Distribution of Accumulated Arsenic in the Seaweed Hijiki, Sargassum fusiforme (Harvey) Setchell*(5)

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Summary

In the preceding papers, we reported the distribution of arsenic accumulated by Hijiki plants harvested along the seashores of Tsushima Archipelago. To investigate them harvested in some other areas, we collected Hijiki plants along the seashores of Goto Archipelago, Japan, in May 2001. Hijiki plants were separated into several parts such as leaves, stalks and filamentous holdfasts. After washing them with distilled water, the samples were lyophilized. Arsenic was determined by neutron activation analysis in the nuclear reactor of Research Reactor Institute, Kyoto University. The non-uniformity of arsenic localization in individual plants along their stems was observed as shown previously when expressed in μg arsenic per g of wet or dry weight (ppm).

Key words: arsenic; *Hizikia fusiforme* Okam.; *Sargassum fusiforme* (Harvey) Setchell; seaweeds; Goto Archipelago; neutron activation analysis

We have investigated the distribution of arsenic accumulated by Hijiki plants harvested along the seashores of Tsushima Archipelago^{2, 3)}. To investigate Hijiki harvested in some other areas, we collected Hijiki plants along the seashores of six districts in Goto Archipelago^{4, 5)}, Nagasaki, Japan in May 2001. In both Archipelagoes, Hijiki plants grew to more than 100 cm in length in some districts. There were large differences in arsenic concentration along the stalk, and these differences may depend on the environmental sea water conditions⁶⁾. This non-uniform localization of arsenic along the Hijki stalk seems to be a typical phenomenon also occurring in some other seaweeds⁴⁾.

In the present study, we intended to present distribution data of arsenic accumulated by Hijiki plants harvested along the seashores of other three districts in Goto Archipelago, Nagasaki, Japan.

Experimental

Hijiki, Sargassum fusiforme (Harvey) Setchell

We collected Hijiki plants, *Sargassum fusiforme* (Harvey) Setchell, in May 2001 along the seashores of three districts, Tomie, Taihou and Tamanoura of Goto Archipelago, Japan. Samples of the Hijiki plants were stored in an ice-box until we brought them back to our laboratory.

^{*}Newly proposed taxonomic name¹⁾ of *Hizikia fusiforme* Okam.

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Preparation of samples²⁾

Hijiki plants were washed with artificial seawater three times and washed more than twice with distilled water. Excessive water on the samples was removed by blotting them on filter paper. Hijiki plants were cut into pieces of 10 cm in length along their main branches from the top (shoot apex) down to the filamentous holdfast, and separated into leaves and stalks. The shoot apexes of the respective main branches and filamentous holdfast (radicle-like) were separated. After washing them with distilled water, the samples were separately lyophilized in small polyethylene bags.

Arsenic determination⁷⁾

The amount of arsenic in each sample was determined in duplicate in comparison with the arsenic standard. The dried samples were mixed well and separately packaged in small polyethylene bags. To determine the arsenic concentration in the samples, 40 of those bags were put together in a polyethylene Neuma-Capsule, along with 10 bags of various amounts of a standard arsenic compound; two standard specimens were arranged for every 8 specimens of Hijiki.

Thermal neutron activation analysis⁷⁾

The samples in the Neuma-capsules were irradiated in a flux of 10^{13} neutrons · cm⁻² · sec⁻¹ for 20 min in the center position of the nuclear reactor of the Research Reactor Institute, Kyoto University. After a cooling time of 72 hr, the arsenic content in the samples was determined by gamma radiation from ⁷⁶As using a pure Ge gamma-detector at 559.1 keV. The energy levels of ⁶⁰Co and ¹³⁷Cs were used for calibration.

Results

Growing state of Hijiki

The Hijki plants from the three districts showed different growth rates (Table 1).

Tomie District: The Tomie district produced Hijiki plants with two to four branches from one filamentous holdfast and they were about 10 to 20 cm in length.

Taiho District: The Taihou district produced plants with three to four branches from one filamentous holdfast and they were about 10 cm or less in length. The ratios of the dry weight to the wet weight suggest that they are more mature than those of the other districts in spite of their shortness.

Tamanoura District: The Tamanoura district produced plants with three branches from one filamentous holdfast and the three branches were different in length, about 10 cm, 40 cm and 60 cm, respectively.

Arsenic contents in individual tissues

The arsenic contents in the respective sections are shown in Table 2 and Table 3.

The arsenic contents along the main branches in the respective sections (10 cm in length) were 0.02 μ g to 0.6 μ g (Tomie district) and 0.03 μ g to 1.6 μ g (Taihou district) in the leaves and 0.004 μ g to 0.6 μ g (Tomie district) and 0.007 μ g to 0.4 μ g (Taihou district) in the stalks. The samples from Tamanoura showed larger amounts of arsenic in their leaves than in their stalks. Moreover, the total amounts of arsenic in the respective sections of the samples of Tamanoura were ten times higher than those of the other districts, although their wet weights or dry weights were more or less similar to those of the other samples.

Arsenic concentrations in the tissues on the wet weight basis (Table 2)

The distribution patterns of the arsenic concentration expressed on the wet weight (g) basis were not uniform along their main branches (stalks) (Table 2), and the values were generally greater in the samples from Tamanoura than those from the other districts.

0.02095

Table 1 Growth states of Hijiki plants, harvested at the Tomie, Taihou and Tamanoura districts.

