Journal of Advances and Scholarly Researches in Allied Education
Vol. 17, Issue No. 2, October-2020, ISSN 2230-7540

Lactic Acid Bacteria: Its Applications

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***Abstract** - LAB are a diverse collection of bacteria that are important in a number of fermentation processes. Food carbs are fermented, and the primary end result is lactic acid. The formation of numerous alcohols, aldehydes, acids, esters, and sulphur compounds, along with the breakdown of proteins and lipids, also contribute to the development of a particular flavour in diverse fermented food items. The primary use of LAB is as probiotic bacteria for a wide range of items that are fermented, including dairy, meat, fish, fruit, vegetables, and cereals. Additionally, they serve as supplementary cultures because they improve the flavour, texture, and nutritional content of fermented foods. Examples include quickening the maturity of cheese, improving the texture of yoghurt by producing exopolysaccharides, and managing secondary fermentations while making wine.*

***Keyword** - lactic acid bacteria, fermented foods, applications*

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INTRODUCTION

LAB is usually found in fermented food items as a naturally occurring microbial flora. Lactic acid bacteria have been widely used as beginning cultures for starter cultures for many decades. The LAB is capable of producing a wide range of natural antibacterial substances. Bacteriocin, organic acids, and hydrogen peroxide are among them. Antimicrobial compounds have the power to suppress or destroy harmful microorganisms in the food that are present in the product. It is because of this that starting cultures may be employed for food preservation and for extending the shelf life of food. Lactic acid bacteria and their health benefits.[1]

Figure 1: Lactic acid bacteria may have a positive impact on bio-preservation.

Lactic acid bacteria have been shown to have a vital role in food preservation. In the food, the antimicrobial metabolites may destroy spoilage microorganisms that are present. The food's organoleptic characteristics are enhanced by the bioactive substances generated by LAB. Vitamins, enzymes, and exopolysaccharides are also included in this group. Compounds alter the taste, texture, and flavour of food to improve its quality. LAB are safe to eat because of their favourable impact on human health. Food uses for bacteriocins generated by lactic acid bacteria have been extensively described in the scientific literature. Those who eat the preserved food on a daily basis are not at danger from the bacteriocins.[2-3]

How Lactic Acid Bacteria Live and Work Lactic acid bacteria are a common bacterial species found in a broad range of habitats, including the gastrointestinal or urogenital tracts of people and animals, soil, and water. They may be found in all of these places. In the course of history, lactic acid bacteria have evolved from soil and plant environments into those of mammals. There are around 100 trillion bacteria in the mammalian gut, which are collectively known as microbiota. An individual's immune system, metabolism, and digestion are all aided by the microbiota that lives in their gastrointestinal tracts.[4] There are three key elements that make the microbiota well-adapted to the mammalian gut: attachment to intestinal cells, tolerance to host barriers, or substrate production in the gut. Additionally, the microbiome's lipid membrane composition may be influenced by bile salts and low pH. Peristalsis and mucins, which protect or line the epithelial cells of the intestinal epithelium, aid in the adherence of LAB to a intestinal cells. Lactic acid bacteria are better able

to cling to intestinal cells because of this coordination. As a result, intestinal mucins play a critical role in boosting the activity of indigenous intestinal bacteria by preventing harmful bacteria from sticking to intestinal epithelial cells. Consequently, these gut bacteria operate as a protective barrier against pathogens in the digestive tract. Researchers have found antibiotic compounds generated by Lactobacilli and Bifidobacteria spp. that may suppress the activity of diarrhea-causing enteric bacteria. Both genera produce antimicrobial substances with these antimicrobial capabilities.[5-6]

