

The Cell as an Old and New Source of Bioactive Compounds

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Let us look at cells as integrated biological systems that serve as continuous sources of bioactive and therapeutically relevant compounds.

The concept of viewing cells as bioreactors that produce bioactive molecules represents an integrative perspective in the life sciences that emphasizes the continuity between biological systems traditionally studied as separate kingdoms and provides a more unified understanding of living systems as interconnected sources of future medicines¹. Animal- and plant-based bioreactors play complementary roles in this framework. Animal systems, including recombinant cell lines, enable the production of complex biologics such as antibodies, hormones, vaccines, and therapeutic proteins. A well-known example is trastuzumab and its antibody-drug conjugate derivative ado-trastuzumab emtansine (Kadcyla), which illustrates how mammalian cell systems can be used to generate highly specific and effective anticancer therapies².

Plant cells, in turn, function as efficient and sustainable bioreactors producing a wide spectrum of secondary metabolites, proteins, and phytohormones with pharmaceutical relevance. A representative example is sulforaphane, a dietary isothiocyanate derived from cruciferous vegetables, which exhibits cytoprotective and anticancer activity and can enhance the efficacy of chemotherapeutic agents³. In triple-negative breast cancer models, sulforaphane has demonstrated both antitumor and antimetastatic effects, as well as synergy with anticancer drugs that improve intracellular drug delivery^{4,5}. The metabolic output of plant cell can be further modulated through genetic and environmental approaches, enabling the generation of novel or enriched bioactive compounds. Another interesting class of plant-derived molecules is phytohormones. Although traditionally associated with plant growth and stress responses, it has been recently shown that they may also exert biological effects in animal systems, opening new perspectives for their potential role in modulating cancer-related pathways¹.

In this context, the lecture will discuss selected examples from my own research, highlighting this emerging perspective as a promising and rapidly developing area of biomedical science. A brief discussion of the Baltic Sea as a potential source of bioactive molecules and marine bioreactor systems will also be introduced.

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