Buku Abstrak

2011

Simposium Gizi Nasional 2011

Inovasi Terapi Gizi pada Penanggulangan Malnutrisi dan Penyakit Degeneratif dengan Pemanfaatan Potensi Pangan Lokal

presented by :

PROGRAM STUDI GIZI KESEHATAN
FAKULTAS KEDOKTERAN
UNIVERSITAS GADJAH MADA

Nutrient Composition of Two Edible Indonesian Marine Seaweeds and Older Adult Nutritional Requirement

(Makalah ini telah dipresentasikan pada Simposium Gizi Nasional, 15 Oktober 2011 yang diadakan oleh Program Studi Gizi Kesehtan, Fakultas Kedokteran, Universitas Gadjah Mada)

Lili Indrawati[1,4], Nugroho Abikusno[2], Thamrin Wikanta[3]

[1]Faculty of Medicine, Christian University of Indonesia

[2]Head, InResAge, Center for Commmunity Health & Population Studies, Trisakti University

[3] Reseacher of Research Center for Marine and Fisheries Product Processing and Biotechnology

[4] Associate Researcher of Centre for Ageing Studies, University of Indonesia

Abstract

Indonesia has a potency to be the biggest producer of seaweed in the world[1] but most of the seaweeds are under-utilized, and their health benefits are unknown. Seaweeds can be a very interesting natural source of new compounds with biological activity. [2]

The significant changes in age-associated nutrient requirements among others is the need for energy decreases but the protein requirements increase with age. The significant micronutrients that may be associated with deficiencies in elderly women include calcium, iron, zinc, and other trace minerals and vitamins are available in seaweeds.[3]

This study was conducted to create a nutritional data for two species of seaweeds commonly found in Binuangen coast of south Banten in order to popularize its consumption and utilization in Indonesian older people. The proximate composition, minerals, protein, fat, carbohydrate profiles of two tropical edible seaweeds, *Ulva fasciata* and *Rhodymenia palmata*, were studied.

The protein and carbohydrate content of seaweed were 11.55-17.61 g/100 g and 24.23-25.90 g/100 g dry weight (d.w.) respectively. The seaweeds were low in lipid content on dry weight basis. These seaweeds contain 7.98-11.01% macro-minerals (Na, K, Ca and Mg) and 695.48- 2048.19 ppm trace elements (Fe, Zn, Cu, and Mn). These seaweeds are nutritionally valuable thus making them a potential health ingredient for use in older people nutrition. The average daily consumption of 5 g of *Ulva fasciata* and *Rhodymenia palmata* is sufficient to meet 5-40% and 10-115% respectively of the trace elements daily requirement for older people, respectively.

Keywords: nutrient composition, edible seaweed, older people nutrition, Binuangen coast of Banten.

Abstrak

Indonesia mempunyai potensi untuk menjadi produsen rumput laut terbesar di dunia [1]tetapi kebanyakan masih belum dimanfaatkan dan manfaatnya untuk kesehatan belum banyak diketahui. Rumput laut adalah sumber bahan alami yang memiliki aktivitas biologis.[2]

Perubahan kebutuhan nutrisi terkait usia yang bermakna antara lain adalah penurunan kebutuhan energy dan peningkatan kebutuhan protein. Zat gizi mikro yang berhubungan dengan defisiensi pada wanita usia lanjut antara lain kalsium, besi, seng, dan mineral lain dan beberapa vitamin.[3]

Penelitian ini bertujuan mengetahui data kandungan gizi dari dua spesies rumput laut yang banyak ditemukan di pantai Binuangen Banten dalam rangka mempopulerkan penggunaanya pada populasi usia lanjut Indonesia. Profil mineral, protein, lemak, karbohidrat dari dua jenis rumput laut yang biasa dikonsumsi, yaitu *Ulva fasciata* and *Rhodymenia palmata* dianalisis.

Kandungan protein dan karbohidrat rumput laut tersebut adalah berkisar 11.55-17.61 g/100 g dan 24.23-25.90 g/100 g berat kering. Rumput laut tersebut mengandung lemak yang rendah, mengandung 7.98-11.01% mineral makro (Na, K, Ca and Mg) and 695.48- 2048.19 ppm elemen renik (Fe, Zn, Cu, and Mn). Rumput laut mengandung zat gizi yang bermanfaat bagi kesehatan untuk digunakan pada populasi usia lanjut. Konsumsi harian *Ulva fasciata* dan *Rhodymenia palmata* sebanyak 5 g cukup dapat memenuhi masing-masing 5-40% dan 10-115% kebutuhan harian elemen renik bagi usia lanjut.

