Food & Nutrition: Current Research
FNCR, 1(1): 38-41
www.scitcentral.com

Original Mini-Review: Open Access

The Biomedical Potentials of Metabolites Synthesized by Microalgae

Balaji B. Prasath[1], Xiaojun Ye[1], Ruihua Wang[2] and Karen Poon[1*]

*[*1]Program of Food Science and Technology, Division of Science and Technology, BNU-HKBU United International College, Guangdong, China*

[2]Department of Gastroenterology, Shenzhen Hospital of Southern Medical University, China

Received November 27, 2017; Accepted January 10, 2018; Published February 25, 2018

Review

A future science of tiny microorganism plays a vital role in biomedical research specifically emphasizing the microalgae. They are photosynthetic unicellular (prokaryotic and eukaryotic) organisms that play a key role in fresh and marine habitats [1]. In the last several decades, microalgae have produced various applications in pharmaceutical and nutraceutical industries owing to the presence of several primary and secondary metabolites such as glycolipids, vitamins, pigments, proteins, fatty acids, and polysaccharides [2,3]. The recent scientific progress from worldwide making effort in the area of microalgal biotechnology has been undertaken, including genetic engineering to modify the strains of microalgae, stress induced production of secondary metabolites using various chemicals [4,5] and different stress conditions to enhance the species to produce more bioactive compounds and biofuel [6]. Bio-medical applications of microalgae can prevent alzheimer's disease, parkinson's disease, coronary heart diseases, prostate cancer, lung cancer, colon cancer, breast cancer, and other chronic diseases. The commercially used microalgal chemicals include β-carotene, lutein, canthaxanthin, fucoxanthin, phycoerythrin, astaxanthin, lutein, zeaxanthin and lycopene. Several previous reports have also shown the carotenoid contents of different strains of microalgae including *Haematococcus pluvialis, Nannochloropsis gladitana, Dunaliella salina, Dunaliella bardawil, Dunaliella kona, Spirulina platensi, Arthrospira species* and *Chlorella zofingiensis* [7-10].

Polyunsaturated fatty acids (PUFAs) are found in microalgae cells. They are naturally synthesized by microalgae. Omega-3 and omega-6 fatty acids include γ-linolenic acid (GLA, C18:3, n-6), α- linolenic acid (ALA, C18:3, n-3), eicosapentaenoic acid (EPA, C20:5, n-3), docosahexaenoic acid (DHA, C22:6, n-3), arachidonic acid (AA, C20:4, n-6). They are important components of human development. As they cannot be synthesized by mammalian cell, they are essential nutrients and provided through the diet. PUFAs are important for the function of cerebral cortex, skin, sperm, testicles and retina, and they could reduce the risk of heart disease. Data from previous reports revealed, the most common microalgae used in the production of rich PUFA are *Porphyridium cruentum, Crypthecodinium cohnii, Phaeodactylum tricornutum, Nannochloropsis oculata, Phaeodactylum tricornutum Chlorella vulgaris, Schizochytrium sp, Chlamydomonas variabills* and *Porphyridium cruentum* [11-16].

Microalgae are considered today an important potential raw material for the production of a variety of products, and they are useful in human nutrition, health and pharmaceutical products. Based on their bioactive properties, this review will summarize the potential use of microalgae-derived compounds to treat metabolic dysfunction and hopefully contribute to the discovery of novel use of the bioactive compounds for the treatment of human diseases and the application in microalgal biotechnology.

Acknowledgement
Authors would like to thank UIC College Research Grant R201620 for supporting this project.

Corresponding author: Karen Poon, Program of Food Science and Technology, Division of Science and Technology, BNU-HKBU United International College, 28 Jinfeng Road, Tangjiawan, Zhuhai, Guangdong, China 519085, Tel: (86) 756-3620621; Fax: (86) 756-3620882; Email: karenpoon@uic.edu.hk

Citation: Prasath B B, Ye X, Wang R & Poon K (2018) The Biomedical Potentials of Metabolites Synthesized by Microalgae. Food Nutr Current Res, 1(1): 38-41.

