Research & Reviews: Journal of Microbiology and Biotechnology

e-ISSN: 2320-3528
p-ISSN: 2347-2286

The Prospect of Daphnetin against Drug-Resistant Bacteria: A Mini Review

Genzhu Wang, Xiaoying Wang, Zhikun Xun, Qiang Sun, Baiqian Xing, Zhong-dong Li*

Electric Power Teaching Hospital, Capital Medical University, Beijing, 100073, China

Short Communication

Received date: 12/10/2019
Accepted date: 22/10/2019
Published date: 28/10/2019

***For Correspondence**

Zhong-dong Li, Electric Power Teaching Hospital, Capital Medical University, Beijing 100073, China, Tel: 010-63503242/Ext: +86

E-mail: zhdl009@126.com

Keywords: Daphentin, Drug-resistant bacteria, *H. pylori*

ABSTRACT

The increasing risk of antibiotic resistance put forward urgent requirements for novel drugs to treat infection diseases. The objective of this study is to perform a review of the advantages of daphnetin against drug-resistant bacteria.

INTRODUCTION

Antibiotics have saved millions of patients and brought a revolution in the field of infectious diseases [1]. However, due to the overuse and inappropriate use, an enormous threat has been posed here that many antibiotics are no longer effective [2]. Millions of people are affected with antibiotic-resistant bacteria infection, among which about one percent died from the infection [2]. Without action, bacterial infections that can now be shrugged off with a simple course of treatment could again become common causes of death and we will return to the "pre-antibiotic era" [3]. Moreover, the production of new antibiotics (especially the antibiotics against Gram-negative bacteria) has diminished progressively over the past 20 years and too few new drugs have moved from the laboratory into clinical trials [4]. Leading to the treatment of infections caused by drug-resistant pathogens become more complicated and limited [5]. For example, vancomycin and daptomycin- the 'last resort' antibiotics against methicillin-resistant Staphylococcus aureus infections, have found their resistant strains [6-8]. Polymyxins have been considered as one of better choices for carbapenem-resistant Gram-negative pathogens [9]. However, mutations of pmrA/B, phoP/Q and mgrB genes located in the chromosome and plasmids carrying the mcr-1 gene make these drugs no longer effective [10]. So what should we do when facing these drug-resistant strain infections?

ABOUT THE STUDY

Numerous chemical compounds purified from medicinal plants are considered to be potential solutions of drug-resistant strain infection [11]. Literally thousands of the compounds alone and combined with antibiotics have been tested against drug-resistant bacteria [11-13]. Daphnetin (7, 8-dihydroxycoumarin) is a major bioactive component extracted from medicinal plant-Daphne koreane Nakai. It has been used clinically to treat Buerger's disease in China for many years. Moreover, its anti-tumor, -malarial, -inflammatory properties were investigated due to its inhibition effects on tumor invasion and migration, lipopolysaccharide -induced inducible nitric oxide synthase and cyclooxygenase 2 expressions and reactive oxygen species production, and protein alkylation [14-16]. Based on these multiple pharmacological profiles, the antibacterial spectrum of daphnetin was also investigated. Although its antibacterial activity was found to be weaker than some antibiotics [17], daphnetin has some specific advantages as a novel agent against drug-resistant bacteria (e.g. metronidazole resistant *H. pylori* and methicillin resistant S. aureus). (1) It is stable in different environments and is not easy to develop resistance [18]. (2) The activity against drug -resistant bacteria is almost equal to the one against drug-sensitive bacteria [12, 17]. (3) It has stronger activity against Gram-negative bacteria than Gram-positive bacteria [12,17,19]. (4) The specific mechanisms of daphnetin against *H. pylori* were related to increase of DNA damage and phosphatidylserine translocation, decrease of its attachment to gastric epithelial cells and inhibition of its urease activity [12, 20]. (5) No toxic effects and genetic toxicity were found [21,22]. (6) It improves human immunity and reduces pathogens colonization [15,16,23].

e-ISSN: 2320-3528
p-ISSN: 2347-2286

CONCLUSION

Although daphnetin antibacterial activity was weak, the rapid emergence of resistance bacterial strains has forced it to be re-evaluated in assisting antibacterial aspect because of its advantages in reducing virulence and colonization ability of pathogens and its protective effect on human cells. Taken together, our review suggests that daphnetin has a potential to be a novel, safe, and effective agent for the prevention and/or treatment of infection diseases induced by drug-resistant bacteria.