Keywords: kandungan gizi, rumput laut, gizi usia lanjut, pantai Binuangen Banten

Introduction

Indonesia has a potency to be a biggest producer of seaweed in the world[1] but most of the seaweeds are under-utilized, and their health benefits are unknown. Seaweeds can be a very interesting natural source of new compounds with biological activity. Marine algae, like other photosynthesizing plants, are exposed to a combination of light and oxygen that leads to the formation of free radicals and other strong oxidizing agents.[2]

Seaweeds is one of natural sources of new compounds with biological activity. As a photosynthesizing plant, marine algae is exposed to a combination of light and oxygen that leads to the formation of free radicals and other strong oxidizing agents.[2]

Nutrition is an important element of health in the older population and affects the aging process. The prevalence of malnutrition is increasing in this population and is associated with a decline in: functional status, impaired muscle function, decreased bone mass, immune dysfunction, anemia, reduced cognitive function, poor wound healing, delayed recovery from surgery, higher hospital readmission rates, and mortality.[4]

One of important elements of health in the older population that affects the aging process is nutrition. The high prevalence of malnutrition in this population is associated with a decline in: functional status, impaired muscle function, decreased bone mass, immune dysfunction, anemia, reduced cognitive function, poor wound healing, delayed recovery from surgery, higher hospital readmission rates, and mortality.[4]

Older adults have a greater risk for nutritional deficiencies than younger adults due to physiologic changes associated with aging, acute and chronic illnesses, prescription and over-the-counter medications, financial and social status, and functional decline. The significant changes in age-associated nutrient requirements is the need for energy decreases but the protein requirements increases with age. The micronutrients, that are significantly associated with deficiencies in elderly women include vitamin B-12, vitamin A, vitamin C, vitamin D, calcium, iron, zinc, and other trace minerals.[3]

Though, protein is not a micronutrient but it is an important nutrient for old and very old individuals. Body mass will decrease with age, it would seem that protein requirements would also decline, but protein requirement will increase to maintain nitrogen equilibrium, because of demand increases to heal wounds, fight infection, repair fractures, or restore muscle mass lost from immobility, so dietary protein must be increased above maintenance requirements.[3]

Recently, the demands for seaweed product is increase, both as food and as an ingredient. The aim of this study was to investigate the nutritional composition of two species of seaweeds commonly found in Binuangen coast of south Banten in order to popularize its consumption and utilization to Indonesian older people.

Materials and Methods

Processing of seaweeds

The collected seaweeds were processed to remove the attached specimens on its surface. After that, the samples were washed in tap water and in distilled water. To remove the adhered microflora, the seaweeds were washed with alcohol. The processed seaweeds were stored in airtight zip-lock containers and stored.

Minerals: Evaluation of mineral contents was done by flame atomic absorptionspectroscopy [5]. The minerals analyzed were Sodium, Potassium, Calcium and Magnesium and trace elements (Iron, Zinc, Copper and Manganese).

Carbohydrate: Total carbohydrate estimation was done by Phenol-sulphuricacid method [6].

Fiber: The content of total dietary fibre (TDF) in seaweeds was deter-mined according to the AOAC enzymatic gravimetric method (AOAC official methods of Analysis; 2005: 962.09).

Lipid: Crude lipids were extracted from the powdered seaweed sample using Soxhlet apparatus [7]. The contents of the crude lipids were determined gravimetrically after oven-drying (80 ◦C) the extract overnight.

Protein: Estimation of crude protein content was determined by Lowryet al [8].

Results and Discussion

Ulva fasciata and *Rhodymenia palmate* have reasonable levels of proteins and carbohydrate. The seaweeds were low in lipid content (below 1%) on dry weight basis. *Ulva fasciata* and *Rhodymenia palmate* contain 7.98 and 11.01% macro-minerals (Na, K, Ca and Mg) respectively,

695.48 and 2048.19 ppm trace elements (Fe, Zn, Cu, and Mn) respectively. The presence of heavy metals such as cadmium and lead was also detected.

