Journal of Marine Biology and Aquaculture

OMMEGA Publishers
Answering Intelligence

Short communication

OPEN ACCESS

Bioprospecting of Uncultured Marine Microorganisms Needs More New Cultivation Techniques for Natural Products Discovery

Zhi-Qiang Xiong*

School of Medical Instrument and Food Engineering, University of Shanghai for Science and Technology, Shanghai, 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: December 2, 2015 **Accepted date: December 9, 2015** **Published date: December 15, 2015**

Citation: Xiong, Z.Q. Bioprospecting of uncultured marine microorganisms needs more new cultivation techniques for natural products discovery. (2015) J Marine Biol Aquacult 1(2): 1-2.

Introduction

Natural products are benefit for human health such as using in organ transplantation, cancer treatment and cholesterol control as well as serving as antibiotics, insecticides, and antiparasitics[1]. More than 15,000 structurally diverse marine natural products (MNPs) have been discovered since the 1970s[2], in which the major source is marine microorganism. However, to date, five phyla Actinobacteria, Bacteroidetes, Cyanobacteria, Firmicutes, and Proteobacteria that represent 95% of all cultivated and published species produce bioactive molecules[3]. The limited diversity of culturable microorganisms is thereby one of the most important reasons for 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[4]. Hence, isolation and cultivation of new marine microorganisms especially uncultured microbes (do not grow under laboratory conditions) might be a shortcut to discover novel MNPs that is a perpetual need to combat new diseases and drug-resistant pathogens for public health[5, 6].

However, approximately 99% of microbial species cannot be cultured by traditional techniques[6,7]. Because pure culture may be the only way to comprehensive characterization of physiological properties and full assessment of application potential of individual microbial species[8], developing cultivation techniques play an important role for systematic investigation of uncultured marine microorganisms, there by allowing for the exploitation of the previously inaccessible MNPs. Therefore, a significant focus for marine microbiologists today is to develop strategies to cultivate the uncultured majority of the microbial world for MNPs discovery.

Despites some novel microbial species were successfully cultured by varying media and growth conditions, new technologies and cultivation approaches iChip[6], high-throughput extinction culturing[9,10], diffusion chamber [11], single cell encapsulation combined with flow cytometry[12], coculture[13], microbial culture chip[14], filtration-acclimatization[15], double encapsulation[16], micromanipulator[17], optical tweezers[18], transwell plates[19], and community culture[20] have been emerged for culture of uncultured microorganisms. Although the above cultivation techniques have a significant effect onisolation of uncultivated microorganisms, novel approaches and techniques of isolation and cultivation will still be required for recovering more uncultivated microbial species to find the structurally unique MNPs with interesting biological activities. For instance, several promising techniques e.g., single cell Roman sorting[21] and micro fluidic system[22] could be developed for growing marine uncultured microorganisms.

Uncultured microorganisms have recently been reported to produce a new cell wall inhibitor teixobactin that kills pathogens without detectable resistance[6] and other diverse MNPs[23], new technologies for bio-prospecting of marine uncultivated microbes thus have the great application potential for the discovery of MNPs with unique scaffolds and for exploitation in the pharmaceutical and agricultural industries. I believe new uncultivated marine microorganisms will be better understood and discovered in the next decade by a combination of both conventional and innovative approaches, which allow for the exploitation of MNPs potential as a source of drug discovery.

