

## Concise Review: Importance of Probiotics Yogurt for Human Health Improvement

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**Abstract:** Yogurt is one of the most popular fermented dairy products consumed worldwide which have great consumer acceptability due to its health benefits other than its basic nutrition. In general, yogurt provides milk proteins with higher biological value and provides almost all the essential amino acids necessary to maintain good health. Yogurt is considered as a probiotic carrier food that can deliver significant amounts of probiotic bacteria into the body which can claim specific health benefits once ingested. Moreover, yogurt is reported to claim improved lactose tolerance, immune enhancement, metabolic disorder and prevention of gastrointestinal disorders. Because of these known health benefits of yogurt, consumer demand for yogurt has been increased and became the fastest growing dairy category in the global market. Yogurts are now being manufactured in a numerous styles and varieties with different fat contents, flavors and textures suitable for different meal occasions.

**Keywords-** probiotics, yoghurt, gastrointestinal disorders, metabolic disorder, Human Health

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### I. Introduction

In the current situation to achieve the targets set up by government under the theme for millennium development goals, the under nutrition need to be addressed immediately in an effective manner with the aim to target larger section of the society mainly low income group who could not afford food having nutritional value to certain extent. In this context, the development of ready to use therapeutic foods (RUTFs) has bought revolution in terms of treatment of severe acute malnutrition and to catalyze the development of other food-based commodities so as to treat and prevent less severe and other forms of undernutrition (Raghuwanshi *et al.*, 2015; Ciliberto *et al.*, 2005; Collins *et al.*, 2006; De Pee and Bloem, 2009).

Yogurt is one of the most popular fermented dairy products known for centuries has worldwide acceptance in terms of nutritional and health benefits. Yogurt is a mixture of milk (whole, reduced-fat, low fat) fermented by lactic acid-producing bacteria, *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, other bacteria e.g. *Acidophilus* and other strains of the bacteria may be added to the culture [1]. Yogurt is considered as healthy food due to its high digestibility and bioavailability of nutrients. This fermented drink could also be recommended to the people with metabolic disorder, lactose intolerance, gastrointestinal disorders such as inflammatory bowel disease and irritable bowel disease, and aids in immune function and weight control.

Over centuries, the importance of probiotics is known across civilizations and strata of societies in the form of practice of consuming preserved foods obtained through the process of fermentation. Since ages, traditional fermentation processes, using locally available ingredients, which may be of plant or animal origin, are converted into edible products by the physiological activities of microorganisms [2]. The traditional fermented foods are mainly obtained from dairy products viz. yoghurt, dahi, kefir, cheese (after long storage), fermented vegetable or from vegetable juices and from non fermented fruit and berry juices. Indigenous fermented foods have been prepared and consumed for thousands of years, and are strongly linked to culture and tradition. The organisms that are best studied and generally regarded as probiotics are species of the bacteria *Bifidobacterium*, *Lactobacillus*, and *Streptococcus*, and also including yeast such as *Saccharomyces boulardii* [3 & 4].

At present, people in the modern world are getting health conscious and have therefore opted for changes in terms of diet and their lifestyle. The dietary changes include the supplementation of probiotics and probiotic based products. The importance of probiotics has been reported by several researchers and in reports that it promotes proper digestion, improves immune system, treats diarrhea which mainly originated due to antibiotic course or travelling and prevents ulceration caused due to *helicobacter pylori* [5], and assists in nutrient assimilation particularly B vitamins and omega-3 fatty acids. These health benefits initiated the research to support the concept that there are clinical health benefits to ingest these micro-organisms [6]. It is a major

focus of attention of scientists across the world due to their promising health benefits and their applications offers an innovative approach for development of novel probiotic formulations.

The article reviews the reports available on probiotics, describes the functioning of probiotics in human ecosystems. The potential of probiotics in solving number of diseases such as gastrointestinal problems, lactose intolerance, treatment of acute diarrhea, cancer, diabetes, prevention and treatment of allergy related problems.

## **II. Yogurt**

Yogurt is a bacterial fermented food products produce with combine effects of *Lactobacillus delbrueckii* subspecies *bulgaricus* and *Streptococcus salivarius* subspecies *thermophilus*. These Lactic acid bacteria were referred as "yogurt cultures".