Table 1. Compounds obtained from microalgae and their biological activities

Species	Activity	Compound	References
Haematococcuspluvialis	Anticancer	Astaxanthin	[17]
Dunaliella tertiolecta	Antiproliferative	violaxanthin	[18]
Chlorella stigmatophora	Anti-inflammatory	Polysaccharide	[19]
Chlorella pyrenoidosa	Antitumor	Polypeptide	[20]
Porphyridium cruentum	Antitumor	Polysaccharide	[21]
Calothrix sp.	Anticancer	Quinones	[22]
Isochrysis galbana	Antioxidant	Polysaccharide	[23]
Spirulina maxima	Anti-hyperlipemic	α-linolenic acid	[24]
Porphyridium cruentum	Antiviral	Polysaccharide	[14]
Odontellaaurita	Antioxidant	fucoxanthin	[9]
Rhodella reticulate	Antioxidant	Polysaccharide	[25]
Lyngbya majuscule	Anticancer	Amides	[26]
Graesiella sp.	Antiproliferative	Polysaccharide	[27]
Dunaliella salina	Anticancer	β-carotene	[28]
Navicula directa	Antiviral	Polysaccharide	[29]
Spirulina maxima	Anticarcinoma	α-tocopherol	[30]
Porphyridium cruentum	Anti-HBV	Polysaccharide	[31]
Chlorella ellipsoidea	Anti-inflammatory	violaxanthin	[32]
Nannochloropsisoculata	Anti-inflammatory	DPA	[33]
Tetraselmis sp.	Anti-angiogenic	EPA	[34]

REFERENCES

1. Ferreira SP, Soares LA, Costa JA (2013) Microalgas: uma fonte alternativa na obtenção de ácidos gordos essenciais. Revista de Ciências Agrárias 36: 275-287.
2. Kent M, Welladsen HM, Mangott A, Li Y (2015) Nutritional evaluation of Australian microalgae as potential human health supplements. PLoS ONE 10.
3. Ibanez E, Herrero M, Mendiola JA, Castro-Puyana M (2011) Extraction and ˜ characterization of bioactive compounds with health benefits from marine resources: macro and micro algae, cyanobacteria, and invertebrates. Marine bioactive compounds: sources, characterization and applications. Springer, New York, USA.
4. Yaakob Z, Ali E, Zainal A, Mohamad M, Takriff MS (2014) An overview: biomolecules from microalgae for animal feed and aquaculture. J Biol Res 21: 6-15.
5. Yu X, Chen L, Zhang W (2015) Chemicals to enhance microalgal growth and accumulation of high value bioproducts. Front Microbiol 6.
6. Pailwal C, Mitra M, Bhayani K, Vamsi Bharadwaj SV, Ghosh T, Dubey S, Mishra S (2017) Abiotic stresses as tools for metabolites in microalgae. Bioresource Technol 244: 1216-1226.
7. Goiris K, Muylaert K, Fraeye I, Foubert I, Brabanter J, et al. (2012) Antioxidant potential of microalgae in relation to their phenolic and carotenoid content. J Appl Phycol 24: 1477.