The Use of Lactic Acid Bacteria in Bio-Preservation

When microbes digest a carbon source, they produce energy without producing any net oxidation. Microbiological fermentation normally produces alcohols or organic acids including such lactate, acetic acid, or propionic acid as its principal by-products, although In the past, lactic acid bacteria have been used to preserve food or prevent rotting via food fermentation. Nutrition and health advantages are increasingly driving consumer food tastes, resulting in an increasing preference for natural preservatives over chemicals. Because of this transition, lactic acid bacteria are now being used more often in food. Thus, lactic acid bacteria have been widely used in food processing and various fermented foods because of their preservation capacity and health advantages to people when LAB fermenting foods are ingested.[7] To ensure safe food, lactic acid bacteria synthesises tiny proteins from ribosomes called bacteriocins, which function as a deterrent to foodborne pathogens. Dairy starter cultures that are ideal candidates for use in food applications include bacteriocinogenic lactic acid bacteria. It has been determined that there are four primary categories of bacteriocins. Bacteriocins that belong to class one, known as lantibiotics, include nisin, one of the most often used and extensively investigated bacteriocins. Small, heat-stable proteins make up the second category, which is subdivided into three groups: Listeria monocytogenes is a bacterium that can be killed by a variety of bacteriocins, including Pediocen PA-1, Lactococcin A and B, Leucococin A, Sakacins And a P, Curvacin A, &Bavaricin MN; and bacteriocins that are activated by 2 different bacterial peptides are known as two-peptide bacteriocins. Lactococcin G &Enterocosins are the two peptides that make up these two proteins.[8] Groups G and M are instances of Lactococcins G and M; Lactacin F is a lactacin; and (iii) subgroups (2c) are circular cationic peptide that have an enhanced antibacterial property in contrast to linear-shaped bacteriocins. Enterococin AS-48 is an instance of a circular bacteriocin. Lactacins A and B, or helveticins J and V, are part of group three bacteriocins, which are bigger heat-labile proteins. The carbohydrate metabolism moieties of group four bacteriocins make them complicated. Based on their lipid and carbohydrate moieties, leuconocin S, lactocin 27, or pediocin SJ-1 all fall under this category. Class A (lanthibiotics), Class B (non-lanthionine), and Class C (non-lanthionine) are three separate groups of Gram-positive bacteriocins identified by Yang, Lin, Sung, & Fang (2014). . There were five subclasses of Class B in a new research by Cotter, Ross, & Hill (2013).[9] Nisin seems to be the only commercially available biocide that occurs in its purest form among the several classes of bacteriocins that are commercially available. In the food industry, nisin has significant economic significance since it is often used as a component in milk and other dairy-based products, mayonnaise, tinned meals, and newborn and baby foods. Because they are often used as starting cultures, bacteriocinogenic cultures are essential as components in both fermented and non-fermented meals. Bacteriocins are also vulnerable to protease digestion because of their sensitivity and susceptibility. As a result, bacteriocins are widely accepted as food additives that are both safe and useful to the digestive system. A list of all the metabolites produced by lactic acid bacteria, including bacteriocins, along with a description of how they work and the organisms they could affect.[10]

Probiotics

Beneficial bacteria, such as probiotics, aid in the restoration of healthy gut flora, which in turn improves human health and well-being. Probiotics and prebiotics are increasingly sought after by today's customers. Probiotic bacteria feed on nondigestible prebiotic dietary components and aid in the development of a healthy flora in the intestines by consuming them. Due to its bioactive compounds and health advantages seen in Fig. 1.2, probiotic organisms are considered GRAS by the FDA. Gut bacteria are colonised by probiotics, which help to control immune system response and maintain homeostasis. Pathogenic germs may be eliminated from the body via the production of immunoglobulins, notably Ig A. It is the organic acids & antimicrobial peptides in the gastrointestinal environment that are responsible for killing pathogenic organisms.[11]

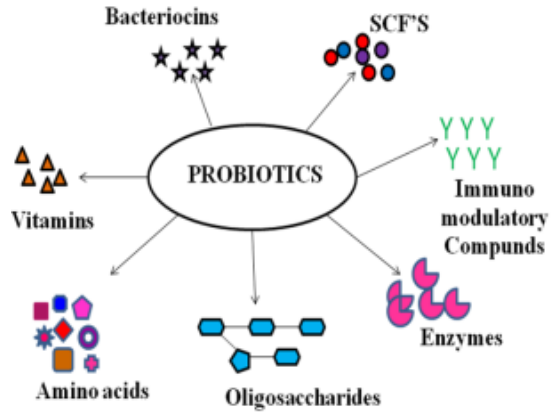

Figure 2: Lactic Acid Bacteria Create A Variety Of Bioactive Compounds.

Probiotics for infants, livestock feed, food preservation, and vitamin capsules were sent in from Europe for usage in India. Sporolac, Bifilac, Darolac, and ViBact are the commercialized probiotic formulations in use for human consumption. One or even more strains are employed in the creation of probiotics for the treatment of different human ailments.[12] Bacteriocin-producing bacteria with probiotic properties are used in a variety of sectors to combat infections. Probiotic sales in India now represent or less 1% of global totals. With increasing demand towards functional foods, lifestyle issues and a stressful environment, India's probiotic industry is now predicted to rise. Functional foods, probiotic formulations, and dietary supplements are expected to be in high demand in the future. Increased immunological response, colonisation of helpful bacteria, delivery of nutrients to a host as well as the resident bacteria, and avoidance of unwanted organisms are only few of the many advantages of probiotic bacteria use.[13-15]