Yogurt starter cultures which acts in yoghurt preparation, ferment lactose (milk sugar) and produce lactic acid in the milk and consequently milk clot or form soft gel. Flavor compounds are also produced during milk fermentation. Yogurt is made using a special starter culture in which a symbiotic blend of two major bacteria are present in a 1:1 ratio- *S. thermophilus* and *L. bulgaricus*. *S. thermophilus* produced acid whereas aroma components are formed by *L. bulgaricus*. Rate of acid production is much higher when they grow together in comparison to individual growth. *S. thermophilus* grows faster and produces both acid and carbon dioxide which stimulates the growth of *L. bulgaricus*. Whereas proteolytic activity of *L. bulgaricus* produces stimulatory peptides and amino acids which is utilized by *S. thermophilus*. Generally freshly prepared yogurt contains  $10^9$  cells per gram.

These bacteria produced lactic acid which acts on milk protein to give yogurt its texture and its characteristic tang. Due to high digestibility, bioavailability of its protein, energy, calcium and other micro and macronutrients, yoghurt is considered as healthy fermented food for human beings. Different types of milk are used for yoghurt preparation like whole milk for full fat yogurt ( $\geq 3.25\%$  milk fat), low fat milk for low fat yogurt ( $\geq 2\%$  milk fat) and skim milk for nonfat yogurt ( $\geq 0.5\%$  milk fat), composition of yoghurt is adjusted by using other dairy ingredients like cream and non fat dry milk. Stabilizers (Alginates, gelatins, gums, pectins, and starch) may also be used in yogurt to improve the body and texture. Stabilizers preventing separation of the whey (syneresis), and helping to keep the fruit uniformly mixed in the yogurt.

## **III. Probiotic**

The probiotics are generally consumed as a part of the fermented foods with specially added active live cultures; such as in yogurt and soy yogurt, or as dietary supplements. Metchnikoff (1907) reported that there is a potentiality for the modification of the gut micro flora and the replacement of harmful microbes by beneficial bacteria i.e. probiotics [1].

Due to their potential of providing health benefits, Probiotics become an integral part of the complex world as food, nutritional supplements, biologics and pharmaceuticals. These acts as food supplements as well as preventive or curative drug which contains live non pathogenic bacteria. It is mainly the bacteria and metabolites that are produced by them which impart these probiotics their health promoting properties. Probiotics are present as natural temporary constituent of the intestinal microflora with an insufficient concentration, but when administered in adequate amounts, it confer a health benefit on the host and enable to prevent or cure some diseases to certain extent [7].

There has been a growing awareness among Indian consumers in recent years about the importance of nutrition, health, and quality of food they eat. Consumers are preferred to healthy diet instead of physical activities. They are switching towards health supplements which could have deleterious effect. An increase in sale of health products amongst the health conscious consumers globally showed the interest of consumers towards these products, creating new health food categories. At present, the probiotics is at nascent stage and awareness as food supplement is limited to urban areas. Regular use of probiotics could improve the quality of life and reduces the dependence on drugs and medical expenses. Probiotics presumably exert a dual effect by preventing/decreasing the intestinal colonization with pathogen microorganisms or interacting with the gut associated lymphoid tissue (GALT) to prevent inflammatory responses and promote a state of tolerance to themselves and possibly to foods [8].

Benefits of probiotics include the strengthening of the immune system, the improvement of the skin's function, the protection of DNA, the protection of proteins and lipids from oxidative damage and the maintaining of individual intestinal microbiota in subjects receiving antibiotic treatment.

The most promising probiotic strains include the members of the Genera- *Lactobacillus*, *Bifidobacterium* and *Enterococcus* [9, 10]. Probiotic cultures are available in fermented dairy products and probiotic fortified foods and also in tablets, capsules, powders and sachets containing the bacteria in freeze dried form are also available. Different probiotic strains have shown their efficacy in various infections like urogenital infections, gut infections and oral infections. Experimental studies have showed probiotics' ability for gastric ulcer healing [11, 12].

