The distribution and profile of nutrients and catechins of some Indonesian seaweeds

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INTRODUCTION

As foodstuff sources, seaweeds have high nutritional value as source of minerals, dietary fibers, fatty acids, and free amino acids¹⁻⁴⁾ and also potential source of antioxidant compound like catechin.^{5,6)} Indonesia is an archipelago country, having large number of seaweeds. The potential of seaweeds resources is estimated at 482,400 ton/year.⁷⁾ However the utilization up to present is limited to a few species. Furthermore research activity about them is rare and still fertile area. Therefore we studied this research to obtain data about the distribution and profile of nutrients and catechin of some Indonesian edible seaweeds.

MATERIALS AND METHODS

Six species of Indonesian edible seaweeds were used in this experiment. Two green algae (*Caulerpa sertularioides* (CS), and *Caulerpa racemosa* (CR)), three brown algae (*Turbinaria conoides* (TC), *Sargassum polycystum* (SP), and *Padina australis* (PA)), and one red alga (*Kappaphycus alvarezii* (KA)) were collected from Seribu Islands, Jakarta Prefecture. After removing sand, the seaweed samples were washed with clean seawater and transported to the laboratory under refrigeration. After washing with tap water and wiping with paper towel, seaweed samples were minced by a food cutter (MK-K75; Matsushita Electric Corp., Osaka, Japan), and stored at -20°C until used. Moisture, ash, and protein contents were determined according to AOAC⁸⁾, whereas fat was extracted with methanol and chloroform according to the method of Bligh and Dyer.⁹⁾ Mineral and fatty acid contents were analyzed by an atomic absorption spectrophotometer and a gas-liquid chromatograph, respectively. Soluble and insoluble dietary fibers were determined according to the enzymatic gravimetric method,⁴⁾ whereas the seaweed catechins were extracted and determined according to the modified method for tea catechins.¹⁰⁻¹²⁾

RESULTS

Proximate composition, mineral contents and fatty acid composition of the seaweed samples are presented in Table 1.

Table 1 Proximate, mineral contents, and fatty acids composition of Indonesian edible seaweeds.