- .					m u				
Tomie	m:			B 11.73	Taihou	m:	1 0 **		I 5 11.65
Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)	Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)
l	Apex		0.67	0.07396		Apex		0.23	0.03207
1 1	Stalk	<u>a</u>	0.58	0.10603	A-1	Stalk	a	0.36	0.07559
A-1		ь	0.23	0.04868	-	Leaf	a	1.77	0.27842
1 F	Leaf	a ous holdfast	7.77	0.8611	L	Filamento	us holdfast	0.91	0.17623
	rnamento	ous noidrast	0.22	0.048		m'	0 **	111 A 1 1 A 1 A 1 A 1 A 1 A 1 A 1 A 1 A	D 11.7
		1	1	5	Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)
Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)	1 -	Apex	-	0.08	0.0096
	Apex		0.92	0.08424	A-2	Stalk	a	0.09	0.01684
A-2	Stalk	a	0.51	0.08246	-	Leaf	a	0.87	0.11316
-	Leaf	a	3.81	0.39069	LL	Filamento	us holdfast	0.91	0.17623
L	Filamento	ous holdfast	0.22	0.048			Г	T	I
		T			Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)
Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)		Apex		0.04	0.00515
1	Apex		0.94	0.0886	A-3	Stalk	a	0.25	0.05168
A-3	Stalk	a	0.29	0.05112		Leaf	a	1.68	0.24918
	Leaf	a	2.69	0.30123	L	Filamento	us holdfast	0.91	0.17623
L	Filamento	ous holdfast	0.22	0.048					г
					Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)
Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)		Apex		0.25	0.02927
	Apex		0.31	0.03404	B-1	Stalk	a	0.12	0.02188
A-4	Stalk	a	0.14	0.02568		Leaf	a	0.93	0.11301
"'	Leaf	a	1.02	0.12376		Filamento	us holdfast	0.56	0.09274
	Filamento	ous holdfast	0.22	0.048			,		
		·	Ţ~~~~		Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)
Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)		Apex		0.37	0.04541
1 [Apex		0.39	0.0383	B-2	Stalk	a	0.12	0.02408
	Stalk	a	0.59	0.0963	D-2	Leaf	a	1.68	0.20359
B-i	Stark	b	0.24	0.04527		Filamento	us holdfast	0.56	0.09274
D-1	Leaf	a	6.43	0.66131					
1	Leai	b	0.32	0.03218	Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)
	Filamento	ous holdfast	0.24	0.04321		Apex		0.44	0.05265
							I		
Samples*					B.3 L	Stalk	a	0.18	0.03684
	Tissues	Sections**	Wet weight (g)	Dry weight (g)	В-3	Stalk Leaf	a	0.18 2.07	0.03684 0.26048
	Tissues Apex	Sections**	Wet weight (g) 0.21	Dry weight (g) 0.01908	В-3		a		
B 2		Sections**			В-3	Leaf	a	2.07	0.26048
B-2	Apex		0.21	0.01908	B-3 -	Leaf	a	2.07	0.26048
B-2	Apex Stalk Leaf		0.21 0.06	0.01908 0.00837		Leaf Filamento	a us holdfast	2.07 0.56	0.26048 0.09274
B-2	Apex Stalk Leaf	a a	0.21 0.06 0.55	0.01908 0.00837 0.0515	Samples*	Leaf Filamento	a us holdfast	2.07 0.56 Wet weight (g)	0.26048 0.09274 Dry weight (g)
B-2 Samples*	Apex Stalk Leaf	a a	0.21 0.06 0.55	0.01908 0.00837 0.0515		Leaf Filamento Tissues Apex	a us holdfast Sections**	2.07 0.56 Wet weight (g) 0.15	0.26048 0.09274 Dry weight (g) 0.0192
	Apex Stalk Leaf Filamento	a a ous holdfast	0.21 0.06 0.55 0.24	0.01908 0.00837 0.0515 0.04321	Samples*	Leaf Filamento Tissues Apex Stalk	a us holdfast Sections** a a	2.07 0.56 Wet weight (g) 0.15 0.21	0.26048 0.09274 Dry weight (g) 0.0192 0.03755
Samples*	Apex Stalk Leaf Filamento	a a ous holdfast	0.21 0.06 0.55 0.24 Wet weight (g)	0.01908 0.00837 0.0515 0.04321 Dry weight (g)	Samples*	Leaf Filamento Tissues Apex Stalk Leaf	a us holdfast Sections** a a	2.07 0.56 Wet weight (g) 0.15 0.21 0.81	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768
	Apex Stalk Leaf Filamento Tissues Apex	a a bus holdfast Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35	0.01908 0.00837 0.0515 0.04321 Dry weight (g) 0.03244	Samples*	Leaf Filamento Tissues Apex Stalk Leaf	a us holdfast Sections** a a	2.07 0.56 Wet weight (g) 0.15 0.21 0.81	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768
Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf	a a bus holdfast Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01	0.01908 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945	Samples*	Leaf Filamento Tissues Apex Stalk Leaf	a us holdfast Sections** a a	2.07 0.56 Wet weight (g) 0.15 0.21 0.81	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768
Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf	a a sus holdfast Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23	0.01908 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681	Samples* B-4 Tamanoura	Leaf Filamentor Tissues Apex Stalk Leaf Filamentor	a us holdfast Sections** a a us holdfast	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274
Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento	a a sus holdfast Sections** a a a sus holdfast	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24	0.01908 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321	Samples*	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues	a us holdfast Sections** a a	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274
Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues	a a sus holdfast Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g)	0.01908 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g)	Samples* B-4 Tamanoura	Leaf Filamentor Tissues Apex Stalk Leaf Filamentor	a us holdfast Sections** a a us holdfast Sections**	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664
Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex	a a us holdfast Sections** a a us holdfast Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g)	0.01908 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495	Samples* B-4 Tamanoura	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues	a us holdfast Sections** a a us holdfast Sections**	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342
Samples* B-3 Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues	a a sus holdfast Sections** a a sus holdfast Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g) 0.69 0.55	0.01908 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495 0.09626	Samples* B-4 Tamanoura	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex	a us holdfast Sections** a a us holdfast Sections**	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17 0.47 0.61	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342 0.08822
Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk	a a sus holdfast Sections** a a a sus holdfast Sections** Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g) 0.69 0.55 0.24	0.01908 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495 0.09626 0.04837	Samples* B-4 Tamanoura	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues	a us holdfast Sections** a a us holdfast Sections** Sections**	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17 0.47 0.61 0.7	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342 0.08822 0.1147
Samples* B-3 Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex	a a sus holdfast Sections** a a sus holdfast Sections** Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g) 0.69 0.55 0.24 8.75	0.01908 0.00837 0.00515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495 0.09626 0.04837 0.9534	Samples* B-4 Tamanoura	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex	Sections** a a a a us holdfast Sections** Sections** Sections**	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17 0.47 0.61 0.7 0.63	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342 0.08822 0.1147 0.10985
Samples* B-3 Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues At Filamento Tissues Apex Stalk Leaf Leaf	a a a bus holdfast Sections** a a a bus holdfast Sections** Sections** Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g) 0.69 0.55 0.24 8.75 0.21	0.01908 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495 0.09626 0.04837 0.9534 0.0237	Samples* B-4 Tamanoura Samples*	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex	a us holdfast Sections** a a us holdfast Sections** Sections** a b c c d e e	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17 0.47 0.61 0.7 0.63 0.63	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342 0.08822 0.1147 0.10985 0.12042
Samples* B-3 Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues At Filamento Tissues Apex Stalk Leaf Leaf	a a sus holdfast Sections** a a sus holdfast Sections** Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g) 0.69 0.55 0.24 8.75	0.01908 0.00837 0.00515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495 0.09626 0.04837 0.9534	Samples* B-4 Tamanoura	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex	Sections** a a a us holdfast Sections** Sections** Sections** c d e f	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17 0.47 0.61 0.7 0.63 0.63 0.38	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342 0.08822 0.1147 0.10985 0.12042 0.08912
Samples* B-3 Samples* C-1	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento	a a bus holdfast Sections** a a bus holdfast Sections** A b b bus holdfast	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g) 0.69 0.55 0.24 8.75 0.21 0.36	0.01908 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495 0.09626 0.04837 0.9534 0.0237 0.07672	Samples* B-4 Tamanoura Samples*	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex	Sections** a a a us holdfast Sections** A a b c d d e f a	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17 0.47 0.61 0.7 0.63 0.63 0.38 4.33	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342 0.08822 0.1147 0.10985 0.12042 0.08912 0.41658
Samples* B-3 Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento	a a a bus holdfast Sections** a a a bus holdfast Sections** Sections** Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g) 0.69 0.55 0.24 8.75 0.21 0.36 Wet weight (g)	0.01908 0.00837 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495 0.09626 0.04837 0.9534 0.0237 0.07672 Dry weight (g)	Samples* B-4 Tamanoura Samples*	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Stalk	Sections** a a a us holdfast Sections** a b c d c d c f a b b	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17 0.47 0.61 0.7 0.63 0.63 0.38 4.33 6.03	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342 0.08822 0.1147 0.10985 0.12042 0.08912 0.41658 0.64008
Samples* B-3 Samples* C-1 Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento	a a sus holdfast Sections** a a sus holdfast Sections** Sections** b a b b sus holdfast Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g) 0.69 0.55 0.24 8.75 0.21 0.36 Wet weight (g) 0.36	0.01908 0.00837 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495 0.09626 0.04837 0.9534 0.0237 0.07672 Dry weight (g) 0.07672	Samples* B-4 Tamanoura Samples*	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex	Sections** a a a us holdfast Sections** Sections** a b c d e f a b c c	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17 0.47 0.61 0.7 0.63 0.63 0.38 4.33 6.03 6.9	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342 0.08822 0.1147 0.10985 0.12042 0.08912 0.41658 0.64008 0.77875
Samples* B-3 Samples* C-1	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Tissues Apex Stalk Leaf Filamento Stalk Leaf Filamento Tissues Apex Stalk	a a a a a us holdfast Sections** a a a a a a a a a a a a a a a a a a	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g) 0.69 0.55 0.24 8.75 0.21 0.36 Wet weight (g) 0.69 0.14	0.01908 0.00837 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495 0.09626 0.04837 0.9534 0.0237 0.07672 Dry weight (g) 0.02579 0.0225	Samples* B-4 Tamanoura Samples*	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Stalk	Sections** a a a us holdfast Sections** Sections** a b c d e f a b c d d e f a d	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17 0.47 0.61 0.7 0.63 0.63 0.38 4.33 6.03 6.9 7.41	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342 0.08822 0.1147 0.10985 0.12042 0.08912 0.41658 0.64008 0.77875 0.82216
Samples* B-3 Samples* C-1 Samples*	Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Leaf Filamento Leaf Filamento	a a sus holdfast Sections** a a sus holdfast Sections** Sections** b a b b sus holdfast Sections**	0.21 0.06 0.55 0.24 Wet weight (g) 0.35 0.23 1.01 0.24 Wet weight (g) 0.69 0.55 0.24 8.75 0.21 0.36 Wet weight (g) 0.36	0.01908 0.00837 0.00837 0.0515 0.04321 Dry weight (g) 0.03244 0.03681 0.09945 0.04321 Dry weight (g) 0.07495 0.09626 0.04837 0.9534 0.0237 0.07672 Dry weight (g) 0.07672	Samples* B-4 Tamanoura Samples*	Leaf Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Stalk	Sections** a a a us holdfast Sections** Sections** a b c d e f a b c c	2.07 0.56 Wet weight (g) 0.15 0.21 0.81 0.56 Wet weight (g) 0.17 0.47 0.61 0.7 0.63 0.63 0.38 4.33 6.03 6.9	0.26048 0.09274 Dry weight (g) 0.0192 0.03755 0.10768 0.09274 Dry weight (g) 0.01664 0.06342 0.08822 0.1147 0.10985 0.12042 0.08912 0.41658 0.64008 0.77875

