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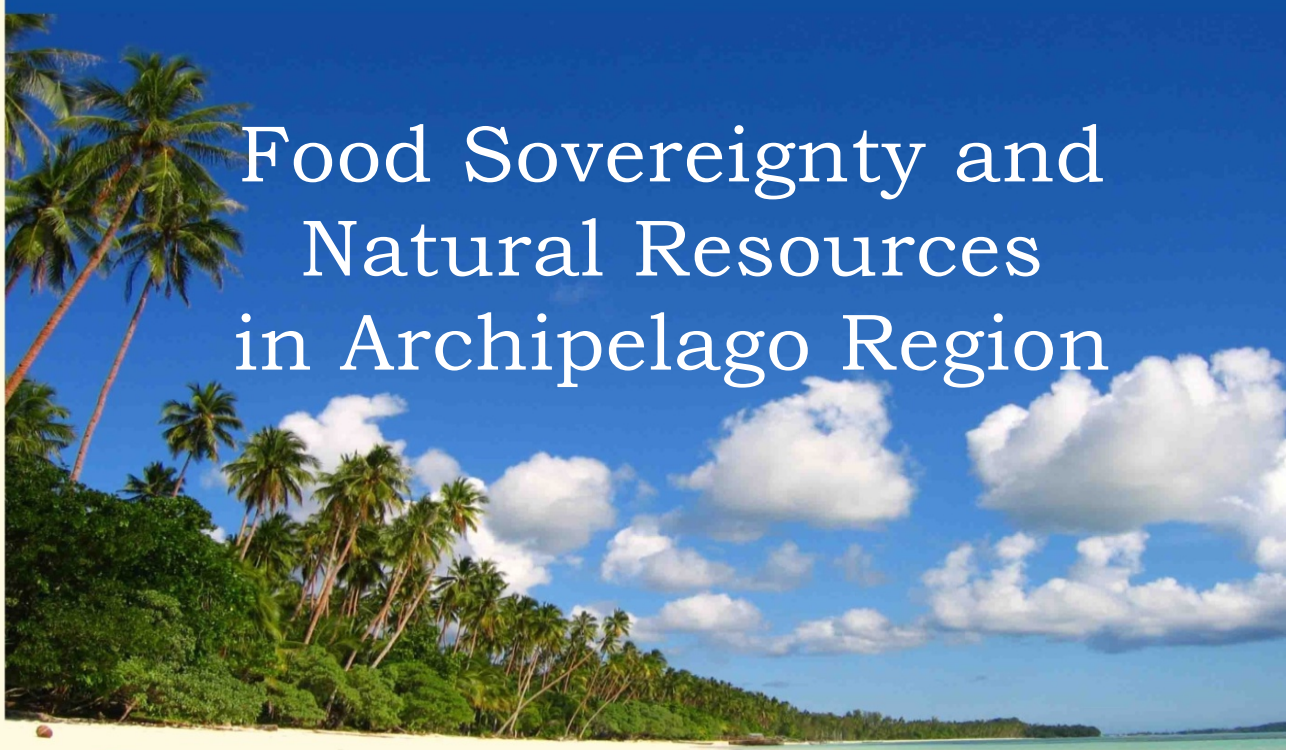

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SEAWEED COMMODITY OPPORTUNITIES AS FUNCTIONAL FOOD FOR CARDIOVASCULAR PROBLEM IN INDONESIA

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Abstract

Indonesia is an archipelago country, approximately 70% of its area is sea. Because of that Indonesian has an opportunity to develop the potential of marine resources. One of them is seaweed. Seaweed consists of many species with different benefits for health. One of the known species of seaweed that are beneficial to human health is Sargassum algae. As its socioeconomic situation is improving, Indonesia is now in an epidemiological transition, having the double burden of infectious and emerging non-communicable, diseases especially cardiovascular, diseases. The World Health Organization (WHO) has predicted that in 2030, the people with cardiovascular problems will increase to 23 million people worldwide. It also predicted that 76 percent or 17.5 million cases of heart disease will occur in developing countries. Based on the Ministry of Health Primary Health Research 2010, heart disease is still the first cause of death in Indonesia with the prevalence rate reaching 7.2 percent. Therefore this article will discuss the potential benefits of Sargassum sp. as functional food for cardiovascular disease.

