ACTA SCIENTIFIC NUTRITIONAL HEALTH

Volume 3 Issue 2 February 2019

Editorial

A Glimpse into Molecular Farming of Microalgae; a Reliable Functional Food

Narges Atabaki[1] and Rambod Abiri[1,2]*

[1]*Department of Biochemistry, Faculty of Biotechnology and Biomolecular Science, Universiti Putra Malaysia, Selangor, Malaysia*

[2]*Young Researchers and Elite Club of IAU, Kermanshah, Iran*

***Corresponding Author:** Rambod Abiri, Department of Biochemistry, Faculty of Biotechnology and Molecular Science, Universiti Putra Malaysia, Selangor, Malaysia and Young Researchers and Elite Club of IAU, Kermanshah, Iran.

Received: December 21, 2018; **Published:** December 31, 2018

Keywords: Microalgae; Molecular Farming; Recombinant Protein; Functional Food

Microalgae as promising natural resources demonstrate an enormous capacity for human food, animal feed, functional products, bio-fertilizers and water bioremediation [14]. The history of microalgae application can be traced back to 2,000 years ago, when Chinese found microalgae to survive during period of famine [21]. Nowadays, microalgae are marketed in various forms such as liquids, capsules and tablets. Moreover, microalgae can be incorporated into beverage, gums, candy bar, snack foods and noodles as well as raw or dried biomass [2]. Although the microalgae nutritional value is influenced by different factors such as shape, size, biochemical composition and digestibility, but this sustainable organism possesses anti-oxidants, vitamins, carbohydrates, lipids, proteins and pigments [5].

Over the years, using microalgae for production of high-value recombinant proteins has grown as an alternative platform to using conventional organisms' system [1]. Supporting evidence demonstrates that microalgae based platform has both microorganism and plant advantages which introduce them as an appropriate candidate for development of molecular farming systems [19]. Like other organism- based system, using microalgae as a green cell- factory to produce recombinant protein have some pros and cons [12]. Most considerable advantages of microalgae based system in molecular farming can be listed down as follow: short generation and life time [12], low overall cost [7], relatively rapid growth rate [20], low public perception of risk [25], culture flexibility and capability of cultivation in the closed [airlift column, bubble column, helical tubular, seaweed-type, tubular, flat-plate, stirred tank and conical] [24] or open photobioreactor like pond [raceway and circular] [13], genetic elements [8], inducible production system, post-transcriptional/translational processing and ease of genetic manipulation [10], chloroplast engineering [4], sexual reproduction features, biosafety [13], downstream processes and generally recognized as safe [GRAS], being unicellular and haploidy, secretion system and microalgae milking and by products [15]. Notwithstanding the mentioned positive factors of molecular farming in algae, there are some main bottlenecks, which may decrease the efficiency of this bioreactor. The disadvantages of this bioreactor can be categorised into lack of enough experience and knowledge [3], gene silencing [9], mRNA instability [11], incorrect polyadenylation as well as lack of adequate regulatory elements and/ or enhancer [17].

High efficiency production of recombinant protein in microalgae are dependent on various vital factors such genetic engineering related and other unexpected/unknown factors [1]. Selecting an appropriate promoter influences the transcription levels in a host. So far, different types of promoters have been using in algae as follow: constitutive promoters [*CamV35S, Chop-2, SV40, UBI, atpA, CV-AMT, psbA, psbD, CV-Vp54, rbcS and Prrn*], inducible promoters [*Cyc6, CAH1, DCA1, Nit1, Nia1, Pnr, GAPDH, FCP, b2-tubulin, PyAct1, RPB1, HSP70A, HSP70A/RBCS2, cabII-1, Lhcb-1*] [6]. Untranslated regions [5'- and 3'-UTRs] are other considerable factors in the microalgae molecular farming in which UTRs [*atpA, psbD, rbcL, psbA, rbcL, RbcS, Tnr, FCP,* etc] may evolve in a way to form secondary structures that improve efficiency of translational through interactions with trans-acting factors [22]. Translation initiation [Kozak] sites is another restriction factor which implicates an elongation-competent ribosome formation at the appropriate start codon site [AUG- methionine] either by a cap-independent or a ribosome scanning mechanism [16]. The influence of introns on the microalgae molecular arming can be matter of necessity through transcription regulation, controlling the sequences and regulation of gene expression [18]. So far, various types of selectable marker have been employed in the microalgae molecular farming process, which these markers are a part of herbicide and/ or antibiotic resistance as well as complement a photosynthetic

or metabolic mutant [11]. On the other hand, selecting an efficient and stable transformation system [electroporation, *Agrobacterium tumifaciens*, polyethylene glycol, glass blead agitation and particle bombardment] is still one of the most significant factor in nuclear or chloroplast engineering of microalgae [23]. Optimum culture condition is the last but not least factor in the molecular faming of microalgae. The culture condition can cover all the environmental factors, which may lead to increase growth rate and productivity of microalgae such as temperature, Co_2, pH, agitation, illumination and media composition [1]. Generally speaking, molecular farming of microalgae may suggest significant benefits; however, as with most new aspect of science and biotechnology, this system may have potential risks, which should be defined early in its development to avoid any negative influence on the animal and human health.