	Seaweeds Species					
	CS	CR	TC	SP	PA	KA
Proximate composition (mean $\pm$ SD g /100 g)						
Moisture	82.39 $\pm$ 0.62	88.76 $\pm$ 0.54	85.05 $\pm$ 0.34	84.67 $\pm$ 0.37	83.08 $\pm$ 0.95	83.28 $\pm$ 0.69
Ash	2.86 $\pm$ 0.30	2.14 $\pm$ 0.23	2.50 $\pm$ 0.08	3.83 $\pm$ 0.26	5.47 $\pm$ 0.35	3.37 $\pm$ 0.09
Fat	2.26 $\pm$ 0.12	0.53 $\pm$ 0.02	0.75 $\pm$ 0.05	0.33 $\pm$ 0.02	0.75 $\pm$ 0.12	0.15 $\pm$ 0.01
Protein	3.05 $\pm$ 0.18	1.45 $\pm$ 0.16	1.04 $\pm$ 0.11	0.91 $\pm$ 0.02	1.48 $\pm$ 0.03	0.74 $\pm$ 0.05
Mineral contents (mean $\pm$ SD mg/g dry weight)						
Cu	-	-	-	0.01 $\pm$ 0.01	-	-
Fe	0.03 $\pm$ 0.01	0.10 $\pm$ 0.06	-	0.13 $\pm$ 0.02	0.23 $\pm$ 0.05	-
Zn	-	-	0.02 $\pm$ 0.01	0.01 $\pm$ 0.01	0.01 $\pm$ 0.00	0.01 $\pm$ 0.00
Mg	3.68 $\pm$ 1.03	3.84 $\pm$ 0.32	5.74 $\pm$ 0.26	5.69 $\pm$ 0.66	4.04 $\pm$ 1.58	2.88 $\pm$ 0.34
Ca	11.95 $\pm$ 4.43	18.52 $\pm$ 5.30	14.79 $\pm$ 2.17	18.67 $\pm$ 1.44	28.31 $\pm$ 4.26	2.80 $\pm$ 0.51
K	2.50 $\pm$ 0.37	3.18 $\pm$ 0.22	27.92 $\pm$ 1.08	17.54 $\pm$ 1.35	2.59 $\pm$ 0.40	87.10 $\pm$ 5.83
Na	29.09 $\pm$ 1.56	25.74 $\pm$ 1.18	11.47 $\pm$ 0.45	9.65 $\pm$ 1.36	16.88 $\pm$ 1.32	11.93 $\pm$ 2.47
Fatty acid composition (mean $\pm$ SD %)						
C8:0	0	0	0	0	0.22 $\pm$ 0.19	0
C9:0	0	0	0	0	0	0
C10:0	0	0	0	0	0	0
C11:0	0.47 $\pm$ 0.25	0.73 $\pm$ 0.04	0	0	0	0
C12:0	0.17 $\pm$ 0.03	0	0	0	0	0
C13:0	0.93 $\pm$ 0.22	1.28 $\pm$ 0.22	0	0	0.75 $\pm$ 0.16	0
C14:0	6.02 $\pm$ 0.06	4.50 $\pm$ 0.37	4.77 $\pm$ 0.56	6.68 $\pm$ 1.32	6.38 $\pm$ 0.52	6.55 $\pm$ 2.55
C15:0	0	0	0	0	0.49 $\pm$ 0.01	0
C16:0	45.25 $\pm$ 1.11	48.42 $\pm$ 3.48	41.51 $\pm$ 1.18	41.31 $\pm$ 0.28	39.08 $\pm$ 1.45	42.39 $\pm$ 6.46
C17:0	7.93 $\pm$ 0.07	3.07 $\pm$ 0.50	0	0	0.45 $\pm$ 0.10	0
C18:0	1.94 $\pm$ 0.20	3.93 $\pm$ 1.48	15.06 $\pm$ 0.50	12.96 $\pm$ 0.12	21.53 $\pm$ 0.67	10.60 $\pm$ 0.55
C18:1	7.09 $\pm$ 0.15	6.27 $\pm$ 0.47	5.48 $\pm$ 0.39	4.69 $\pm$ 0.77	3.24 $\pm$ 0.17	3.68 $\pm$ 1.58
C18:2	1.02 $\pm$ 0.04	1.24 $\pm$ 0.17	8.63 $\pm$ 0.27	5.47 $\pm$ 0.39	2.82 $\pm$ 0.19	2.91 $\pm$ 0.21
C18:3	13.65 $\pm$ 0.23	9.60 $\pm$ 1.08	3.67 $\pm$ 0.10	3.77 $\pm$ 0.14	4.30 $\pm$ 0.19	1.39 $\pm$ 1.29
C19:0	2.18 $\pm$ 0.07	1.85 $\pm$ 1.06	0	0	0	0
C20:0	0	0	0	0	1.22 $\pm$ 0.04	0
C20:1	0	0	0	0	0	0
C20:4	1.59 $\pm$ 0.24	7.31 $\pm$ 0.40	12.77 $\pm$ 0.88	14.43 $\pm$ 0.83	5.45 $\pm$ 0.34	9.88 $\pm$ 2.55
C20:5	5.37 $\pm$ 0.34	2.76 $\pm$ 0.36	3.69 $\pm$ 0.65	3.75 $\pm$ 0.29	1.30 $\pm$ 0.06	8.09 $\pm$ 1.76
C22:0	0	0	0	0	0	0
C22:1	0	1.72 $\pm$ 2.38	0	0	0.32 $\pm$ 0.29	0
C22:6	0	0	0	0	0	0
C24:0	1.29 $\pm$ 0.34	1.92 $\pm$ 0.46	0	0	0	0
C24:1	0	0	0	0	0	0
Others	5.11 $\pm$ 0.17	5.41 $\pm$ 0.59	4.41 $\pm$ 0.51	6.93 $\pm$ 0.57	12.46 $\pm$ 2.44	14.51 $\pm$ 4.13

Note: - : originally the sample did not contain this mineral

All of seaweeds had moisture contents around 85%. The ash content in PA was higher than other seaweeds,

and the lowest content was found in CR. The fat content were quite varying, with values ranges 0.15-2.26%. CS had the highest content of protein (3.05%). There was no copper in all of seaweeds samples, except only SP having trace amount. The contents of minerals were dominated by calcium, potassium and sodium. Palmitic acid (C16:0) was the main fatty acid found all of seaweeds. The distributions of dietary fiber and catechins of the Indonesian edible seaweeds are shown in Table 2.

