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Overview on The Use of Probiotic in The Treatment of Atopic Dermatitis

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Abstract. Atopic dermatitis is a condition that reduces the quality of life for those afflicted. This syndrome is often linked to recurrent dermatological infections, heightened allergic sensitivity, and compromised skin barrier integrity. The prevalence of atopic dermatitis ranges from 1% to 20%. Research on probiotics has progressed markedly, showing effectiveness in addressing several conditions, including atopic dermatitis. A multitude of research investigates their effectiveness in treating and easing the symptoms of atopic dermatitis.This review will analyse the importance of probiotics in the management of atopic dermatitis, the possible mechanisms involved, and recent research on the subject.

Highlights:

1. Immune Modulation. Probiotics help balance Th1/Th2 responses and promote regulatory T cells to reduce allergic reactions and inflammation.
2. Clinical Evidence. Multiple studies and meta-analyses support probiotics' efficacy in reducing SCORAD scores and AD severity.
3. Strain-Specific Benefits. Lactobacillus and Bifidobacterium strains show most effectiveness, especially in mixed formulations over monotherapy.

Keywords: Probiotics, Atopic Dermatitis, Inflammation, Allergy, Immune Response

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Introduction

The word "probiotics" refers to live, non-pathogenic microorganisms and their beneficial effects on hosts. The title derives from a Greek phrase meaning "for life." A probiotic is a viable microbe that, when delivered in sufficient numbers, confers a health advantage to the host, as per the latest definition (1).

Probiotics may be ingested as supplements or incorporated into food or beverages, irrespective of their dairy or non-dairy nature. Many fermented foods include live microorganisms that are genetically associated with probiotic strains. Fermented foods may improve nutritional value and effectiveness by converting substrates into bioactive and bioavailable compounds.

Probiotic research has advanced considerably; nevertheless, no major breakthrough in understanding their methods of action has been documented.

Probiotics may benefit human health via many primary pathways, including enhancing intestinal barrier function, synthesising neurotransmitters, competitively eliminating pathogens, and modulating host immune responses (Figure 1) (4).

