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Prevention of Allergic Diseases with Probiotic Lactic Acid Bacteria

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Review Article

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Abstract

Food allergy is an immune illness to dietary proteins, with symptoms extending from mild gastrointestinal symptoms to critical anaphylactic shock. Probiotic bacteria may advance endogenous barrier systems in patients with food allergy, and by relieving intestinal inflammation, may perform as a useful tool in the prevention and management of food allergy. Recently, it was reported that using probiotics in the treatment and prevention of food allergy and other allergic diseases show some effects. Generally, the effect is dependent on the strains used, length and way of the treatment. In the allergy treatments, *Lactobacillus rhamnosus*, *Lb. reuteri*, *Lb. acidophilus*, *Bifidobacterium breve* and *Bf. Lactis* are used typically.

Keywords: Lactic acid bacteria; Atopic eczema; Allergy

Introduction

It was known that allergy is an illness associated with an imbalance immune system and allergies increased rapidly in the developed countries especially eczema, allergic rhinitis, asthma, inflammatory bowel disease and food allergy. It was claimed that health effects of probiotics are based on the hygiene hypothesis, which suggests that sanitary condition is important for health but limited reports are provided about environmental condition increases allergic diseases [1].

Food allergy prevalence is published approximately 6–8% in children and 1–4% in adults every year [2]. As from January 01, 2006, all food products controlled by the FDA should be labeled in a definitive way to identify the major food allergens: milk, egg, fish, crustacean shell fish, tree nuts, wheat, peanuts, and soybeans. Food Allergen Labeling and Consumer Protection Act labeling utilizes to all retail and food-service organizations that package, label, and provide products for human consumption (e.g. machines and all packages labeled “for individual sale”) [3].

Probiotics are live microorganisms associated with mainly lactic acid bacteria. The use of lactic acid bacteria culture as probiotic and as bioprotective ways in fermented products has been known. According to the clarification of the Food and Agriculture Organization and the World Health Organization (FAO/WHO), probiotics are living bacteria that, when consumed in sufficient amounts, provide a health benefit on the host [4,5]. Probiotic lactic acid bacteria (LAB) are regarded as one of the significant bioactive compounds contained in commonly consumed functional foods for this purpose [2]. They change the microflora of the digestive system, especially in the intestinal microflora. Prophylactic management of probiotics in the initially stages of life (naturally in breast milk or milk synthetic compounds) is very significant because intestinal microflora plays an important role in the growth of the immune system [6,7].

Probiotics take place within the gut or within the intestinal tissue. Some effects of probiotics are hydrolysis of antigenic peptides in the gut; they change modulation of intestinal permeability and provide reduction of systemic entrance of antigens, increased local IgA production and epithelial cell growth, and transition of inflammation [8]. Human consumption of various probiotic bacteria stimulates phagocytic activity and increases the formation of T and B lymphocytes and production of antibodies, such as immunoglobulins A (IgA), IgM and IgG [3]. Furthermore, probiotics can hold the allergic compounds and change or convert them into non-allergic forms. For example, they can hydrolyze polypeptides or complex proteins into harmless peptides. Some strains of enteric bacteria with probiotic activities are effective to improve allergic responses with various immunological mechanisms, such as the enhancement of Th1 or regulatory T (Treg) cell functions depending on various bacterial strains [2]. The potential of probiotics in auto immune diseases has been explained in some researches. Selected probiotic bacteria showed to be able to contribute a safe way that is necessary for the immune system develop [9].

Huang, et al. [2] reported about *Lactobacillus murinus* is a functional probiotic bacteria against food allergy. This study provides the first case to show the anti-allergic effect of *L. murinus in vivo*. Investigation realized that the expression of both IL-12 and OX40L by intestinal dendritic cell was managed by *L. murinus* stimulation of intestinal Th1 immunity and decreasing allergic responses. These results suggest that *L. murinus* can be used as a functional probiotic for modulate Th2-mediated allergic disorders. In a study probiotics were tested against allergic conditions comes from a double-blind, placebo-controlled, randomized trial in which *Lactobacillus paracasei* subsp. *Paracasei* LP-33 was given to patients with allergic rhinitis who were already being treated with anti-histidine loratadine. This research showed consistently increased ocular symptoms, but the lack of effect on nasal symptoms [10].

However, in another study Dupont, et al. [11] researched supplementation to the infant formula with a combination of two probiotics; *Lactobacillus casei* CRL431 and *Bifidobacterium lactis* Bb-12. This study included 119 allergic infants fed with high hydrolysed casein- based formula (eHCF) either supplemented with probiotics or without probiotics for 6 months. Research results showed that the probiotic supplementation has no effect on growth in infants allergic to Cows' milk protein allergy.

