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# Microalgae Technology for Nutraceuticals

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**Abstract :** Production of nutraceuticals from microalgae—a virtually untapped natural phyto-based source of which there are 200,000 to 1,000,000 species—offers a sustainable and healthy alternative to conventionally sourced nutraceuticals for the market. Microalgae can be grown organically using only natural sunlight, water and nutrients at an extremely fast rate, e.g. 10-100 times more efficiently than crops or trees. However, the commercial success of microalgae products at scale remains limited largely due to the lack of economically viable technologies. There are two major microalgae production systems or technologies currently available: 1) the open system as represented by open pond technology and 2) the closed system such as photobioreactors (PBR). Each carries its own unique features and challenges. Although an open system requires a lower initial capital investment relative to a PBR, it conveys many unavoidable drawbacks; for example, much lower productivity, difficulty in contamination control/cleaning, inconsistent product quality, inconvenience in automation, restriction in location selection, and unsuitability for cold areas – all directly linked to the system openness and flat underground design. On the other hand, a PBR system has characteristics almost entirely opposite to the open system, such as higher initial capital investment, better productivity, better contamination and environmental control, wider suitability in different climates, ease in automation, higher and consistent product quality, higher energy demand (particularly if using artificial lights), and variable operational expenses if not automated. Although closed systems like PBRs are not highly competitive yet in current nutraceutical supply market, technological advances can be made, in particular for the PBR technology, to narrow the gap significantly. One example is a readily scalable P2P Microalgae PBR Technology at Grande Prairie Regional College, Canada, developed over 11 years considering return on investment (ROI) for key production processes. The P2P PBR system is approaching economic viability at a pre-commercial stage due to five ROI-integrated major components. They include: (1) optimum use of free sunlight through attenuation (patented); (2) simple, economical, and chemical-free harvesting (patent ready to file); (3) optimum pH- and nutrient-balanced culture medium (published), (4) reliable water and nutrient recycling system (trade secret); and (5) low-cost automated system design (trade secret). These innovations have allowed P2P Microalgae Technology to increase daily yield to 106 g/m2/day of Chlorella vulgaris, which contains 50% proteins and 2-3% omega-3. Based on the current market prices and scale-up factors, this P2P PBR system presents as a promising microalgae technology for market competitive nutraceutical supply.

**Keywords :** microalgae technology, nutraceuticals, open pond, photobioreactor PBR, return on investment ROI, technological advances

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