx and decreases the level of infection [36].

4. CONCLUSION

The probiotic bacteria present in traditionally fermented Indian foods can be explored to get novel isolates. By understanding the fruitful application of probiotics will make it a necessity to realize the importance of Indian traditional fermented foods which act as a reservoir of the probiotic micro biome. Probiotic organisms can produce a greater impact in the field of medicine. Probiotic therapy can be used as an alternative tool for curing various health hazards in the modern era. The use of the probiotic drug is eco-friendly, cost-effective and it aids as a preventive drug against various diseases without any adverse effects.

5. ACKNOWLEDGEMENT

We would like to thank Sri Ramakrishna College of Arts &Science for Women, Coimbatore-641004 for their technical support.

6. FUNDING INFORMATION

Catalysed and financially supported by Tamilnadu State Council for Science and Technology, Dept. of. Higher Education, Government of Tamilnadu.

Conflict of interest

The authors declare no conflict of interest.

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