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## Probiotic Milk- A Review

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### Review Article

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#### ABSTRACT

In the current century, probiotic food and drinks are playing a major role in maintaining a healthy lifestyle for people. Various factors like edible chemicals, GMOs, stress are killing the gut flora which otherwise is important for a healthy digestive system. Probiotics are nothing but food or drinks inoculated with microorganisms which play a crucial role in maintaining nourishment and vitality of our body. These microbes help in processing vitamins and invigorate insusceptible cells. The micro flora benefits us by balancing lactose intolerance, cholesterol, bacterial vaginosis etc. Along with benefits there are also various side-effects which hinder the growth of the probiotic market. The use of excessive sugar, skim milk, the plastic packaging of probiotic supplements and flavoring agents raises a question mark on its benefit and efficacy. But with the advancement of research in the field of Probiotic supplements, the consumption and market shows a positive growth trend in the near future. According to analysts, it is estimated that the Global market will reach up to USD 46.55 billion by 2020. Thus the market for probiotics is highly competitive and promising in the coming time.

#### INTRODUCTION

The World Health Organization's (WHO) 2001 meaning of probiotics is "live small scale living beings which, when directed in sufficient sums, give a wellbeing benefit on the host". Tailing this definition, a working gathering assembled by the FAO/WHO in May 2002 issued the "Rules for the Evaluation of Probiotics in Food". Probiotics are a progression of lactic corrosive microscopic organisms, *bifidobacteria*, *enterococci*, *propionibacteria* and even yeasts, which advance solid impacts when ingested. They are conveyed on business sector in containers, powders, enhanced yogurts, yogurt-like items and milk. Most probiotic strains can be suddenly discovered either in the human body, as a component of the commensal vegetation or in dairy items around the world [1-5]. The World Health association (WHO) and the Food and Agriculture Organization (FAO) inferred that probiotics can be for the most part

viewed as sheltered. The base successful measurement of a probiotic is around  $10^8$ - $10^9$  cells for every day except there is no proof construct agreement with respect to the ideal grouping of microorganism's professional dosage. For the most part, human-gut recuperated lactic corrosive microscopic organisms are announced safe since they may consistently colonize the intestinal tract and evacuate other pathogenic microorganisms shape the gut environment. This objective can be expected likewise to the development hindering pathogenic microorganisms by creating bacteriocins. Regardless of the fact that the impacts of a few strains have not been attractively assessed yet, no firm rules exist for wellbeing testing [6-10].

These days the idea of sustenance has changed from nourishment giving vitality to our body to eating methodologies that convey physiological advantages in administration and counteractive action of infections. Insurance of prosperity for the buyer's requests adjusted nourishing admission for the digestion system of the human body to counteract lack or overabundance of specific segments, and the possibility of practical sustenance was gone before from the aforementioned origination. Verifiably, high admission of sugars, salt, soaked and trans-unsaturated fats, and low admission of filaments, vitamins, and fundamental minerals influence the nutritious condition of populaces. These propensities are the primary bringing about issues of non-transmissible ceaseless degenerative sicknesses. Thus, to lessen the danger of such ailment, the advancement of new sustenance items that contain organically dynamic substances has been proposed and pro-biotification of nourishments is one of the strategies used to deliver such new useful sustenance's. Probiotics speak to the gathering of useful sustenance's, which are characterized as live microbial food that gives an intestinal medical advantage to the host. Various in vitro and in vivo studies are accessible which demonstrates the advantages of probiotic nourishments for people by keeping up or enhancing their intestinal microflora. These small scale living beings have various wellbeing advancing impacts, for example, enhances lactose digestion system, anticipates intestinal tract diseases and upgrade safety, lessens serum cholesterol level animates calcium retention, combination of vitamins (vitamin B, nicotinic corrosive, and folic corrosive), enhances protein digestibility and neutralizes the impacts of sustenance borne pathogens. Probiotic items must be made accessible for purchasers who experience the ill effects of sustenance related issue like lactose narrow mindedness, so they don't need to desert advantages of probiotics. This need has prompted improvement of probiotic items from different nourishment networks including leafy foods. Products of the soil have been recommended as reasonable media for development of probiotics since they inalienably contain key supplements; high measure of vitamins, mineral and polyphenolic mixes, free from allergens and effectively accessible with appealing appearance and taste. The historical backdrop of probiotics can be followed to the main utilization of cheddar and aged items that were surely understood to the Greeks and Romans who suggested their utilization.

