doi 10.18699/bgrs2024-9.2-24

Mesenchymal stem cell proliferation and NO production under cyanobacteria and microalgae condition

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Key words: microalgae, cyanobacteria, mesenchymal stem cells, proliferation, NO

Motivation and Aim: Numerous nutrients, such as proteins, fats (fatty acids, polyunsaturated fatty acids, transisomers of fatty acids), carbohydrates, vitamins (B, K, and E), different carotenoids, and colors can be found in microalgae and cyanobacteria [1]. It has been demonstrated that *Chlorella vulgaris* aqueous extract can function in lieu of fetal embryonic serum in the culture of Chinese hamster ovary cells and mesenchymal stem cells [2, 3]. The goal of this research is to determine whether extracts from cyanobacteria and microalgae can affect the way rat and human mesenchymal stem cells function. The purpose of the study is to: 1) assess how extracts from microalgae and cyanobacteria affect the viability and proliferation of human and rat mesenchymal stem cells (MSCs) *in vitro*; and 2) investigate how these extracts affect the secretory activity of these cells in order to produce nitric oxide (NO) *in vitro*.

Methods and Algorithms: Green microalgae (*Tetraselmis (Platymonas) viridis* Rouchijajnen), cyanobacteria (*Leptolyngbya cf. ectocarpi*, *Planktothrix agardhii*, and *Roholtiella mixta sp. nov.)*, and diatoms (*Nanofrustulum shiloi*) were obtained from the Kovalevsky Institute of Biology of the Southern Seas culture collection. Sample extracts were made from dry biomass by passive diffusion of physiologically active chemicals into a 1% dimethyl sulfoxide (DMSO) solution for 24 hours at 37°C.

The impact of DMSO extracts of cyanobacteria and microalgae on MSCs from rat and human bone marrow was assessed. Proliferative potential (MTT method) and NO production (Griss reagent) were assessed, and cell membership to true MSCs was confirmed by immunophenotyping and differentiation in the connective tissue direction. Data is presented in the form of mean and standard deviation (M±SD) in the tables. Utilizing Statistica 10.0 for Windows, data was examined. Statistical significance of differences between samples was evaluated using one-factor analysis of variance (ANOVA) with Bonferroni post hoc test, and accepted at $p < 0.05$.

Results: Except *for N. shiloi* (human MSCs) and phycocyanin (rat MSCs), it was observed that adding extracts of microalgae, cyanobacteria, and fucoxanthin to the culture medium promotes the proliferation/viability of human and rat MSCs. Furthermore, it was discovered that, with the exception of *N. shiloi* and *L. cf. ectocarpi*, extracts of microalgae, cyanobacteria, and phycocyanin increase NO generation in human MSCs in a dose-dependent manner. When phycocyanin, microalgae, and cyanobacteria extracts were added to the culture medium, rat MSCs were likewise accountable for enhanced NO generation; however, no obvious dose-dependent effect was observed.

Conclusion: Since the capacity of these microalgae and cyanobacteria species to be examined had not been before, our results of boosting the proliferation and secretory capabilities of human and rat MSCs with DMSO extracts of these microorganisms are unique.

Funding: The work was performed within the framework of the state assignment registration number 122022800132-1, 1023032700554-2-1.6.16, and 121030300149-0.

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