Keywords: *seaweed, functional food, cardiovascular*

INTRODUCTION

Indonesia is defined by its marine environment. The country is an archipelagic nation strung out across more than 17,000 islands and bounded by deep ocean basins and shallow seas. In fact, close to 75% of Indonesia's total area is sea. With so many islands, its coastline is thought to exceed 80,000 km including large areas of sea grass, mangrove and coral reef habitats. This marine environment is of incredible importance to the people that live in Indonesia. The country is the 4th most populace in the world and close to ¼ of this huge population lives in coastal communities and depends directly on marine and coastal resources. Still an even larger proportion lives on coastal plains and a significant percentage of their daily protein intake comes from the sea. In addition, it is estimated that over 20% of Indonesia's GDP comes from its seas and oceans (1).

Seaweed is a loose colloquial term encompassing macroscopic, multi-cellular, benthic marine algae. The term includes some members of the red, brown and green algae. Seaweeds can also be classified by use (as food, medicine, fertilizer, industrial, etc.). Like all algae, seaweeds are not plants. A certain seaweed may belong to one of the several groups of multi-cellular algae: the red algae, green algae, and brown algae. As these three groups are not thought to have a common multi-cellular ancestor, the seaweeds are a polyphyletic group. In addition, some tuft-forming blue-green algae (*Cyanobacteria*) are sometimes considered to be seaweeds. "Seaweed" is a colloquial term and lacks a formal definition (2).

As its socioeconomic situation is improving, Indonesia is now in an epidemiological transition, having the double burden of infectious and emerging non-communicable diseases, especially cardiovascular diseases (CVD). A review of the data from recent community surveys indicates an increase in cardiovascular diseases, particularly ischaemic heart disease and hypertension and its sequelae, as causes of morbidity and mortality, most markedly among the elderly, while rheumatic heart disease and congenital heart disease continue to have much lower incidences. The World Health Organization (WHO) has predicted that in 2030, the people with cardiovascular problems will increase of to 23 million people in the world. It also predicted that 76 percent or 17.5 million cases of heart disease will occur in developing countries. Based on the Ministry of Health Primary Health Research 2010, heart disease is still the first cause of death in Indonesia with the prevalence rate reached 7.2 percent. There are some cause of CVD such as smoking, hypertension, lack of sleep, hyperlipidaemia, diabetic, unhealthy eating, physical inactivity, stress, air pollution, alcohol etc (3). Seaweed consists of many species with different benefits for health.

One of the known species of seaweed that are beneficial to health is Sargassum algae.

Content

The Sargassum species, a brown warm water macroalgae with variously shaped plastids in each cell, is rich in carotenoids, fatty acids, phycobillins, vitamins, sterols, tocopherols and polysaccharides such as mannitol, cellulose, alginate, fucoidan, fucoxanthine, and laminaran. Many Sargassum species have recognizable holdfast, stripes and blades that vary a lot in size and morphology. The spread of these species are common in the waters of Indonesia, Sumatra, Java, Seribu Islands, Sulawesi and Aru.

Figure 1 Sargassum sp

Moreover, it is a good source of dietary fibers. Its biological activity and chemical and nutritional composition may depend on many factors, including species, geographical origin or area of cultivation, seasonal, environmental and physiological variations, time of harvest, water temperature, and processing methods which can greatly influence its protein t5 content, carbohydrates, lipids, fiber, and metabolites.
Several pre-clinical studies on Sargassum species revealed numerous physiological and biological activities; such as: antioxidant, anti-tumor, anti angiogenic, anti inflammatory, anti-coagulant, anti-viral and anti-vasculogenic. It also has bioactive compounds like antioxidants and healing properties.

Sargassum sp. has benefit in lipid plasma decreased. The research showed that supplementing 5% seaweeds to HCF diet significantly reduced plasma TC (-11.4% to -18.5%), LDL-C (-22% to -49.3%), and TG (-33.7% to -36.1%) levels and significantly increased HDL-C levels (16.3-55%). Among the seaweeds, *Sargassum polycystum* showed the best anti-obesity and blood GSH-Px properties, *K. alvarezii* showed the best antihyperlipemic and in vivo antioxidation effects, and *C. lentillifera* was most effective at reducing plasma TC. All seaweeds significantly reduced body weight gain, erythrocyte GSH-Px, and plasma lipid peroxidation of HCF diet rats towards the values of normal rats (4).

