

**Supplementary Material for**  
**Effects of culinary procedures on concentrations and bioaccessibility**  
**of Cu, Zn,**  
**and As in different food ingredients**

**Subcellular distribution of Cu, Zn, and As**

The fresh food ingredients were frozen and ground into a power in liquid nitrogen. Approximately 1 g of food ingredient power were homogenized in 10 mL of 20 mM Tris–NaCl buffer (pH = 8.0, 5 mM antioxidant 2-mercaptoethanol, and 0.1 mM freshly prepared antiprotease phenylmethylsulfonyl fluoride). The homogenate was first centrifuged at 1500  $\times g$  at 4°C for 15 min. The separated pellets were digested in 4 mL of 1 N NaOH at 80°C for 10 min and then centrifuged at 5000  $\times g$  for 10 min. The secondary pellet was metal-rich granules (MRG) and the supernatant was cellular debris (CD). The supernatant from the first centrifugation was further centrifuged at 100,000  $\times g$  at 4°C for 1 h. The pellet from this step was the organelles, and the supernatant was the cytosolic proteins. After heat treatment at 80°C for 10 minutes, the cytosolic proteins were cooled down in an ice bath for 30 minutes and then centrifuged at 50,000  $\times g$  at 4°C for 30 minutes. The final pellets and supernatant were HDP and HSP fractions, respectively.

Table S1. The concentrations of Cu, Zn, and As in raw food ingredients

( $\mu\text{g g}^{-1}$  dry weight)

	Cu	Zn	As
Pork	$1.22 \pm 0.07$	$50.1 \pm 0.39$	
Beef	$3.38 \pm 0.04$	$192 \pm 10.8$	
Chicken	$1.08 \pm 0.05$	$23.4 \pm 1.61$	
Prawns	$7.32 \pm 2.56$	$62.5 \pm 1.44$	$3.13 \pm 0.01$
Squid	$3.77 \pm 0.60$	$70.3 \pm 6.32$	$3.62 \pm 0.12$
Grass carp	$1.31 \pm 0.31$	$13.7 \pm 1.12$	
Sea bream	$1.42 \pm 0.05$	$13.6 \pm 1.04$	$2.85 \pm 0.07$
Oysters	$104 \pm 29.3$	$624 \pm 148$	$12.0 \pm 0.37$
Clams	$5.87 \pm 0.48$	$50.2 \pm 2.56$	$11.9 \pm 0.82$
Potatoes	$4.66 \pm 0.15$	$17.52 \pm 1.18$	
Kelp	$1.75 \pm 0.17$	$41.1 \pm 2.84$	$37.4 \pm 0.41$
Water spinach	$10.7 \pm 0.19$	$28.5 \pm 0.43$	$1.31 \pm 0.31$

Table S2. The subcellular distribution of Cu, Zn, and As in raw food ingredients (%)