#### **IV. Metabolic Disorder**

Complex set of chemical reactions taking place in the body to convert or use energy is referred as metabolism. These chemical reactions include breaking down of food to its simpler components mainly proteins, sugars, and fats, transforming excess nitrogen into waste products, breaking down or converting chemicals into other substances and making available for cells etc. A metabolic disorder occurs when abnormal chemical reactions in your body disrupt this process. When this happens, body might have too much of some substances or too little of other ones that it need to stay healthy. Metabolic disorders also developed when some organs, such as pancreas or liver, become diseased or do not function normally, diabetes is an example of such disorder. More than hundreds of a genetic metabolic disorder caused by mutations of single genes was reported by the National Institutes of Health. These mutations can be transmitted down through generations of families.

##### **1.1. Diabetes:**

Diabetes mellitus is a group of metabolic disorders of carbohydrate metabolism characterized by high blood glucose levels (hyperglycemia) and usually resulting from insufficient production of the hormone insulin (type 1 diabetes) or an ineffective response of cells to insulin (type 2 diabetes; T2D) [13, 14]. Pancreas secreted the hormone insulin which is required to transport blood glucose (sugar) into cells. Symptoms of marked hyperglycemia include weight loss, polydipsia, polyuria and sometimes with polyphagia and blurred vision. Susceptibility to certain infections and Impairment of growth may also accompany chronic hyperglycemia. Acute Life-threatening effect of uncontrolled diabetes is hyperglycemia with ketoacidosis or the nonketotic hyperosmolar syndrome. Long-term consequences of diabetes include nephropathy leading to retinopathy with potential loss of vision, renal failure, amputations, peripheral neuropathy with risk of foot ulcers and Charcot joints and autonomic neuropathy causing gastrointestinal, cardiovascular symptoms, genitourinary and sexual dysfunction. Patients with diabetes also have an increased risk of peripheral arterial, atherosclerotic cardiovascular and cerebrovascular disease. Abnormalities of lipoprotein metabolism and Hypertension are often found in people with diabetes [15].

Mu Chen et.al [16] conducted a meta-analysis and investigated the association between dairy products and T2D. They found that consumption of 28.0 g. serving of yogurt per day was associated with an 18% lower risk of T2D. Research has suggested magnesium, calcium, or specific fatty acids present in dairy products may lower the risk of T2D. Study has been shown that probiotic bacteria found in yogurt improves fat profiles and antioxidant status in people with type2 diabetes. Frank Hu, Harvard School of Public Health, found that higher intake of yogurt is associated with a reduced risk of T2D, on contrary other dairy foods and consumption of total dairy did not show this association. The consistent findings for yogurt recommend that it can be incorporated into a healthy dietary pattern. Blood sugar levels that are either too high or too low over a long period of time can cause serious harm to the body. Hyperglycemia or High Blood Sugar is a condition in which an excessive amount of glucose circulates in the blood plasma. Hyperglycemia is one of the classic symptoms of diabetes mellitus, others including frequent and excessive thirst accompanied by frequent and excessive urination.

##### **1.2. Obesity**

Obesity has become a serious public health problem and has reached epidemic proportions worldwide, not only in industrialized countries but also in developing countries. Each year, as a result of obesity or overweight, at least 2.6 million individuals are more likely to suffer a heart attack or to die from pathologies related to obesity [17].

The diet that humans typically consume influences the microbiota structure, and thus the role of microbes in energy balance together with dietary factors and genotype all seem to contribute to increased adiposity and development of obesity [18]. A survey conducted by the University Tennessee, Knoxville, it is observed that regular eating of curd helps to burn belly fat. There is a hormone called cortisol present in the waist, which sends a signal to the body to accumulate more fat in the belly region. Yogurt contains enough amount of calcium, which instructs cortisol to release lesser amount of fat cells. The presence of amino acid is also good in burning of fat. In this case, the eating of Greek yogurt is more beneficial in weight loss management because it contains higher percentage of calcium than the normal yogurt. Greek yogurt has double amount of protein, half of sodium and carbohydrate than the normal yogurt. High amount of protein in Greek yogurt makes it a high demand product among the athletes and the senior citizen. The lower amount of sodium is also good for the high blood pressure patients.

