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Mini Review

Bacteriocin: A potent therapeutic weapon used as an alternative to antibiotics

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Abstract

Aim: Conventional antibiotics are easily accessible for the treatment of various health ailments. Excessive consumption of these drugs escalates serious bacterial infections. There is need to combat with this threat with effective alternatives. Bacteriocin is one such option. The aim of this review is to highlight classification, mode of action and application of bacteriocin.

Method: In the present study the literature was collected from Pubmed, Scopus, and Google Scholar.

Introduction

Bacteriocin has proved its potential as an alternative therapeutic molecule. The discovery of bacteriocin has been a miracle to combat Antibiotic Resistance including both multidrug-resistant and chronic bacterial infections. They are ribosomally synthesised Anti-Microbial Protein (AMP), produced by bacteria [1,2]. Many species of bacteria develop this antimicrobial defence for self-preservation and competitive advantage. In comparison to antibiotics bacteriocin are sensitive to proteases and being undisruptive for human consumption [3]. Bacteriocins are small cationic (30–60 amino acids), membrane-permeabilizing peptides produced by Gram-positive (small- 2-6kDa)/negative (large- >10kDa<20kDa) bacterial species. Bacteriocins of Gram-negative bacteria are usually released through cell lysis often dependent on SOS regulation. Gram-positive bacteria follow self-regulated and dedicated transport mechanisms to release bacteriocin. These bacteriocins have a varied spectrum of activity, mode of action and biochemical properties [4,5].

Classification

Among several classifications, Klaenhammer proposed first classification of bacteriocin in1993 [6]. According to data classification based on biological activity and biosynthesis mechanism of bacteriocin was given by Alvarez-Sieiro et al in 2016 [7]. They proposed three major classes: Class I (Lantibiotics- Type A, B and C) – small post-translationally modified peptides; Class II – unmodified bacteriocins (receptors seem to be proteins rather than lipids); and Class III – larger peptides (>10 kDa, thermo-labile), being each one subdivided into subclasses [8].

Mode of action

The mechanistic action of bacteriocin includes promotion of bactericidal and bacteriostatic effect with or without cell lysis. Thus, inhibiting cell growth resulting in deficiency of cell wall synthesis, changes in the membrane permeability or formation of pores causing the death of the target cells [9]. Such mechanism was observed by Cleveland J, et al. where Lantibiotics inhibited inhibit target cells by forming pores in the membrane, depleting the transmembrane potential ($\Delta\psi$) and/or the pH gradient, resulting in the leakage of cellular materials [10]. Some Bacteriocins targets the bacterial membrane while other Bacteriocins interfere with cells such as leuconocin S or pediocin JD and colicin E9 and inhibits essential enzymes [11]. Traditional antibiotics inactivate microbes by inhibiting and disrupting synthesis of cell wall, folate, protein, DNA transcription and replication; functioning of cell membrane. Bacteriocins on the other hand along with the above-mentioned modes of action forms septum to inactivate bacteria [12].

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Application

Being non-pathogenic and harmless these Bacteriocins are considered to be a great medication for human body. Use of antibiotics on the loss of these bacteria can result the invasion in human body by some pathogenic bacteria. Bacteriocins produced by LAB are used as clinical drugs or as food preservatives [13]. Some pharmaceutical applications of bacteriocin are to control Gram negative bacteria by using microcin [14].

Malignancy and AMR pathogenic infections has increased mortality rate, resulting in global health crisis. Duration and severity of morbidity increases when it comes to the immunity of oncology patients [15]. Biocompatibility, biodegradablity and non-immunogenic nature of Bacteriocins makes it most suitable for therapeutic application [16]. In-vitro application of bacteriocins has shown therapeutic anticancer-activity against proliferation of unscheduled and unregulated tumour cell lines [17].

Due to overexploitation of antibiotics, human population is heading towards disaster, so scientists are focusing in finding new alternative. Bacteriocin show potential in this context. Bacteriocins can be used for prevention of infections, to fight against antibiotic resistance and treatment owing to their diversity and abundance. Much more research is required towards development of novel effective bacteriocins which successfully target complex bacterial systems such as cell membranes.

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