Table 2 Dietary fiber and catechin contents of Indonesian edible seaweeds.

	Seaweeds Species					
	CS	CR	TC	SP	PA	KA
Dietary fiber contents (mean $\pm$ SD g/100 g dry weight)						
TDF	61.8 $\pm$ 1.4	64.9 $\pm$ 4.4	63.7 $\pm$ 3.6	65.7 $\pm$ 0.6	56.6 $\pm$ 6.6	69.3 $\pm$ 1.8
IDF	60.1 $\pm$ 0.7	64.1 $\pm$ 3.8	61.0 $\pm$ 4.6	63.5 $\pm$ 0.9	51.7 $\pm$ 4.7	58.6 $\pm$ 2.7
SDF	1.4 $\pm$ 0.8	0.9 $\pm$ 0.6	2.6 $\pm$ 1.0	2.3 $\pm$ 0.4	4.9 $\pm$ 2.1	10.7 $\pm$ 1.9
Catechin contents (mean $\pm$ SD μ g/g dry weight)						
GC	98 $\pm$ 19	-	-	-	-	-
EGC	-	-	170 $\pm$ 49	18 $\pm$ 16	-	-
C	-	-	+	-	52 $\pm$ 25	-
EC	91 $\pm$ 33	-	+	-	+	-
EGCg	-	-	-	-	-	-
GCg	-	-	-	-	-	-
ECg	-	-	-	-	-	-
Cg	17 $\pm$ 9	-	-	-	-	-

Notes: TDF: total dietary fiber, IDF: insoluble dietary fiber, SDF: soluble dietary fiber, GC: galliccatechin, EGC: epigallocatechin, C: catechin, EC: epicatechin, EGCg: epigallocatechin gallate, GCg: galliccatechin gallate, ECg: epicatechin gallate, Cg: catechin gallate, -: not detected, +: trace amount

SDF and TDF levels in KA were higher than other seaweeds, but the content of IDF was lower than another seaweed, except PA. CR had the highest content of IDF. CR and KA did not contain catechin and its isomers, whereas CS contained GC, EC and Cg. EGC was found in TC and SP, and C in PA.

DISCUSSION

The proximate compositions of Indonesian edible seaweeds were almost same to Japanese edible seaweeds like *Hizikia fusiformis*, *Undaria pinnatifida*.¹³⁾ Furthermore, the main mineral contents of Japanese edible seaweeds were also the same; they contained sodium, potassium and calcium, whereas the contents of iron and zinc were higher than Indonesian edible seaweeds.¹³⁾

The main fatty acid of Indonesian seaweed was palmitic acids. It was the same to Japanese seaweeds *Laminaria japonica*, *Hizikia fusiformis* and *Undaria pinnatifida*¹³⁾ but different from another Japanese seaweed *Porphyra yezoensis*, in which eicosapentaenoic acid was found as a main fatty acid.¹⁴⁾

The contents of SDF in Indonesian seaweed (0.9-10.7g) was lower than those in Japanese seaweed (7.1-25.1g).⁴⁾ On the contrary, Indonesian seaweeds had higher IDF content than Japanese seaweeds.

The distribution of catechin in Indonesian CR was similar to Japanese CR and *C serrulata*,⁵⁾ and they did not contain catechin and its isomers. The content of EGC in SP and TC were lower than Japanese *Sargassum* and *Turbinaria* genus, and also the content of C in PA was lower than that in Japanese *Padina* genus.⁵⁾

From the results can be concluded that Indonesian seaweeds contained the high nutritional compounds, were almost same to Japanese seaweeds, although the catechin content and its isomer were lower.

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