References

1. Stewart, E.J. Growing unculturable bacteria. (2012) J Bacteriol 194(16): 4151-4160.
2. Salomon, C.E., Magarvey, N.A., Sherman, D.H. Merging the potential of microbial genetics with biological and chemical diversity: an even brighter future for marine natural product drug discovery. (2004) Nat Prod Rep 21(1): 105-121.
3. Keller, M., Zengler, K. Tapping into microbial diversity. (2004) Nat Rev Microbiol 2(2): 141-150.
4. Silver, L.L. Challenges of antibacterial discovery. (2011) Clin Microbiol Rev 24(1): 71-109.
5. Xiong, Z.Q., Zhang, Z.P., Li, J.H., et al. Characterization of Streptomyces padanus JAU4234, a producer of actinomycin X2, fungichromin, and a new polyene macrolide antibiotic. (2012) Appl Environ Microbiol 78(2): 589-592.
6. Ling, L.L., Schneider, T., Peoples, A.J., et al. A new antibiotic kills pathogens without detectable resistance. (2015) Nature 517(7535): 455-459.
7. Xiong, Z.Q., Wang, J.F., Hao, Y.Y., et al. Recent advances in the discovery and development of marine microbial natural products. (2013) Mar Drugs 11(3): 700-717.
8. Vartoukian, S.R., Palmer, R.M., Wade, W.G. Strategies for culture of 'unculturable' bacteria. (2010) FEMS Microbiol Lett 309(1): 1-7.
9. Rappe, M.S., Connon, S.A., Vergin, K.L., et al. Cultivation of the ubiquitous SAR11 marine bacterioplankton clade. (2002) Nature 418(6898): 630-633.
10. Song, J., Oh, H.M., Chom, J.C. Improved culturability of SAR11 strains in dilution-to-extinction culturing from the East Sea, West Pacific Ocean. (2009) FEMS Microbiol Lett 295(2): 141-147.
11. Kaeberlein, T., Lewis, K., Epstein, S.S. Isolating "uncultivable" microorganisms in pure culture in a simulated natural environment. (2002) Science 296(5570): 1127-1129.
12. Zengler, K., Toledo, G., Rappe, M., et al. Cultivating the uncultured. (2002) Proc Natl Acad Sci USA 99 (24): 15681-15686.
13. Nichols, D., Lewis, K., Orjala, J., et al. Short peptide induces an "uncultivable" microorganism to grow in vitro. (2008) Appl Environ Microbiol 74(15): 4889-4897.
14. Ingham, C.J., Sprenkels, A., Bomer, J., et al. The micro-Petri dish, a million-well growth chip for the culture and high-throughput screening of microorganisms. (2007) Proc Natl Acad Sci USA 104(46): 18217-18222.
15. Hahn, M.W., Stadler, P., Wu, Q.L. The filtration-acclimatization method for isolation of an important fraction of the not readily cultivable bacteria. (2004) J Microbiol Methods 57(3): 379-390.
16. Ben-Dov, E., Kramarsky-Winter, E., Kushmaro, A. An in situ method for cultivating microorganisms using a double encapsulation technique. (2009) FEMS Microbiol Ecol 68(3): 363-371.
17. Pham, V.H., Kim, J. Cultivation of unculturable soil bacteria. (2012) Trends Biotechnol 30(9): 475-484.
18. Zhang, H., Liu, K.K. Optical tweezers for single cells. (2008) J R Soc Interface 5(24): 671-690.
19. Svenning, M.M., Wartiainen, I., Hestnes, A.G., et al. Isolation of methane oxidising bacteria from soil by use of a soil substrate membrane system. (2003) FEMS Microbiol Ecol 44(3): 347-354.
20. Brenner, K., You, L., Arnold, F.H. Engineering microbial consortia: a new frontier in synthetic biology. (2008) Trends Biotechnol 26(9): 483-489.
21. Li, M., Boardman, D.G., Ward, A., et al. Single-cell Raman sorting. (2014) Methods Mol Biol 1096: 147-153.
22. Marcy, Y., Ouverney, C., Bik, E.M., et al. Dissecting biological "dark matter" with single-cell genetic analysis of rare and uncultivated TM7 microbes from the human mouth. (2007) Proc Natl Acad Sci USA 104(29): 11889-11894.
23. Wilson, M.C., Mori, T., Ruckert, C., et al. An environmental bacterial taxon with a large and distinct metabolic repertoire. (2014) Nature 506(7486): 58-62.

Ommega Online Publishers
Journal Title: Journal of Marine Biology and Aquaculture
Journal Short Name: J Marine Biol Aquacult

Journal ISSN 2381-0750
E-mail: marinelife@ommegaonline.org
Website: www.ommegaonline.org