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Antagonistic Effect of Probiotics on Recurring Infectious Diseases

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Abstract

Probiotics are normal microbiota that are said to antagonize the activities of microbial pathogens of human through mechanisms such as colonizing and preventing microbial multiplicity in the human body system. This study however reviewed the antagonistic potential of probiotics against recurring infectious pathogens as well as the global threats of antimicrobial resistance using extensive literature search. Based on this study, a number of probiotic strains have been identified with antimicrobial potential against pathogenic organisms and could be helpful in combating the current trends of recurrent infectious diseases and the advent of continuous resistant microbial strains. The study recommends the need to study these beneficial strains at the genomic level and their mechanisms of antagonism on infectious pathogens while further study on discovering more probiotic strains is strongly advocated.
Keywords: Antagonistic; Probiotics; Recurring infectious diseases.

1. Introduction

Probiotics are live microorganisms that are believed to provide health benefits when consumed. The beneficial concept of probiotics was initially introduced in 1980 by Nobel laureate Élie Metchnikoff who postulated that yogurt-consuming *Bulgarian peasants* lived longer [1]. The dependence of the intestinal microbes on food make it possible to adopt measures to modify the flora in our bodies and to replace the harmful microbes by useful microbes has triggered various research to investigate various beneficial microbial strains that could be used in combating the harmful microorganisms.
[2]. Numerous claimed benefits have been attributed to the use of probiotics in different ways, these includes; reducti on of gastrointestinal distress, intensifying the immune system, inhibition of other pathogenic infections and its impact in combating antibiotic resistance, in some microbes. Antibiotics in contrast to Probiotics are class of antimicrobial chemicals which are produced by microorganisms (mainly the saprophytic molds and bacteria of the soil) that are used in the treatment and prevention of bacterial infections. Probiotics substances inhibit the multiplication of various microorganisms or may even destroy these organisms by either interfering with cell wall development or metabolic processes [3]. With the exception of the penicillin and cephalosporin which are produced by molds, all major classes of antibiotics are derived from bacteria.

1.1. Antibiotic Resistance (ABR)

World Health Organization [4] defined antimicrobial resistance (ABR), as the resistance of a microbe to an antimicrobial agent that is effective in treating or preventing an infection caused by that microbe this is a serious health problem. After many years of widespread antibiotic use, bacterial pathogens of human and animal origin are becoming increasingly resistant to many antimicrobial agents. Resistance can happen spontaneously owing to random mutations, to a buildup of resistance over time, or to misuse of antibiotics or antimicrobials, although the latter two pathways are the most important. World Health Organization [5], reported that Resistant microbes become increasingly difficult to treat, requiring alternative medications or higher doses, both of which may be more costly or constitute toxicity.

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1.2. Recurring Infectious Diseases

Out of the total microorganisms of 1000,000,000 only a few of them causes infection; these includes 538 bacteria, 317 fungi, 287 helminthes, 208 viruses and 57 protozoa which indicates that a number of microorganisms are beneficial to humans and can be used in combating some of the emerging diseases [6].

