SLCARP
Sri Lanka Council for Agricultural Research Policy

G to G 2025
INTERNATIONAL RESEARCH CONFERENCE

Green to Green
International Research Conference

BOOK OF ABSTRACTS

SRI LANKA COUNCIL FOR AGRICULTURAL RESEARCH POLICY
MINISTRY OF AGRICULTURE, LIVESTOCK, LANDS AND IRRIGATION

This book contains the abstracts presented at the Green to Green International Research Conference (GtoG), held on the 16th December, 2025.

Published by: Sri Lanka Council for Agricultural Research Policy

ISBN: 978-624-6163-03-7

Bioavailability of Antioxidants, Minerals and Heavy Metals in Two Edible Seaweed Species: *Kappaphycus alvarezii* and *Caulerpa racemose*

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Sri Lanka is endowed with an abundance of marine resources, yet numerous seaweed species remain underutilized and accumulate as waste along coastal beaches. This represents a missed opportunity to transform marine biomass into valuable resources. The present study was undertaken to evaluate the bioavailability of antioxidants, minerals, and heavy metals in two edible, Sri Lankan seaweeds: *Kappaphycus alvarezii* and *Caulerpa racemose*. Seaweed drying at 55 °C and powdered and subjected to the *in vitro* gastrointestinal digestion, simulating enzymatic breakdown and intestinal absorption using a 12 kDa dialysis membrane. Polyphenol contents were quantified before and after digestion by Folin-Ciocalteu and aluminium chloride colorimetric methods, while antioxidant capacities were evaluated through 2,2-Diphenyl-1-picryl-hyrazyl-hydrate radical scavenging (DPPH) activity, 2,2′-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) radical scavenging (ABTS) activity and ferric reducing antioxidant power assays (FRAP). Essential minerals (Fe, K, Mg, Al, Zn) and potential heavy metals were analyzed using Inductively Coupled Plasma-Optical Emission spectroscopy. Results revealed significantly higher total phenolic content in bioavailable fractions compared to raw seaweed for both species, while total flavonoid content was undetectable. Notably, bioavailable fractions enhanced antioxidant activity in the ABTS assay, but reduced activity in DPPH radical scavenging compared to raw fractions. *C. racemosa* showed greater FRAP values in the bioavailable fraction. The bio-accessible mineral and heavy metal contents were markedly higher in *K. alvarezii*. These findings demonstrate that digestion increases the release and accessibility of polyphenols and minerals in seaweeds, supporting marine biomass recycling as functional ingredients to address micronutrient deficiencies and oxidative stress-related diseases while promote sustainable resource utilization and reducing coastal waste.

Keywords: Antioxidants, Bioavailability, Heavy Metals, In Vitro Digestion, Seaweed

Acknowledgement,
The authors sincerely thank Mr. Nirooparaj Balachandran, Assistant Director (Coastal–Northern Province) at the National Aquaculture Development Authority, Sri Lanka, for his valuable assistance in the collection of seaweed samples.