For the samples of the respective districts:

- * The samples, A-1, A-2, A-3 etc mean the main branches, connected to one common filamentous holdfast (the same as expressed in A-1 column). B-1, B-2, etc and C-1, C-2, etc mean the same as A-1, A-2 etc.
- ** The alphabets, a, b, c, etc mean the 10 cm sections from the top down to the filamentous holdfast.

	Leaf	С	6.9	0.77875
	Leai	d	7.41	0.82216
		e	8.21	0.85512
		f	3.51	0.3851
	Filamento	ıs holdfast	0.08	0.02095
Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)
	Apex		0.14	0.01675
		a	0.44	0.06073
	Stalk	b	0.55	0.08645
	Stark	с	0.67	0.11812
A-2		d	0.47	0.10065
A-2		a	6.37	0.36202
	Leaf	b	4.06	0.45431
	Leai	С	6.3	0.69734
		d	2.76	0.3261

Samples*	Tissues	Sections**	Wet weight (g)	Dry weight (g)
	Stalk	a	0.29	0.04891
A-3	Leaf	a	1.19	0.12385
	Filamentou	is holdfast	0.08	0.02095

0.08

Filamentous holdfast

 $\textbf{Table 2} \ \, \text{Arsenic concentrations in Hijiki plants, harvested at the Tomie, Taihou and} \\$ Tamanoura districts, expressed on the wet weight basis.