2. Antimicrobial Properties of Probiotics

The use of probiotics in combating infectious diseases is a global approach to control our immediate health challenges as the world encounter new infectious diseases daily. From the perspective of antibiotic use, probiotics have been observed to reduce the risk of certain infectious disease such as certain types of diarrhea, prevention of dental carries and respiratory tract infection [7]. This may be accompanied with a reduced need of antibiotics for secondary infections. Antibiotics tend to be effective against most common diseases, but increasingly resistance is being observed among microbial pathogens and as a result of this, probiotics are specifically selected to help combat antibiotic resistance [2]. Concomitant use of probiotics with antibiotics has been observed to reduce the incidence, duration and severity of antibiotic-associated diarrhea. This contributes to better adherence to the antibiotic prescription and thereby reduces the evolution of resistance. Kivanc, *et al.* [8], reported that the emergence of probiotics have raised arguments on its beneficial effect on human and the extent to which it directly reduce the spread of antibiotic resistance. Probiotic strains maintains a balanced microbiota during antibiotic use and provides opportunities for reducing the spread of resistances and decreases the risk of certain infectious diseases and thereby lower the need for antibiotics as it attack organisms such as *Candida* in a couple of different ways [9]. Firstly they restore intestinal system to balance by replacing the good bacteria that were lost during overgrowth of *Candida* species Anzaku and Pedro [10], thereby keeping *Candida* under control by inhibiting its growth. Yonekura, *et al.* [11], stated that probiotics helps in absorbing and destroying toxins released by certain "bad" bacteria that can make you sick, producing substances that prevent infection, preventing harmful bacteria from attaching to the gut wall and growing there, boosting your immune system, sending signals to your cells to strengthen the mucus in your intestine, which helps it act as a barrier against infection, production of vitamins B. production and bloating. Probiotic strains such as *B. longum, L. acidophilus, L. casei subsp. rhamnosum, and Lactobacillus helveticus* have been reported to portray the ability to induce immunologic response [12].

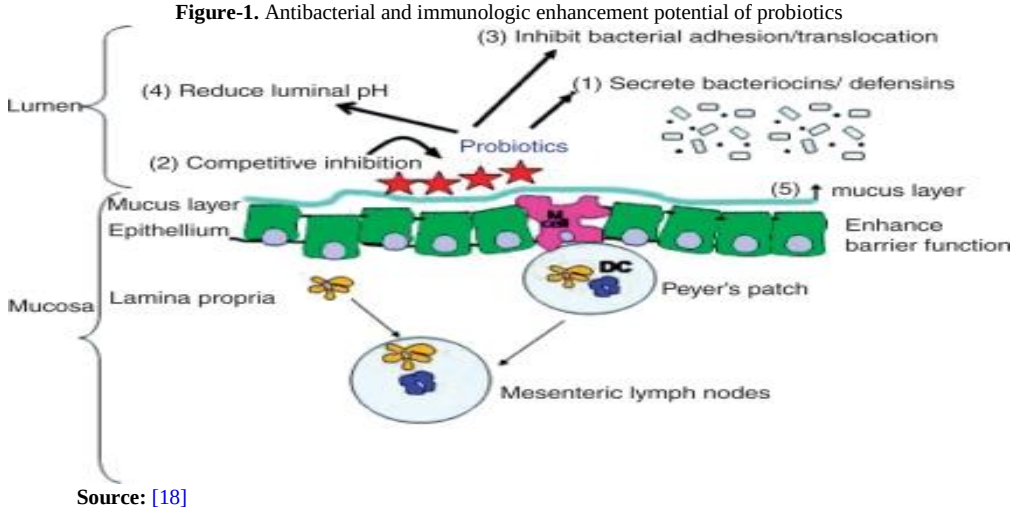
2.1. Immunologic Enhancement

Nagpal, *et al.* [13], reported that probiotics has the ability to enhance phagocytic activity of granulocytes and cytokine excretion in lymphocytes and apparently increasing immunoglobulin-secreting cells in blood. [14] observed increased lymphocyte proliferation in the spleen, peripheral blood, and Peyer's patches and also increased IFN-c production in Peyer's patches and spleen of rats fed yogurt containing *L. bulgaricus 100158* and *S. thermophilus 001158*.

2.2. Anticarcinogenic Properties of Probiotics

According to Goldin and Gorbach [15], introducing *L. acidophilus* into the diet lowers the incidence of chemically induced colon tumors in rat and can significantly lower the generation of carcinogens (cancer induced substances) in the colon and reduce chemically induced tumors [16]. A possible mechanism for these anticancer effects relies on inhibiting intestinal bacterial enzymes that convert procarcinogens into more proximal carcinogens which can be expanded by testing probiotics for their ability to inhibit the growth of organisms normally found [17]. Figure 1 below described the antimicrobial and immunologic enhancement pathway of probiotic strains.