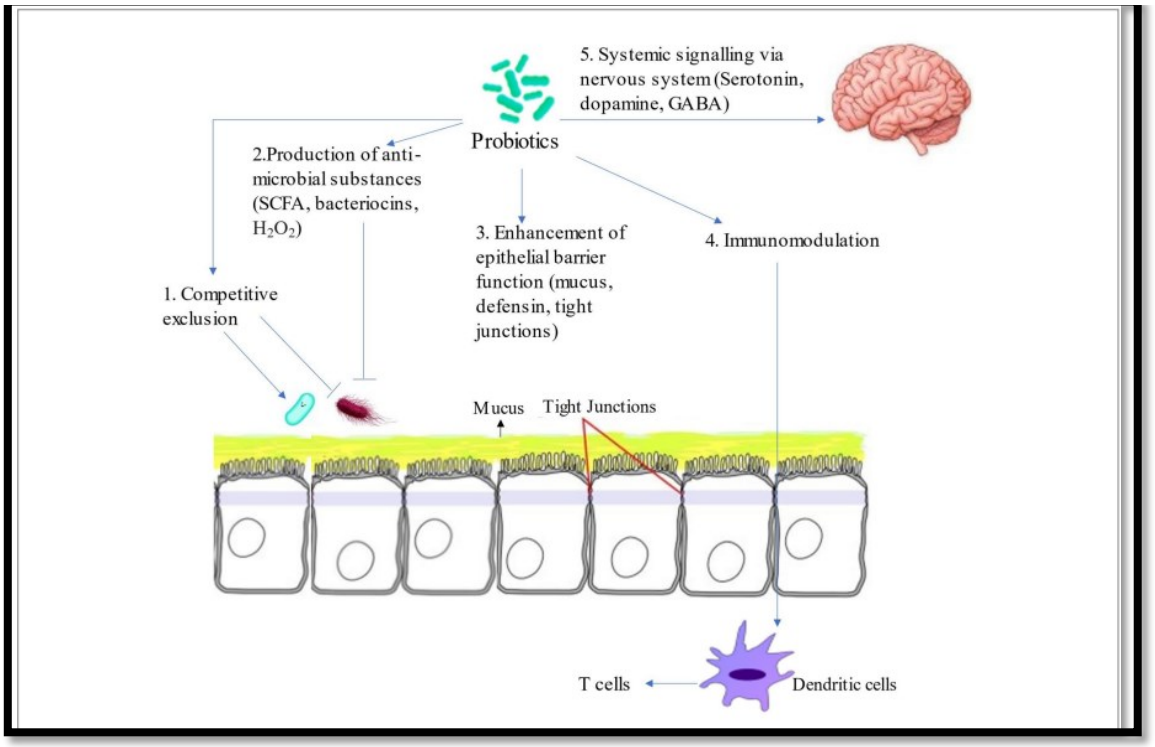

Figure 1. the Mechanisms of action of probiotics (4)

Pathogens have difficulties in surviving inside the gastrointestinal system since

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probiotics compete with them for nutrition and receptor sites (4). Probiotics may function as antimicrobial agents by producing chemicals including hydrogen peroxide, organic acids, bacteriocins, and short-chain fatty acids, therefore reducing detrimental flora in the gastrointestinal system. Moreover, probiotics augment the efficacy of the gastrointestinal barrier by boosting the production of mucin proteins, facilitating the development of tight junction proteins occludin and claudin-1, and modulating the gut's immunological response. Furthermore, probiotics modulate the responses of innate and adaptive immunity by influencing B and T lymphocytes, macrophages, and dendritic cells. Furthermore, probiotics recruit macrophages and mononuclear cells, engage with intestinal epithelial cells, and augment the synthesis of cytokines that suppress inflammation. Probiotics enlist macrophages and mononuclear cells, interact with gastrointestinal epithelial cells, and augment the synthesis of cytokines that alleviate inflammation (7). Moreover, within the gut-brain axis, probiotics may enhance the synthesis of certain neurotransmitters in the gastrointestinal system. Specific strains of probiotics may modify concentrations of gamma-aminobutyric acid (GABA), dopamine, and serotonin, potentially affecting behaviour, mood, gastrointestinal motility, and stress circuits. (8). Probiotics are harmless microorganisms that, when supplied in sufficient quantities and at appropriate periods, confer numerous health benefits to the host. Probiotics may theoretically cause four types of deleterious consequences in susceptible individuals: systemic infections, detrimental metabolic activities, excessive immunological activation, and gene transfer. In actuality, lactobacilli and bifidobacteria, together with probiotics generated from these organisms, are seldom linked to infections in people. This low pathogenicity is constant across all age categories and includes immunocompromised persons as well.

The main difficulty with probiotics in the food sector is their vulnerability to processing conditions and susceptibility to gastrointestinal (GI) stress (10).

Researchers have developed innovative approaches, including nanoencapsulation and genetic modification, enabling probiotics to withstand the harsh conditions seen during processing and inside the gastrointestinal system (11).

Atopic dermatitis:

Atopic dermatitis (AD) is an incurable disease that diminishes the quality of life for those afflicted by it. Atopic dermatitis (AD) is a persistent inflammatory condition of the skin, often linked to a familial history of atopy, including allergies and asthma. This

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condition is often associated with recurrent skin infections, allergy sensitivity, and impaired skin barrier function.(12, 13)

Epidemiological studies indicate that the global prevalence of Alzheimer's Disease (AD) varies between 1% and 20%.(14). Atopic dermatitis typically initially appears between three and six months of age, with around 60% of persons experiencing disease progression during the first year of life, and roughly 90% affected by the age of five years. Patients with atopic dermatitis presenting to the clinic primarily report recurrent pruritus, xerosis, and erythema (15, 16). Multiple established treatment modalities for atopic dermatitis (AD) include allergen avoidance, topical emollient application, promotion of skin hydration, and administration of corticosteroids or antihistamines during exacerbations. Although these therapies may mitigate symptoms, their efficacy is often inadequate, and the recurrence rate remains elevated (17,18).

