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Review Article: Beneficial Bacteria and Their Effect on The Immune System

Salim Shamkhi Jaafar[1], Ehab Y. Jabber[2]
[1,2]University of Babylon, Iraq

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ABSTRACT

Objective: *This study aimed to show some of the commensal species in the parts of the digestive system and their role in developing the immune system and other functions and their positive effect on the health of the host.* ***Method:*** *Molecular investigations have shown the presence of single, if not dozens of trillions of species, nutrients, and host cells.* ***Results:*** *The commensal bacteria in the digestive system play an important role in modifying and developing the immune system, as they provide environmental requirements of nutrients that protect the mucosal lining of the intestine, which in turn is affected by mutual interactions with the microbes of the digestive system.* ***Novelty:*** *Thus, the digestive system is considered one of the most complex systems due to the continuous interaction between the enormous number of microorganisms.*

INTRODUCTION

The commensal microorganisms in the human body influence various bodily functions, including metabolism, immune system development, and resistance to pathogens [1] Through the interaction between gut microbes and the immune system lining the intestinal mucosa via pattern recognition receptors (Tool-Like) on the surfaces of epithelial cells, the body ensures the integrity of its immune system. These receptors improve intestinal inflammation, help distinguish between beneficial and harmful bacteria, and increase the number of immune cells or their pattern recognition receptors. All of this contributes to the safety and health of the host [2]. The friendly microbes of the gut degrade polysaccharides and indigestible proteins to convert them into short-chain fatty acids and amino acids [3]. Some plant bacteria, in a manner similar to systemic induced resistance (SAR), exert their mechanistic principle, involving recognition of the plant cell surface, stimulation of early cellular immune events, transmission of systemic signals through subtle hormonal interactions, and activation of defense mechanisms [4].

The gut-associated lymphoid tissue (GAL), which belongs to the mucosal-associated lymphoid tissue (MAL), is the largest constituent of the total immune capacity and represents a major source of T and B cells that usually migrate to sites of infection to stimulate the immune response. Dendritic cells have also been found [5].

RESEARCH METHOD

The emergence of intestinal microbes and the factors influencing their emergence

It is known that the fetus is exposed to microscopic organisms, if not non-existent, and the fetus is exposed to microbes before birth. This colonization is extremely important, and researchers have shown that early colonization is extremely important for the establishment of immune systems [6], [7].

The method of delivery is an important factor in the acquisition of microorganisms. Babies born vaginally carry a large number of microorganisms similar to those found in the mother's vagina, while babies born by cesarean section acquire microorganisms similar to those found in the skin and environment [8], [9]. The duration of pregnancy, antibiotic use, and type of diet. Studies have shown that breastfeeding provides infants with more beneficial microorganisms, such as bifidobacteria, than formula-fed infants. [10], The duration of pregnancy also affects the level of beneficial bacteria acquired. Studies have shown that babies born prematurely have lower levels of anaerobic bacteria, such as Bifdobacterium or Bacterodes, and higher levels of pathogenic bacteria, such as *Klebsiella* and *E. coli* [11].

RESULTS AND DISCUSSION

The role of human intestinal organisms in the growth of the immune system:

The commensal intestinal microbes play a major role in the development of the human immune system immediately after birth, as the host provides them with essential nutrients, which in turn maintain the mucous membrane and also break down complex, indigestible proteins and sugars into short chains and essential amino acids, Protecting the mucosal barrier is a major biological task performed by commensal gut microbes, as they compete for space in the intestinal mucus to prevent pathogenic and harmful microbes from adhering. See the figure below. The process of distinguishing between beneficial and pathogenic bacteria is important for the immune system, which attacks harmful microbes and does not attack companion gut microbes that share many commonalities with pathogens, including immune receptors and cell walls, a mechanism called immune tolerance [12].

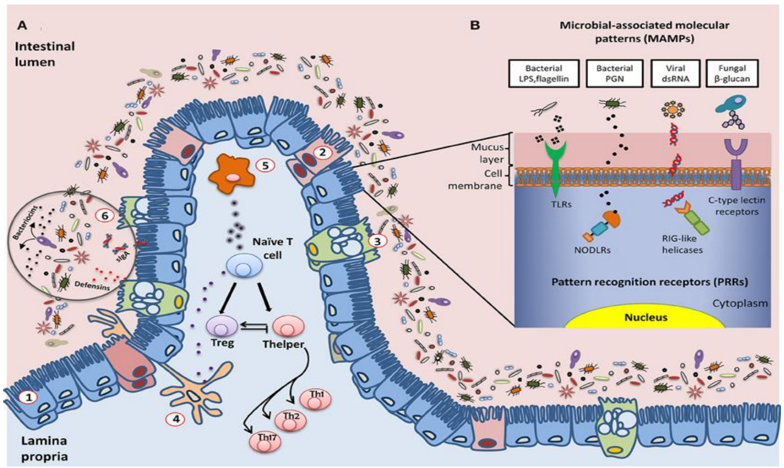

Figure 1. The relationship between intestinal microbial functions and mucosal development.