Tomie	m:	Book to			Taihou	m.	T	T	
Samples*	Tissues	Sections**	μg As/g Wet weight	Percentage ratio (%***)	Samples*	Tissues	Sections**	μ g As/g Wet weight	Percentage ratio (%***
	Apex		0.0386	1.82		Apex		0.0278	5.49
	Stalk	a	0.0564	2.66		Stalk	a	0.5071	100.00
A-1	Stark	ь	2.1210	100.00	A-1	Leaf	а	0.0328	6.47
Ī	Leaf	a	0.0382	1.80		Filament	ous holdfast	0.0721	14.21
Ì		us holdfast	0.0649	3.06	i			.1	
					Samples*	Tissues	Sections**	μ g As/g Wet weight	Percentage ratio (%***
Samples*	Tissues	Sections**	u G. Asla Wat weight	Percentage ratio (9/ ***)	dumpies		Sections		
Samples		Sections	μ g As/g Wet weight	Percentage ratio (%***)		Apex		0.0337	1.83
-	Apex		0.0297	45.79	A-2	Stalk	a	1.5237	82.68
A-2	Stalk	a	0.0567	87.36		Leaf	а	1.8429	100.00
	Leaf	a	0.0177	27.20		Filament	ous holdfast	0.0721	3.91
	Filamento	us holdfast	0.0649	100.00					
					Samples*	Tissues	Sections**	μ g As/g Wet weight	Percentage ratio (%***
Samples*	Tissues	Sections**	μ g As/g Wet weight	Percentage ratio (%***)		Apex		0.0438	2.85
	Apex		0.0191	29.46		Stalk	a	1.5361	100.00
ľ	Stalk	а	0.0395	60.78	A-3	Leaf	a	0.0728	4.74
A-3	Leaf	a	0.0230	35.47			ous holdfast		
ŀ		us holdfast				1 Hamene	ous noidiasi	0.0721	4.69
	rnamento	ous noidiast	0.0649	100.00			1	T	
					Samples*	Tissues	Sections**	μ g As/g Wet weight	Percentage ratio (%***
Samples*	Tissues	Sections**	μ g As/g Wet weight	Percentage ratio (%***)		Apex		0.2038	31.04
	Apex		0.0321	49.50	B-1	Stalk	a	0.6566	100.00
A 4	Stalk	а	0.0500	76.98	D-1	Leaf	a	0.5118	77.95
A-4	Leaf	a	0.0410	63.10			ous holdfast	0.0052	0.79
ľ		us holdfast	0.0649	100.00					
					Samples*	Tissues	Sections**	Q. An/g W	Domontos
Samples*	Ticovac	Sections**	u a Ada W	Demonstrate well (0/***)	Samples		occions.*	μ g As/g Wet weight	Percentage ratio (%***
samples*	Tissues		μ g As/g Wet weight	Percentage ratio (%***)		Apex	ļ	0.0027	0.30
.	Apex		0.0361	3.40	B-2	Stalk	a	0.9160	100.00
1	Stalk	a	0.5634	53.05		Leaf	a	0.0351	3.83
B-1		b	1.0620	100.00		Filament	ous holdfast	0.0052	0.57
D-1	T C	a	0.0409	3.85	1				
	Leaf	b	0.0646	6.08	Samples*	Tissues	Sections**	μ g As/g Wet weight	Percentage ratio (%***
ı	Filamento	us holdfast	0.0674	6.35		Apex		0.0333	2.60
<u>-</u>			0.0014	0.55			 		
	m.				B-3	Stalk	a	1.2799	100.00
Samples*	Tissues	Sections**	μ g As/g Wet weight	Percentage ratio (%***)		Leaf	a	0.0249	1.94
	Apex		0.0375	55.61		Filament	ous holdfast	0.0052	0.40
B-2	Stalk	a	0.0580	85.98					
[Leaf	a	0.0391	57.91	Samples*	Tissues	Sections**	μg As/g Wet weight	Percentage ratio (%***
	Filamento	us holdfast	0.0674	100.00		Apex		0.0203	58.87
					1 1	Stalk	a	0.0322	93.70
Samples*	Tissues	Sections**	μ g As/g Wet weight	Percentage ratio (%***)	B-4	Leaf	a	0.0344	100.00
Dampies		Sections			1 1		ous holdfast		
-	Apex		0.0288	42.70		Thanten	ous noithast	0.0052	15.05
B-3	Stalk	a	0.0624	92.51					
1			0.0460						
- h	Leaf	a		68.16					
		us holdfast	0.0674	100.00	Tamanoura				
					Tamanoura Samples*	Tissues	Sections**	μ g As/g Wet weight	Percentage ratio (%***
· · · · · · · · · · · · · · · · · · ·			0.0674	100.00			Sections**	μ g As/g Wet weight	Percentage ratio (%***
	Filamento Tissues	us holdfast	0.0674 μ g As/g Wet weight	100.00 Percentage ratio (%***)		Tissues Apex		0.9212	52.86
	Filamento Tissues Apex	Sections**	0.0674 μ g As/g Wet weight 0.8516	100.00 Percentage ratio (%***) 34.13			a	0.9212 0.5731	52.86 32.88
Samples*	Filamento Tissues	Sections**	0.0674 μ g As/g Wet weight 0.8516 0.0573	100.00 Percentage ratio (%***) 34.13 2.30			a b	0.9212 0.5731 0.5512	52.86 32.88 31.63
	Filamento Tissues Apex	Sections** a b	0.0674 # 9 As/g Wet weight 0.8516 0.0573 0.1135	100.00 Percentage ratio (%***) 34.13 2.30 4.55			a b c	0.9212 0.5731 0.5512 0.6557	52.86 32.88 31.63 37.62
Samples*	Filamento Tissues Apex	Sections** a b a	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711	100.00 Percentage ratio (%***) 34.13 2.30 4.55 2.85		Apex	a b c	0.9212 0.5731 0.5512 0.6557 0.8104	52.86 32.88 31.63 37.62 46.50
Samples*	Tissues Apex Stalk Leaf	Sections** a b a b	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00		Apex	a b c d e	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386	52.86 32.88 31.63 37.62 46.50 76.81
Samples*	Tissues Apex Stalk Leaf	Sections** a b a	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711	100.00 Percentage ratio (%***) 34.13 2.30 4.55 2.85	Samples*	Apex	a b c	0.9212 0.5731 0.5512 0.6557 0.8104	52.86 32.88 31.63 37.62 46.50
Samples*	Tissues Apex Stalk Leaf	Sections** a b a b	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00		Apex	a b c d e	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386	52.86 32.88 31.63 37.62 46.50 76.81
Samples*	Tissues Apex Stalk Leaf	Sections** a b a b	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00	Samples*	Apex	a b c d e f	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757	52.86 32.88 31.63 37.62 46.50 76.81 96.14
Samples*	Filamento Tissues Apex Stalk Leaf Filamento Tissues	Sections** a b a b b us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (%***)	Samples*	Apex Stalk	a b c d e f a	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22
C-1 -	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex	Sections** a b a b b us holdfast Sections**	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450	100.00 Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (%***) 59.01	Samples*	Apex	a b c d e f a b c	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59
Samples*	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk	Sections** a b a b b sus holdfast Sections**	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (%***) 59.01 100.00	Samples*	Apex Stalk	a b c d e f a b c	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98
C-1 -	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf	Sections** a b a b solutions b sus holdfast Sections**	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples*	Apex Stalk	a b c d c f a b c d c f a	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74
C-1 -	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf	Sections** a b a b b sus holdfast Sections**	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (%***) 59.01 100.00	Samples*	Apex Stalk Leaf	a b c d c f a b c f a b c	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00
C-1 -	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf	Sections** a b a b solutions b sus holdfast Sections**	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples*	Apex Stalk Leaf	a b c d c f a b c d c f a	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74
C-1 - Samples* C-2 -	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento	Sections** a b a b b us holdfast Sections** Sections** a a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples*	Apex Stalk Leaf Filamente	a b c d e f a b c d d e f a b c d c	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00
C-1	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento Other Stalk Leaf Filamento	Sections** a b a b b us holdfast Sections** Sections**	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples*	Apex Stalk Leaf	a b c d c f a b c f a b c	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70
C-1 Samples* C-2 or the samp **: The samp	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples*	Apex Stalk Leaf Filamente	a b c d e f a b c d d e f a b c d c	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70
