International Journal of Early Childhood Special Education (INT-JECSE)
DOI:10.9756/INTJECSE/V14I5.766 ISSN: 1308-5581 Vol 14, Issue 05 2022

Probiotics And Gut Health

Running Title: -Probiotics And Gut Health

Deepak Pathania[1*], Ruhi Bunger[2], Prakriti Vohra[3]
[1]Department of Family & Community Medicine, Prince Sattam Bin Abdulaziz University, Al Kharj, Saudi Arabia. Email- d.pal@psau.edu.sa
[2]Consultant Microbiologist, Shree Krishna Diagnostics, Kaithal, India.
Email- ruhi.dr@gmail.com
[3]Professor, Department of Microbiology, SHKM, GMC, Nalhar, Nuh, Haryana
Email- prakriti.doc@gmail.com

***Corresponding Author: -**Deepak Pathania
[1]Department of Family & Community Medicine, Prince Sattam Bin Abdulaziz University, Al Kharj, Saudi Arabia.Email- d.pal@psau.edu.sa

Abstract:
The growth of flora in gut starts with the birth and within the few initial days of infant life, the gut starts teeming with bacteria**.** The intestinal micro biota exhibits both detrimental and useful effects on human health and hence is the largest source of microbial stimulation. Each year digestive system diseases contribute large numbers of hospitalizations and deaths worldwide. According to the World Health Organization (WHO) estimates, there are about four billion episodes of diarrheal disease annually. Digestive system infections affect people more than other diseases, particularly in developing countries. The health endorsing benefits and usefulness of probiotics like fermented milks, cheese, enriched yoghurt; has been demonstrated in many gastrointestinal diseases.Various research has been conducted to investigate the effects of different probiotic bacteria. More research needs to be done in pre-term and immunodeficient patients for determining the risk of overstimulation (or alteration) of the immune system.

Key words: Probiotics, Gut Health.

Introduction:
The immunity of mammals comprises of complex colonies of cells and chemicals which interact and ward off challenges by pathogenic microorganisms like bacteria and viruses. The intestinal micro biota exhibits both detrimental and useful effects on human health and hence is the largest source of microbial stimulation.The term *PROBIOTICS* is a relatively new word meaning "for life" and is currently used to name bacteria associated with beneficial effects for humans and animals. [1]

WHAT IS A PROBIOTIC?
Probiotics was defined by Fuller in 1989"as a viable microbial dietary supplement that beneficially affects the host through its effects in the intestinal tract ". Initially it was thought to be used as animal feed product. Recently FAO/WHO has defined it as: "Live microorganisms that when being administered in appropriate dose, they confer benefit of health to the receiver. [2]

HISTORY
Fermented milk used for human consumption had been recorded as the first probiotic. After that, probiotics started gaining popularity. The pioneer work on healthy effects of these bacteria has been credited to Metchnikoff from Pasteur Institute in the early 1900s. [3]

CHARACTERISTICS OF GOOD PROBIOTICS
An ideal probiotic agent must be free from disease causing organisms and free from toxins. It must withstand gastric acid /bile and should adhere to gut epithelial tissue and produce antibacterial substances (Figure1).Besides these antibacterial mechanisms, the ideal probiotic must be able to evade the effects of peristalsis, which tends to flush out bacteria with food. This can be achieved either by tethering themselves to the gut or by outgrowing the rate of removal by peristalsis. When probiotics are administered with antibiotics, they increase the efficacy of antibiotics and decrease the side effects of antibiotic therapy. [4]

DOI:10.9756/INTJECSE/V14I5.766 ISSN: 1308-5581 Vol 14, Issue 05 2022

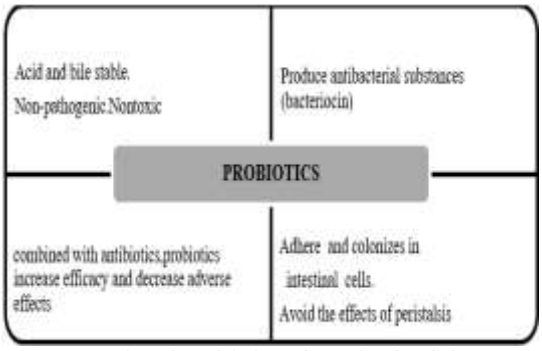

FIGURE 1 PROBIOTICS STRAIN CHARACTERISTCS

GUT FLORA- THE SOURCE OF PROBIOTICS

The growth of flora in gutstarts with the birth and within the few initial days of infant life, the gut starts teeming with bacteria. In majority of breastfed infants, the Bifidobacteria surges rapidly and it constitutes around 80%–90% of the total flora. Whereas, lactobacilli and bacteroides do not rise rapidly,Enterobacteria countsdecrease. Contrary to it, formula-fed infants tend to grow a more complex flora which comprises majorlity of coliforms and Bacteroides, with comparatively lower counts of Bifidobacteria. [5] After introduction of other foods, the gut flora of children begins to resemble that of adults.It has been estimated that human gastrointestinal tract contains about 10^{14} bacteria, with small numbers in the stomach ($<10^{3}$/ml) rising as we go distally where itreaches around 10^{11}–10^{12}/ml in the large intestine. Here the anaerobic bacteriaoutgrow the aerobic bacteriaby 100– 1000 fold. [6]

