Enzybiotics, A New Class of Enzyme Antimicrobials Targeted against Multidrug-Resistant Superbugs

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Abstract
Gut microbiota with 2X10^{12} bacterial populations is essential for synthesis of vitamins, coenzymes and many other biomolecules in human and animal. But high dose of antibiotics destructed (since 1928) such bacteria in the alimentary tract posing a threat to extinct of human life. As a result signalling from human and bacteria orchestrated to build a defence to protect symbiotic relations saving both life forms. Bacteria synthesized hundreds of new genes (MDR Genes) to destroy antibiotics in different modes of actions. G-20 leaders and scientists have vowed a strong action plans (as assembled recently in Germany) to abolish the horror of superbugs which are claiming millions of death worldwide. Enzymes as therapeutic antibiotics has taken as emerging new antimicrobials derived from bacteriophages as well as bacteria like Staphylococcus sp., Streptococcus sp. and Histeria monocytogenes. Simply, autolysins, lysozymes, lysins and bacteriocins are great enzybiotics. Genetically modified enzybiotic (GMEnzy) has now a new field of enzyme antibiotic production using molecular biology and genetic engineering principles to overcome the antibiotic resistance. GMEnzy database has built for researchers and is available at http://biotechlab.fudan.edu.cn/database/gmenzy/.

Introduction
The term enzybiotic was coined from two words, enzyme and antibiotic and usually refers as the bacteriophage enzymes that attack the cell wall of bacteria with lyses [1]. However, enzybiotic present in bacteria, bacteria infected phages and in body fluids like tears, saliva and animal mucus [2]. Antibiotics had used 80 years with success to eradicate pathogenic bacteria like Escherichia, Klebsiella, Salmonella, Mycobacterium, Pseudomonas and Vibrio species. However, last two decades gradual increase of clinical isolates had shown with >95% now ampicillin and amoxicillin resistant which was controlled by synthesis of new derivatives of penicillin like cephalosporin and carbapenem drugs [3]. In 2009 NDM-1 Escherichia coli was found however, resistant to all class of penicillins including Beta-lactamase inhibitors like cefalidine and sulbactam but avibactam [4]. Skin infections by MRSA Staphylococcus aureus, PDR nosocomial infections by Pseudomonas aeroginosa and XDR tuberculosis by Mycobacterium tuberculosis are now serious threat to human and alternative approaches should be needed to overcome such crisis [5]. MDR genes (blaTEM, amp, blaNDM, blaOXA, sul1/2, catB3, aacA4, aacC2, aph, aad, dhfr, arr3,strA/B, etc) and drug efflux genes (tetA, acrAB-ToIC, mexAB-oprM, mcr, macAB, norA, mdtA etc.) are wide spread in conjugative plasmids and chromosomes of superbugs which are also found in rain, sea and river water posing a threat to global peoples [6].

Thus a new field of science is enzybiotics which is under clinical trial in many research foundations. If enzybiotic is injected into patient with success then all physicians believe that such single enzyme or chimera enzyme would be most useful in superbug cure [7]. It is to save gut microbiota that provide life saving coenzymes involved in glycosysis, TCA cycle and ATP generation [5].

Result
Some important enzybiotics are:
(a) Lysins. PlyG is Phage-γ amidase which can destroy Bacillus anthracis (Figure 1) [8].
(b) Bacteriocins. Lysostaphin is Streptococcus simulans enzyme that acts as endopeptidase on Staphylococcus aureus and many Streptococcei sp. (Figure 2) [9].
(c) Autolysins. *S. equidermis* autolysin enzyme lyses β (1-4) glycoside bond between N-acetyl glucosamine and N-acetyl muraminic acid of many bacteria (Figure 3) [10].

(d) Lysozymes. Egg white lysozyme is muramidase that destroy peptidoglycans and very effective against Gram (+) bacteria [11].
The lysins are 453-473aa long extracellular enzymes and have been sequenced from *Streptococcus suis*, *Streptococcus galactiae* and others (protein ids. WP_061713285, WP_043026720, WP_070043600) with 50-150 mutations among themselves[12,13]. The multispecies bacteriocin (protein id. WP_013103375) has only 54% amino acid similarities to the Leuconostoc sp. Bacteriocin secretory protein (protein id. WP_030058663) but further pharmacological data are lacking. Autolysins are also much diverged as *S. aureus* enzyme (protein id. AAA99982; accession no. L41499) has only 60% homology with 8% gap to other autolysin enzymes (protein id. BADB3399) [14]. Genetically recombinant Lysins have great potential in curing MDR-bacteria [15-18]. P2neumococcal LytA autolysin, a potent therapeutic agent in peritonitis-sepsis caused by highly beta-lactamase resistant *Streptococcus pneumoniae* [19,20].

**Discussion**

Enzybiotics is an emerging field of medicinal science with many molecular approaches have undertaken which have patent literatures and many data are hidden from GenBank database now [13]. It also has combined with phage therapy technologies targeting both Gram (+) and Gram (-) bacterial pathogenesis originating from MDR genes of superbugs [10]. We believe as MDR genes are created both from human and bacteria symbiosis, it will be there with gut microbiota [5]. So to eliminate the pathogenic bacteria alternative to antibiotics will be forthcoming like gene medicines (antisense, Casper-Cas, SiRNA, miRNA, ribozyme) and nanodrug-carriers [21]. Thus enzybiotic is in good place in molecular medicine and its success is ahead. Novel chimerical endolysins with broad antimicrobial activity against methicillin-resistant *Staphylococcus aureus* was reported [16,22]. About 1144 enzybiotics along with 216 natural resources (heterogeneous phyto-antibiotics) have been listed in GMEnzy database [2,13,23,24].

**References**

24. Chakraborty AK (2017) Multi-drug resistant bacteria from Kolkata Ganga river with heterogeneous MDR genes have four hallmarks of Ganga river with heterogeneous MDR genes have four hallmarks of...

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