C-1 - Gamples* C-2 - C-	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b b us holdfast Sections** Sections**	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples*	Apex Stalk Leaf Filamento	a b c d e f a b c d c f a b c d se f sections**	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70
C-1 - Gamples* C-2 - C-	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples*	Apex Stalk Leaf Filamento Tissues Apex	a b c d e f a b c d e f a b c d Sections**	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 µ g As/g Wet weight 0.7660 0.5792	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%**** 66.17 50.03
C-1 Samples* C-2 or the samp **: The samp	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples*	Apex Stalk Leaf Filamento	a b c d e f a b c d e f a b c d e f s b c d e f s b s sections**	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%**** 50.03 2.28
C-1 Samples* C-2 or the samp **: The samp	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples*	Apex Stalk Leaf Filamento Tissues Apex	a b c d e f a b c d e f a b c d e f sus holdfast	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 \$\mu\$ 9 As/g Wet weight 0.7660 0.5792 0.0263 0.2894	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%**** 66.17 50.03 2.28 24.99
C-1 - Gamples* C-2 - C-	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples*	Apex Stalk Leaf Filamento Tissues Apex	a b c d e f a b c d c f a b c d e f souther the second	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 ### Q As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%*** 66.17 50.03 2.28 24.99 69.18
C-1 - Gamples* C-2 - C-	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	A-1 Samples*	Apex Stalk Leaf Filamento Tissues Apex	a b c d e f a b c d e f a b c d e f sus holdfast	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 ### 9 As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010 0.4034	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (***** 66.17 50.03 2.28 24.99 69.18 34.85
C-1 Gamples* C-2 or the samp **: The samp	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	A-1 Samples*	Apex Stalk Leaf Filamente Tissues Apex Stalk	a b c d e f a b c d c f a b c d e f souther the second	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 ### Q As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%**** 66.17 50.03 2.28 24.99 69.18
C-1 - Gamples* C-2 - C-	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	A-1 Samples*	Apex Stalk Leaf Filamento Tissues Apex	a b c d e f a b c d c f s b c d c d c d c d c d c d c d c d c d c	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 ### 9 As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010 0.4034	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (***** 66.17 50.03 2.28 24.99 69.18 34.85
C-1 - Gamples* C-2 - C-	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	A-1 Samples*	Apex Stalk Leaf Filamente Tissues Apex Stalk	a b c d c f a b c d c f a b c d c d c d c d a b c d a b c d a b b	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 μ g As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010 0.4034 1.1578 0.6988	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%*** 66.17 50.03 2.28 24.99 69.18 34.85 100.00 60.35
C-1 Gamples* C-2 or the samp **: The samp	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	A-1 Samples*	Apex Stalk Leaf Filamente Tissues Apex Stalk Leaf	a b c d c f a b c d e f a b c d e f a b c d e f ous holdfast	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 μ g As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010 0.4034 1.1578 0.6988	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%**** 66.17 50.03 2.28 24.99 69.18 34.85 100.00 60.35 76.92
C-1 amples* C-2 or the samp **: The samp	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	A-1 Samples*	Apex Stalk Leaf Filamente Tissues Apex Stalk Leaf	a b c d e f a b c d e f a b c d e d e d e d e d e d e d e f bus holdfast	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 μ g As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010 0.4034 1.1578 0.6988	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%*** 66.17 50.03 2.28 24.99 69.18 34.85 100.00 60.35
C-1 amples* C-2 or the samp **: The samp	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	A-1 Samples* A-2	Apex Stalk Leaf Filamente Tissues Apex Stalk Leaf Filamente	a b c d c f a b c d c f a b c d c d c d c d c d c d c d c d c d c	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 μ g As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010 0.4034 1.1578 0.6988 0.8905 0.9708	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%*** 66.17 50.03 2.28 24.99 69.18 34.85 100.00 60.35 76.92 83.85
C-1 amples* C-2 or the samp **: The samp	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	A-1 Samples*	Apex Stalk Leaf Filamente Tissues Apex Stalk Leaf Filamente Tissues	a b c d c f a b c d e f a b c d e f a b c d e f ous holdfast	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 μ g As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010 0.4034 1.1578 0.6988 0.8905 0.9708	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%*** 66.17 50.03 2.28 24.99 69.18 34.85 100.00 60.35 76.92 83.85
C-1 amples* C-2 or the samp **: The samp	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples* A-1 Samples* A-2 Samples*	Apex Stalk Leaf Filamente Tissues Apex Stalk Leaf Filamente Tissues Stalk	a b c d c f a b c d c f a b c d c d c d c d c d c d c d c d c d c	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 μ g As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010 0.4034 1.1578 0.6988 0.8905 0.9708	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (**** 66.17 50.03 2.28 24.99 69.18 34.85 100.00 60.35 76.92 83.85
Samples* C-1 Samples* C-2 or the samp **: The si	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	A-1 Samples* A-2	Apex Stalk Leaf Filamente Tissues Apex Stalk Leaf Filamente Tissues	a b c d c f a b c d c f a b c d c d c d c d c d c d c d c d c d c	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 μ g As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010 0.4034 1.1578 0.6988 0.8905 0.9708	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%****) 66.17 50.03 2.28 24.99 69.18 34.85 100.00 60.35 76.92 83.85
amples* C-1 amples* C-2 r the samp **: The samp	Filamento Tissues Apex Stalk Leaf Filamento Tissues Apex Stalk Leaf Filamento oles of the respeame as describe	Sections** a b a b us holdfast Sections** Sections** a a us holdfast	0.0674 μ g As/g Wet weight 0.8516 0.0573 0.1135 0.0711 2.4948 0.0632 μ g As/g Wet weight 0.0450 0.0763 0.0478	Percentage ratio (%***) 34.13 2.30 4.55 2.85 100.00 2.53 Percentage ratio (****) 59.01 100.00 62.57	Samples* A-1 Samples* A-2 Samples*	Apex Stalk Leaf Filamente Tissues Apex Stalk Leaf Filamente Tissues Stalk Leaf	a b c d e f a b c d e f a b c d e f b c d d e f b c d d e f b c d d c d d c d d c d d c d d c d d c d d d c d d d c d d d d c d	0.9212 0.5731 0.5512 0.6557 0.8104 1.3386 1.6757 0.4111 0.4047 0.3763 0.7491 1.1110 1.7429 0.9708 μ g As/g Wet weight 0.7660 0.5792 0.0263 0.2894 0.8010 0.4034 1.1578 0.6988 0.8905 0.9708	52.86 32.88 31.63 37.62 46.50 76.81 96.14 23.59 23.22 21.59 42.98 63.74 100.00 55.70 Percentage ratio (%**** 66.17 50.03 2.28 24.99 69.18 34.85 100.00 60.35 76.92 83.85