PROBIOTICS AND GASTROINTESTINAL INFECTIONS

Digestive system infections affect people more than other diseases, particularly in developing countries. Fig 2 shows the list of disorders on which probiotics act.

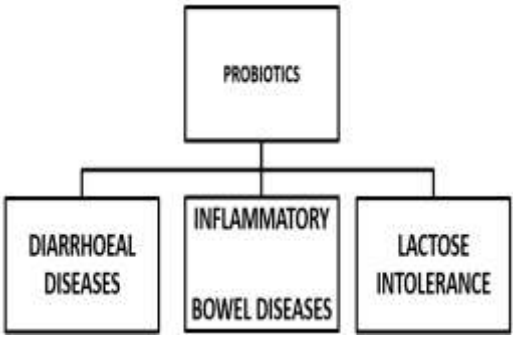

FIG: 2 LIST OF DISORDERS ON WHICH PROBIOTICS ACTS

1) DIARRHOEAL DISEASE

Each year digestive system diseases contribute large numbers of hospitalizations and deaths worldwide.According to the World Health Organization (WHO) estimates, there are about four billion episodes of diarrheal disease annually, anddiarrheal diseases led about 2.2 million deaths in 2004.[7]Treatment of diarrhea and its prevention include probiotics apart from others.

1.1 ANTIBIOTIC-INDUCED DIARRHOEAL DISEASE.

The two most prevalent bacteria implicated in the causation of antibiotic-associated diarrhea (AAD) are Clostridiumdifficile and Klebsiella oxytoca. They act by releasing two exotoxins, toxin A and toxin B. AAD is thought to be caused due tohyperosmolaritydue to undigested carbohydrates and decreased formation of short-chain fatty acids(SFA).[8] Probiotics areeffective in prevention of AAD as they steady the microbial population in the large intestine by reinstatingnatural flora and by stimulating the immune system.

1.2 TRAVELLER'S DIARRHOEA: Numerous microbes can cause traveler's diarrhea, notably implicated is the Enterotoxigenic E. coli (ETEC).The two known Enterotoxins produced by ETEC are heat-labile enterotoxin (LT) and heat-stable enterotoxin (ST). [9]LT acts by increasing the level of cyclical AMP (cAMP) in colonic mucosal cells thereby leading to an increased excretion of variouselectrolytes and water (diarrhoea).ST acts by increasingthe levels of cyclical GMP (cGMP), leading to diarrhoea. Lactobacilli are most commonly used in the prevention of traveler's diarrhea

1.3 ACUTE DIARRHOEA CAUSED BY ROTA VIRUS

Rotavirus predominantly infects intestinal epithelial cells of the ileum.Malabsorption occurs because of the destruction of gut cells called enterocytes. They stimulates the overgrowth of urease producing bacteria. Urease is an enzyme which as an inflammatory mediator that leads to destruction of gut mucosa by ammonia-induced pathways. The Probiotics appeared to normalize fecal urease concentration, thereby stabilizing the gut microbial environment. [10]

1.4 DIARRHEA IN IMMUNOCOMPROMISED SUBJECTS

The most common and serious presentation of human immunodeficiency virus (HIV) infection and cancer patients receiving chemotherapy and radiotherapy is diarrhea. This leads to several changes in the immune system followed by reduction of indigenous gut flora and/or increased opportunistic colonisation of the Candida albicans in gut and other organs. *S.* boulardii, a probiotic bacteria decreases the side effects of the administration of radiotherapy. [11]

2) INFLAMMATORY BOWEL DISEASE (IBD)

IBDencompasses bowel disorders which features inflammation as the main pathology, but where there is no concrete evidence to prove that infection is the responsible cause. Out of many known forms of IBD, the most prevalent ones are ulcerative colitis and Crohn's disease. There are certain common and some diverse features amongst the two.The pathogenesis of IBD is still unclear, but it has multi factorial aetiology. (Figure 3) However, recent evidence suggests the role of gut micro flora in initiation and maintenance of mucosal inflammatory response in IBD.