REFERENCES

1. Aminov RI. A brief history of the antibiotic era: lessons learned and challenges for the future. Front Microbiol. 2010; 1: 134.
2. Prestinaci F, et al. Antimicrobial resistance: a global multifaceted phenomenon. Pathog Glob Health. 2015; 109: 309-318.
3. Shlaes DM. Antibiotics-From There to Where? How the antibiotic miracle is threatened by resistance and a broken market and what we can do about it. Pathog Immun. 2018; 3: 19-43.
4. Ventola CL. The antibiotic resistance crisis: part 1: causes and threats. 2015; P T. 40: 277-283.
5. Kanj SS, et al. Current concepts in antimicrobial therapy against resistant gram-negative organisms: extended-spectrum β-lactamase-producing Enterobacteriaceae, carbapenem-resistant Enterobacteriaceae, and multidrug-resistant Pseudomonas aeruginosa. Mayo Clin Proc. 2011; 86: 250-259.
6. Rincon S, et al. Resistance to "last resort" antibiotics in Gram-positive cocci: The post-vancomycin era. Biomedica. 2014; 1: 191-208.
7. Centers for Disease C. Prevention. Vancomycin-resistant Staphylococcus aureus--Pennsylvania. MMWR Morb Mortal Wkly Rep. 2002; 51: 902.
8. Marty FM, et al. Emergence of a clinical daptomycin-resistant Staphylococcus aureus isolate during treatment of methicillin-resistant Staphylococcus aureus bacteremia and osteomyelitis. J Clin Microbiol. 2006; 44: 595-597.
9. Olaitan AO. Mechanisms of polymyxin resistance: acquired and intrinsic resistance in bacteria. Front Microbiol. 2014; 5: 643.
10. Liu YY, et al. Emergence of plasmid-mediated colistin resistance mechanism MCR-1 in animals and human beings in China: a microbiological and molecular biological study. Lancet Infect Dis. 2016; 16: 161-168.
11. Mahady GB. Medicinal plants for the prevention and treatment of bacterial infections. Curr Pharm Des. 2005; 11: 2405-2427.
12. Wang G, et al. Daphnetin: a novel anti-Helicobacter pylori agent. Int J Mol Sci. 2019; 20.
13. Wang G, et al. Hypericin enhances β-lactam antibiotics activity by inhibiting sarA expression in methicillin-resistant Staphylococcus aureus. Acta Pharmaceutica Sinica B. 2019;
14. Yang YZ, et al, Daphnetin: a novel antimalarial agent with *in vitro* and *in vivo* activity. Am J Trop Med Hyg. 1992; 46: 15-20.
15. Fukuda H, et al. Daphnetin inhibits invasion and migration of LM8 murine osteosarcoma cells by decreasing RhoA and Cdc42 expression. Biochem Biophys Res Commun. 2016; 471: 63-67.
16. Shen L, et al. Daphnetin reduces endotoxin lethality in mice and decreases LPS-induced inflammation in Raw264.7 cells via suppressing JAK/STATs activation and ROS production. Inflamm Res. 2017; 66: 579-589.
17. Rehman S, et al. Isolation, characterisation and antibacterial activity studies of coumarins from Rhododendron lepidotum Wall. ex G. Don, Ericaceae. Revista Brasileira de Farmacognosia. 2010; 20: 886-890.
18. Yang L, et al. New insights into the antibacterial activity of Hydroxycoumarins against Ralstonia solanacearum. Molecules. 2016; 21: 468.
19. Cottiglia F, et al. Antimicrobial evaluation of coumarins and flavonoids from the stems of Daphne gnidium L. Phytomedicine. 2001; 8: 302-305.
20. Jadhav SG, et al. Inhibition of growth of Helicobacter pylori and its urease by coumarin derivatives: Molecular docking analysis. J Pharma Res. 2013; 7: 705-711.
21. Nanzhen K, et al. Toxicological studies of daphnetin. Pharmacognosy Magazine. 2018; 14: 561-566.
22. Yao R, et al. Regulatory effect of daphnetin, a coumarin extracted from Daphne odora, on the balance of Treg and Th17 in collagen-induced arthritis. Eur J Pharmacol. 2011; 670: 286-294.
23. Finn GJ, et al. Daphnetin induced differentiation of human renal carcinoma cells and its mediation by p38 mitogen-activated protein kinase. Biochem Pharmacol. 2004; 67: 1779-1788.