Table 3 Arsenic concentrations in Hijiki plants, hrvested in the Tomie, Taihou and Tamanoura districts, on the dry weight basis.

Tomie					Taihou			
Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)	Samples*	Tissues	Sections**	μg As/g D
	Apex		0.3495	3.49		Apex		0.19
Ī		а	0.3087	3.08		Stalk	a	2.41
A-I	Stalk	b	10.0211	100.00	A-1	Leaf	a	0.20
	Leaf	a	0.3444	3.44		Filament	ous holdfast	0.37
Ì	Filamento	us holdfast	0.2975	2.97				
1					Samples*	Tissues	Sections**	μg As/g D
Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)		Apex		0.28
	Apex		0.3246	92.56	A-2	Stalk	a	8.14
A-2	Stalk	a	0.3507	100.00	A-2	Leaf	a	14.1
A-2	Leaf	a	0.1722	49.09		Filament	ous holdfast	0.37
	Filamento	us holdfast	0.2975	84.83				
1		*			Samples*	Tissues	Sections**	μg As/g D
Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)		Apex		0.33
Į.	Apex		0.2029	68.19	A-3	Stalk	a	7.43
A-3	Stalk	a	0.2238	75.23		Leaf	a	0.49
11-3	Leaf	a	0.2056	69.10		Filament	ous holdfast	0.37
	Filamento	us holdfast	0.2975	100.00			·	
					Samples*	Tissues	Sections**	μg As/g D
Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)		Apex		1.74
1	Apex		0.2926	86.69	B-1	Stalk	a	3.60
A-4	Stalk	a	0.2724	80.70		Leaf	a	4.21
	Leaf	a	0.3376	100.00		Filament	ous holdfast	0.03
	Filamento	us holdfast	0.2975	88.13				
					Samples*	Tissues	Sections**	μg As/g D
Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)		Apex		0.02
-	Apex		0.3678	6.53	B-2	Stalk	a	4.56
	Stalk	<u>a</u>	3.4520	61.31	1	Leaf	a	0.28
B-1		b	5.6305	100.00	L	Filament	ous holdfast	0.03
	Leaf	a	0.3976	7.06				
-	P'I	b 1.110 ·	0.6424	11.41	Samples*	Tissues	Sections**	μg As/g D
	Filamento	us holdfast	0.3746	6.65		Apex		0.27
	m'	T n .: **			B-3	Stalk	a	6.25
Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)	1 1	Leaf	us holdfast	0.19
ŀ	Apex Stalk		0.4128 0.4157	98.97 99.66		1 Hamein	Jus Holdidst	0.03
B-2		a				T1	Sections**	1 / D
	Leaf	ous holdfast	0.4171	100.00	Samples*	Tissues	Sections	μg As/g D 0.15
	Filamento	ous noturast	0.3746	89.81		Apex		
Commisse	Tinguag	Sections**	A./- Diska	D	B-4	Stalk Leaf	a	0.18
Samples*	Tissues Apex	Sections	μg As/g Dry weight 0.3107	Percentage ratio (%***) 66.55			ous holdfast	0.23
-	Stalk	-	0.3898	83.50	L	1 marion	ous nordiast	0.0.
B-3	Leaf	a	0.4669	100.00				
1		ous holdfast	0.3746	80.23	Tamanoura			
	Thancino	us iroidiust	0.5740	80.23	Samples*	Tissues	Sections**	μg As/g D
Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)	Samples	Apex	Sections	9,41
Dampies	Apex	Sections	7.8396	35.46		прек	a	4.24
		a	0.3275	1.48			b	3.81
	Stalk	ь	0.5631	2.55			c	4.00
C-1		a	0.6523	2.95		Stalk	d	4.64
	Leaf	h	22.1060	100.00			e	7.00
ł	Filamento	us holdfast	0.2965	1.34			f	7.14
			1	,	A-1		a	4.27
Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)			b	3.81
	Apex		0.4541	95.61			c	3.33
					1 1	Leaf		
		я		100,00		Lear	d	6.75
C-2	Stalk	a a	0.4750	100.00 93.16		Lear	d e	6.75
C-2	Stalk Leaf	a a ous holdfast		100.00 93.16 62.42		Lear	d e f	6.75 10.6 15.8

For the samples of the respective districts:

*, **: The same as described in Table 1.