Significant knowledge remains to be acquired on the principal aetiology of Alzheimer's disease. The result seems to derive from a complex interaction between environmental and genetic variables that undermines the integrity of the epidermal barrier, impairs epidermal differentiation, and disturbs the immune system's balance. The latter is characterised by an imbalance in T helper cell 1 (Th1) and T helper cell 2 (Th2) cytokines, favouring Th2 cell activation, which subsequently leads to IgE production, eosinophil activation, and recruitment. The hygiene theory asserts that a child's susceptibility to atopic illnesses is heightened in the absence of germ exposure throughout their formative years (19). Moreover, superantigen-secreting Staphylococcus aureus colonises individuals with atopic dermatitis at significantly elevated rates, which is associated with the immunosuppressive functions of regulatory T cells. (20).

Role of probiotics in treating atopic dermatitis

Allergy is a hypersensitivity disorder of the immune system characterised by a reaction after an immunological response to a specific antigen. Allergies affect around 50% of individuals in Europe and North America, with a rising incidence. Allergic responses may be induced by many environmental chemicals or antigens (21). Asthma, atopic dermatitis, rhinitis, dermatitis, angioedema, urticaria, hay fever, and hypersensitivity to food, medications, and insects are among the most common allergic reactions (22). The gut microbiota may be a therapeutic target for controlling allergy-related disorders, since it influences immunological and inflammatory responses, hence affecting the development of sensitisation and allergies.

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Allergic diseases are characterised by an imbalance in lymphocyte-mediated immunity, resulting in an excessive Th2 cell-dominated response. Activated Th2 cells in response to allergens produce diverse granular cells, including eosinophils, mast cells, and basophils, which are recruited to the locus of allergy-induced inflammation by interleukins such as IL-1, IL-4, and IL-5. Moreover, the interleukins modify the immunoglobulin isotype of B cells, increasing the concentrations of both total and particular allergen IgE in the bloodstream.(26) Probiotics are expected to improve mucosal barrier functions, although the exact mechanism is not fully understood; they are also thought to strengthen the immune system, reduce antigen translocation across the mucosa, generate cytokines that alleviate inflammation, and enhance the production of IgA (which prevents antigen passage from the intestinal mucosa), degrade food antigens, and increase anti-inflammatory cytokines such as IL-10.27

The suggested mechanism for the anti-allergic effects of probiotics involves the enhancement of Th1/Th2 immunological equilibrium via the diminution of Th2 and the amplification of Th1 cell responses. Probiotics, according to Ma et al. (28), alter the function of dendritic cells, facilitating the generation of peripheral Tregs (regulatory T cells). Tregs regulate Th1 and Th2 cell populations and restrict excessive immunological responses. Moreover, lactobacilli activate regulatory T cells, essential for maintaining a balanced immune response via the production of immunosuppressive cytokines and the regulation of IgA, IgE, and IgG synthesis.As seen in Figure 2.

