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Probiotics: Necessary Therapeutics for Inflammatory Bowel Disease

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Abstract—*Human gut microbiome harbours a vast range of beneficial microorganism. These beneficial microbes can be introduced in the human gut microbiota in the form of probiotic. Probiotics are single or multi culture of live advantageous microorganism. Most commonly applied microorganisms are Lactobacillus spp. and Bifidobacterium spp. Probiotics plays pivotal role in evoking a better immune response against inflammatory bowel disease (IBD). IBD brings about grievous mucosal epithelium inflammation and this leads to even worse condition defined as chronic IBD. There is no possible cure for IBD available till date. In this review we have attempted to assemble the possible therapeutic characteristics of various probiotic strains. Probiotics have been used as therapeutics for treatment since the organism present in the culture has shown modulation effect on epithelial cells, enhancement of barrier functions, immune system activation. Probiotic spp. has been shown to decrease the level of pathogenic spp. (EPEC) by lowering the level of IL-8 produced by the pathogens. Also, colonisation by Lactobacillus reuteri exhibited a pronounced impact on the chronic IBD. These microorganisms can influence cell to cell interaction and cellular stability by enhancing the barrier function. The mode of action of probiotics is solely based on the local modulation of immune system. And by analysing the available studies we establish that probiotics is worthy tool for inflammatory bowel disease and this area of research should be explored more in quest of finding a perpetual treatment for IBD and other GI tract infections.*

Keywords: *inflammatory bowel disease,probiotics, barrier function, modulation.*

1. INTRODUCTION

Tiny microbes in our microbiome can make a big drastic change in our health. The humangutmicrobiome can be thought of as our neglected organ but their development has a great impact on our GIT & immune system and even on our brain [1]. Microbiota forms mutual relationship with the human host and this helps in maintaining homeostasis by performing essential task. Lactic acid bacteria and bifidobacteria are the commonly used microbes as probiotics [2] and also, they are major patron of human gut microbiota.

Probiotics are the live active culture of beneficial microbes that belongs to the genera *lactobacillus* and *Bifidobacterium* also, these microbes possess powerful anti-inflammatory properties. Certainly, probiotic therapy has captivated research interest in human inflammatory bowel disease [3]. Probiotics have shown benefits in immunomodulation, pouchitis, colon cancer, inflammatory bowel disease.

Inflammatory bowel disease can be classified in ulcerative colitis and crohn's disease [4]. Both the disease is a chronic form of inflammatory bowel disease which shows acerbity of gut mucosa. If this condition left untreated it develops chronic inflammatory bowel disease which can lead to severe inflammation of the mucosa.

Probiotics may wield a protective effect in colitis. Protective bacteria present in the probiotics can exclude the pathogenic bacteria with no deleterious effect [5]. Dysbiosis theory reviewed by tamboli et al, [6] prompted that disturbance between protective and harmful gut microbiota leads to inflammatory bowel disease. and thus, probiotics can be a valuable therapy for the host microbiome [7].

Mechanism of action of probiotics is by modulation of immune system. Benefits of probiotics can be 1) inhibition of noxious bacteria [8]. 2) immunomodulation effect. 3) enhancement of barrier function. 4) immune system activation.

This review paper is concerned about the increasing risk of inflammatory bowel disease and the role of probiotics in its treatment which is the most promising medication with no woe effect.

2. MECHANISM OF ACTION OF PROBIOTICS

Bacterial species or strains exerts different effect (see table 1) on the host microbiome. Some shows antimicrobial activity, whereas, others show immune modulation and enhancement of barrier function.

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TABLE 1. Mechanisms of Action of Proboscis

Antimicrobial Activity Decrease luminal pH
Secrete antimicrobial peptides
Inhibit bacterial invasion
Block bacterial adhesion to epithelial cells
Enhancement of Barrier Function
Increase mucus production
Enhance barrier integrity
Immune modulation
Effects on epithelial cells
Effects on dendritic cells
Effects on monocytes/ macrophage
Effects on lymphocytes
B lymphocytes
NK cells
T cells
T cell redistribution

Table 1 shows effect of probiotic bacteria onto human host (adapted from Mechanisms of Action of Proboscis: Recent Advances, S.C. Ng, MRCP,* A.L. Hart, PhD,* M.A. Kamm, MD,† A.J. Stagg, PhD,‡ and S.C. Knight, PhD*)

The precise function of proboscis in host still remain unclear but there is evidence which provides us information about immune modulation and enhancement of barrier function which shows drastic recovery of the mucosal epithelium [10]

The probiotic bacteria *lactobacillus casei* plays a role in innate immune response which increased the production of interleukins [12] and lactic acid bacteria increase the number of secretory IgA antibodies [13]. Lactic acid bacteria also prevent from enteric infections and thus, it is administered orally.

3. IMMUNE MODULATION

Proboscis has a presumed effect on the mucosal immune system (see figure 1). Proboscis modulate humoral, cellular and innate immunity [14]. Role of probiotic bacteria in immune modulation 1) can shape the immune response (see table 2) to the non-inflammatory. 2) down regulation of Th1 cells. 3) activation of IL- 10 and IL-12 which is shown by dendritic cells.