***: The highest value was taken as 100%.

Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)
	Apex		0.1996	8.27
A-1	Stalk	a	2.4152	100.00
	Leaf	a	0.2087	8.64
	Filamente	ous holdfast	0.3721	15.41
	m'			
Samples*	Tissues	Sections**	μ g As/g Dry weight	Percentage ratio (%***)
	Apex		0.2808	1.98
A-2	Stalk Leaf	a	8.1432	57.47 100.00
		us holdfast	14.1684 0.3721	2.63
			0.5721	2.05
Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)
	Apex		0.3399	4.57
	Stalk	a	7.4310	100.00
A-3	Leaf	а	0.4911	6.61
		ous holdfast	0.3721	5.01
Samples*	Tissues	Sections**	μg As/g Dry weight	Percentage ratio (%***)
	Apex		1.7410	41.34
B-1	Stalk	а	3.6012	85.50
D-1	Leaf	а	4.2118	100.00
	Filament	ous holdfast	0.0313	0.74
Samples*	Tissues	Sections**	μ g As/g Dry weight	Percentage ratio (%***)
	Apex		0.0224	0.49
B-2	Stalk	a	4.5647	100.00
5.	Leaf	a	0.2893	6.34
	Filament	ous holdfast	0.0313	0.68
Samples*	Tissues	Sections**	μ g As/g Dry weight	Percentage ratio (%***)
	Apex		0.2780	4.44
B-3	Stalk	a	6.2535	100.00
	Leaf	a	0.1976	3.16
	Filamento	ous holdfast	0.0313	0.50
	m:			
Samples*	Tissues	Sections**	μ g As/g Dry weight	Percentage ratio (%***)
	Apex	_	0.1582	61.14
B-4	Stalk Leaf	a a	0.1803 0.2588	69.66
			0.2366	100.00
	1 Hainent	ous holdfast	0.0313	12.08
l'amanoura	Timilon	ous holdfast	0.0313	12.08
amanoura Samples*	Tissues	Sections**	0.0313 µ g As/g Dry weight	12.08 Percentage ratio (%***)
	Tissues		μg As/g Dry weight	Percentage ratio (%***)
	Tissues	Sections**	μg As/g Dry weight 9.4116	Percentage ratio (%***) 59.25
	Tissues Apex	Sections**	μ g As/g Dry weight 9.4116 4.2473	Percentage ratio (%***) 59.25 26.74
	Tissues	Sections**	μg As/g Dry weight 9.4116 4.2473 3.8114	Percentage ratio (%***) 59.25 26.74 23.99
	Tissues Apex	Sections** a b c	μg As/g Dry weight 9.4116 4.2473 3.8114 4.0019	Percentage ratio (%***) 59.25 26.74 23.99 25.19
Samples*	Tissues Apex	Sections** a b c d	μ g As/g Dry weight 9.4116 4.2473 3.8114 4.0019 4.6479	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26
	Tissues Apex	Sections** a b c d e	μ g As/g Dry weight 9.4116 4.2473 3.8114 4.0019 4.6479 7.0034	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09
Samples*	Tissues Apex	Sections** a b c d e f	μg As/g Dry weight 9,4116 4,2473 3,8114 4,0019 4,6479 7,0034 7,1451	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98
Samples*	Tissues Apex Stalk	Sections** a b c d e f	μg As/g Dry weight 9.4116 4.2473 3.8114 4.0019 4.6479 7.0034 7.1451 4.2735	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90
Samples*	Tissues Apex	Sections** a b c d e f a b	μg As/g Dry weight 9.4116 4.2473 3.8114 4.0019 4.6479 7.0034 7.1451 4.2735 3.8121	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00
Samples*	Tissues Apex Stalk	Sections** a b c d e f a b c	μg As/g Dry weight 9.4116 4.2473 3.8114 4.0019 4.6479 7.0034 7.1451 4.2735 3.8121 3.3340	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99
Samples*	Tissues Apex Stalk	Sections** a b c d e f a b c d c	μg As/g Dry weight 9.4116 4.2473 3.8114 4.0019 4.6479 7.0034 7.1451 4.2735 3.8121 3.3340 6.7511	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50
Samples*	Tissues Apex Stalk	Sections** a b c d e f a b c d e	μg As/g Dry weight 9,4116 4,2473 3,8114 4,0019 4,6479 7,0034 7,1451 4,2735 3,8121 3,3340 6,7511 10,6668	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50 67.15
Samples*	Tissues Apex Stalk	Sections** a b c d e f a b c d e f a b c	μg As/g Dry weight 9.4116 4.2473 3.8114 4.0019 4.6479 7.0034 7.1451 4.2735 3.8121 3.3340 6.7511 10.6668 15.8859	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50 67.15 100.00 23.34
Samples*	Tissues Apex Stalk	Sections** a b c d f a b c c d c f a b c	µg As/g Dry weight 9.4116 4.2473 3.8114 4.0019 4.6479 7.0034 7.1451 4.2735 3.8121 3.3340 6.7511 10.6668 15.8859 3.7072	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50 67.15 100.00 23.34 Percentage ratio (%***)
Samples*	Tissues Apex Stalk Leaf Filamente	Sections** a b c d e f a b c d e f a b c	р g As/g Dry weight 9,4116 4,2473 3,8114 4,0019 4,6479 7,0034 7,1451 4,2735 3,8121 3,3340 6,7511 10,6668 15,8859 3,7072 р g As/g Dry weight 6,4027	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50 67.15 100.00 23.34 Percentage ratio (%***) 61.88
Samples*	Tissues Apex Stalk Leaf Filamente	Sections** a b c d e f a b c d c f a b s Sections**	μg As/g Dry weight 9,4116 4,2473 3,8114 4,0019 4,6479 7,0034 7,1451 4,2735 3,8121 3,3340 6,7511 10,6668 15,8859 3,7072 μg As/g Dry weight 6,4027 4,1964	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50 67.15 100.00 23.34 Percentage ratio (%***) 61.88 40.56
Samples*	Tissues Apex Stalk Leaf Filamente Tissues - Apex	Sections** a b c d e f a b c d e f a b c d s Sections**	μ g As/g Dry weight 9.4116 4.2473 3.8114 4.0019 4.6479 7.0034 7.1451 4.2735 3.8121 3.3340 6.7511 10.6668 15.8859 3.7072 μ g As/g Dry weight 6.4027 4.1964 0.1676	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50 67.15 100.00 23.34 Percentage ratio (%***) 61.88 40.56 1.62
Samples*	Tissues Apex Stalk Leaf Filamente	Sections** a b c d e f a b c d e f a b c d b c d b c d e f a b c d e f c d c d e f c d c	μg As/g Dry weight 9.4116 4.2473 3.8114 4.0019 4.6479 7.0034 7.1451 4.2735 3.8121 3.3340 6.7511 10.6668 15.8859 3.7072 μg As/g Dry weight 6.4027 4.1964 0.1676 1.6414	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50 67.15 100.00 23.34 Percentage ratio (%***) 61.88 40.56 1.62
Samples*	Tissues Apex Stalk Leaf Filamente Tissues - Apex	Sections** a b c d e f a b c d e f a b c d e f a b c d e c d e f c d c d e c d e f c d e d e f c d d e c d e d e d e d e d e f c d d e e f c d d e e f c d d e e f c d d e e f c d d e e f c d d e d d e d d e d d d e d d d d d e d	р g As/g Dry weight 9,4116 4,2473 3,8114 4,0019 4,6479 7,0034 7,1451 4,2735 3,8121 3,3340 6,7511 10,6668 15,8859 3,7072 р g As/g Dry weight 6,4027 4,1964 0,1676 1,6414 3,7403	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50 67.15 100.00 23.34 Percentage ratio (%***) 61.88 40.56 1.62 15.86 36.15
A-1 Samples*	Tissues Apex Stalk Leaf Filamente Tissues - Apex	Sections** a b c d e f a b c d e f f a b c d e f d e f d e d e f d e d e f d e d e	μg As/g Dry weight 9,4116 4,2473 3,8114 4,0019 4,6479 7,0034 7,1451 4,2735 3,8121 3,3340 6,7511 10,6668 15,8859 3,7072 μg As/g Dry weight 6,4027 4,1964 0,1676 1,6414 3,7403 7,0990	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50 67.15 100.00 23.34 Percentage ratio (%***) 61.88 40.56 1.62 15.86 36.15 68.61
A-1 Samples*	Tissues Apex Stalk Leaf Filamente Tissues - Apex	Sections** a b c d e f a b c d e f a b c d e f a b c d e c d e f c d c d e c d e f c d e d e f c d d e c d e d e d e d e d e f c d d e e f c d d e e f c d d e e f c d d e e f c d d e e f c d d e d d e d d e d d d e d d d d d e d	р g As/g Dry weight 9,4116 4,2473 3,8114 4,0019 4,6479 7,0034 7,1451 4,2735 3,8121 3,3340 6,7511 10,6668 15,8859 3,7072 р g As/g Dry weight 6,4027 4,1964 0,1676 1,6414 3,7403	Percentage ratio (%***) 59.25 26.74 23.99 25.19 29.26 44.09 44.98 26.90 24.00 20.99 42.50 67.15 100.00 23.34 Percentage ratio (%***) 61.88 40.56 1.62 15.86 36.15

