

INHIBITORY EFFECT OF BIOACTIVE PREPARATIONS FROM MICROALGAE AND CYANOBACTERIA ON LDL OXIDATION

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<https://doi.org/10.52757/bsd26.61>

Background: Extracts from microalgae and cyanobacteria represent important sources of bioactive compounds with antioxidant potential. Their efficacy depends on their chemical nature and behavior in different environments. For assessing activity in lipid systems, the low-density lipoprotein (LDL) oxidation inhibition assay is an appropriate functional model for comparing the capacity to prevent lipid peroxidation.

Aim: To comparatively evaluate the inhibitory effect on LDL oxidation of selected bioactive preparations of cyanobacterial and microalgal origin.

Materials and methods: Phycobiliproteins from *Porphyridium cruentum* and *Arthrospira platensis* (aqueous extracts), as well as astaxanthin from *Haematococcus pluvialis* (ethanolic extract from aplanospores), were analyzed. The inhibitory effect on LDL oxidation was assessed using a spectrophotometric assay, with results expressed as percentage inhibition at defined concentrations of the tested preparations.

Results: All three preparations exhibited inhibitory activity against LDL oxidation, with variations depending on the chemical nature of the bioactive compounds and their concentration. Astaxanthin from *Haematococcus pluvialis* showed the strongest inhibitory effect, reaching 67.3% at 5 µg/mL, indicating high antioxidant potency at very low concentrations. This effect may be attributed to the specific chemical structure of astaxanthin, which enables activity in lipid systems by localizing within hydrophobic membrane regions and at the lipid-water interface, the primary site of LDL lipid peroxidation initiation. Phycobiliproteins from *Arthrospira platensis* showed an inhibitory effect of 27.9% at 3.99 µg/mL, suggesting high specific activity at low concentrations. Phycobiliproteins from *Porphyridium cruentum* induced 43.4% inhibition at 136.6 µg/mL. These differences in potency may be related to the distinct compositions of phycobilin chromophores (phycocyanobilin vs. phycoerythrobilin), which influence radical-scavenging efficiency and electron-transfer processes. Phycocyanin exhibits high activity at low concentrations through chain-breaking antioxidant mechanisms in the early stages of oxidation. In contrast, phycoerythrin may exhibit higher activity at elevated concentrations due to structural differences that affect interactions at the lipid-water interface of LDL.

Conclusions: The study demonstrates that algal and cyanobacterial preparations inhibit LDL oxidation to varying degrees, depending on compound type and concentration. Astaxanthin from *Haematococcus pluvialis* was the most potent inhibitor at µg/mL levels, while phycobiliproteins from *Arthrospira platensis* and *Porphyridium cruentum* also exhibited relevant antioxidant activity. The LDL oxidation assay proved to be a suitable model for evaluating antioxidant potential in lipid systems.

Keywords: LDL oxidation, inhibitory effect, phycobiliproteins, astaxanthin, *Arthrospira platensis*, *Porphyridium cruentum*, *Haematococcus pluvialis*.

Acknowledgments: This work was supported by research subprogram 020101 funded by the Ministry of Education and Research of the Republic of Moldova.