Utilization of Probiotic Yeast *Saccharomyces Boulardii* in Dairy Products - A Overview

C. Pandiyan and G. Kumaresan

**Abstract**— *Saccharomyces boulardii* is unique probiotic and biotherapeutic yeast, known to survive in gastric acidity and it is not adversely affected or inhibited by antibiotics or does not alter or adversely affect the normal microflora in the bowl. *S. boulardii* has been utilized worldwide as a probiotic supplement to support gastrointestinal health. In recent years, by incorporating *S. boulardii* various dairy foods such as yoghurt, ultra high temperature treated (UHT) milk, acidophilus yeast milk, ice cream etc., are prepared and new varieties of probiotic and functional foods are produced. In this article, the utilization of the probiotic yeast *S. boulardii*, so far in the preparation of dairy products are reviewed.

**Key words**— *Saccharomyces Boulardii*, Dairy Foods

---

**I. INTRODUCTION**

CURRENT lifestyle and eating habits contribute to each individual's overall health status. It is believed that increased stress, a hectic lifestyle, and a diet poor in fermented foods has become a common feature of modern life. This is believed to have resulted in growing incidences of diseases and poor health worldwide (Markowitz and Bengmark 2002). The fast-paced lifestyle together with the unpleasant side effects of antibiotic therapies has led people to prefer preventative rather than curative approaches toward diseases.

Food industries, especially dairy industries, have been quick to realize the huge market potential created by the numerous positive health benefits of these probiotic microorganisms. The development of new food product turns out to be increasingly challenging, as it has to fulfill the consumer's expectancy for products that are simultaneously relishing and healthy. Probiotics are defined as live microorganisms, when administered in adequate amounts; confer health benefits on the host (FAO/WHO, 2001). Dairy food serves as the ideal system for delivery of probiotic bacteria to the human gastrointestinal tract due to provision of a favourable environment that promotes the growth and enhances the viability of these microorganisms (Hattingh and Viljoen, 2001). Probiotic strains must retain their functional health characteristics, including the ability to survive, transit through the stomach and small intestine and to colonize the human gastrointestinal tract. A food can be said to be functional if it contains a component (which may or may not be a nutrient) that affects one or a limited number of functions in the body in a targeted way so as to have positive effects on health (Bellisle *et al.*, 1998), or if it has a physiologic or psychologic effect beyond the traditional nutritional effect (Clydesdale, 1997).

Probiotic organisms are increasingly incorporated into food as dietary adjuncts to help to maintain a healthy microbial gastrointestinal balance, with possible resulting benefits for the human health (Czerucka *et al.*, 2007). Such microorganisms which are predominantly incorporated into fermented dairy products include *Lactobacilli* and *Bifidobacteria*. So far the active use of yeasts as dietary adjuncts for human being has been limited, despite the occurrences of the yeasts as an integral part of the microflora of many dairy related products (Fleet and Mian, 1987). This indicates the potential use of yeasts for incorporation into dairy products as probiotic agents (Jakobsen and Narvhus, 1996). This article reviews the utilization of *S. boulardii* in various dairy products.

---

C. Pandiyan, Associate Professor, Veterinary College and Research Institute, Orathanadu, Thanjavur, E-mail: ch.pandiyan@gmail.com

G. Kumaresan, Department of Dairy Science, Veterinary College and Research Institute, Namakkal – 637 002, Tamil Nadu, India
II. PROBIOTIC YEAST Saccharomyces boulardii

During 1923, French scientist Henri Boulard isolated a tropical strain of a yeast Saccharomyces, (eukaryotes) of Endomycetes family (Ascomycetes group) from Lychee fruit and Mangosteen at Indochina and named it Saccharomyces boulardii and used to treat diarrhea in France in 1950s. It has an unusually high optimal growth temperature of 37°C. S. boulardii is a unique probiotic, known to survive gastric acidity and it is not adversely affected or inhibited by antibiotics or does not alter or adversely affect the normal microflora in the bowl (McFarland and Bernasconi, 1993). Upon consumption, S. boulardii able to achieve high concentration in the colon quickly, maintains constant levels, does not permanently colonize the colon and does not pass easily out of the gastrointestinal tract (Sazawal et al., 2006).