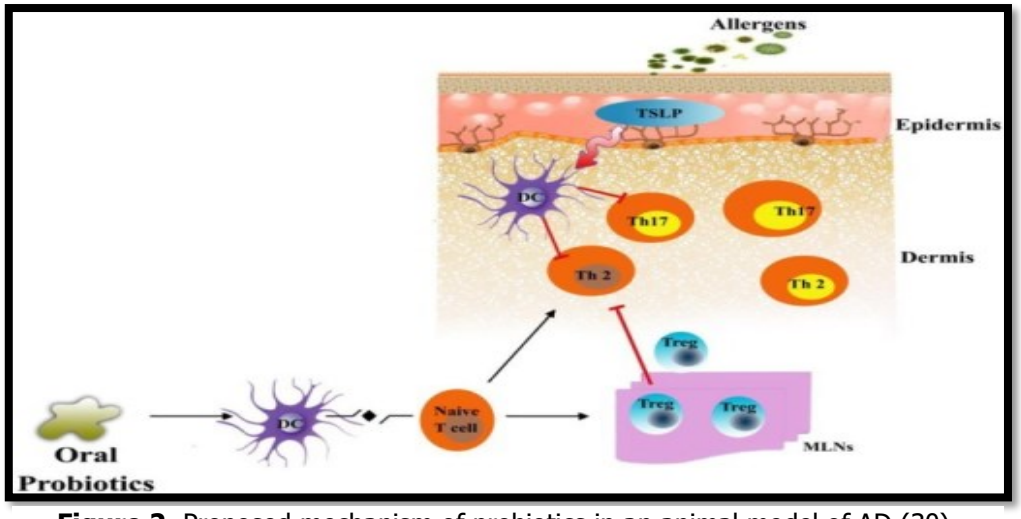

Figure 2. Proposed mechanism of probiotics in an animal model of AD (30).

According to Gerasimov et al., children with moderate to severe AD showed significant improvements when treated with Lactobacillus acidophilus DDS-1 and Bifidobacterium lactis UABLA-12 (Gerasimov et al., 2010) (31).

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In 2012, Y Yeşilova, et al. do a combination of Bifidobacterium bifidum, Lactobacillus casei, Lactobacillus acidophilus, and Lactobacillus salivarius strains were employed in a double-blind, randomized, placebo-controlled research to treat atopic dermatitis in children. Probiotics were found to be useful in lowering blood IgE, IL-5, IL-6, IFN-γ, and Scoring Atopic Dermatitis (SCORAD) (32).

Other research, however, reveals a significant finding from a meta-analysis study that implies the effectiveness of probiotic therapy for primary protection against AD in both the community population and the high-risk community for AD. Additional subgroup analysis show the protective effect of prenatal and postnatal administration of probiotic against the development of AD (33).

The administration of a combination of probiotics as an assisting treatment can be beneficial in lowering the SCORAD index and, consequently, in lowering the usage of steroids throughout AD flare-ups, according to the results of a meta-analysis study, When the groups' baseline SCORAD index reductions were compared, the response rate was statistically significant. (34)

A meta-analysis done in 2022 by Umborowati et al. examined six randomised controlled trials (RCTs) and indicated that probiotics were helpful in treating atopic dermatitis (AD) in elderly individuals, as shown by a drop in SCORAD scores.35 A meta-analysis conducted by Wang et al. included thirty-seven randomised controlled trials, with about 3,145 participants in the control group and 2,986 in the interventional group. Probiotics had superior efficacy compared to a placebo in the prevention of Alzheimer's disease, as shown by the meta-analysis, which reported a risk ratio (RR) (95% CI) of 0.83 (0.73, 0.94) and an I2 of 65.2%. The subgroup meta-analysis indicated that the following groups exhibited enhanced clinical effectiveness in preventing AD: women and children, pre- and post-delivery, Lactobacillus rhamnosus or mixed probiotics, and a follow-up duration of ≤2 years. (36) Numerous factors can boost the reaction to the administration of probiotic administration in AD, treatment period more than 8 weeks could form the useful effect of probiotic usage (37), being older than one year have a superior reaction to probiotics (36,38-40) the severity of AD, moderate to severe patient have a more response,(40) and using a combination of probiotics has useful effects over the use of probiotic monotherapy, particularly when a mixture of lactobacilli and bifidobacteria are included (40-42).

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Conclusions

The researches highlight the importance of incorporating probiotics into healthcare protocols to improve health and prevent diseases. The use of probiotic in AD undervalued area of study and there are many researches that approve their effectiveness. More well-designed, large, strain-specific studies are needed this will put the probiotic in the clinical usage and will decrease the use of corticosteroids in the management of AD.

Conflict of Interest

The authors declares that there are no conflicts of interest regarding the publication of this manuscript.

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