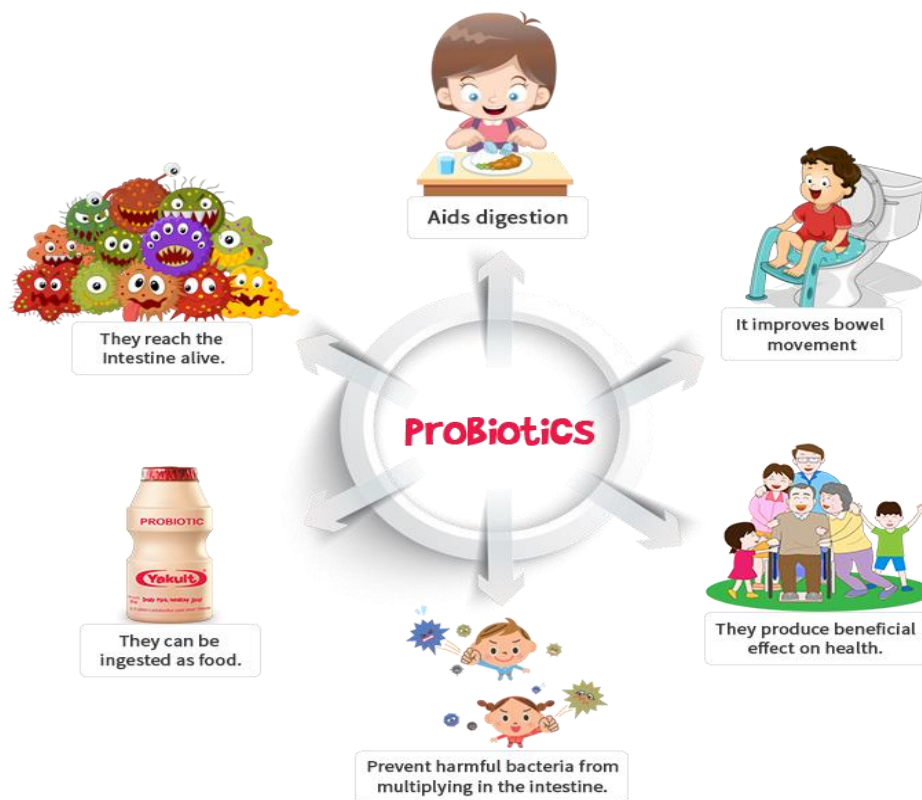
The first cutting edge speculation of the positive pretended by specific microscopic organisms was initially presented by Russian researcher and Nobel laureate Élie Metchnikoff, who in 1907 recommended that it is conceivable to change the gut vegetation and to supplant destructive microorganisms with valuable microorganisms. Metchnikoff proposed the theory that the maturing procedure results from the action of putrefactive (proteolytic) microorganisms delivering poisonous substances in the extensive gut. Proteolytic microbes, for example, clostridia, which are a piece of the ordinary gut verdure, produce lethal substances including phenols, indols, and ammonia from the absorption of proteins. As per Metchnikoff, these mixes were in charge of what he called "intestinal auto-intoxication", which would bring about the physical changes connected with old age. It was around then realized that milk aged with lactic-corrosive microscopic organisms restrains the development of

proteolytic microorganisms as a result of the low pH created by the fermentation of lactose furthermore expands the life range of individuals expending milk aged by *LAC bacillus*.

### PROBIOTIC MILK

Probiotics are helpful microorganisms which are useful for your wellbeing, particularly for your digestive framework and insusceptibility. As indicated by the joint FAO/World Health Organization, Probiotics are characterized as, "Live microorganisms which, when managed in sufficient sums, present a medical advantage on the host". You may consider microscopic organisms being hurtful; be that as it may, there are both valuable and unsafe microbes in your digestive framework. Since advantageous microscopic organisms can process sustenance, assimilate supplements, make vitamins and invigorate safety, it is critical to keep up their number [11-15].

