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Antioxidant activities and polyphenolics of various solvent extracts of red seaweed, *Gracilaria changii*

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Abstract This study determined the levels of polyphenols, flavonoids, carotenoids and antioxidant activity of the edible red seaweed, *Gracilaria changii*. Freeze-dried *G. changii* powder was extracted using five solvent systems: 80 % ethanol, 80 % methanol, 80 % acetone, ethyl acetate and water. The antioxidant activity of the extracts was measured using three assays, namely 2,2-diphenyl-1-picrylhydrazyl (DPPH), ferric reducing power (FRAP) and β-carotene bleaching assays (BCB). The total phenolics (TPC) and total flavonoids content (TFC) and the total carotenoids content (TCC) were also determined. Ethanol extract had the highest yield followed by methanol > water > acetone > ethyl acetate extract. The radical scavenging effects of all the extracts showing dose-dependency properties with the ethyl acetate extract of *G. changii* exhibiting the highest radical scavenging effect (EC_{50} of 0.51±0.09 mg mL^{-1}), while the water extract had the lowest scavenging effect of 7.80±0.57 mg mL^{-1}. Ferric reducing power was in the following descending order: ethyl acetate > ethanol > methanol > acetone > water. TPC was highest in the ethyl acetate extract (21.57±2.58 mg PGE g^{-1}) and least in the water extract (6.06±0.52 mg PGE g^{-1}). The TFC of *G. changii* was in the range of 18.97±0.89–200.87± 3.61 mg RE g^{-1}. The results revealed the effect of different extracting solvents in altering the antioxidant potential of *G.changii*, and ethyl acetate was identified as the most efficient solvent for extracting bioactive compounds from this red seaweed.

Keywords β-carotene · DPPH · FRAP · Total carotenoids · Total flavonoids · Solvents

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Introduction

Reactive oxygen species (ROS) are generated in living organism during metabolism, including superoxide anion (O^{2-}), hydroxyl radical (•OH), hydrogen peroxide (H_2O_2) and nitric oxide (NO) (Chew et al. 2008). Under normal conditions, ROS and free radicals are effectively eliminated by antioxidant defence systems such as antioxidant enzymes and non-enzymatic factors. However, disruption of the balance between the free radicals and antioxidant concentration results in cellular oxidative stress. As a result, biomacromalecules including DNA, membrane lipids, and proteins are damaged by ROS-mediated oxidative stress which leads to numerous diseases and disorders such as cancer, stroke, mycocardial infarction, diabetes, Alzheimer's and Parkinson's (Chew et al. 2008; Je et al. 2009). Antioxidant compounds play an important role as health protective factors. They can delay or inhibit lipid oxidation by inhibiting the initiation or propagation of oxidizing chain reactions, and are also involved in scavenging free radicals (Piccolella et al. 2008). Synthetic antioxidants such as butylatedhydroxytoluene (BHT), butylatedhydroxyanisole (BHA), and propyl gallate (PG) are commercially available and have been used as food preservatives. However, these synthetic antioxidants have side effects that could lead to liver damage and are suspected to be mutagenic and neurotoxic (Vijayabaskar and Shiyamala