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Phytochemical screening, metabolite profiling and enhanced antimicrobial activities of microalgal crude extracts in co-application with silver nanoparticle

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Abstract

Background: Microalgae is one of the major sources of natural compounds with antimicrobial activity. The metabolite profiling of the extracts could identify the bioactive compounds based on methanol (MET), ethanol (ETH), chloroform (CHL), hexane (HEX) and water (W) solvent systems. The microalgal crude extracts in co-application with silver nanoparticles (AgNPs) had enhanced antimicrobial activity with potential to overcome the global problem of microbial antibiotic resistance.

Results: *Chlorella* sp. exhibited the highest lipid, *N. oculata* the highest total saturated fatty acids (TSFA), and *T. suecica* the highest mono-unsaturated (MUFA) and poly-unsaturated fatty acids (PUFA). The highest carbohydrate, protein and total phenolics contents (TPCs) were attained by *N. oculata*. The highest total flavonoids contents (TFCs), and chlorophyll *a* and *b* were in *T. suecica*, while comparable level of carotenoids were found in all species. For high-performance thin-layer chromatography (HPTLC) analyses, the eicosapentaenoic acid (EPA) with high peaks were detected in *T. suecica*-HEX and *N. oculata*-CHL; and β-carotene in *Chlorella* sp.-ETH. The gas chromatography–mass spectrometry (GC–MS) analyses showed high 13-docosenamide (Z)- in *T. suecica*-HEX; phytol in *N. oculata*-HEX; and neophytadiene in *Chlorella* sp.-ETH. The AgNPs–MCEs–MET and HEX at the 1.5:1 ratios exhibited strong activities against *Bacillus subtilis*, *Streptococcus uberis*, and *Salmonella* sp.; and the AgNPs–*T. suecica*-HEX and MET and AgNPs–*Chlorella* sp.-HEX at the 1.5:1 ratios exhibited activities against *Klebsiella pneumoniae*.

Conclusion: Different bioactive components were detected in the MCEs based on the HPTLC and GC–MS analyses. Significant antimicrobial activities against the pathogenic microbes were demonstrated by the synergistic effects of the MCEs in co-application with the AgNPs. This could be beneficial in the fight against sensitive and multidrug-resistant bacteria.

Keywords: Microalgae, Solvent systems, Metabolite profiling, Antimicrobial, Silver nanoparticle, Co-application

Introduction

Microalgae could provide a viable molecular pharming system to produce new compounds because of the ease of cultivation and rapid evolution, a short period of time from transition to expansion, and safety aspect as algae do not induce human pathogens, and several strains are generally regarded as safe (GRAS). Microalgae could

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