8. Guedes ACA, Amaro HM, Malcata FX (2011) Microalgae as sources of carotenoids. Mar Drugs 9: 625-644.
9. Xia S, Wang K, Wan L, Li A, Hu Q, et al. (2013) Production, characterization, and antioxidant activity of fucoxanthin from the marine diatom odontellaaurita. Mar Drugs 11: 2667-2681
10. Liu J, Sun Z, Gerken H, Liu Z, Jiang Y, Chen F (2014) Chlorella zofingiensis as an Alternative Microalgal Producer of Astaxanthin: Biology and Industrial Potential. Mar Drugs 12: 3487-3515.
11. Martins DA, Custódio L, Barreira L, Pereira H, Ben-Hamadou R, et al. (2013) Alternative sources of n-3 long-chain polyunsaturated fatty acids in marine microalgae. Mar Drugs 11: 2259-2281.
12. Cepák V, Přibyl P, Kohoutková J, Kaštánek P (2014) Optimization of cultivation conditions for fatty acid composition and EPA production in the eustigmatophycean microalga Trachydiscus minutus. J Appl Phycol 26: 181-190.
13. Barros MP, Poppe SC, Bondan EF (2014) Neuroprotective properties of the marine carotenoid astaxanthin and omega-3 fatty acids, and perspectives for the atural combination of both in krill oil. Nutrients 6: 1293-1317.
14. Raposo MF, de Morais AM, de Morais RM (2014) Influence of sulphate on the composition and antibacterial and antiviral properties of the exopolysaccharide from Porphyridium cruentum. Life Sci 101: 56-63
15. Dyall SC (2015) Long-chain omega-3 fatty acids and the brain: A review of the independent and shared effects of EPA, DPA and DHA. Front Aging Neurosci 7: 52.
16. Weiser MJ, Butt CM, Mohajeri MH (2016) Docosahexaenoic acid and cognition throughout the lifespan. Nutrients 8: 99.
17. Palozza P, Torelli C, Boninsegna A, Simone R, Catalano A, et al. (2009) Growth-inhibitory effects of the astaxanthinrich alga Haematococcus pluvialis in human colon cancer cells. Cancer Lett 283: 108-117.
18. Pasquet V, Morisset P, Ihammouine S, Chepied A, Aumailley L, et al. (2011) Antiproliferative activity of violaxanthin isolated from bioguided fractionation of Dunaliella tertiolecta extracts. Mar Drugs 9: 819-831.
19. Guzmán S, Gato A, Lamela M, Freire-Garabal M, Calleja JM (2003) Anti-Inflammatory and immunomodulatory activities of polysaccharide from Chlorella stigmatophora and Phaeodactylum tricornutum. Phytother Res 17: 665-670.
20. Wang X, Zhang X (2013) Separation, antitumor activities, and encapsulation of polypeptide from Chlorella pyrenoidosa. Biotechnol Prog 29: 681-687.
21. Sun L, Wang L, Zhou Y (2012) Immunomodulation and antitumor activities of different molecular weight polysaccharides from Porphyridium cruentum. Carbohydr Polym 87: 1206-1210.
22. Hatae N, Satoh R, Chiba H, Osaki T, Nishiyama T, et al. (2014) N-Substituted calothrixin B derivatives inhibited the proliferation of HL-60 promyelocytic leukemia cells. Med Chem Res 23: 4956-4961.
23. Sun Y, Wang H, Guo G, Pu Y, Yan B (2014) The isolation and antioxidant activity of polysaccharides from the marine microalgae Isochrysis galbana. Carbohydr Polym 113: 22-31.
24. Torres-Duran PV, Ferreira-Hermosillo A, Juarez-Oropeza MA (2007) Antihyperlipemic and antihypertensive effects of Spirulina maxima in an open sample of mexican population: A preliminary report. Lipids Health Dis 6: 33.
25. Chen B, You W, Huang J, Yu Y, Chen W (2010) Isolation and antioxidant property of the extracellular polysaccharide from Rhodella reticulata. World J Microbiol Biotechnol 26: 833-840.
26. Kwan JC, Teplitski M, Gunasekera SP, Paul VJ, Luesch H (2010) Isolation and biological evaluation of 8-epi-malyngamide C from the Floridian marine cyanobacterium Lyngbya majuscula. J Nat Prod 73: 463-466.
27. Trabelsi L, Chaieb O, Mnari A, Abid-Essafi S, Aleya L (2016) Partial characterization and antioxidant and antiproliferative activities of the aqueous extracellular polysaccharides from the thermophilic microalgae Graesiella sp. BMC Complement Altern Med 16: 210.
28. Emtyazjoo M, Moghadasi Z, Rabbani M, Emtyazjoo M, Samadi S, et al. (2012) Anticancer effect of Dunaliella salina under stress and normal conditions against skin carcinoma cell line A431 in vitro. Iran J Fish Sci 11: 283-293.
29. Lee JB, Hayashi K, Hirata M, Kuroda E, Suzuki E, et al. (2006) Antiviral sulfated polysaccharide from Navicula directa, a diatom collected from deep-sea water in Toyama Bay. Biol Pharm Bull 29: 21352139.
30. El-Baky Abd HH, El-Baz FK, El-Baroty GS (2003) Spirulina species as a source of carotenoids and α-tocopherol and its anticarcinoma factors. Biotechnol 2: 222-250
31. Huang J, Chen B, You W (2005) Studies on separation of extracellular polysaccharide from Porphyridium cruentum and its anti-HBV activity in vitro. Chin J Mar Drugs 24: 18-21.
32. Soontornchaiboon W, Joo SS, Kim SM (2012) Anti-inflammatory effects of violaxanthin isolated from microalga Chlorella ellipsoidea in RAW 264.7 macrophages. Biol Pharm Bull 35: 1137-1144.
33. Nauroth JM, Liu YC, van Elswyk M, Bell R, Hall EB, et al. (2010) Docosahexaenoic acid (DHA) and docosapentaenoic acid (DPAn-6) algal oils reduce inflammatory mediators in human peripheral mononuclear cells in vitro and paw edema in vivo. Lipids 45: 375-384.

34. Adarme-Vega TC, Thomas-Hall SR, Lim DK, Schenk PM (2014) Effects of long chain fatty acid synthesis and associated gene expression in microalga Tetraselmis sp. Mar. Drugs 12: 3381-3398.