6.3128

7.5369

3.7072

μ g As/g Dry weight 3.5389 12.4687

3.7072

c d Filamentous holdfast

Sections**

72.85

35.83

Percentage ratio (%***)

28.38 100.00

29.73

Samples*

Tissues

Stalk

Leaf a Filamentous holdfast

Tomie District: The concentration of arsenic expressed on the wet weight basis was smaller in the leaves than those in the stalks, reflecting the relatively smaller weight of stalk tissues. The values did not differ greatly between the respective leaves.

It is noticeable that a section or two of one branch out of several branches connecting to the filamentous holdfast (A-1 or B-1 in the Table 2) showed a higher concentration of arsenic. A similar finding was obtained in the sections of the apex and leaves of another branch (C-1 in Table 2).

Taiho District: The concentrations of arsenic were mostly higher in the stalks than those in the leaves, although the differences were not large between the sections of the leaves.

Tamanoura District: The plants from Tamanoura showed good growth rates and even the smallest values of arsenic concentrations showed higher values in comparison with the samples from the other two districts. The higher values of arsenic concentrations were observed generally in sections near the filamentous holdfast.

Arsenic concentrations in the tissues on the dry weight basis (Table 3)

The distribution patterns of the arsenic concentration expressed on the dry weight (g) basis were different along their main branches, although the patterns were not different from those on the wet weight basis.

Tomie District: Arsenic concentrations of the whole plant tissues of Hijiki plants from this district were about 0.5 to 1.3ppm in average, although the stalk of Section b of the sample A - 1 and the leaf of Section b of the sample C - 1 had more than ten times as high arsenic concentrations as the average.

Taiho District: The arsenic concentrations in the leaves of some sections were higher than those of the stalks, but most sections showed levels lower than one-tenth the concentrations in the leaves. The average arsenic concentration was about 1 to 2.5ppm in the whole plant tissues.

Tamanoura District: In most sections, the arsenic concentration was higher in the leaves than in their stalks; even in the stalks, the arsenic level was higher than those of the plants from the other districts, indicating about 7ppm in the average of the whole plant tissues.

Discussion

In the samples harvested in Goto Archipelago, the concentration of total arsenic was lower than those of other specimens hitherto investigated in our laboratory^{7,8)}. As has been discussed in the previous report^{2,4)}, the arsenic level in Hijiki seems to change depending on the environmental conditions of ocean seawater. This seems to coincide with the great discrepancy of arsenic concentrations between the analyzed samples of some 'Giant clams' (*Tridacna maxima and T. derasa*) of Lizard Island and Davies Reef⁶⁾.

The arsenic content of dried Hijiki decreases during the pre-cooking processes, such as soaking it in water and thereafter discarding the water. The total amount of arsenic in daily diets is mostly derived from other marine products. Moreover, a beneficial role of Hijiki's components accelerating arsenic metabolism for arsenic detoxication is observed in the animal body^{10, 11)}.

Seaweeds including Hijiki are rich sources of minerals⁹⁾ as well as beneficial dietary fibers^{12, 13)}. This usefulness will contribute to healthy life in the aging society of Japan, through traditional Japanese diets, as aimed in the policy of *Healthy Japan 21*¹⁴⁾.

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