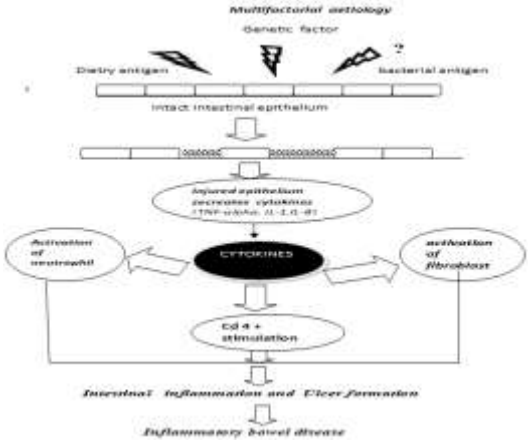

Fig 3: PATHOGENESIS OF INFLAMMATORY BOWEL DISEASES

3) <u>LACTOSE INTOLERANCE</u>

It is a disease affecting humans wherean enzyme named lactase is deficient. Lactase is essential to split the disaccharide in milk to glucose and galactose. Persons havingdeficiency of lactase are not able to digest milk which creates an issue in newborns. Patients having lactasedeficiency experience abdominal discomfort, cramps, diarrhea, and flatulence. As a preventive measure, patients are advised to remain on milk free food items.

There are 3 forms of lactose Intolerance. In primary, lactase enzyme'saction is high at birth, thereafter further decreasing in childhood till adulthood. Secondary forms of lactose intolerance may be due to inflammation or functional loss of the small intestinal mucosa and by protein-energy malnutrition. While some forms are transient,others are irreversible. [12]Thirdly, congenital lactose intolerance, presents as a autosomal-recessive genetic disease. It presents right after birth where affectedinfants are affected by diarrhea after their first feed. [13]

4) <u>H.PYLORI GASTRITIS</u>: As per an estimate, fiftypercent or more of the world's human population is infected by H. pylori. [14] Any alterations in the resident micro flora in the mucosal layer of stomach contribute to the development of ulcers. Probiotics may help prevent or treat *Helicobacter pylori* infections implicated for type B gastritis, peptic ulcers and carcinoma of stomach.[15]Research has shown that probioticsnot only eradicate H. pylori, but they may increase the efficacy of antibiotics to kill H Pylori.

MODE OF ACTION OF PROBIOTICS

There are various proposed mechanisms by which probiotic may protect the host from intestinal disorders (fig 4).They have an bactericidal effect by affecting micro flora, secreting substances that thwart microbial growth, competing with pathogens to prevent their adhesion, competing with nutrients required for sustainence of pathogen,acting as antitoxin and reversing some of the results of infection on the gut epithelium – such as secretory changes in intestine and migration of neutrophils. [16] Inhibitory substances such as organic acids, hydrogen

peroxide and bacteriocins inhibits bacterial metabolism or toxin produced by bacteria.They also do the blockage of receptor sites by competitive inhibition for bacterial adhesion sites on intestinal epithelial surfaces. [17] In addition to that Probioticsalso competes with pathogenic microorganisms for the nutrition. In case of C. difficile infection, probiotic strain ofS. boulardii protects through destruction of receptors of toxins on the intestinal mucosa.Other proposed mechanisms include strengthening tight junctions between enterocytes, increasing IG-A production and stimulation of specific and nonspecific immunity. [18]

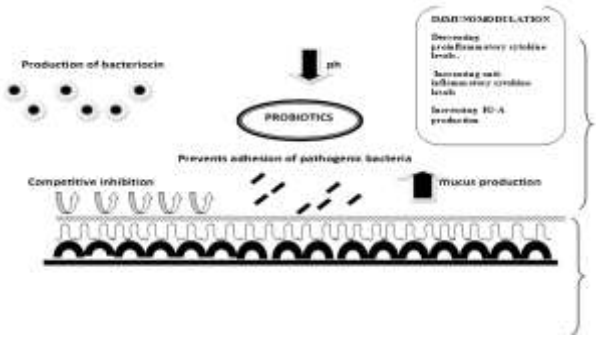

Fig 4-Mechanism of action of Probiotics

In total, probiotics are presumed to generally affect the digestive tract and the associated CD (local) immune system. Various research have been conducted to investigate the effects of different probiotic bacteria. The results from these research have clearly enunciated that different strains of lactobacilli induce very different effects. It has also been seen that effects found in a certain human population with one strain of bacteria can often not be reproduced in other population group. This makes it very difficult to get a final overall conclusion.