Table 1. Result of laboratory examinations

No	Type	Parameter	Results		Method
			Ulva	Rodhy	
1	Seaweed	Dry material			
		Fe (ppm)	617.95	1876.41	AAS
		Mn (ppm)	45.68	128.20	AAS
		Cu (ppm)	11.48	14.88	AAS
		Zn (ppm)	20.37	28.70	AAS
		Pb (ppm)	0.64	19.13	AAS
		Cd (ppm)	4.73	5.53	AAS
		Co (ppm)	ud	ud	AAS
		K (%)	2.14	7.70	AAS
		Na (%)	1.01	0.13	AAS
		Ca (%)	2.32	0.63	AAS
		Mg (%)	2.51	2.55	AAS
		Protein (%)	11.55	17.61	Kjedhal
		Water (%)	11.56	7.54	Gravimerti
		Fat (%)	0.63	0.92	Soxhlet
		Carbohydrate (%)	25.90	24.23	Titrimetri

ud: undetectable; AAS: Atomic absorption spectroscopy

The average daily consumption of 5 g of *Ulva fasciata* is sufficient to meet 1.5-40% of the trace elements daily requirement for older people, meet 40% of Fe daily requirement and 1.5% of Zn daily requirement. The average daily consumption of 5 g of *Rhodymenia palmata* is sufficient to meet 115% of of Fe daily requirement and 2 % of Zn daily requirement for older people.

Table 2: Dietary Reference Intakes for Older Adults

	Calcium (mg)	Iron (mg)	Magnesium (mg)	Manganese (mg)	Zinc (mg)	Potassium (g)	Sodium (g)	Protein (g)	Carbohy-drates (g)
RDA or AI[1]									
Age 51-70									
Male	1200*	**8**	**420**	2.3	**11**	**4.7**	1.3	**56**	**130**
Female	1200*	**8**	**320**	1.8	**8**	**4.7**	1.3	**46**	**130**
Age 70+									
Male	1200*	**8**	**420**	2.3	**11**	**4.7**	1.2	**56**	**130**
Female	1200*	**8**	**320**	1.8	**8**	**4.7**	1.2	**46**	**130**

[1] Recommended Dietary Allowances (RDAs) are in **bold type** and Adequate Intakes (AIs) are in ordinary type followed by an asterisk (*).

Garcı´a -Casal *et al*. reported that *Ulva sp*. is one of good sources of bioavailable Fe.[9] The bioavailability of Fe in seawed makes seaweed consumption could help to combat Fe deficiency and anaemia worldwide. A human study in eighty-three subjects received maize- or wheat-based meals containing marine algae (*Ulva sp., Sargassum sp. and Porphyra sp*.) showed that algae significantly increased Fe absorption in maize- or wheat-based meals, especially *Sargassum sp*., due to its high Fe content. Increases in absorption were dose-dependent and higher in wheat-based than in maize-based meals.[9]

The nutritive value of seaweeds is also due to their polysaccharide and polyunsaturated fatty acid contents. The high levels of non-digestible polysaccharide in their cell wall make seaweeds as a rich source of dietary fibre (330-500 g.kg–1, dry weight basis).[10] Alamsjah *et al*. stated that PUFAs commonly found in *Ulva fasciata* are hexadeca-4,7,10,13-tetraenoic acid (HDTA), octadeca-6,9,12,15-tetraenoic acid (ODTA) and α-linoleic acid.[11]

The fraction of *Ulva fasciata* showed very low toxicity to mice (LD_{50} of 20.66 mg kg^{-1}) and non toxic to liver and kidney.[12] These seaweeds are nutritionally valuable despite the presence of heavy metals, clean seaweeds represent a potential food alternative for older people after appropriate processing and environmental remediation to guarantee food safety.

Ulva fasciata also has bioactivity range and potency such as antioxidant, antiviral and antibacterial and antitumor activity. Since marine algae is a rich source of dietary fibre, minerals, proteins and vitamins, a documented bioactivity data would elevate their value in the human diet as food and pharmaceutical supplements.

Total polyphenol content was 10.84 gallic acid equivalents/g for *Ulva sp*. The polyphenol content found could be partly responsible for the antioxidant potency.[9]

Munifah and Krisnawang (2007) found that the antioxidative assay of each fraction showed that the chlorophyll fractions from green algae (*Ulva fasciata* and *Caulerpa racemosa*) had higher antioxidative activity against free radicals than 3 species of brown algae (*Padina australis*, *Sargassum sp*, and *Turbinaria deccurens*).[13]

Mendes *et al*. evaluated the antiviral activity of *Ulva fasciata*, collected from Rasa beach and Forno beach, Búzios, Rio de Janeiro, Brazil on the replication of human metapneumovirus (HMPV).[14]

The secondary metabolites of seaweeds *Ulva fasciata* collected form southeast and southwest coast of India, has been tested for biotoxicity potential. The green alga *U. fasciata* exhibited broad-spectrum antibacterial activity whereas the red alga *H. musciformis* showed narrow spectrum antibacterial activity. The brine shrimp cytotoxicity profile indicated that the seaweeds were moderately toxic. The overall activity profile indicated that *U. fasciata* contained more biological potency than *H. musciformis*.[15]