Probiotics expand the quantity of gainful microorganisms and diminishing the quantity of destructive microscopic organisms in your body, therefore help you make the most of your life. In 1930 Dr. Minoru Shirota, a Japanese researcher, was the first on the planet to seclude and culture a probiotic strain which achieved the guts alive in expansive numbers and bestowed medical advantages to the host. He utilized this strain to make Yakult, an aged milk drink, to achieve the advantages of the strain to individuals on the loose (**Figure 1**).



**Figure 1:** Advantages of probiotics in human body.

The Top 7 Probiotic Killers include:

- Prescription Antibiotics
- Sugar
- Tap Water
- GMO Foods
- Grains
- Emotional Stress

- Chemicals and medicines

So as to enhance your gut vegetation parity, make a point to keep away from the probiotic executioners. We are presented to large portions of these sustenance's, poisons and stressors every day, and in case you're going to reestablish your digestive wellbeing, they should be tended to. On the off chance that they're not tended to, your gut smaller scale life forms get to be imbalanced and your framework can turn into a rearing ground for awful microscopic organisms, yeast, infections, growths and parasites. The best way to settle this issue and mend your gut is to dispose of the nourishments those food terrible microorganisms and to begin devouring probiotic-rich sustenance's and supplements.

### Methodology

There are an assortment of nourishments that upgrade gut wellbeing by furnishing you with probiotics and others that work to advance probiotic development and verdure equalization.

A few variables must be considered when utilizing probiotic microbes as a part of aged items like yogurt. Essentially, the probiotics must be reasonable and present in high number at time of utilization to accomplish the sought advantages. In this way, a probiotic dairy item ought to contain no less than 6-7 Log cfu.g - 1 of reasonable probiotic microscopic organisms at the season of utilization and ought to be devoured frequently in an amount of higher than 100 g for every day as such no less than 9 Log CFU every day. The expansion of prebiotic sources, for example, inulin has likewise been appeared to enhance the dependability and tactile portrayal of matured milk items [15-20].

Determination criteria as to the choice of the fitting probiotic microscopic organisms and strains are: a) The particular microorganisms must be accounted for in the writing, b) There ought to be solid confirmations of their help to wellbeing c) They must have the capacity to colonize in gastrointestinal track and have an administrative part in microbial parity here, d) keeping in mind the end goal to manage their feasibility in gastrointestinal conditions, they must be impervious to low pH qualities and bile salt e) They need to possess normal anti-infection impact, to counteract pathogen development with their antimicrobial action f) They must be sheltered to devour and demonstrate no anti-infection resistance g) They must be appropriate for commercialization. The conceivable collaborations among the probiotic strains chose to fabricate of dairy item ought to be checked to choose the best combination(s) and to streamline their mechanical execution all the while and their survival in the items amid icy storage [21-25].

Presentation to oxygen may impel an absence of usefulness of probiotic dairy items in light of the fact that the anaerobic digestion system of probiotic microscopic organisms bargains amid storage the upkeep of their practicality to give advantages to shopper wellbeing. The introduction to oxygen along the refrigerated storage constitutes a mechanical test concerning the upkeep of the probiotic dairy items, once an extraordinary part of the probiotic microorganisms develop in anaerobic frameworks. Glucose oxidase which is a chemical delivered by organisms such as *Aspergillus* and *Penicillium* can constitute a potential other option to expand the survival of probiotic microscopic organisms in matured milks [25-30].

Probiotic bacterial strains are *Lactobacillus acidophilus* (**Figure 2**), *Bifidobacterium ssp*, *Lactobacillus casei*, *Enterococcus faecium/Enterococcus faecalis*, *Lactobacillus rhamnosus*, *Streptococcus thermophiles*, *Saccharomyces cerevisiae boulardii*, *Propionibacterium species*, *Lactobacillus gasseri* etc.