FUTURE OUTLOOK AND CONCLUSION

The health endorsing benefits and usefulness of probiotics likefermented milks, cheese, enriched yoghurt; has been demonstrated in many gastrointestinal disease.They are currently available as capsules, and powders. Many companies are planning to introduce them in fermented vegetables and meats.

Probiotics seem to have beneficial effects in some diarrheal and inflammatory conditions in the gastrointestinal tract, where there seems to be an imbalance between `good' and `bad' bacteria. Until now, only a few small studies have been undertaken to define the role of Probiotics in clinical practice, the results of which are encouraging.The advantage of these products includes ease of administration, low cost, and good safety profiles.The mode of action and the optimumschedule – such as type of strain, number of bacteria per dose and frequency and duration of dosage are not known. The second biggest concern is the quality control during the production of the commercial probiotics supplements. The contents of the products and the indications must be properly shown on the labels. It needs legislative requirements. More research need to be done in pre-term and immunodeficient patients for determining the risk of overstimulation (or alteration) of the immune system.

Acknowledgement: This publication was supported by Deanship of scientific research at Prince Sattam Bin Abdulaziz University, Al Kharj, Saudi Arabia.

BIBLIOGRAPHY

1. Fuller, R. Probiotics in man and animals. J. Appl. Bacterial. 1989.66: 365-369.
2. Food and Agriculture Organization, World Health Organization. The Food and Agriculture Organization of the United Nations and the World Health Organization Joint FAO/WHO expert consultation on evaluation of health and nutritional properties of probiotics in food including powder milk with live lactic acid bacteria. FAO/WHOReport No. 10-1-2001.
3. Fuller, R. Probiotics in human medicine. Gut.1991:32; 439–442.
4. Gotteland M, Brunser O, Cruchet S. Systematic review: are probiotics useful in controlling gastric colonization by Helicobacter pylori? Alimentary Pharmacology Therapeutics.2006; 23(8):1077-1086
5. Yoshioka H, Iseki K, Fujita K. Development and differences of intestinal flora in the neonatal period in breast-fed and bottle fed infants. Pediatrics.1983;72:317–321.
6. Campieri M, Gionchetti P. Probiotics in inflammatory bowel disease: new insights to pathogenesis or a possible therapeutic alternative. Gastroenterology.1999; 116:1246–9.
7. The World Health Organization (WHO) Website [http: //www.who. int /healthinfo /global_ burden _ disease/GBD_report_2004update_part2.pdf].
8. Seki H, Shiohara M, Matsumura T, et al. Prevention of antibiotic-associated diarrhea in childrenby Clostridium butyricum MIYAIRI. Pediatr Int. 2003; 45:86–90.

9. KarchH,TarrP,Bielaszewska M(2005)."Enterohaemorrhagic Escherichiacoli inhuman medicine". IntJMedMicrobiol 295 (6-7):405–18.
10. Isolauri E, Kaila M, Mykkanen H, Ling WH, Salminen S. Oral bacteriotherapy for viral gastroenteritis. Dig Dis Sci 1994; 39:2595-600
11. Pergolizzi S, De Renzis C, Famularo G. Prevention of radiation-induced diarrhea with theuse of VSL#3, a new high-potency probiotic preparation. Am J Gastroenterol.2002; 97: 2150–2.
12. Vogelsang H, Ferenci P, Gangl A. Die Laktoseintoleranz. (Lactose intolerance.) Ernährung1987; 11:339–43 (in German).
13. Johnson JD. The regional and ethnic distribution of lactose malabsorption. Adaptive and genetic hypotheses. In: Paige DM, Bayless TM, eds. Lactose digestion. Clinical and nutritional implications. Baltimore: Johns Hopkins University Press, 1981:11–22.
14. Suerbaum S, Michetti P. Helicobacter pylori infection. N Engl J Med 2002; 347(15):1175-86.
15. Pantoflickova D, Corthesy-Theulaz I, Dorta G, et al. Aliment. Pharmacol Ther, (2003)18:805.
16. Michail S, Abernathy F, Lactobacillus plantarum reduces the invitro secretory response ofintestinal epithelial cells in enteropathogenic Escherichia coli infection, J PediatrGastroenterol Nutr, 2002; 35:350–55.
17. Kleeman, E. G. & Klaenhammer, T. R. (1982) Adherence of Lactobacillus species to human fetal intestinal cells. J. Dairy Sci. 65: 2063–2069.
18. Saavedra, J. M., Bauman, N. A., Oung, I., Perman, J. A. & Yolken, R. H. (1994) Feeding of Bifidobacterium bifidum and Streptococcus thermophilus to infants in hospital for prevention of diarrhoea and shedding of rotavirus. Lancet344: 1046–1049.