Studies have demonstrated a beneficial effect of probiotic microbes on adiposity, in an inter-vention trial with *Lactobacillus gasseri* SBT2055, the consumption of fermented milk with this probiotic for 3 months was shown to significantly reduce abdominal visceral and subcutaneous fat, weight and body mass index (BMI) of subjects with elevated BMI at the beginning of the trial [19]. In 2011 Krishnan et al., reported the effects of *L. rhamnosus* (probiotic) on the anthropometric parameters and the lipid profile in adults in comparison to

atorvastatin and sibutramine, they reported that the subscapular skinfold thickness and the suprailiac skinfold thickness were significantly decreased at the end of a twelve weeks treatment [20].

### 1.3. Hyperlipidemia

Alteration in plasma lipid and lipoprotein profile has been documented in diabetic patients. There are some reports in literature suggesting that the insulin resistance has a central role in the development of dyslipidemia in diabetic patients. In insulin resistance status, free fatty acids flux from adipose tissue to liver and subsequently increase synthesis of very low density lipoprotein cholesterol and low density lipoprotein cholesterol (LDL-c) and decrease high density lipoprotein cholesterol (HDL-c) levels. Moreover, Hyperglycemia prompted increased advanced glycation end products density in insulin resistance status. These products may directly promote atherosclerosis by changing the function of macrophage, endothelial, and smooth muscle cells. So, improving dyslipidemia would be effective to prevent complications of diabetic patients [21].

Elevated serum cholesterol level is an acknowledged risk factor for atherosclerosis and coronary heart disease, which are still among the leading causes of mortality in the world. Lactic acid bacteria have been recognized as potential mediators that would have a beneficial impact on hyper-cholesterolaemia, *Lactobacilli* possess enzymes that participate in the deconjugation of bile salts to form primary bile acids, thereby inhibiting micelle formation, cholesterol absorption from the intestine and the enterohepatic circulation of cholesterol. Also, systemic effects are thought to derive from the metabolic activity of probiotic microbes and increased concentrations of fatty acids (acetic, propionic and butyric acids), which may impact the cholesterol synthesis and lipid metabolism systemically [22]. Animal studies have shown quite consistent cholesterol-lowering effects of various probiotic microbes [23] but the data from human studies are very inconsistent [24].

Micelles formation occurs during the lipid metabolism which aids in the absorption of cholesterol in the intestine. *Lactobacilli* deconjugate bile salts to form bile acids in the intestine, thereby inhibiting the micelle formation. This leads to a decrease in the absorption of cholesterol. Similarly, cholesterol that absorbs through enterohepatic circulation also reduced in the intestine. Conjugate Bile acid Hydrolase (CBH) which is elaborated by *Lactobacilli*, hydrolyses the bile salts and the Hydroxyl Steroid Dehydrogenase (HSDH) degrades the bile salts and interrupts the enterohepatic circulation of the bile acids. Another factor, include inhibition of hydroxy methyl glutarate CoA (HMG CoA) which is also thought to be elaborated by *Lactobacilli*. Cardio-vascular disease is the major complication of type 2 diabetes mellitus (T2DM). Cardio-vascular disease may result from associated abnormalities of plasma lipid and lipoprotein metabolism [25]. Yong Zhang et al. 2010, conducted a study to observe the antioxidative effects of *Lactobacillus casei* on hyperlipidaemic rats, he reported that the supplementation of *L. casei* significantly reduced the Malondialdehyde (MDA) levels, whereas the Superoxide Dismutase (SOD) and the glutathione peroxidase levels were increased both in the serum and the liver of these rats [26]. Thus, we can conclude that probiotics reduce the lipid peroxidation and improve the lipid metabolism in vivo.

Varied results have been shown by the human trials which were carried out on dairy foods which were fermented with specific lactic acid bacteria, which emphasized that the bacteria could produce modest reductions in the total and the LDL cholesterol levels. Nevertheless, the studies have suggested that probiotics can be a suitable approach to begin the therapy. Genetically modified soy milk with or without probiotic fermentation can improve the hypercholesterolaemia and reduce the risk of atherosclerosis, as was shown in 112 male Golden Syrian Hamsters [26].