**Figure 2:** Probiotic effect of *Lactobacillus acidophilus*.

Probiotic milk is a type of fermented dairy product and the above bacterial strains are used as culture. In the fermented milk production, milk is heat processed at 95 °C and goes through homogenization. Later, it is cooled to 37 °C and inoculated with 2-5% commercial strain pure culture and left for incubation for 12-24 hours. Following incubation, milk is cooled to 5 °C and kept under cold conditions. However, in some milk productions, milk goes through the heat process at above 120 °C and then cooled and inoculated with 2-5% commercial strain pure culture. The purpose of using high temperatures is to eliminate competition and better bacterial growth. In the production of unfermented milk, commercial strain pure culture is inoculated to cold milk (5-7 °C) and milk is kept under cold conditions.

For e.g. Bifidus milk is the first infant product produced with *Bifidobacteria bifidum* and *Bifidobacterium longum* isolated from healthy humans faeces [31-35]. They form L (+) lactic acid. Milk is standardized and homogenized and kept at 80-120 °C for 5-10 minutes. Then, 10% bifidobacteria culture is inoculated to milk and the milk is left for incubation at 37 °C until coagulation. Once it reaches to a pH value of 4.3-4.7, incubation is ended. It is packed and kept in cold conditions. The final product contains 10<sup>8</sup>-10<sup>9</sup> CFU/ml bacteria.

Acidophilus-Bifidus milk, also known as AB culture, is a fermented dairy product which is produced with *L. acidophilus* and *Bifidobacterium* ssp. It contains high levels of viable bacteria with 1:1 bacteria ratio. Bifidus milk is easy to digest and is still used for the treatment of gastrointestinal and liver diseases and for constipation [35-40].

### **Benefits**

Your digestive framework is home to trillions of microscopic organisms, some are useful and some are hurtful. Valuable microbes can help processing, make vitamins and invigorate insusceptible cells. Unsafe microscopic organisms exasperate the action of the valuable ones and produce hurtful substances that influence your wellbeing.

Unequal eating regimen, high stretch, less rest, and absence of day by day activity would all be able to put your digestive framework out of equalization, which then gives hurtful microbes the chance to increase. Subsequently, you may experience the ill effects of poor absorption or frail resistance.

Probiotics are amicable microbes that live in our digestion tracts. The gut contains 70 percent of our body's invulnerable tissue so a sound gut is essential for solid resistant capacity. Probiotics keep the cells of the colon

solid, advancing great absorption [41-45]. Things like anxiety, absence of rest, drug and disease can divert from the proportion of good to awful microscopic organisms in the guts which can prompt general wellbeing and digestive issues. This microscopic organisms keeps the cells that line the gut sound, they create vitamins and produce lactase, a chemical that separates milk.

Probiotics may appear to be new to the nourishment and supplement industry, yet they have been with us from our first breath. Amid a conveyance through the birth channel, an infant gets the microbes *Bacteroides*, *Bifidobacterium*, *Lactobacillus* [45-50], and *Escherichia coli* from his/her mom. These great microorganisms are not transmitted when a Cesarean area is performed and have been appeared to be the motivation behind why a few babies conceived by C-segment have hypersensitivities, not exactly ideal invulnerable frameworks, and lower levels of gut microflora [51].

As per analysts, other medical benefits of Probiotics could be:

1. Anti-microbial related looseness of the bowels (AAD): Probiotic treatment may decrease the rate and seriousness of AAD as showed in a few meta-examinations. For instance, treatment with probiotic details including *L. rhamnosus* may decrease the danger of AAD, enhance stool consistency amid anti-infection treatment, and upgrade the safe reaction after inoculation.
2. Bacterial vaginosis: Probiotic treatment of bacterial vaginosis is the application or ingestion of bacterial species found in the sound vagina to cure the disease of microscopic organisms bringing about bacterial vaginosis. This treatment depends on the perception that 70% of sound females have a gathering of microbes in the sort *Lactobacillus* that rule the number of inhabitants in creatures in the vagina.
3. Cholesterol: Preparatory human and creature examines have exhibited the viability of a few strains of lactic corrosive microorganisms (LAB) for lessening serum cholesterol levels, probably by separating bile in the gut, accordingly repressing its reabsorption (where it enters the blood as cholesterol).

