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Review Article

Probiotic Potential of Lactic Acid to Improve Immunity during COVID-19 Pandemic (A mini Review)

S. Rehan Ahmad[1*] and Pritha Ghosh[2]

[1]Assistant Professor, Dept. of Zoology, H M M College for Women, Kolkata, W.B, India

[2]ICMR - National Institute of Nutrition, Hyderabad, India

*Corresponding Author E-mail: zoologist.rehan@gmail.com

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ABSTRACT

Persons with strong immunity are able to recover any infectious disease conditions within a short period. Main concern of this content is to support the principle that Probiotic (live microorganisms) can stimulate the cell mediated immunity and adaptive immunity. Probiotic microorganisms include Lactobacillus, Bifidobacterium, Streptococcus are safe for human consumption. Curd, fermented milk product commonly known as "Dahi" is a well-known probiotic. Curd is easily fermented from milk of cows, buffalos or goats, soy by lactic cultures and it is inexpensive. Mammalian gastrointestinal tract is the largest immune organ. Probiotics can regulate immune and inflammatory response in the gut through their interaction with intestinal epithelial cells, M-cells in Peyer's patches, and dendritic cells. Not only gut epithelial cells, probiotics also effective for the upper respiratory tract mucosal system. Probiotics can increase intestinal IgA secretion and provide protection against infection. Probiotics maintain healthy intestinal microbiota; reduce the growth of pathogenic bacteria in the gut by producing bactericidal proteins and decreasing luminal pH. Curd has higher content of peptides, free amino acids, antioxidant activity and better protein digestibility than milk due to the proteolysis by enzymes secreted from present microorganisms in curd. However, it is established that the inclusion of curd as a probiotic in our regular diet helps to combat viral and other infectious diseases through enhancing and maintaining the immune system of our body. Curd is one of the worthy, easily available and inexpensive food items to build up immunity against infection.

Keywords: *Immune system, Gastrointestinal tract, Probiotics, Curd, Traditionally prepared, Regular diet, Inexpensive, Easily available.*

INTRODUCTION

As per the *Codex Alimentarius* of the year 1992, it defined Yogurt as product of milk that is made from coagulating the milk, which is a result of the lactic acid being fermented by the bacteria *Streptococcus thermophilus*and *Lactobacillus bulgaricus*. The bacteria *S. thermophilus*and L. *bulgaricus*are able to combine with other LAB (lactic acid bacteria).

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For the yogurt to form, this LAB is required to be present in huge amounts and is required to be alive. It has been more than a millennium that people are using the LABs for the process of producing food and milk products though fermentation. There are numerous types of microorganism that are able to fermentation are present in the products that are fermented and these microorganisms belong to numerous types of species and genera and supposedly produce lactic acids. The composition of mineral and vitamins that are present in the products of milk and in the yogurt are almost similar and has only few differences. The Folic acid is produced after the consumption of the vitamins C and B12 that happens during the time of the fermentation. It is depending on the type of bacterial strain that is used in the process of the fermentation that creates the difference in the yogurt and in the milk of the vitamins present in them.

The bioavailability of some minerals is higher in the yogurt, for example minerals such as calcium, in comparison to the milk, regardless of both the milk and the yogurt having the same composition of minerals. It is even seen generally that the contents of compounds such are free fatty acids, peptides; lactose, free amino acids and lactose are higher in the yogurt than that of the milk. There were various investigators as well who were able to report and study various therapy benefits of the LAB since Metchnikoff was able to discover that the *L. bulgaricus* bacteria was able to suppress different toxins that are present and produced in the intestine of a human body by the putrefactive bacteria. Nevertheless, the studies that were carried out resulted in inconsistency and it was found out that the reason of this inconsistency was due to the various LAB strains and their differences in formulation and the procedures that were used in the process of experimentation. This also resulted in differences in the reports of the therapies that used LAB.