Figure-1. Antibacterial and immunologic enhancement potential of probiotics



Source: [18]

2.3. Health Benefits of Probiotics

However it has only been during the last few years that well designed clinical studies have provided clear evidence of health promoting effects of probiotics such as prevention of antibiotic- associated diarrhoea, treatment of acute diarrhea, inflammatory bowel disease, and eradication of C. *difficile* infection and enhancement of intestinal

immunity [19]. A large number of new lactobacilli strains have been previously isolated from faecal sample were identified by means of genetic analysis, as naturally persisting in the same subjects for several following days. Following phenotypic characterization and *in vitro* evaluation, three strains lactobacilli (*L. paracasei* strain B 21060, *L. paracasei* B21070 and *L. gasseri* strain B21090) have finally selected in view of their use as probiotics.

3. Curbing Antibiotic Resistance with Probiotic Strains

World Health Organization [4] reported that antibiotic resistance (ABR) remain one of the major global health challenges as it threatens the effective prevention and treatment of an ever- increasing range of infections caused by bacteria, fungi, viruses and parasites. World Health Organization [4] cautioned that globally, 480 000 people develop multi-drug resistant TB each year, and drug resistance is starting to complicate the fight against HIV and Malaria as well. Microorganisms that develop antimicrobial resistance are sometimes referred to as "superbugs". Examples of some of these microorganisms are: Methicyllin resistance *Staphylococcus aureus*, Vancomycin resistance *Staphylococcus aureus*, Multidrug resistant Tuberculosis Drug resistant Malaria Beta lactamase producing *Staphylococcus aureus* and Multi-Drug Resistance *Escherichia coli* [20]. Poor infection control, inadequate sanitary conditions and inappropriate food-handling encourage the spread of antimicrobial resistance. The *in-vitro* and *in-vivo* clinical evidence supporting the role of BLPB in the increasing failure of penicillin to resolve such infections and the implications of this phenomenon for the management of infections are discussed. Consumption of probiotics (living micro-organisms), Prebiotics (non-digestible oligosaccharides) and Synbiotics (mixture of probiotics and prebiotics) has been demonstrated to modify the composition of the microflora, restore the microbial balance and therefore have the ability to curb resistant strains such *Helicobacter pylori* and carbapenam-resistant enerobacteriaceae [21]. For a long time colonic microbiota has been considered to play an important role in the maintenance of the health and well-being of the host, promote normal gastrointestinal functions and protecting against pathogenic bacteria as well as exerting beneficial effects on systemic metabolism and immune system [22].

3.1. Properties Essential for Effective and Successful Probiotics

Probiotic strain survives the site where it is presumed to be active and is be able to proliferate and colonize at this specific location and should not be pathogenic, allergic, or mutagenic/carcinogenic [23]. Probiotics for human should have 'generally regarded as safe' status, with a proven low risk of inducing or being associated with the etiology of disease. The probiotic organisms should preferably be of human origin [24], must be able to survive and grow in the in vivo conditions of the desired site of administration, and thus must be able to tolerate low pH and high concentration of both conjugated and deconjugated bile acids. For successful application in foods, the probiotic used should also be technologically compatible with the food manufacturing process [25].

4. Conclusion

Probiotics as microbial strains that plays vital roles in human health as few strains have been identified and proved effective and can be used alongside antibiotics to fight recurring infectious diseases and continuous resistant microbial strains.

Recommendations

Therefore there is a need to search for more strains that can help in fighting some of the trending diseases.

As researchers are ransacking for substances that can help curb some of the emerging and re-emerging diseases caused by microorganisms, focus should also be made to see if these microorganisms can be used in dealing with health challenges caused by various strains of microbes and antibiotic resistance as well. International Society, World Health Organization and all nations of the world should empower researchers, academic institutions and health practitioners with needed facilities and funding in their quest to unveil some of the hidden discoveries.

Literature Search

The literature search was extensively reviewed using Wikipedia, PubMed, Scopus, and Web of Science.

Ethical Consideration

It is not applicable. No human or animal subject was used however, all reviewed articles were properly cited.

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Competing Interests

All authors have declared that no competing interest exists.

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