Bibliography

1. Abiri Rambod., *et al*. "A critical review of the concept of transgenic plants: insights into pharmaceutical biotechnology and molecular farming". *Current Issues in Molecular Biology Peer-Reviewed Journal* 18 (2015): 21-42.

2. Brooks Geoffrey., *et al*. "Microalgal food compositions". U.S. Patent Application No. 15/698,579. 2018.

3. Breyer Didier., *et al*. "Biosafety of molecular farming in genetically modified plants". *Molecular Farming in Plants: Recent Advances and Future Prospects*. Springer, Dordrecht, 2012. 259-274.

4. Chen Meng., *et al*. "Effect of nutrients on growth and lipid accumulation in the green algae Dunaliella tertiolecta". *Bioresource technology* 102.2 (2011): 1649-1655.

5. Chew Kit Wayne., *et al*. "Microalgae biorefinery: high value products perspectives". *Bioresource technology* 229 (2017): 53-62.

6. Doron Lior., *et al*. "Transgene expression in microalgae - from tools to applications". *Frontiers in plant science* 7 (2016): 505.

7. Gimpel, Javier A.., *et al*. "Production of recombinant proteins in microalgae at pilot greenhouse scale". *Biotechnology and bioengineering* 112.2 (2015): 339-345.

8. Griesbeck Christoph and Anna Kirchmayr. "Algae: an alternative to the higher plant system in gene farming". *Molecular Farming in Plants: Recent Advances and Future Prospects*. Springer, Dordrecht, (2012): 125-143.

9. Kim Eun-Jeong., *et al*. "Gene silencing in microalgae: mechanisms and biological roles". *Bioresource Technology* 184 (2015): 23-32.

10. Koblenz Bettina and Karl-Ferdinand Lechtreck. "The NIT1 promoter allows inducible and reversible silencing of centr in in Chlamydomonas reinhardtii". *Eukaryotic cell* 4.11 (2005): 1959-1962.

11. León-Bañares Rosa., *et al*. "Transgenic microalgae as green cell-factories". *TRENDS in Biotechnology* 22.1 (2004): 45-52.

12. Mayfield Stephen P and Scott E Franklin. "Expression of human antibodies in eukaryotic micro-algae". *Vaccine* 23.15 (2005): 1828-1832.

13. Mishra Avinash., *et al*. "Characterization of extracellular polymeric substances produced by micro-algae Dunaliella salina". *Carbohydrate Polymers* 83.2 (2011): 852-857.

14. Polikovsky Mark., *et al*. "Towards marine biorefineries: Selective proteins extractions from marine macroalgae Ulva with pulsed electric fields". *Innovative Food Science and Emerging Technologies* 37 (2016): 194-200.

15. Potvin Gabriel and Zisheng Zhang. "Strategies for high-level recombinant protein expression in transgenic microalgae: a review". *Biotechnology Advances* 28.6 (2010): 910-918.

16. Raught, Brian., *et al*. "Phosphorylation of eucaryotic translation initiation factor 4B Ser422 is modulated by S6 kinases". *The EMBO Journal* 23.8 (2004): 1761-1769.

17. Rosales-Mendoza., *et al*. "Chlamydomonas reinhardtii as a viable platform for the production of recombinant proteins: current status and perspectives". *Plant Cell Reports* 31.3 (2012): 479-494.

18. Saurabh Satyajit., *et al*. "RNA interference: concept to reality in crop improvement". *Planta* 239.3 (2014): 543-564.

19. Scranton Melissa A., *et al*. "Synthetic promoters capable of driving robust nuclear gene expression in the green alga Chlamydomonas reinhardtii". *Algal Research* 15 (2016): 135-142.

20. Sørensen Iben., *et al*. "Stable transformation and reverse genetic analysis of P enium margaritaceum: a platform for studies of charophyte green algae, the immediate ancestors of land plants". *The Plant Journal* 77.3 (2014): 339-351.

21. Spolaore Pauline., *et al*. "Commercial applications of microalgae". *Journal of Bioscience and Bioengineering* 101.2 (2006): 87-96.

22. Stephens Evan., *et al*. "Genetic engineering for microalgae strain improvement in relation to biocrude production systems". *Biomass and Biofuels from Microalgae*. Springer, Cham, (2015): 191-249.

23. Tandon Puja and Qiang Jin. "Microalgae culture enhancement through key microbial approaches". *Renewable and Sustainable Energy Reviews* 80 (2017): 1089-1099.

24. Valdiani, Alireza., *et al*. "Bioreactor-based advances in plant tissue and cell culture: challenges and prospects". *Critical Reviews in Biotechnology* (2018): 1-15.

25. Wang Hui-Min David., *et al*. "Exploring the potential of using algae in cosmetics". *Bioresource Technology* 184 (2015): 355-362.

Volume 3 Issue 2 February 2019