These results in which there were administration of the LAB that were derived from various studies, were generally not used to predict the LABs parenteral administration neither it was used to check the results of yogurt oral consumption. However, these results did show something that was significant, and it showed that the yogurt consumption were able to enhance the response system of the non-specific immunity and acted as responses like antigen specific and adjuvant. It is also argued among scholars and in their studies, which the changes that are induced due to the yogurt consumption in the human body and it gastrointestinal micro ecology is the effect that happens as potential immunostimulatory effect of the therapy that is due to the presence of LAB in yogurt and its consumption. It is even recorded that higher consumption of yogurt can lead in to heightened anti-carcinogenic effects and contributes to the reduction of the infection as the increase in the LAB counts due to consumption, suppresses the pathogenic bacteria's growth. The effect of LAB is dependent on how much there is the chance of contact of the bacteria that colonizes the lumen of the human intestine and are transient along with the tissues of lymphoid and this effect of LAB is also immuostimulatory.

Thus, it is seen that he immunogenicity of the bacteria that are present in the GI tracts is influenced by the ability of the LAB to survive in the GI tract as well. It is the pH value of the gastric inside the GI tract that decides the rate of survival of the LAB in it. Among the genus *Lactobacillus,* the bacteria that has increase resistance towards the juices of gastric in the conventional culture of the lactic is the *L. acidophilus* and *L. bulgaricus*is considered able to resist more than *S. thermophilus.* It was also found that there are four species of *Bifid bacterium* (namely *B. longum, B. adolescentis, B. bifidum and the B. infantis*). Among these four, *B. longum*is the one, which has the most resistance against that of the gastric acids. That LAB which are not dead after the process that takes place in the intestinal GI tracts generally to further survive sticks to the epithelial cells that are present on the GI tract walls and later bind themselves into the M cell's surface in the luminal wall.

It is also shown in the studies of animals that the tissues of lymphoid that have its association with the guts are influenced by the LAB, which survives the GI tract and leads towards immense production of the antibodies and of the cytokines increasing the PP (pathc of the Peyer's) and the cells of the spelocytes. Apart from that, it was also seen that in the human body, with the increase in the consumption of the yogurt, the production of antibodies such as the cytokine, functions of the T cells, activity in the phagocisis and in the activity of cells is enhanced if in vitro is exposed to the LAB. It is also reported that the incidence of diseases such as gastric disorders, symptoms and allergies can also be reduced by the enhancement of the immune system through inducing yogurt in the system.

IMMUNE SYSTEM FUNCTIONS

The significant role of the immunity system is working towards the removal of the foreign microorganism and the viruses that invades into our body, to remove the damaged tissues from our body and for elimination of the neoplasm that are present in our body. The bodies of any healthy human beings have two kinds of mechanisms that provide immunity: firstly, it is the acquired immunity, which is specific towards responding to specific antigens that acts like stimuli and this kind of mechanism keeps on enhancing itself by the repeated exposure. The second kind of immunity is the non-specific or the innate immunity, which does not enhance itself even after getting repeated exposure and it, does not need any kind of stimuli to act on. The mechanism of the innate immune system comprises of physical barriers such as the NK cells or the lymphatic cells, macrophages, monocytes, the cytotoxic and the phagocytic functions that are performed by the neutrophils and the mucous membranes. Based on the responses that are mediated by the components of the immune system the acquired immunity can be divided into two groups. These groups are cell-mediated immunity and the hum oral immunity. The role of the humoral immunity is to recognize specific antigens and to eliminate the extracellular and the foreign antigens in our body. The bone marrow that is derived by the lymphocytes provides the immunoglobulins that mediate the humoral immunity. The T lymphocytes which is derived from the thymus are usually responsible for mediating the cells of the immune system under the cell-mediated immunity. The responsibilities of the cell-mediated immunity is towards tumor immunosurveillance, providing resistance to the body from various pathogens that are present, rejection from the foreign graft and for the reactions of the DTH (delayed type hypersensitivity). Additionally, the non specific immunity also comprises of the macrophages which are extremely significant for the production of the mediators (eicosanoids and cytokines) which regulates immunity in our body and it is also required for the cell-mediated immunity to provide antigen-presenting cells. The functions of the immunity cells are assessed by the numerous in vitro and in vivo developed tests. Even though it can be seen that the responses of immunity in both humans and animals are based on the principles, which are quite similar. However, the measures for the separation of the cells; the varied kind of stimuli that are developed in the in vitro and the kinds of the antigens that are used for the challenge in the in vivo might vary.