S. boulardii has been used either to prevent or to treat human diseases by interacting with the natural microecology of the host. Further the probiotic effects enhanced by its ability to produce polyamines, which strongly affect the cell growth. It has been proven that S. boulardii has an antagonistic activity against various bacterial pathogens. It reduces the number of intracellular bacteria but does not modify the number of cell-associated bacteria (Ipek et al., 2006). S. boulardii has been utilized worldwide as a probiotic supplement to support gastrointestinal health. It benefits the gastrointestinal tract by increasing intestinal populations of healthy bifidobacteria and lactobacilli while decreasing numbers of disease-causing organisms.

S. boulardii is recognized to have probiotic effectiveness used alone and/or in combination with other probiotics to support digestion. It is useful as biotherapeutic agent in combination with antibiotic for the treatment of Clostridiuni difficile diarrhoea and colitis. Biotherapeutic agents, as with probiotics, must be given in sufficient concentration to exert therapeutic properties, remain stable and viable before use and survive in the intestinal ecosystem of the host to exert their therapeutic properties. Dietary supplementation with the probiotic organism such as Lactobacilli and S. boulardii was reported to help in reducing some effects of ageing (Nivien et al., 2006).

S. boulardii secretes enzymatic proteins, including a protease that degrades Clostridium difficile toxins and a phosphatase that inactivates endotoxin such as the lipopolysaccharide produced by E. coli. It also strengthens tight junctions between enterocytes (reducing chloride secretion), promotes maturation of the intestinal brush border membrane and stimulates production of glycoproteins (including secretory IgA). S. boulardii also promotes production of disaccharidases such as lactase, sucrase, maltase, and N-aminopeptidase in the brush border allowing increased carbohydrate degradation and absorption in patients with diarrhea, and restores normal levels of short chain fatty acids in the colon which are necessary for absorption of water and electrolytes. In addition, S. boulardii may reduce inflammation in the gastro intestinal tract by stimulating regulatory T cells and inhibiting mitogen-activating protein kinase and nuclear factor-kappa B-signal transduction pathways, resulting in decreased secretion of interleukin and tumor necrosis factor alpha. S boulardii also decreases inducible nitric oxide synthase activity and up-regulates proliferators-activated receptor gamma, leading to a reduction in intestinal inflammation (Marcia, 2009).

Pharmaceutical preparations containing S. boulardii are available in market like SB kid (Paris Dakner Microspherules, Chennai), Econorm (Dr.Reddys laboratory, Hyderabad), Derolac (Aristo Pharmaceuticals, Mumbai) and Florastar (Biocodex Pharmaceutical, San Francisco) used against different types of diarrhea. S. boulardii has been used in combination with other probiotics and also administered with or without food. The lyophilized powder should be mixed with water, milk, or juice and swallowed immediately after mixing (Costalos et al., 2003). Even though S. boulardii has been employed as biotherapeutic agent in various formulations; Literatures regarding the utilization of S. boulardii in dairy foods are limited.

III. PROBIOTIC YEAST S. boulardii IN DAIRY PRODUCTS

- Preparation of Yoghurt

Hattingh and Viljoen, (2001) harvested yeast cells (S. boulardii ATCC 74012) from (Yeast Nitrogen base, oxoid, Basingstoke) YNB broth by centrifugation method and mixed with sterile water so as to contain more than 10^6 cfu yeast cells /ml. The yoghurt samples such as plain yoghurt, fruit cocktail yoghurt and UHT treated yoghurt were prepared by inoculating 2.5 per cent (weight cells per volume product) of the yeast culture. The
yeast cell population in plain yoghurt and UHT yoghurt remained virtually same over a storage period of 29 days at 5°C and maintained a cell population of above 7.6 log_{10} cfu/ml. In fruit yoghurt, the cell population of *S. boulardii* increased from 7.7 log 10 cfu/ml to 8.1 log 10 cfu/ml over the storage at 5°C for 29 days. This increase in fruit yoghurt is due to easily fermented sugars, sucrose and fructose derived from the added fruit. The number of yeast populations was substantially higher in fruit based yoghurt, mainly due to the presence of proportions of sucrose and fructose derived from the fruit. Despite the inability of utilizing lactose, the yeast species utilized available organic acids, galactose and glucose derived from bacterial metabolism of lactose present in the dairy products.