Robotic bacteria act as a commensal organism which is recognized by toll like receptor (TLR's) which induces epithelial cell proliferation and prevent apoptosis [15].

Lactobacillus acidophilus & *Bifidobacterium bifidum* increase the number of plasma cells producing sIgA antibodies [16] and increase in its number has shown that it significantly decreased the number of enteric pathogens.

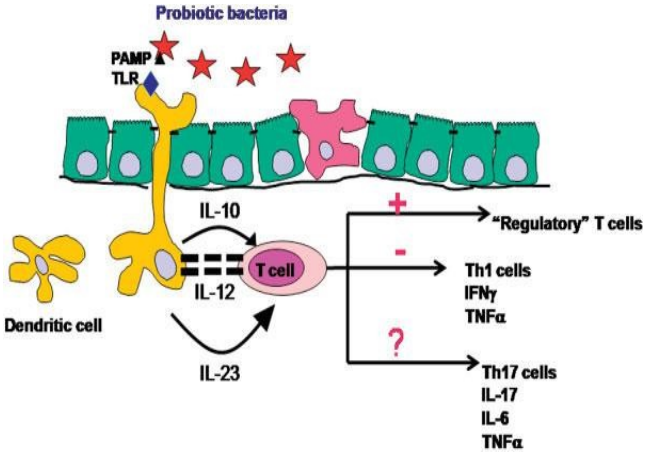

Figure 1 shows immunomodulation by probiotic bacteria(adapted from Mechanisms of Action of Probiotics: Recent Advances, S.C. Ng, MRCP,* A.L. Hart, PhD,* M.A. Kamm, MD,† A.J. Stagg, PhD,‡ and S.C. Knight, PhD*)

TABLE 2: MODULATORY RSPONSE BY DIFFERENT PROBIOTIC BACTERIA

Probiotic bacteria	Immune response	Effect on
Salmonella pullorum	Attenuates IL-8 production	Salmonella typhimurium
VSL#3 [7]	Delays NF-B activity and lowers the IB level	All pathogenic strains
Lactobacillus rahmnosus	Prevent apoptosis	–
Escherichia coli nissel 1917	Lowers the IL-8 levels	Salmonella dysentriae ,EPEC

4. BARRIER FUNCTION ENHANCEMENT

Enhancement of barrier function (see figure 2) is an imperative defence mechanism. Epithelial barriers provide sIgA and antimicrobial peptides [22]. And probiotics with the help of barrier function enhancement it prevents from colitis, IBD, irritable bowel syndrome etc.

Probiotics enhance barrier functions by influencing cell to cell interaction and also cellular stability. *Lactobacillus plantarum* strains shows the ability to enhance tight junction integrity [17]. Probiotics protect from cytokine and oxidant induced epithelial damage [18].

In rat's *lactobacillus brevis* enhances barrier function by providing mannitol permeability [19]. *Streptococcus thermophilus* and *lactobacillus acidophilus* limits the chloride and water secretion thus making it difficult for pathogens to survive in the gut [20].

In *E. coli* nissel 1917 can counteract the effect of EPEC by affecting protein kinase C signalling [21]. Inflammatory bowel disease causes disruption of epithelial barrier function and treating IBD with probiotics enhances barrier functions.

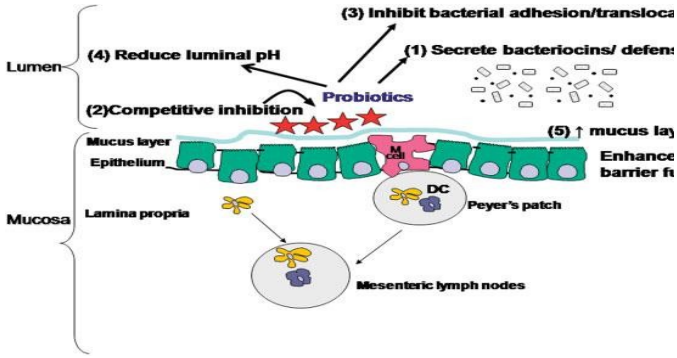

Figure 2: Enhancement of barrier function by probiotics (adapted from Mechanisms of Action of Probiotics: Recent Advances *S.C. Ng, MRCP,* A.L. Hart, PhD,* M.A. Kamm, MD,† A.J. Stagg, PhD,‡ and S.C. Knight, PhD*)*

5. CONCLUSION

Probiotics are the only promising eradication therapy available for inflammatory bowel disease. Probiotics can be used as a therapeutic for the treatment of IBD as well chronic IBD. As it has shown potential to immunomodulation effect as well as intensify the barrier functions. And probiotics are the medication because they magnify the immune response both locally and systematically in both innate as well as adaptive immunity with no side effects. But it is difficult to administer probiotic eradication therapy because each strain has a different immune response to different host. Future studies can help in a evaluate individual microbiome, type of probiotic therapy involved, and their interaction. Probiotics will provide great therapy in coming years.

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