Importance of Immunity during COVID - 19 Pandemic:

COVID -19 turned into pandemic and became a major health and economical concern worldwide mainly in low and middle income countries. Now the world is facing a health and economical crisis due to COVID -19 pandemic and it will take a long time to cope with this situation (Akseer et al., 2020). This SARS-CoV-2 infection divided into three stages: 1) an asymptomatic incubation period with or without detectable virus; 2) non-severe symptomatic period with the presence of virus; 3) severe respiratory symptomatic stage with high viral load. We can eliminate the viral and prevent the disease progression to severe stage by boosting adaptive immune response of the human body. Due to impaired immune system

virus multiply readily and cause tissue damage mainly in the organs such as intestine and kidney. Tissue destruction causes inflammation in the lungs due to pro-inflammatory responses by macrophages and granulocytes and leads to severe respiratory disorders in severe stage (Shi et al., 2020). Through dietary modification and proper balanced nutrition we can decrease viral infection risk including COVID-19 and build up our immunity at individual level. To maintain an effective immune system and decrease infection susceptibility, a diet rich in iron, zinc, vitamins A, E, C, B6, and B12, protein should consume adequately (Naja & Hamadeh, 2020)

Overview of the Gut Immune System:

The mammalian gastrointestinal tract is the largest immune organ in the body and primary site of interaction between the host immune system and foreign particle. Intestinal epithelial cells, intercellular tight junctions, and the mucus all together acts as a physical barrier against infection.

Acidic environment (low pH), bile salts, proteolytic enzymes, lysozymes, antibacterial proteins, and dendritic cells (activate T cells) also can decrease microbial load in the intestine. Cytokines, chemokines secreted from epithelia can activate immune cells like neutrophils, macrophages, basophils, T-cells through chemotaxis. Microfold (M) cells, commonly visible over the B-cell follicles surface [Peyer's patches and isolated lymphoid follicles] are effective against pathogenic microorganisms and also induce mucosal adaptive immunity. IgA secreted from gut subepithelial B cells acts as immunological barrier against spreading of enteropathogens and intestinal derived pathogens into circulation (Chassaing et al., 2014).

Role of probiotics in Intestinal immune Function:

The human gastrointestinal (GI) tract contains more than 100 trillion microorganisms including bacteria, yeast, and viruses (Rinninella et al., 2019). Intestinal microbiomes maintain gut functions, integrity, immune homeostasis and host energy metabolism. Changes in gut microbes are very common due to dysbiosis which leads to altered composition and functions of the gut microbiome. Probiotics are living microorganisms that promote gut health through enhancing the functionality of gut microbes, suppression of pathogens, immunomodulation, and stimulating epithelial cell proliferation (Hemarajata & Versalovic, 2013). Gut microbiota can modulate the immune response in Covid-19 through immune homeostasis between overactive and underactive immune responses. Decrease in under reactive immune responses due to reduced anti-inflammatory responses and increase in over reactive immune response due to high response of pro inflammatory substances can lead to clinical adverse effect (Dhar & Mohanty, 2020). Probiotics promote human health through inhibiting the growth of the pathogens, decline luminal pH, reduce their attachment with the intestinal wall, synthesis of organic acids (acetic and lactic acids), and antimicrobial compounds (bacteriocins). Probiotics helps to increase the number of IgA^+ cells and cytokines secretion from T cells in the lamina propria of the intestine which stimulates adaptive immune responses (Maldonado & Cazorla, 2019).

Probiotics are now worldwide commercially available and used through dietary supplements, drugs, functional foods, and beverages, other products products such as skin creams, vaginal capsules and tampons, and chewable tablets for gum health (Fijan et al., 2019). Probiotic strains of the following genera: *Lactobacillus*, *Bifidobacterium*, *Saccharomyces*, *Enterococcus*, *Streptococcus*, *Lactococcus* shows health benefit (Fijan, 2014).

"Curd", a Fermented Milk Product as a Traditional Food:

In India, milk and milk products are widely consumed by all age groups and approximately 9% of it used for fermented milk products of which 77.8% used for direct consumption as "Dahi". "Dahi" is a very popular fermented milk product, prepared from milk of cows, buffalos, goats, soy by mesophilic lactic

cultures such as *Lactococcuslactis ssp. Lactis*, *Lactococcuslactis ssp. Diacetylactis and Lactococcuslactis ssp. Cremoris* (Goyal et al., 2016). In most of the households in India curd is a part of daily diet and prepared by fermentation of milk with an inoculum of previously made curd, is part of the daily diet (Balamurugan et al., 2014). Whole milk curd, skim milk curd, sweet curd, sour curd and sweetened curd are some popular form of curd.