#### **Side effects**

Probiotics side effects which occurred are tend to be mild and digestive (such as gas or bloating). More serious effects have been seen in some people. Probiotics might theoretically cause infections that need to be treated with antibiotics, especially in people with underlying health conditions. They could also cause unhealthy metabolic activities, too much stimulation of the immune system, or gene transfer (insertion of genetic material into a cell). The manipulation of the gut microbiota is complex and may cause bacterial-host interactions. There are many pros for consuming probiotic drinks but along with that there are some consequences also, which encourages us to avoid them. The following reasons can be:

1. Sugar: Everyone knows the harmful effects of sugar in our diet and that most people are consuming for too much. A standard probiotics drink has 10.2 grams of sucrose per serve i.e. 2.5 teaspoons of pure sugar.
2. Skim milk powder: Skim milk powder is a horrible food source not only because all the nutritious fat has been 'skimmed off', but because of the heat treatment the milk receives to turn it into the powder form. This turns a healthy nutritious food into a inflammation health bomb.
3. Ultra heat treated: High temperature treatment of milk destroys milk proteins and can lead to auto immune issues. Rapid heat treatments like pasteurization, and especially ultra-pasteurization, actually flatten the molecules so the enzymes cannot do their work.
4. Homogenization: Homogenization destroys milk molecules. Milk companies use homogenization to ensure a consistent texture. They literally blend the milk and cream from the cow's milk to produce a standard, consistent product.

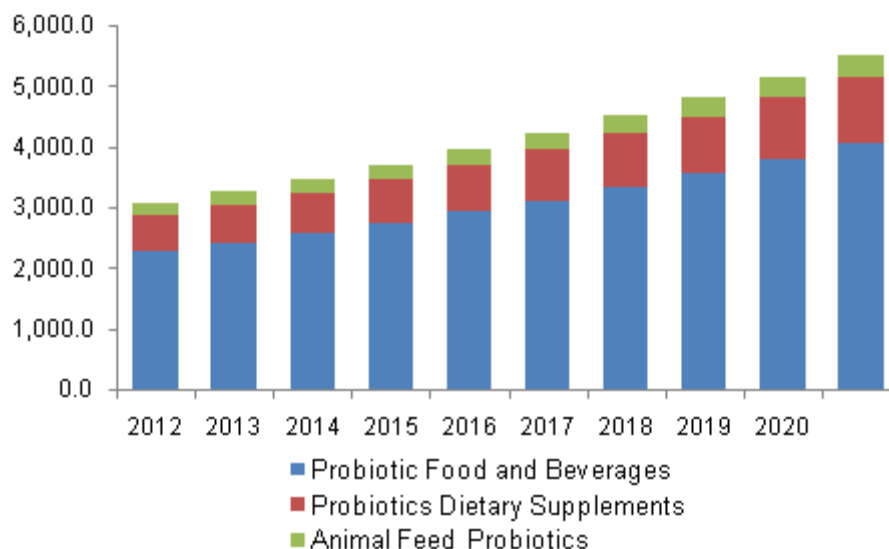
5. Plastic Bottles: Probiotic milk unique-shaped plastic bottles are produced on-site from triple food grade polystyrene pellets using injection blow-molding machines. Pellets are melted and injected under pressure onto 'core' rods. Plastics have been shown to leech into food products and disrupt our endocrine system, impact our hormonal and reproductive systems and have even been linked to cancer and neurological damage.

## MARKET OF PROBIOTICS

The term "functional food", or nutraceutical, is generally used to describe foods enriched with health-promoting ingredients. The area of probiotic products belongs to the functional foods, where research efforts to develop new dairy products are always under way.