The ability of *Sargassum siliquosum* to prevent the initiation of free radicals causing cellular damage was investigated in vitro. The plant was extracted exhaustively using methanol and partition using solvents of different polarities. Total phenolic contents (TPC) and flavonoid contents (TFC) were evaluated according to Folin-Ciocalteu and aluminium chloride colorimetric assays, respectively. TPC results showed significant difference in the mean gallic acid equivalent (GAE) ($p<0.001$) using the five fractions: water < (butanol-water = methanol-water) < hexane < dichloromethane

(DCM), in which the mean GAE using DCM is significantly the highest with 69.03 mg/g GAE. TFC demonstrated a significant difference in the mean quercitin equivalent ($p<0.001$) in which the mean QE using dichloromethane is significantly the highest (65 mg/g) compared with other samples.

Radical scavenging activities of fractions with the highest TPC and TFC were tested against OH, NO and H2O2. The strongest inhibition was demonstrated by DCM fraction against radical scavengers OH, NO and H2O2 in a dose-dependent manner with IC50 value of 0.28, 0.29, and 2.27 mg/mL, respectively. These results clearly indicate the beneficial effect of *S. siliquosum* as antioxidant agent being a free radical scavenger. The polysaccharides isolated from the Sargassum species possess medicinal value and contain unique set of bio-molecules that can provide health benefits for the human body. Sargassum species is considered as vegetable, and is a normal ingredient in salads. A dish called Inabraw makes use of the boiled young part of brown seaweed plus fish and other vegetables It is used as a health drink in Bohol and as fertilizer in both agricultural and horticultural fields by adding salt-free algae with any plant-potting media (5). *Sargassum sp* also has antiobesity effect in the rats fed a high-fat diet supplemented with different doses of the seaweed powder.

The High Dose Seaweed (HDS) (10.0 % seaweed treatment diet) showed the greatest effect in suppressing weight gain, followed by the Medium Dose Seaweed (MDS) (5.0 % seaweed treatment diet) and Low Dose Seaweed (LDS) (2.5 % seaweed treatment diet). The HDG decreased the levels of total cholesterol and triglycerides in plasma. This finding shows that *S. polycystum* powder treatment had a positive effect on the inhibition of weight gain and has a promising value in preventing obesity (6).

S. polycystum extracts also can improve insulin sensitivity, decrease blood sugar levels and blood lipid levels in a rat model of type 2 diabetese. The diabetes was induced by a high-sugar, high-fat diet for 16 weeks to enhance insulin resistance, followed by a low-dose intraperitoneal injection of streptozotocin (35 mg kg^{-1} body weight). The doses of *S. polycystum* tested on diabetic rats were 150 and 300 mg kg^{-1} body weight for the ethanolic extract or 150 and 300 mg kg^{-1} for the water extract. Normal rats, untreated diabetic and metformin-treated diabetic rats ($n = 6$) were used as control. Both doses of the alcohol extract of *S. polycystum* and the 300 mg kg^{-1} water extract, significantly reduced blood glucose and glycosylated haemoglobin (HbA_{1C}) levels. Serum total cholesterol, triglyceride levels and plasma atherogenic index were significantly lower after 22 days treatment in all seaweed groups. Unlike metformin, *S. polycystum* did not significantly change plasma insulin in the rats, but increased the response to insulin. The consumption of either

ethanolic or water extracts of *S. polycystum* dose dependently reduced dyslipidaemia in type 2 diabetic rats. *S. polycystum* is a potential insulin sensitiser, for a comestible complementary therapy in the management of type 2 diabetes which can help reduce atherogenic risk (7)

CONCLUSION

Edible seaweeds are rich in bioactive antioxidants, soluble dietary fibers, proteins, minerals, vitamins, phytochemicals, and polyunsaturated fatty acids. Although previously the seaweeds were only used as gelling and thickening agents in the food or pharmaceutical industries, recent researches have revealed their potential as complementary medicine. The brown seaweeds have been shown to have therapeutic properties for health and disease management, such as anticancer, antiobesity, antidiabetic, antihypertensive, antihyperlipidemic, antioxidant, anti-inflammatory, immunomodulatory, thyroid stimulating, and tissue healing properties *in vivo*. Active compounds include sulphated polysaccharides, phlorotannins, carotenoids (e.g. fucoxanthin), minerals, peptides and sulfolipids, with proven benefits against degenerative metabolic diseases. Their therapeutic modes of action and bioactive components have been continously studied

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