### 1.4. Oxidative stress

The mechanism by which oxidative stress results in diabetic complications and tissue damage is the overproduction of the reactive oxygen species and reduction of the antioxidant defense function of the body. Lipid peroxidation is one of the main biological targets of oxidative stress, which leads to formation of secondary products such as malondialdehyde that exacerbates oxidative damage. MDA has been found to significantly increase in pathological conditions which are considered as a common oxidative stress biomarker in recent years [27]. Ejtahed et al. showed a significant reduction in blood glucose and MDA level in type 2 diabetic patients after consuming probiotic yogurt [28]. Songisepp et al. evaluated the functional efficacy of antioxidative properties of probiotic in healthy subjects and found a significant improvement in blood total antioxidant activity (TAA) and total antioxidant status (TAS) after receiving probiotics [29]. Harisa et al. also reported a significant decrease in MDA concentration after treating diabetic rats with *L. acidophilus* [30].

### 1.5. Diabetic foot ulcer

Diabetic foot ulcer (DFU) is a growing health problem with the increasing prevalence of diabetes. DFU occur in around 15% of all diabetic patients and are a predominant source of nontraumatic amputation worldwide. Treatment of chronic conditions like diabetic foot ulcer (DFU) is challenging due to increased susceptibility for infection and delayed wound healing [31]. Due to Complexity of existing therapy and adverse

effects and microbial resistance emphasizes the need of an alternative approach for the management of DFU. The increasing body of evidence associated with probiotic application in diverse disease states merits its use in wound healing and infection too [32]. Underlying mechanism of the above therapeutic effects of probiotics involves modulation of local and systemic immunity. The hypothesis is based on the concept that mechanism of anti-infective and ulcer healing action of probiotics will be same in peripheral wound ulcers as like it acts on any other part of the body [33].

### 1.6. Blood pressure

A study found long-term yogurt-eaters were less likely to develop high blood pressure and on average had lower systolic blood pressure than those who didn't eat yogurt. Systolic blood pressure is the top number in a blood pressure reading. It measures the force of blood against the walls of your arteries when your heart is beating. High blood pressure is a risk factor for stroke and heart disease and is often called the "silent killer" because it mostly has no symptoms.

According to a study conducted by American Heart Association over 15 year, they found that if at least 2% of daily calories came from yogurt, there is 31% less likely to develop high blood pressure [34]. A meta-analysis suggested that probiotic fermented milk has BP-lowering effects in pre-hypertensive and hypertensive subjects [35]. Recently in 2014, S. Khalesi et.al, reported the positive effects of probiotics on diastolic blood pressure were greatest in people whose blood pressure was equal to or greater than 130/85, which is considered elevated, and said that Probiotic consumption with a daily bacteria volume of  $10^9$ - $10^{12}$  colony-forming units (CFU) may improve blood pressure. Probiotics with multiple bacteria lowered blood pressure more than those with single bacteria [36]. Ingestion of milk fermented with *Lactobacillus helveticus* compared with placebo for 12 weeks did not significantly reduce blood pressure in patients with T2D [37]. In a daily routine, we are taking more amount of sodium in the form of salt that leads to diseases like hypertension, kidney and heart diseases. Since, yogurt is containing a good amount of potassium that counters sodium and reduces the chances of high blood pressure.

## V. Conclusions

Probiotic market is expanding at a rapid pace due to globalization and increase in health awareness [38]. Realizing this, the dairy industry has undergone a paradigm shift from manufacturing traditional milk products towards more beneficial functional milk products such as probiotics, or yogurt. Consumers should understand that anything in excess is not always good though probiotic has shown a lot of potential in aiding number of illness and conditions. In the past few decades, lot of research has been carried out in this direction but no concrete conclusion could be drawn till date and have to still wait more as research is going on in this direction. Till then, consumers should understand the concept, "probiotic rather than medicine". Besides this, in the existing situation, excellent growth opportunities are stored for both domestic as well as for foreign companies to venture their capital in the probiotic industry and to make a mark for the betterment of the society.

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