

# Research Trends in Probiotic Technology

**Dr. Harshada Joshi**

Associate Professor, Department of Biotechnology, Mohanlal Sukhadia  
University, Udaipur, Rajasthan, India

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**Author:** Dr. Harshada Joshi

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## Table of Content

<b>S. No.</b>	<b>Chapter</b>	<b>Page No.</b>
1.	<b>Probiotics: An Introduction</b> (Hemant Chundawat and Preeti Upadhyay)	01-11
2.	<b>Camel Milk an Important Source of Probiotics</b> (Deepti Khandelwal and Preeti Upadhyay)	12-27
3.	<b>Lactic Acid Bacteria</b> (Harshada Joshi and Deepti Khandelwal)	28-48
4.	<b>Health Benefits of Probiotic Lactobacilli</b> (Hemant Chundawat, Deepti Khandelwal and Preeti Upadhyay)	49-59
5.	<b>Probiotic Properties of Lactobacilli</b> (Hemant Chundawat, Deepti Khandelwal and Preeti Upadhyay)	60-73
6.	<b>Antibiotic Resistance in Lactobacilli</b> (Hemant Chundawat and Deepti Khandelwal)	74-84
7.	<b>Antibacterial Spectrum of Lactobacilli</b> (Harshada Joshi)	85-99
8.	<b>Bacteriocins of Lactic acid Bacteria</b> (Harshada Joshi)	100-118
9.	<b>Factors Affecting Bacteriocin Production by Lactobacilli</b> (Harshada Joshi)	119-129
10.	<b>Lactobacilli Viability and Physicochemical Properties of Probiotic Products</b> (Hemant Chundawat and Preeti Upadhyay)	130-141

### **Affiliation of Contributors:**

**Molecular Microbiology Laboratory, Department of Biotechnology, Mohanlal Sukhadia University, Udaipur, Rajasthan, India**

# Chapter - 3

## Lactic Acid Bacteria

Harshada Joshi and Deepti Khandelwal

In 1873, ten years after Pasteur studied lactic acid fermentation (between 1857 and 1863) the first pure culture of a lactic acid bacterium ("*Bacterium lactis*") was obtained by Lister. Starter cultures for cheese and sour milk production were introduced in 1890, while fermented food has been used by man for more than 5,000 years (Schlegel, 1999 and Stiles and Holzapfel, 1997). The first monograph by S. Orla-Jensen appeared in 1919. A typical lactic acid bacterium grown under standard conditions (nonlimiting glucose concentration, growth factors and oxygen limitation) is gram-positive, nonsporing, catalase negative in the absence of porphorinoids, aerotolerant, acid tolerant, organotrophic and a strictly fermentative rod or coccus, producing lactic acid as a major end product. Its features can vary under certain conditions. Catalase and cytochromes may be formed in the presence of hemes and lactic acid can be further metabolized, resulting in lower lactic acid concentrations. Cell division occurs in one plane, except pediococci. The cells are usually nonmotile. They have a requirement for complex growth factors such as vitamins and amino acids. Axelsson (2004) suggested that an unequivocal definition of LAB is not possible.

The term lactic acid bacteria were accepted in the beginning of the 20<sup>th</sup> century (Carol and Leon, 2010). Other terms normally used such as "milk souring" and "lactic acid producing" for the same bacteria causing a slight confusion. Lactic acid bacteria form a group of bacteria that shows morphological, metabolic and physiological similarities, and they are also phylogenetically related. Lactic acid bacteria have been used in food fermentations for more than 4000 years. The term "Lactic acid bacteria" which is usually used has no official status in taxonomy and is only a general term used for convenience to describe the group of functionally and genetically related bacteria. They consist of bacterial genera within the *Firmicutes* comprised of about 20 genera. This is a core group consisting of following four genera; *Lactobacillus*, *Leuconostoc*, *Pediococcus* and *Streptococcus*. Recent taxonomic revisions have proposed several new genera and the group now comprises of the following: *Aerococcus*,

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# Chapter - 7

## Antibacterial Spectrum of Lactobacilli

Harshada Joshi

Lactic acid bacteria exhibit the antagonistic effect against the growth of various organisms. The effect is based on the metabolic products resulting from different biochemical activities of LAB and competitive organisms. Certain metabolites in cultured dairy products may be responsible for increased shelf life of the foods by inhibiting a wide spectrum of food spoilage organisms. The antibacterial principles elaborated by lactic cultures used in preparation of cultural dairy products apparently contribute to the increase in shelf life of food and inhibition of food-borne organisms. The consumption of cultured products containing such antibacterial substances elaborated by LAB may provide the consumer with protection against disease causing organisms.

Evidence has been mounting concerning the inhibition of *Staphylococcus aureus*, *Pseudomonas putrefaciens*, *Escherichia coli*, *Clostridium perfringens*, *Salmonella tennessee*, *Vibrio parahemolyticus* and other spoilage and pathogenic organisms by lactic cultures such as *Streptococcus lactis*, *Streptococcus diacetylactis*, *Leuconostoc cremoris* and several strains of lactobacilli (Shahani and Chandan, 1979). Grosswies *et al.* (1947) observed that antibiotic substance produced by a strain of *Lactobacillus* was found to be effective in *in vitro* study against gram positive and gram negative organisms. In another study, Wheater *et al.* (1952) reported that inhibitory substance of lactobacilli was found active against *Staphylococcus aureus*. In another experiment, definite inhibition of growth of *Staphylococcus aureus* and *Pseudomonas aeruginosa* was observed when these organisms were streaked on liver veal agar plates heavily grown with lactobacilli isolated from rat intestine (Vincent *et al.*, 1955).

Vincent *et al.* (1959) claimed that antibiotic like substance from certain strains of intestinal *Lb. acidophilus* had a broad antibacterial spectrum in its crude form and inhibited the growth of *Staphylococcus* spp. and *Escherichia coli* isolated from human faeces. Neri (1961) reported that several strains of *Lactobacillus* such as *Lb. casei* 22, *Lb. acidophilus* 1 and *Lb. acidophilus* 3