Gut microbes perform numerous digestive and enzymatic functions, mucus formation, and other functions, such as peristalsis. They also play a key role in the development and differentiation of the immune system. Commensal bacteria have been described as a major component of mucosal immunity, including cellular components and soluble substances. They repel the entry of pathogenic bacteria directly or by transmitting signals and stimulating the immune system [13].

In a study conducted by Vaishnava S and colleagues in mice, intestinal epithelial cells and Paneth cells, which are specialized cells, sense and become activated when there is a massive bacterial invasion, leading to the production of Reg3γ, which is dependent on MyD88. Citation26, Citation27 has been shown to be important in the spatial separation of bacteria and the inhibition of adaptive immunity [14].

The relationship between gut microbes and immune cells

Gut microbes contribute to enhancing innate and adaptive immunity by sending signals to intestinal epithelial cells, which in turn produce thymes stromal lymphpoietin (TSLP) (transforming growth factor beta, TGF-β) and interlukin-25 (APRIL), which influence both adaptive and innate immune cells [15].

The role of short-chain fatty acids in suppressing pathogens:

Short-chain fatty acids help acidify pathogens within cells, providing protection from infection and promoting an oxygen-free environment. This, in turn, leads to pH imbalance, preventing pathogen colonization See the figure below [16].

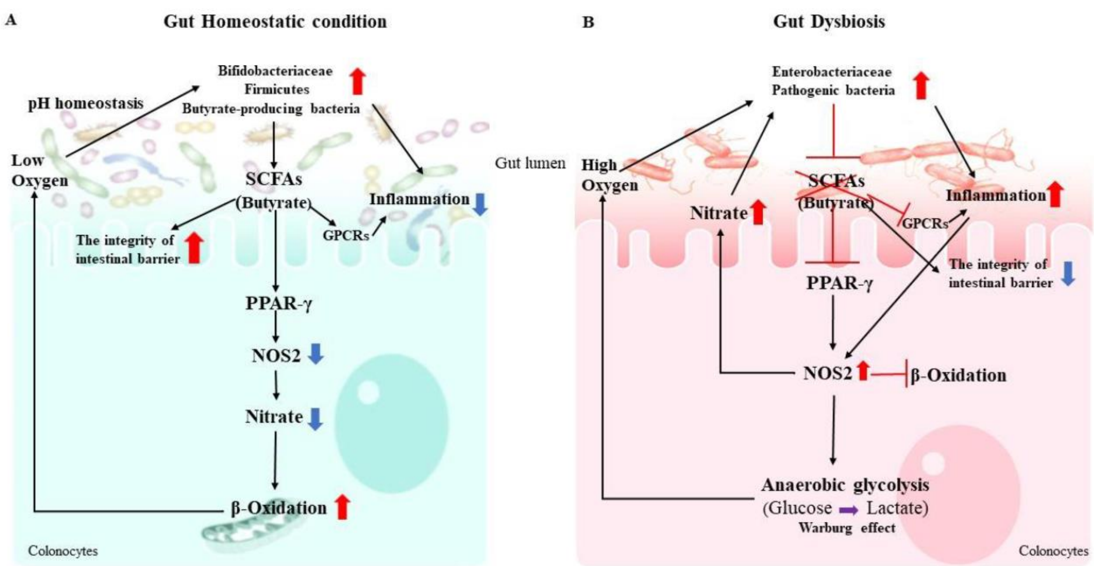

Figure 2. Diagram illustrating the biological processes of the intestinal microbiota [16].

CONCLUSION

Fundamental Finding : The microorganisms that inhabit the digestive system and are associated with it in a symbiotic relationship play a major role in protecting the body from diseases caused by pathogens. This is achieved by stimulating and developing the immune system, or preventing colonization by pathogens through competition for shelter and food. **Implication :** We recommend caring for and preserving them by not using antibiotics that suppress these organisms except after consulting a specialist doctor, and when treatment is urgently needed. The more pathogens there are in the intestine, the more deteriorating the health condition becomes. **Limitation :** It is difficult to restore these communities if they are lost or if the balance between them and pathogens is lost. This highlights the fragility of microbial balance and the challenge in recovering gut health once disrupted. **Future Research :** Other very important factors include encouraging exclusive breastfeeding and trying to avoid or reduce the consumption of fast and processed foods. These factors deserve further investigation to understand their precise role in supporting microbial health and preventing pathogenic dominance in the gut ecosystem.

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Salim Shamkhi Jaafar
University of Babylon, Iraq

***Ehab Y. Jabber (Corresponding Author)**
University of Babylon, Iraq
Email: pre260.ehab.yehaa@uobabylon.edu.iq