Alcoholic extracts of *Ulva faciata* and *Ulva lactuca* from the Gujarat coast exhibited antiviral and antiinflamation activities, respectively. Ethanolic extracts of the Indian marine algae belonged to the Rhodophyceae, Phaeophyceae, and Chlorophyceae have been tested against *Semiliki forest* (SFV),*Ranikhet disease* (RDV) and *Vaccinia* viruses (VV). The bioactivity of the extracts was, significantly, exhibited by the green algae *Ulva fasciata* (70%, SFV).[16]

Hexane fraction of *Ulva fasciata* showed the best cytotoxic activity against HeLa tumor cell line (IC_{50}=25.6 ppm) and T47D tumor cell line (IC_{50}=28.7 ppm).[17]

Conclusions

These Indonesian seaweeds shown have high nutritive value, thus making them as a food health ingredient for use in older people nutrition. More research is needed to establish the nutritional value of these seaweeds, especially, in the fields of biochemical analysis and evaluation of their bioavailability using human and animal feeding studies.

References

1. Ministry of Maritime-affairs and Fisheries RoI. Indonesia Produsen Rumput Laut Terbesar. http://wwwkkpgoid/indexphp/arsip/c/541/Indonesia-Produsen-Rumput-Laut-Terbesar/. 2008.
2. Matanjun P, Teng CP, Ismail NB, Kassim M, Yi C, editors. Nutrient Composition and Antioxidant Activities of Several Malaysian Tropical Seaweeds. The 12th ASEAN Food Conference; 2011.
3. Chernoff R. Micronutrient requirements in older women. The American journal of clinical nutrition. 2005;81(5):1240S-5S.
4. Ahmed T, Haboubi N. Assessment and management of nutrition in older people and its importance to health. Clinical interventions in aging. 2010;5:207.
5. Rupérez P. Mineral content of edible marine seaweeds. Food Chemistry. 2002;79(1):23-6.
6. Fournier E. Colorimetric quantification of carbohydrates. Current protocols in food analytical chemistry. 2001.
7. Wong KH, Cheung PCK. Nutritional evaluation of some subtropical red and green seaweeds: Part I — proximate composition, amino acid profiles and some physico-chemical properties. Food Chemistry. 2000;71(4):475-82.
8. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin phenol reagent. J Biol Chem. 1951;193(1):265-75.
9. García-Casal MN, Ramírez J, Leets I, Pereira AC, Quiroga MF. Antioxidant capacity, polyphenol content and iron bioavailability from algae (Ulva sp., Sargassum sp. and Porphyra sp.) in human subjects. British Journal of Nutrition. 2009;101(01):79-85.
10. Carvalho A, Portela M, Sousa M, Martins F, Rocha F, Farias D, et al. Physiological and physico-chemical characterization of dietary fibre from the green seaweed Ulva fasciata Delile. Brazilian Journal of Biology. 2009;69(3):969-77.
11. Alamsjah MA, Hirao S, Ishibashi F, Fujita Y. Isolation and structure determination of algicidal compounds from Ulva fasciata. Bioscience, biotechnology, and biochemistry. 2005;69(11):2186-92.
12. Wikanta T. Toksisitas akut dan subkronis Ulva fasciata. Jurnal Pascapanen dan Bioteknologi Kelautan dan Perikanan (In Press). 2011;3.
13. Munifah IaK, H. Isolation & Antioxidative Assay of Several Marine Macroalgae Components Within Ethyl-Acetate Fraction International Conference On Chemical Sciences (ICCS-2007), Yogyakarta-Indonesia. 2007.
14. Mendes GdS, Soares AR, Martins FO, Albuquerque MCMd, Costa SS, Yoneshigue-Valentin Y, et al. Antiviral activity of the green marine alga Ulva fasciata on the replication of human metapneumovirus. Revista do Instituto de Medicina Tropical de São Paulo. 2010;52(1):03-10.
15. Selvin J, Lipton AP. Biopotentials of Ulva fasciata and Hypnea musciformis collected from the peninsular coast of India. Journal of Marine Science and Technology. 2004;12(1):1-6.
16. Bhakuni DS, Rawat DS. Bioactive marine natural products: Springer Science & Business Media; 2006.
17. Marraskuranto E, Fajarningsih, N.D., Januar, H.I., dan Wikanta, T. Aktivitas Antitumor (HeLa dan T47D) dan Antioksidan Ekstrak Makroalga Hijau Ulva fasciata. Jurnal Pascapanen dan Bioteknologi Kelautan dan Perikanan (In Press). 2008;3(2):107-12.