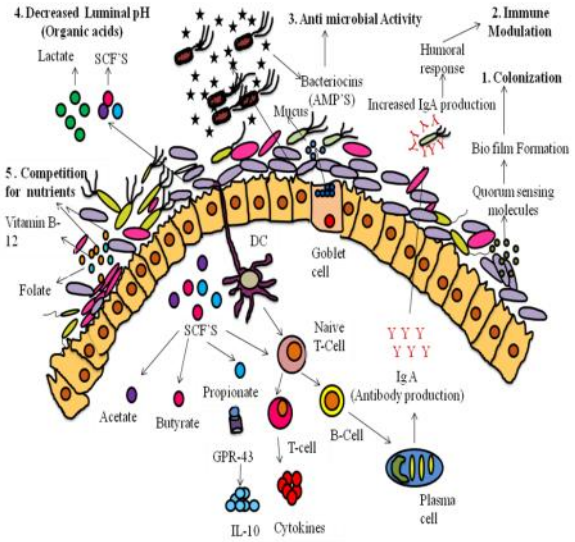

Figure 3: Introduction to probiotic microorganisms and the health advantages they provide in the gut.

To be considered for commercialization, the probiotic bacteria must pass both in-vitro and also in testing. Adhesion to human cells, acid or bile salt tolerance, antibacterial activity, antibiotic resistance, generation of biogenic amines & enzymes are some of the in-vitro analysis criteria. Probiotic newcomers are chosen according on a set of criteria. In order to get FAO/WHO approval, the in-vitro and in-vivo data were compared, and toxicity tests were carried out.[16]

Fermentation Culture Starter Packs

LAB ferments carbohydrates to make fermented foods, a process whose beginnings are lost to history. In food fermentation, this LAB is the most widely employed as starting cultures. Dairy goods, such as cheese and yoghurt, make up the majority of starting cultures, but fermented meats, fish, pickled vegetables and olives, and a wide range of cereal items are also made using starter cultures today.[15] It was the best-adapted strains dominance that determined the product characteristics in previous back slopping productions, but the earliest productions of these products were based on Today, most fermented foods are made using starting cultures that have been carefully chosen for their unique characteristics and are particular to the product being made. There are many different types of starting cultures.[16-18]

Intermingled Cultures

A secondary culture, or adjunct culture, is any culture that is intentionally introduced at some time during the manufacturing of fermentation, but whose main function is not acid generation.. A few of the biodiversity that is lost via pasteurisation, enhanced cleanliness, and the insertion of a defined-strain starting culture is compensated for by the use of adjunct cultures. Most of them are not starting LAB, but they may greatly enhance the flavour and speed up the maturing process.[19]

Bacteria may create EPSs, which are polysaccharides that are attached to the cell membrane or discharged into the culture media.[20] Yogurt, cheese, fermented cream, and milk-based sweets all benefit from the use of these polymers in the manufacturing process, which contributes to the finished product's texture, mouthfeel, flavour, and stability. Prebiotics, cholesterol-lowering, and immunomodulating properties have also been proposed for these EPSs or fermented milk products containing these EPSs. To improve the texture and viscosity of yoghurt, the EPS-producing strains : Streptococcus thermophilus or Lactobacillus ssp. bulgaricus have been found to minimise syneresis.[21-22]

Malate decarboxylase, commonly known as that of the malolactic enzyme, is used in the lactic acid fermentation fermentation, a secondary fermentation, to convert L-malate to L-lactate &

CO2, reducing the acidity of the wine, stabilising the microbiome, and altering the fragrance.[23-25]

CONCLUSION

For food preservation and fermentation, LAB are most often employed microorganisms. Their significance stems mostly from the fact that they are capable to producing organic acids as well as other metabolites when growing in diets that include sugar. Research in the fields of genetics, cell genetics, physiology, or biochemistry of LAB has yielded a wealth of new knowledge and uses for these microbes. Since the entire genomic sequences of Lc. lactis ssp. lactis IL1403 was discovered in 2001, bacterial cultures with particular features have been created and sold, including commercial starter, functional, bioprotective, and probiotic cultures.[26]

Creating diverse strain cultures with varied functionalities for different goods from different parts of the globe is a huge problem for food business professionals. Meals that are identical in flavour and nutritional content to conventional foods, even if they have specific health-enhancing attributes, are difficult to create in a standardised, safe, and regulated way.[27]

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