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Predatory Bacteria-Bdellovibrio and Like Organisms (Balos) A Prospective Rescuer to Alleviate Human Ailments

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Abstract

The twenty first century human beings face innumerable health and environmental issues due to anthropogenic activities such as destruction of nature in the name of scientific development, industrialization and introduction of xenobiotic components without minding the future. Nature has its own ways to maintain sustainability without affecting flora and fauna. One such wonder of nature is the periplasmic predatory bacterium that feeds on other bacteria, Bdellovibrio, the world's smallest hunters (0.2-0.5µm wide and 0.5 -2.5µm long) that support environment, agriculture, food processing and control human ailments. The antibiotic resistance, medicine's most pressing and emerging problem has forced the scientists to look for alternative treatments to combat bacterial infections. This global issue can be overcome by one of the alternative treatment of using predatory bacteria as "living antibiotics" replacing the use of conventional antibiotics.

Introduction

Recent findings indicate an intricate interplay between the predatory bacteria and the prey with reciprocal effects acting as ecological balancers [1]. Stolp and Starr identified Bdellovibrio bacteriovorus, the gram negative, highly motile organism with single sheathed polar flagella and described as predatory, ectoparasitic and bacteriolytic [2]. Bdellovibrio show a dimorphic cell cycle that has been divided into seven separate events-based on periods such as prey location, attachment, penetration, establishment, elongation, septation (or) development and release [3]. Bdellovibrio attack and utilize the cellular contents of the other gram negative bacteria as nutrients for growth and reproduction by creating pores in the host cell walls using an array of degradative enzymes [4]. The intracellular life style of the bacterium has an adaptation of formation of osmotically-stable Bdelloplast, wherein the (usually) rod-shaped prey cell becomes rounded up immediately after Bdellovibrio instigates prey invasion [5]. BALO attacks from inside out using enzymes (DD-endopeptidases) that loosen the cell walls of prey bacteria and it uses an ankyrin-type protein called Bd3460 as a shield [6]. B. bacteriovorus HD100 can be used as a probiotic bacterium owing to its ability to predate upon gram-negative bacterial strains and their biofilms, including those composed of known human pathogens [7]. B. bacteriovorus possesses a relatively large genome size (3.8Mb) encoding a diverse range of hydrolases and proteases that are involved in killing gram negative pathogens such as Salmonella tyhimurium, Pseudomonas aeruginosa and Helicobacter pylori [8]. Multidrug-resistant (MDR) gram-negative bacteria have emerged as a serious health threat and the predatory bacteria (B. bacteriovorous and Microvibrio spp.) are capable of attacking clinical strains of β-lactamase producing MDR pathogens. Since the predatory bacteria maintains to prey on MDR bacteria in spite of their antimicrobial resistance it can be used as a therapeutic agent when other antimicrobial drugs fail [9].

Dashiff and Kadouri demonstrated B. bacteriovorus predation of biofilms made by oral pathogens i.e., Eikenella corrodens and A. actinomycetemcomitans in the presence of saliva which will be of great significance to use it in future as an oral antibacterial agent [10]. The antibacterial evaluation studies reveal violacein, antibiotic that is effective against gram-positive bacteria and bacterial predator B.bacteriovorus HD100 did not antagonize the activity of the other. The combined application of both violacein and B.bacteriovorus HD100 against 4-species culture containing S. aureus, A. baumannii, B. cereus and K. pneumoniae reduced total population by 2,965-fold (99.98%) [11]. Predatory studies of B.bacteriovorous strains 109J and HD100 and Micavibrio aeruginosovorous strain-ARL-13 on five human cell lines have proved that it is not toxic and its potential use as a live antibiotic against human microbial pathogens [12]. Dwidar and Yokobayashi performed genetic manipulation experiments in predatory bacterium for practical applications by

developing basic genetic parts. To control gene expression they have identified theophylline-activated riboswitches that function in B.bacteriovorus for predation. They inserted the riboswitches in Escherichia coli and observed that the engineered strain shows a faster predation kinetics [13].

Conclusion

As the indiscriminate global use of antibiotics in treating persistent bacterial diseases leads to antibiotic resistance, it is imperative to go for alternative therapy. The one plausible solution to combat the disease causing gram negative bacteria is to use the unique type of predatory bacteria that feeds on other bacteria. Research findings reveal the non toxic nature of predatory strains to human and recommend their use to reduce gram negative bacteria that affect human beings, animals, agricultural crops, food and environment. They could probably act as prophylatic agent to fight infections and also used in a broad approach as an antibiotic. Latest results provide scope for developing genetically engineered "Tailor made Live antibiotics" for drug resistant bacterial strains. However multifaceted research studies are warranted to prove the advantages of the predatory bacterium to put into regular use in treating MDR bacterial diseases.

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