DOI: 10.46991/JISEES.2025.SI1.163

Study of the Anti-Cancer Effect of Glycoglycerolipids Isolated from Microalgae

Baghish Harutyunyan[1*] Anna Zakoyan[1], Ani Aghabekyan[1], Angelina Sayadyan[1], Elena Kalita[2,5], Nelly Babayan[2,3], Iren Shahazizyan[3,4], Vigen Goginyan[1]

[1] Scientific and Production Center "Armbiotechnology", NAS, Yerevan, Armenia
[2] Institute of Molecular Biology, NAS, Yerevan, Armenia
[3] Faculty of Biology, Yerevan State University, Armenia
[4] Research Institute of Biology, Yerevan State University, Armenia
[5] CANDLE Synchrotron Research Institute, Yerevan, Armenia

ABSTRACT

Glycoglycerolipids are amphiphilic compounds found in cyanobacteria, algae, and plants that have attracted significant attention for their therapeutic potential, particularly as anticancer agents. These lipids, primarily located in the thylakoid membranes of chloroplasts, selectively interact with biological molecules, exhibiting anticancer, antiviral, and anti-inflammatory properties. Among them, monogalactosyldiacylglycerol (MGDG) is notable for its ability to inhibit cancer cell proliferation through mechanisms such as DNA-polymerase inhibition, mitotic centromere-associated kinesin suppression, and killer T-cell activation. While plant-derived MGDGs have been well-studied, their counterparts from microalgae remain underexplored. This study aimed to isolate MGDGs from the green unicellular microalgae *Chlorella vulgaris* and *Neochloris oleoabundans* and evaluate their anticancer potential. Microalgae were cultivated in a 3L photobioreactor under blue-red light illumination for 14 days. Total lipids were extracted using the Bligh and Dyer method, and MGDGs were purified through column chromatography with the gradient elution method. HPLC was employed to identify and quantify MGDGs in lipid fractions. NMR spectroscopy revealed unique structural features of *C. vulgaris*-derived MGDG, which may explain its bioactivity. *In vitro* MTT assays showed that MGDGs (dissolved in dimethyl sulfoxide (DMSO)) derived from *C. vulgaris* and *N. oleoabundans* significantly reduced the viability of MCF-7 breast cancer cells to 4.2% and 7.3%, respectively, at a concentration of 10,000 ng/ml. Combining MGDGs with 5-aminolevulinic acid reduced cell viability, with viability dropping to as low as 0.4% and 0.6%. Plant-derived MGDG (parsley) served as a standard, resulting in 16% cell viability. Notably, DMSO alone reduced cancer cell viability to approximately 70%. These results highlight the promising anticancer potential of MGDGs from microalgae and emphasize the need for further investigation into their therapeutic applications.

Keywords: microalgae, bioactivity, glycoglycerolipids, cytotoxicity, breast cancer

Acknowledgement: This research was supported by the Higher Education and Science Committee of MESCS RA (Research projects No. 22YR-2I015 and No. 25YR-2I016).

References:

1. Abedin, M.R.; Barua, S. Isolation and purification of glycoglycerolipids to induce apoptosis in breast cancer cells. *Sci. Rep.* **2021,** *11*, 1298. DOI:10.1038/s41598-020-80484-x
2. Hölzl, G.; Dörmann, P. Structure and function of glycoglycerolipids in plants and bacteria. *Prog. Lipid Res.* **2007,** *46*, 225–243. DOI:10.1016/j.plipres.2007.05.001

[*]Corresponding Author:

Baghish Harutyunyan, Scientific, and Production Center "Armbiotechnology" NAS RA, 14 Gyurjyan, Street, Yerevan, Republic of Armenia.
Email: baghishharutyunyan@armbiotech.am