Atopic Dermatitis

Atopic disease is the most common of the chronic skin conditions generally known as eczema. It is defined as an excess of inflammation in the skin and mucous membranes of individuals of any age. The incidence changes but up to 20% of children have been suffered from the condition. Prevention of atopic eczema by probiotic treatment to pregnant mothers and newborn infants seems effective. Researchers showed the efficacy of *Lb. rhamnosus* GG in alleviating the symptoms of atopic dermatitis. *Lb. rhamnosus* GG shows able to reduce atopic disease, not only in infants but also where the mother was given the bacterium. In studies have suggested that an increase in IL-10 in the serum of infants taking *Lb. rhamnosus*GG may be responsible for the probiotic effect. IL-10 is an immunomodulatory cytokine that modulates pro-inflammatory IL-2, IL-6, IL-12, TNF-α and interferon gamma (IFN-γ) [12-14].

In a study capsules were prepared with *L. rhamnosus* GG (ATCC 53103) 5×10^9colony-forming units (cfu), *L. rhamnosus* LC705 5×10^9 cfu, *Bifidobacterium breve* Bb99 2×10^8 cfu, and *Propionibacterium freudenreichii* ssp. *shermanii* JS 2×10^9cfu. These capsules were given to the mothers once a day; those given probiotics were mixed with sugar syrup containing 0.8 g of prebiotic sugars (galacto-oligosaccharides). The mothers received these products for 2–4 weeks before delivery, and their infants for the first 6 months. In this clinical study, which included 925 children, the prevalence of eczema and atopic eczema was decreased by 2 years age children who received probiotics [3].

It was reported that the therapeutic effect of *L. rhamnosus* GG (LGG) as a food supplement in children suffering from atopic dermatitis. It was resulted that the supplementation of food with lactobacilli may retard or improve atopic dermatitis as the infants who received lactobacilli pre- and post- natal were less likely to develop atopic dermatitis than the placebo-fed infants [3]. At the age of 4 years, there was a significant reduction in the control of atopic dermatitis in the *Lactobacillus*treatment group, indicating a role for probiotics in the prevention of the development of allergic disease. However, the children with allergic rhinitis and asthma did not differ between the two groups. Therefore, oral administration of probiotics to children with food allergy, some of whom being allergic to peanut is related with a decrease in IgE production *in vitro* [3].

Celiac Disease

Lindfors, et al. [15] researched whether probiotics *L. fermentum* or *B. lactis* can inhibit the toxic effects of gliadin in intestinal conditions. They were observed that among the probiotics tested, live *B. lactis* can directly inhibit the harmful effects exerted by celiac-toxic gliadin and would warrant further studies of its potential as a novel dietary supplement in the treatment of coeliac disease. The efficacy of different numbers of both *L. fermentum* and *B. lactis* inhibiting the gliadin-induced with increase in Caco-2 cell permeability. Freeze-dried preparation of VSL#3 containing *S. thermophilus*, *L. plantarum, L. acidophilus*, *L. casei*, *L. delbrueckii* spp. *bulgaricus*, *B. breve*, *B. longum*, and *B. infantis* was used for dough fermentation and gliadin polypeptides hydrolysis [3].

Cow's Milk Allergy

Cow's milk allergy (CMA) is the most frequent food allergy in children, effecting about 2% to 3% of them. Individuals with milk allergy are at risk for allergic reactions and some problems in finding alternative replacements for the nutritional content those milk-based products obtained. A child may have to live with the limitations by milk allergy for several years, as recent studies are reported that milk allergy generally continues into later childhood. Gut microflora affects the milk allergy problem, as the cause of food allergy is thought to in difference from the default state of mucosal immune insensitivity that may be managed by diet, commensal microflora, and interactions between them.Differences in infant gut flora have been related with allergy skin prick test (SPT) response, specific IgE (sIgE) levels, atopic dermatitis,and food allergy condition. The enrichment of *Clostridia* and *Firmicutes* in the infant gut microflora of 3- to 6-month-old infants whose milk allergy problem resolved by age 8 years. The microflora of these young infants whose milk allergy resolved was related with reduction of fatty acid metabolism. These results are showed the relationship between gut microbiota and food allergy resolution, and these findings suggest directions for potential therapeutic consideration. Early infancy is a indicator during which gut microbiota may direct food allergy outcomes in childhood [16-18].

An increasing amount of data suggests the role of selected probiotics in prevention or management of CMA. Research data show the importance of a—nutritional immunology advance may not be only effectively cure the symptoms, but also to accelerate tolerance obtaining in children with Cows' milk allergy [8]. In a research supplementation of infant formula containing viable *Lactobacillus* GG could prevent cow's milk allergy. Some studies demonstrated that probiotic strains could degrade dietary antigens in the intestine and prevent allergy symptoms [19].