The market leaders in nutraceuticals include USA (> 400\$), Europe (>200\$ billion) and Japan. Between 2007 and 2008, the global probiotic market increased from \$14.9 billion to \$15.9 billion with an expected value of \$19.6 billion by 2013. Global probiotics market was valued at USD 32.6 billion in 2013. Consumer tendency to take dietary supplements and consume dairy products mostly across the western countries plays an important role in the industry growth. The growth of global functional industry is expected to drive the demand for probiotics industry. The market for probiotic ingredients is projected to reach USD 46.55 Billion by 2020. In 2015, Europe is estimated to be the largest market for probiotic ingredients. The Asia-Pacific district is anticipated to be the quickest developing business sector during the review period. This development is driven by the expanding customer interest for probiotic fixings in the bakery and confectionary industry, particularly in well developing countries, for example, India and China.

The probiotics market has been studied on four fronts: Application, end use, strain types, and geography. The worldwide probiotics business sector is partitioned on the premise of geography into Europe, North America, Asia Pacific and Rest of the world. Asia Pacific drove the overall probiotics market in 2013 and this area anticipated holding its prevailing position through 2020 exhausting a 7.10% CAGR. The development of this business sector can be credited to the surging interest for probiotics from Australia, Japan, China, and India. Europe is also a major market for probiotics. Germany and France are two of the top performing nations in the area, with the previous growing a 6.80% CAGR over the span of the estimate time frame and the last enrolling a 6.60% CAGR from 2014 to 2020. North America without further ado holds a generally little partake in the universal probiotics market. According to the analysts assessment the locale will enroll solid development throughout the following four years. Germany and France are two of the top performing nations in the area, with the previous growing a 6.80% CAGR over the span of the estimate time frame and the last enrolling a 6.60% CAGR from 2014 to 2020. North America without further ado holds a generally little partake in the universal probiotics market. According to the analysts assessment the locale will enroll solid development throughout the following four years (**Figure 3**).



**Figure 3:** Probiotics market revenue, by application, 2012 – 2020 (USD Million).

Global probiotics market is moderately fragmented with the top five markets participants sharing over 30% of the global industry. The market is highly competitive with frequent mergers, acquisitions and strategic alliances. To gain share, the industry participants are extensively investing in R&D to enhance product portfolio.

### CONCLUSION

According to the above review, it can be determined that Probiotics play an important role in the well-being of human beings in this current stressful lifestyle. These microorganism containing supplements, not only increase the gut flora of our digestive system but also maintain cholesterol, increase immunity and provide other additional health benefits to us. Despite of few harms, the global market of probiotics shows a promising growth curve in the near future.

### REFERENCES

1. Aasen IM, et al. Influence of complex nutrients, temperature and pH on bacteriocin production by *Lactobacillus sakei* CCUG 42687. *Appl Microbiol Biotechnol.* 2000;53:159-166.
2. Suskovic B, et al. Role of Lactic Acid Bacteria and Bifidobacteria in Synbiotic Effect. *Food Technol. Biotechnol.* 2001;39:227-235.
3. Djomne VS, et al. Probiotic properties of lactobacilli strains isolated from raw cow milk in the western highlands of Cameroon. *Innovative Romanian Food Biotechnology.* 2011;9:12-28.
4. Coeuret V, et al. Isolation, characterisation and identification of lactobacilli focusing mainly on cheeses and other dairy products. *Lait.* 2003;83:269–306.
5. Oyetayo VO, et al. Safety and protective effect of *Lactobacillus acidophilus* and *Lactobacillus casei* used as probiotic agent in vivo. *Afr J Biotech.* 2003;2:448-452.
6. Abdelbasset M and Djamila K. Antimicrobial activity of autochthonous lactic acid bacteria isolated from Algerian traditional fermented milk Raïb. *Afr J Biotechnol.* 2008;7:2908-2914.



