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Mini Review

Bacteriocin: A Potential Antiviral and Antimicrobial Agent; an Alternative to Antibiotics

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Abstract

The microbial flora present in the soil habitat used for the production of antibiotics against various types of pathogens. Due to limited availability of the nutritional requirement and for the competition of survival among soil microorganisms results the production of bactericidal molecules by some strains of bacteria. This bactericidal molecules used as an antibacterial chemotherapeutic agent for the treatment of various diseases. But the continuous and misuse of antibiotics resulted in the emergence of antibiotic resistance. Many strategies have been explored to control the growth of antibiotic resistant microbes. One such approach is the use of bacteriocin. Bacteriocins are ribosomically peptides having antibacterial killing mode of action against bacteria closely related to the producer strain. These are thought to be as an alternative bioactive substances that could be used to avoid the broad side-effects and alarming resistance dissemination produced by the classical antibiotics. The incorporation of bacteriocins as pharmaceutical product needs more studies on the toxicity and on any adverse effect must be performed both *in vitro* and *in vivo* experimental systems. Bacteriocins showing not only the antibacterial and anticancer properties but also show the promising results as antiviral agents. The present paper describe the potential use of the bacteriocin producing bacteria that can be a broad spectrum alternative to antibiotics and promising agents as an antiviral agents.

Keywords: *Bacteriocin; Antibiotics; Alternative; Resistance; Bacteria; Probiotics; Antiviral*

Introduction

Bacteriocins are low molecular weight peptides secreted by the predator bacterial cells to kill sensitive cells present in the same ecosystem competing for food and other nutrients [1,2]. Bacteriocins are generally produced by Gm+, Gm- and archaea bacteria. Bacteriocins from Gm + bacteria especially from lactic acid bacteria (LAB) have been thoroughly investigated considering their great biosafety and broad industrial applications [3]. LAB expressing bacteriocins were isolated from fermented milk and milk products, rumen of animals and soil using deferred antagonism assay [4]. The most extensively studies bacteriocin-Niacin is the only bacteriocin that has got FDA approval for application as a food preservative which is produced by *Lactococcus lactis* subsp. *lactis* [5-9].

Bacteriocins showed a great diversity in structure and function [10]. The structures of these compounds have shown that many bacteriocins are synthesized by ribosomes as precursor peptide and followed by post translational modifications to get biologically functional molecule. Furthermore, post-translational modifications can be used as a mechanism to control the bacteriocidal activity and thus exert control expression [11]. The bacteriocin production gene could be located on the bacterial chromosome or on plasmid and their production can occur at any stages of bacterial growth and under different environment [12]. The first bacteriocin, which was named as colicin, was discovered by Gratia in 1925 [13]. Since then, the exploration of a number of bacteriocins from gram positive bacteria and gram negative bacteria has significantly increased. This leads to a large group of heterogeneous nature antimicrobial compounds which are organized in many databases [14-16]. Out of many bacteriocins exceptionally some bacteriocins besides their antibacterial activities also show antiviral activities. This review focused on the latest information regarding antiviral and antimicrobial potentialities of bacteriocins.

Bacteriocin classification and mechanism of action

The classification of bacteriocins was proposed based on various criteria such as bacteriocin producing strains, mechanism of killing, presence of unique type of amino acids i.e. lanthionine and structure [17]. On the basis of physiochemical criteria, the bacterions are clas-

sified into three classes. The first class consists of a modified amino acid (lanthionine), heat stable and having the molecular weight less than 5 KDa [18,19]. The Class II group of bacteriocins were further divided into subgroups such as Class IIa, Class IIb and Class IIc on the basis of their activity and heat stability [20]. The Class III bacteriocin are having molecular weight more than 30KDa and big in size [21].

Due to the great variety of their chemical structures, bacteriocins affect different essential functions of the cells such as biosynthetic and molecular processes but the most common lytic action is by forming pores or membrane channels that destroy the energy potential of the sensitive cells [22-26].

Bacteriocins as anti-viral agents

Due to the emergence of the resistance against the available anti-viral agents, new alternatives have been explored by many scientists [29,30]. The bacteriocin seems to be a very promising molecule to treat the various viral infections. The studies on bacteriocin revealed that these are not only very effective in food industry as probiotics but can also acts as an antibacterial and enhanced the host immune response [31-33]. The novel concept to exploit the probiotics ability of bacteriocin as antiviral agent for the treatment in aquaculture was given by Bestha., *et al.* in 2013 [34]. The subtilisin, a cyclic bacteriocin produced by *Bacillus subtilis* and *Bacillus amyloliquefaciens* found to be effective against Herpes Simplex Virus Type I and Type II [35-38].

Bacteriocin as an antibacterial Agent

The bacteria belongs to Enterobacteriaceae family are considered to be the causative organisms for hospital acquired infections. These bacteria which sometimes named as ESKAPE (*Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa,* and *Enterobacter species*) showed antibiotic resistant for many antibiotics [39-41]. This resistant mechanisms have given a challenge to the scientific community for developing novel drugs that could prevent public health [42-45]. The bacteriocins seems to be a potential alternative and effective agent that could be used for better management of the challenges for antibiotic resistance [46-48].

Conclusion and Future Prospects

The application of bacteriocin is well established in the food sector, infect till now niacin is the only bacteriocin which was approved by FDA to use as a biopreservative although many more like pediocin are in the pipeline. The study on bacteriocins demonstrated that these molecules showed effective response against viral and many bacterial pathogens. A great attentions for study as an antifungal and anticancer agent required exploring the enormous potentialities of bacteriocins.

Conflict of Interest

Author declare no conflicts of interest.

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