Fermented Dairy Products for Prevention of Allergic Reactions

Fermented milk products, such as yoghurt, kefir or others produced with probiotic cultures, are regarded as products with lower antigen amounts than milk and therefore they can be included in the diet for cow's milk allergic patients. Lactic acid bacteria (LAB) are required to have proved immune-modulating effects. Several LAB strains show the documented ability to manage immune host responses, and can also increase antibody production and macrophage activity, prevent intestinal inflammation, and facilitate allergic disease symptoms and autoimmune disorders. The application of *L. acidophilus* in fermented milk production permit reduction of the immunoreactivity of major milk allergens, beta-lactoglobulin, alpha-casein, which additionally was reduced with cross-linked reaction and relating with cross-linked microbial transglutaminase (m-TG) and also with the 30 days of storage. The immunoblot analysis showed the specific reaction between milk proteins with high molecular weight (66-80 kDa) and 29 kDa and specific IgE antibodies of cow milk allergic patients. Moreover, the product with m-TG was characterized by high quality than those obtained without m-TG. In the study, the more allergenic proteins were found bovine serum albumin (BSA), lactoferrin and alpha-casein [13,20].

In a study probiotic Dahi were produced with co-culturing Dahi bacteria (*Lactococcus lactis* ssp. *Cremoris* NCDC-86 and *Lactococcus lactis* ssp. *Lactis* biovar *diacetylactis* NCDC-60) and additionally with selected strain of *Lactobacillus acidophilus* LaVK2 and *Bifidobacterium bifidum* BbVK3. Mice were fed with probiotic Dahi (La-Dahi and LaBb-Dahi) from 7 days before sensitization with whey protein (WP), respectively, in addition to milk protein-free based diet, and control group received no addition.Results of the study show that probiotic Dahi treated Th2-specific immune response towards Th1-specific response and suppressed IgE in serum. As the result, the study shows the potential use of probiotics treatment in prevention of the allergic response to whey proteins in mice [21].

The daily consumption of a probiotic product containing *L. gasseri* CECT5714 and *L.coryniformis* CECT5711 for 3 months stimulates, in allergic children, beneficial effects on immune parameters required in the allergic reactions such as a reduction of IgE in plasma and an increase in regulatory T cells. The probiotic product

also improved natural and specific immune parameters that may stimulate the general health condition of children [22]. It may be applicable to allow food labels to indicate that consumption of certain probiotic yoghurt prior to and during the allergic conditions might be beneficial. Probiotic *Bifidobacterium adolescentis* isolate had never been used in yoghurt, but it can be added because of its anti-allergic properties. The yoghurt is tolerated by the subjects, and although it did not have a statistically significant effect on allergy-related quality of life scores, use of antihistamines, or eosinophil cationic protein concentration in nasal lavage, it was found significantly increase serum IL-10 and IL-12 levels during grass allergy season and TGF-b levels during ragweed season [10].

Biola milk and yogurt contained *Lactobacillus acidophilus* LA-5, *Bifidobacterium lactis* Bb12, and *Lactobacillus rhamnosus*, and cultured milk contained *L. acidophilus* LA-5 and *B. lactis* Bb12 were prepared and tested in a research and results showed that parental probiotic milk consumption is related with a statistically significant reduced risk of atopic eczema at 6 months and of rhino-conjunctivitis at 18 to 36 months in the group (86% of subjects) Probiotic enrichment is expected to be of particular importance during the first few months after birth continuous supplementation is been claimed to be necessary to obtain beneficial effects later in childhood probiotic milk consumption in pregnancy is related with reduced risk of atopic eczema by 6 months but not affected atopic eczema at 18 months [23]. Researches were shown that an increasingly important factor in determining if a child develops allergic disease, and the level of complexity and the specific organisms present in the gut microflora. Higher levels of *Bifidobacterium* and group1 lactobacilli (obligate heterofermentative lactobacilli such as *L. acidophilus, L. delbrueckii, and L.helveticus*) in the gut of infant are related with a lower incidence level of allergic disease later in life, and both kefir and kefiran are observed to show these effects on the gut microbiota in animal trials. Enrichment with *Bifidobacterium* is shown to affect the intestinal microflora of infants by reduction counts of *Bacteroides* and is related with lower incidence of food allergy. Studies with antibiotics in the early life are also highlighted the importance of allow microbial stimulation of the immune system for protection against asthma development. Yeasts isolated from kefir have also shown to improve the probiotic properties of bacterial species by supporting the viability of these bacterial strains in simulated gastric and intestinal juice, and through increasing the adhesion of LAB to Caco-2 cells in an *in vitro* model [24].

Conclusion

Probiotic bacteria are claimed to have documented ability to modulate immune host responses, and can also increase antibody production and macrophage producing, inhibit allergic disease symptoms and autoimmune disorders.Probiotics, due to their immunomodulatory advantageous and safety of use are natural alternatives for the prevention and treatment of allergies. It is important to determine the knowledge about their use and to carry out next clinical studies.

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