7. Biller JA, et al. Treatment of recurrent *Clostridium difficile* colitis with *Lactobacillus* GG. *J Pediatr Gastroenterol Nutr.* 1995;21:224-226.
8. Maragkoudakis PA, et al. Probiotic potential of *Lactobacillus* strains isolated from dairy products. *International Dairy Journal.* 2006;16:189-199.
9. Fuller R. Probiotic in man and animals. A Review. *Journal of Applied Bacteriology.* 1989;90:3452- 3453.
10. Helland MH, et al. Growth and metabolism of selected strains of probiotic bacteria, in maize porridge with added malted barley. *Int J Food Microbiol.* 2004;91:305-313.
11. Parvez S, et al. Probiotics and their fermented food products are beneficial for health. *J Appl Microbiol.* 2006;100:1171-1185.
12. Wang IJ and Wang JY. Children with atopic dermatitis show clinical improvement after *Lactobacillus* exposure. *Clin Exp Allergy.* 2015;45:779-787.
13. Ogier JC, et al. Identification of bacterial microflora in dairy products by temporal temperature gradient gel electrophoresis. *J Appl Environ Microbiol.* 2002;68:3691-3701.
14. Rijkers GT, et al. Health benefits and health claims of probiotics: bridging science and marketing. *Br J Nutr.* 2011;106:1291-1296.
15. Svetoch EA and Stern NJ. Bacteriocins to control *Campylobacter* spp. in poultry-A review. *Poult Sci.* 2010;89:1763-1768.
16. Cotter PD, et al. Bacteriocins-a viable alternative to antibiotics? *Nat Rev Microbiol.* 2013;11:95-105.
17. Parada JL, et al. Bacteriocins from lactic acid bacteria: purification, properties and use as biopreservatives. *Braz arch biol technol.* 2007;50:512-542.
18. Williams ST. *Bergeys manual of systematic bacteriology.* Baltimore: Williams and Wilkins. 1989;4.
19. Ogunbanwo ST, et al. Characterization of bacteriocin produced by *Lactobacillus plantarum* F and *Lactobacillus brevis* OGI. *African J Biotechnol.* 2003;2:219-227.
20. Pot B, et al. Chemical Methods in Prokaryotic Systematics. In *Modern Microbiological Methods series.* 1994;5:493-521.
21. Ivanova I, et al. Detection, purification and partial characterization of a novel bacteriocin substance produced by *Lactococcus lactis* subsp. *lactis* b14 isolated from Boza-Bulgarian traditional cereal beverage. *Biocatalysis.* 2000;41:47-53.
22. Tambekar DH and Bhutada SA. An evaluation of probiotic potential of *Lactobacillus* sp. from milk of domestic animals and commercial available probiotic preparations in prevention of enteric bacterial infections. *Recent Research in Science and Technology.* 2010;2:82-88.
23. Oyetayo VO. Phenotypic characterisation and assessment of the inhibitory potential of *Lactobacillus* isolates from different sources *African Journal of Biotechnology.* 2004;3:355-357.
24. Todorov SD, et al. Optimization of bacteriocin production by *Lactobacillus plantarum* ST13BR, a strain isolated from barley beer. *J Gen Appl Microbiol.* 2004;50:149-157.
25. Jeevaratnam K, et al. Biological preservation of foods-bacteriocins of lactic acid bacteria. *Indian J Biotechnol.* 2005;4:446-454.
26. Abd El-Moez SI, et al. Observations on *Lactobacillus* spp. In the Genital Tract of Buffalo-Cows with Emphasis on its In Vitro Probiotic Activity. *Global Veterinaria.* 2008;2:15-21.
27. Shih-Chun Y, et al. Antibacterial activities of bacteriocins: application in foods and pharmaceuticals. *Front Microbiol.* 2014;5:241.