- *Preparation of UHT Treated Milk*

*S. boulardii* treated UHT milk was prepared by inoculating 2.5 per cent (weight cells per volume product) of the yeast culture. In the UHT milk, the cell population of *S. boulardii* survived and increased slightly from 8.15 log 10 cfu/ml to 8.5 log 10 cfu/ml over the storage at 5°C for 29 days. The pH of the *S. boulardii* treated UHT milk was 6.55 on day one and remained 6.59 until 29 days of storage at 5°C. Due to UHT treatment, a small portion of hydrolyzed lactose was utilized by the yeast cells in the UHT treated milk. Also, *S. boulardii* growth did produce small amounts of lactic acid (1.04 per cent) and alcohol (0.5 per cent) suggesting carbohydrate metabolism. Hattingh and Viljoen (2001) concluded that application of yeast species such as *S. boulardii* as a probiotic microorganism seems promising in milk since no gas or alcohol were formed.

### IV. Probiotic Saccharomyces Species for the Preparation of Yeast-Acidophilus Milk

Kalpana (2008) prepared yeast-acidophilus milk by sterilizing skim milk and then tempered at room temperature to attain 30°C and after subsequent cooling, inoculated with 2 per cent probiotic Saccharomyces yeast culture (a total of 5 isolates were used) and kept at 37°C for 24 hours. Then *L. acidophilus* (NCDC 15) was inoculated at the rate of 1 per cent and incubated for 12 hours. After incubation, the inoculums were broken and stored at 4°C. Saccharomyces yeast species is capable of utilizing lactic acid as a growth substrate and maintaining cell counts exceeding six log counts. Further, in the acidophilus-yeast milk (*L. acidophilus* - NCDC 15 and *Saccharomyces* isolate - VG) the count was 7.105 log count cfu/ml and 5.263 log count cfu/ml at a pH of 5.27 in the fresh samples and the samples stored under refrigeration condition for 10 days were 7.195 log count cfu/ml and 5.938 log count cfu/ml and finally concluded that the yeast-acidophilus milk prepared by using *L. acidophilus* - NCDC 15 and 8S4, VG Saccharomyces isolates were capable to form acceptable yeast-acidophilus milk by sensory evaluation. Incorporation of probiotic *Saccharomyces* species showed a synergistic effect by the enhanced growth of lactic culture in fermented dairy products with increased probiotic activity (Lang and Lang, 1975). Addition of probiotic *Saccharomyces* yeast in acidophilus milk enhances its demand as probiotic drink because of addition of beneficial properties like fast recovery from diarrhea as well as from tuberculosis.

- *Preparation of Ice Cream*

Ice cream mix was prepared by using prebiotic substances viz., honey, oligofructose and inulin added at the rate of each 3 per cent. In each treatment, mix ingredients were homogenized and then heated to 80°C for 30 sec. Mixes were cooled to 5°C and aged overnight at the same temperature. After ageing, the mix was heat treated to 80°C for 30 seconds and cooled to 37°C. Probiotic cultures such as *L. acidophilus* and *S. boulardii* (alone and in combination) were inoculated into ice cream mix at the rate of 4 per cent and incubated at 37°C until the pH of 5.5 is reached. *L. acidophilus* maintained in the sterile skim milk was inoculated in the ice cream mix. *S. boulardii* culture was activated in YPD broth was inoculated into the sterile skim milk at 37°C for 24 hours was inoculated in the ice cream mix. Both the cultures were inoculated at the rate of 4 per cent into ice cream mix and incubated at 37°C until the pH of 5.5 is reached. After freezing, the ice cream was filled in 50 ml food grade paper cups, covered with food grade lids and stored at -18°C to -23°C. All the ice cream samples supplemented with or without prebiotics and with probiotic *L. acidophilus* and *S. boulardii* and in combination of both, were acceptable and gave a good total impression without any off flavour, without losing the therapeutic level of 10^6 cell counts/ml. *S. boulardii* growth was better in combinations than alone in the ice cream samples (Pandiyan, 2010).
The ice cream samples either with L. acidophilus or S. boulardii, or in combinations, consumed by human volunteers could significantly improve the gut health by increasing probiotic population thereby reducing the coliforms in the faeces. Especially, the combined effect of L. acidophilus and S. boulardii organism has pronounced effect on the gut of human volunteers by increasing the counts by symbiotic growth. Since, ice cream is delicious product consumed by all age groups; it can be used as a medium for the growth and transfer of probiotic bacteria and yeast as well as prebiotic substances to maintain the normal flora and also for restoration of the gut microbes in combating the gut associated illness.

V. CONCLUSION

Dairy foods serve as the ideal system for delivery of probiotics to the human gastrointestinal tract, due to provision of a favorable environment that promotes the growth and enhances the viability of these microorganisms. From the above review, the probiotic yeast S. boulardii can be well incorporated into dairy based foods to develop functional and therapeutic foods.

REFERENCES