Effects of "Curd" on Human Health:

Fermented milk product "Dahi" plays an important role in human health due to probiotic activity through interaction of ingested life microorganisms with the host. It shows higher concentration of antioxidant than normal milk due to release of bioactive peptides by proteolysis of milk proteins (especially α-lactalbumin, β-lactoglobulin, and α-casein). Milk fat content reduces the antioxidant activity of fermented milk products. Many studies show that curd has better protein digestibility than milk due to proteolysis by enzymes secreted from microorganisms. Proteolysis releases free amino acids and peptides from proteins present in milk, which makes it easily digestible and absorbable.

Curd is antihypertensive because enzymes secreted from microorganisms are able to produce ACE-inhibitory peptides from milk proteins which have blood pressure lowering effects. Patients with lactose intolerance can also consume fermented milk products every day because fermented milk products are able to produce lactase enzymes for lactose degradation(Melini et al., 2019). Yogurts makes some minerals such as calcium, more bioavailable and has also less lactose , more lactic acid, galactose, peptides, free amino acids, and free fatty acid than milk (Meydani, 2017).For beneficial health effect probiotic products which contain 10^8 to 10^9probiotic microorganisms (minimum concentration of 10^6 CFU/mL or gram) should consume daily basis (Kechagia et al., 2013).Daniel J. Lisko et al., showed changes in bacterial composition and structure by three techniques(classical fingerprinting techniques, Sanger analyses and Illumine MiSeq 16S rRNA gene amplicon sequencing) in healthy subjects who consumed high doses of yogurt daily throughout the study (Lisko et al., 2017). Ramadass Balamurugan et al. conducted a study and evaluated home-made curd for lactic acid bacteria (LAB) with probiotic potential. Study showed LAB in curd had probiotic potential properties. Concentration of LAB in curd increased rapidly at 12 h of fermentation at room temperature and declined thereafter (Balamurugan et al., 2014) . Bafna, H et al., conducted a double-blind randomized control trial experiment to check the effect on salivary *Streptococcusmutans* count in high caries risk individuals after short-term consumption of probiotic yogurt containing *Lactobacillus acidophilus* La5 and *Bifidobacterium*lactis Bb12 and the study showed the significant reduction of *S. mutans* in saliva (Bafna et al., 2018) .

Demand of Low cost foods During COVID-19 Pandemic:

In the COVID-19 pandemic situation the world goes through an impending economic crisis and recession due to reduced workforce across all economic sectors and uncountable job loss (Nicola et al., 2020) .COVID-19 will be the biggest public health crisis state since World War II. The COVID-19 pandemic situation affects the global economy and leads to serious implications in socio-economic status and daily lives of mankind commonly in low and middle income countries (Mitra et al., 2020).

Therefore, low cost nutritious foods are very important to maintain a healthy lifestyle for people under lower socio economic status.

CONCLUSION

In this COVID-19 pandemic situation it is very essential to boost the immune function to cope with this pandemic situation. Foods can play a role as an immune booster at the individual level. Food cannot increase our immunity "overnight". It is a long term process to increase our immunity through diet. If our immunity is strong we can prevent or decrease

the severity of the infectious disease. Probiotics like "Curd" is an excellent source to maintain the composition and function of gut bacteria, which is important for our immune system. "Curd" is an easily available, inexpensive, fermented milk product which is commonly consumed by most of the family in India.

Yogurt or as it is commonly called "Curd" in India, not only is filled with the vital proteins and vitamins, but it is also a immense source of those bacteria which are beneficial (probiotic and lactobacillus) for the immune system to keep up with the infections and viruses and it provides boosts in the immune system. With the regular consumption of "Curd" the levels of cholesterol also reduces in the human body and reduces the risks of hypertension and of blood pressure issues thus keeping the heart and the level of cholesterol healthy.

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This study has nothing to do with human and animal testing.

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