28. Mohammed SD and Ijah UJJ. Isolation and screening of lactic acid bacteria from fermented milk products for bacteriocin production. *Annals Food Science and Technology*. 2013;14:122-128.
29. Gilliland SF and Speck ML. Antagonistic action of *Lactobacillus acidophilus* towards intestinal and food pathogen in associative culture. *J Food Protect*. 1977;40:820-823.
30. Aly EA. Characterization of a bacteriocin-like inhibitory substance produced by *Lactobacillus plantarum* isolated from Egyptian home-made yogurt. *Science Asia*. 2007;33:313-319.
31. Atta HM, et al. Application of biotechnology for production, purification and characterization of peptide antibiotic produced by probiotic *Lactobacillus plantarum* NRRL B-227. *Global J Biotechnol Biochem*. 2009;4:115-125.
32. Lengkey HAW and Adriani L. Effects OF milk fermented with *Lactobacillus acidophilus* and *Bifidobacterium* spp., on lactic acid and acetic acid content and on *Staphylococcus aureus* and *Pseudomonas aeruginosa*. *Biotechnology in Animal Husbandry*. 2009;25:719-724.
33. Jin LZ, et al. Antagonistic effects of intestinal *Lactobacillus* isolates on pathogens of chicken. *Lett Appl Microbiol*. 1996;23:67-71.
34. Ehrmann MA, et al. Characterization of lactobacilli towards their use as probiotic adjuncts in poultry. *J Appl Microbiol*. 2002;92:966-975.
35. Itoh T, et al. Inhibition of food-borne pathogenic bacteria by bacteriocins from *Lactobacillus gasseri*. *Lett Appl Microbiol*. 1995;21:137-141.
36. Heredia-Castro PY, et al. Antimicrobial activity and partial characterization of bacteriocin-like inhibitory substances produced by *Lactobacillus* spp. isolated from artisanal Mexican cheese. *J Dairy Sci*. 2015;98:8285-8293.
37. Bromberg R, et al. Isolation of bacteriocin producing lactic acid bacteria from meat and meat products and its spectrum of inhibitory activity. *Braz J Microbiol*. 2004;35:137-144.
38. Moghaddam MZ, et al. Inhibitory effect of yogurt *Lactobacilli* bacteriocins on growth and verotoxins production of Enterohemorrhagic *Escherichia coli* O157:H7. *Pak J Biol Sci*. 2006;9:2112-2116.
39. Alpay S, et al. Antimicrobial activity and characteristics of bacteriocins produced by vaginal *Lactobacilli*. *Turk J Med Sci*. 2003;33:7-13.
40. Papanthanasopoulos MA, et al. Multiple bacteriocin production by *Leuconostoc mesenteroides* TA33a and other *Leuconostoc/Weissella* strains. *Current Microbiol*. 1997;35:331-335.
41. Cruchet S, et al. Effect of the ingestion of a dietary product containing *Lactobacillus johnsonii* La1 on *Helicobacter pylori* colonization in children. *Nutrition*. 2003;19:716-721.
42. Di Pierro F, et al. Clinical evaluation of the oral probiotic *Streptococcus salivarius* K12 in the prevention of recurrent pharyngitis and/or tonsillitis caused by *Streptococcus pyogenes* in adults. *Expert Opin. Biol. Ther*. 2013;13:339-343.
43. Ejtahed HS, et al. Probiotic yogurt improves antioxidant status in type 2 diabetic patients. *Nutrition*. 2012;28:539-543.
44. Floch MH, et al. Recommendations for probiotic use-2011 update. *J. Clin. Gastroenterol*. 2011;45S:S168-S171.
45. Fontana L, et al. Sources, isolation, characterisation and evaluation of probiotics. *Br. J. Nutr*. 2013;109:S35-S50.

46. Gareau MG, et al. Probiotics and the gut microbiota in intestinal health and disease. *Nat. Rev. Gastroenterol. Hepatol.* 2010;7:503-514.
47. Guillemand E, et al. Consumption of a fermented dairy product containing the probiotic *Lactobacillus casei* DN-114001 reduces the duration of respiratory infections in the elderly in a randomised controlled trial. *Br. J. Nutr.* 2010;103:58-68.
48. Reid G. Probiotics: Which to recommend and why. *Medical Post.* 2011;47:65-66.
49. Reid G and Bruce AW. Selection of *Lactobacillus* strains for urogenital probiotic applications. *J. Infect. Dis.* 2001;183:S77-S80.
50. Sanders ME. Use of probiotics and yogurts in maintenance of health. *J. Clin. Gastroenterol.* 2008;42:S71-S74.
51. Sanders ME, et al. An update on the use and investigation of probiotics in health and disease. *Gut.* 2013;62:787-796.