Clinical Microbiology: Open Access

Xiong, Clin Microbiol 2016, 5:1
DOI: 10.4172/2327-5073.1000e132

Editorial Open Access

Bioprospecting of Uncultured Microorganisms: The Dawning of Antibiotic Discovery

Zhi-Qiang Xiong*

School of Medical Instrument and Food Engineering, University of Shanghai for Science and Technology, Shanghai 200093, China

***Corresponding author:** Zhi-Qiang Xiong, School of Medical Instrument and Food Engineering, University of Shanghai for Science and Technology, Shanghai 200093, China, Tel.: +86-21-55803272; E-mail: xiongzq@hotmail.com

Received date: January 28, 2016; **Accepted date:** February 01, 2016; **Published date:** February 08, 2016

Editorial

Antibiotics are of great benefit for human health such as using in pathogenic infection, organ transplantation, cancer treatment and cholesterol control [1]. But a huge threat of global public health caused by multi-drug-resistance pathogens (e.g., gram-positive methicillin and vancomycin resistant *Staphylococcus aureus* and New Delhi metallo-beta-lactamase 1 gram-negative bacteria) has emerged extensively [2]. Despite this threat has ever-increasing public awareness regarding "superbug" infections, treatment options, unfortunately, continued to be limited [3]. The discovery of new antibiotics is one of direct action on the treat of drug resistant pathogenic infections for avoiding an epidemic [2]. However, the pace of antibiotic discovery and development with unique scaffold is dramatically declining after the past 60 years of intensive screening [4], especially the collapse of the antibiotic discovery pipeline that the last new class of antibiotics daptomycin discovered in 1987 has been successfully developed into a clinical therapeutic [5]. Currently, all microorganism derived commercial antibiotics come from cultivated species, especially five phyla Actinobacteria, Bacteroidetes, Cyanobacteria, Firmicutes, and Proteobacteria that represent 95% of antibiotic-producing microbes [6]. Because uncultured microorganisms are approximately 99% of microbial species, a recent trend in antibiotic discovery from natural sources emphasizes the investigation of uncultured microorganisms (do not grow under laboratory conditions) to meet the urgent demand for novel drug.

Uncultured microorganisms cannot be cultured by traditional culture techniques [4,7], developing cultivation methods of uncultured microorganisms thus play a key role for systematic investigation of the previously inaccessible antibiotics with interesting biological activities. Some novel technologies and cultivation methods (iChip [7], high-throughput extinction culturing [8,9], diffusion chamber [10], single cell encapsulation combined with flow cytometry [11], coculture [12], microbial culture chip [13], filtration-acclimatization [14], double encapsulation [15], micromanipulator [16], optical tweezers [17], transwell plates [18], and community culture [19]) have been exploited for isolation and cultivation of uncultured microorganisms. Despite these techniques have significant effect on isolation and culture of uncultivated microorganisms, new approaches and techniques are still required for recovering more uncultivated microbial species to discover the structurally unique antibiotics.

Pure culture may be the only way to comprehensive characterization of physiological properties and full assessment of application potential of individual microbial species [20]. I believe, with the development of the large-scale cultivation strategies of the uncultured majority of the microbial world, bio-prospecting of uncultured microbes could be a shortcut to discover novel antibiotics that is a perpetual need to combat new diseases and drug-resistant pathogens for public health [3,7]. Uncultured microbes have recently been reported to produce a new cell wall inhibitor teixobactin that kills pathogens without detectable resistance [7] and other diverse natural products [21], which could be a new dawning of antibiotic discovery. Uncultivated microorganisms will be better understood and discovered in the next decade by a combination of both conventional and innovative techniques. Thus, bio-prospecting of uncultivated microorganisms has a great application potential for the discovery of antibiotics with unique scaffolds and for exploitation in the pharmaceutical and agricultural industries.

References

1. Stewart EJ (2012) Growing unculturable bacteria. J Bacteriol 194: 4151-4160.
2. Xiong ZQ (2013) Metagenomic-Guided Antibiotics Discovery. Clin Microbial 2:101.
3. Xiong ZQ, Zhang ZP, Li JH, Wei SJ, Tu GQ (2012) Characterization of Streptomyces padanus JAU4234, a Producer of actinomycin X2, Fungichromin, and a new polyene macrolide antibiotic. Appl Environ Microbiol 78: 589-592.
4. Xiong ZQ, Wang JF, Hao YY, Wang Y (2013) Recent advances in the discovery and development of marine microbial natural products. Mar Drugs 11: 700-717.
5. Silver LL (2011) Challenges of antibacterial discovery. Clin Microbiol Rev 24: 71-109.
6. Keller M, Zengler K (2004) Tapping into microbial diversity. Nat Rev Microbiol 2: 141-150.
7. Ling LL, Schneider T, Peoples AJ, Spoering AL, Engels I, et al. (2015) A new antibiotic kills pathogens without detectable resistance. Nature 517: 455-459.
8. Rappé MS, Connon SA, Vergin KL, Giovannoni SJ (2002) Cultivation of the ubiquitous SAR11 marine bacterioplankton clade. Nature 418: 630-633.
9. Song J, Oh HM, Cho JC (2009) Improved culturability of SAR11 strains in dilution-to-extinction culturing from the East Sea, West Pacific Ocean. FEMS Microbiol Lett 295: 141-147.
10. Kaeberlein T, Lewis K, Epstein SS (2002) Isolating "uncultivable" microorganisms in pure culture in a simulated natural environment. Science 296: 1127-1129.
11. Zengler K, Toledo G, Rappe M, Elkins J, Mathur EJ, et al. (2002) Cultivating the uncultured. Proc Natl Acad Sci U S A 99: 15681-15686.
12. Nichols D, Lewis K, Orjala J, Mo S, Ortenberg R, et al. (2008) Short peptide induces an "uncultivable" microorganism to grow in vitro. Appl Environ Microbiol 74: 4889-4897.
13. Ingham CJ, Sprenkels A, Bomer J, Molenaar D, van den Berg A, et al. (2007) The micro-Petri dish, a million-well growth chip for the culture and high-throughput screening of microorganisms. Proc Natl Acad Sci U S A 104: 18217-18222.

14. Hahn MW, Stadler P, Wu QL, Pöckl M (2004) The filtration-acclimatization method for isolation of an important fraction of the not readily cultivable bacteria. J Microbiol Methods 57: 379-390.
15. Ben-Dov E, Kramarsky-Winter E, Kushmaro A (2009) An in situ method for cultivating microorganisms using a double encapsulation technique. FEMS Microbiol Ecol 68: 363-371.
16. Pham VH, Kim J (2012) Cultivation of unculturable soil bacteria. Trends Biotechnol 30: 475-484.
17. Zhang H, Liu KK (2008) Optical tweezers for single cells. J R Soc Interface 5: 671-690.
18. Svenning MM, Wartiainen I, Hestnes AG, Binnerup SJ (2003) Isolation of methane oxidising bacteria from soil by use of a soil substrate membrane system. FEMS Microbiol Ecol 44: 347-354.
19. Brenner K, You L, Arnold FH (2008) Engineering microbial consortia: a new frontier in synthetic biology. Trends Biotechnol 26: 483-489.
20. Vartoukian SR, Palmer RM, Wade WG (2010) Strategies for culture of 'unculturable' bacteria. FEMS Microbiol Lett 309: 1-7.
21. Wilson MC, Mori T, Rückert C, Uria AR, Helf MJ, et al. (2014) An environmental bacterial taxon with a large and distinct metabolic repertoire. Nature 506: 58-62.