	Heat-stable proteins (HSP)	Heat-denatured proteins (HDP)	Organelle	Insoluble fraction
Cu				
Pork	10 ± 1.2	17 ± 1.3	8.7 ± 1.2	64 ± 1.6
Beef	8.3 ± 0.8	16 ± 0.9	10 ± 2.9	66 ± 1.9
Chicken	8.6 ± 1.1	15 ± 0.8	5.4 ± 0.7	71 ± 2.2
Prawns	7.2 ± 1.6	16 ± 2.0	3.5 ± 0.2	74 ± 1.9
Squid	6.6 ± 1.3	28 ± 1.7	7.3 ± 1.8	58 ± 2.0
Grass carp	4.4 ± 0.8	29 ± 1.4	17 ± 1.5	50 ± 3.3
Sea bream	5.8 ± 0.7	30 ± 2.7	15 ± 0.6	49 ± 3.0
Oysters	24 ± 3.7	25 ± 3.6	8.6 ± 0.8	42 ± 2.2
Clams	23 ± 2.8	9.8 ± 0.9	10 ± 0.2	57 ± 2.0
Potatoes	64 ± 5.7	22 ± 5.3	4.8 ± 0.3	9 ± 1.6
Kelp	27 ± 2.2	3.8 ± 1.0	13 ± 0.5	57 ± 1.6
Water spinach	41 ± 4.9	16 ± 4.5	4.6 ± 0.2	39 ± 0.5
Zn				
Pork	5.6 ± 0.3	38 ± 3.8	3.0 ± 1.1	54 ± 3.3
Beef	22 ± 4.0	14 ± 4.0	1.2 ± 0.1	63 ± 0.2
Chicken	3.7 ± 0.5	41 ± 0.1	1.9 ± 0.1	53 ± 0.5
Prawns	5.5 ± 1	20 ± 1.8	1.8 ± 0.1	72 ± 1.0
Squid	11 ± 1.1	29 ± 1.6	4.6 ± 0.5	56 ± 1.9
Grass carp	2.5 ± 0.3	42 ± 1.1	5.6 ± 1.1	50 ± 0.6
Sea bream	2.6 ± 0.2	46 ± 2.1	5.5 ± 1.3	46 ± 0.7
Oysters	17 ± 0.6	40 ± 2.2	8.5 ± 0.2	34 ± 1.9
Clams	21 ± 2.7	35 ± 2.0	8.3 ± 0.8	36 ± 1.0
Potatoes	52 ± 2.0	41 ± 2.7	2.6 ± 0.1	4.7 ± 1.2
Kelp	27 ± 0.3	16 ± 1.4	12 ± 1.9	44 ± 3.0
Water spinach	18 ± 0.4	53 ± 1.8	4.2 ± 0.9	25 ± 0.8
As				
Prawns	63 ± 1.9	3 ± 0.5	3.7 ± 0.4	31 ± 1.2
Squid	59 ± 1.6	2.5 ± 1.1	3.1 ± 0.2	36 ± 0.4
Sea bream	71 ± 2.2	4.4 ± 2.0	3.2 ± 0.7	21 ± 1.3
Oysters	51 ± 0.4	2.1 ± 1.1	12 ± 0.6	35 ± 1.7
Clams	60 ± 3.0	6.2 ± 2.8	6.4 ± 0.8	27 ± 0.6
Kelp	5.1 ± 0.8	4.3 ± 1.4	22 ± 1.4	68 ± 3.2
Water spinach	59 ± 8.2	9.4 ± 8.8	2.7 ± 0.3	29 ± 1.5

Table S3. The retention rate of Cu, Zn, and As in food ingredients (%)

	raw	boiled	steamed	baked	fried
Cu					
Pork	100 ± 5.8	93 ± 4.7	104 ± 7.4	99 ± 8.6	80 ± 4.7
Beef	100 ± 1.1	93 ± 2.0	104 ± 3.7	107 ± 12	82 ± 2.5
Chicken	100 ± 4.4	89 ± 4.4	93 ± 4.9	82 ± 6.2	66 ± 7.6
Prawns	100 ± 18	88 ± 7.9	104 ± 17	98 ± 9.3	80 ± 9.6
Squid	100 ± 16	95 ± 11	113 ± 15	96 ± 17	76 ± 12
Grass carp	100 ± 5.1	91 ± 17	97 ± 18	95 ± 21	93 ± 14
Sea bream	100 ± 12	93 ± 16	112 ± 8.5	95 ± 9	90 ± 10
Oysters	100 ± 19	95 ± 6.5	107 ± 18	93 ± 11	67 ± 14
Clams	100 ± 8.1	96 ± 13	92 ± 5.6	98 ± 6.8	71 ± 6.2
Potatoes	100 ± 3.2	84 ± 7.2	91 ± 4.9	104 ± 9.4	74 ± 5.7
Kelp	100 ± 9.8	89 ± 3.8	105 ± 17	104 ± 18	60 ± 2.7
Water spinach	100 ± 1.8	85 ± 3.3	95 ± 5.4	100 ± 8.1	27 ± 0.7
Average	100 ± 8.8	91 ± 8.7	101 ± 12	98 ± 12	72 ± 18
Zn					
Pork	100 ± 0.8	92 ± 3.7	108 ± 2.8	100 ± 9.3	82 ± 3.3
Beef	100 ± 5.6	95 ± 2.8	103 ± 3.8	98 ± 3.0	84 ± 3.8
Chicken	100 ± 6.9	87 ± 11	105 ± 1.6	100 ± 12	82 ± 9.3
Prawns	100 ± 2.3	94 ± 1.7	107 ± 6.1	101 ± 4.4	87 ± 6.1
Squid	100 ± 9.0	96 ± 2.1	99 ± 3.2	94 ± 7.3	87 ± 9.5
Grass carp	100 ± 8.2	83 ± 5.2	87 ± 22	92 ± 1.5	95 ± 3.6
Sea bream	100 ± 7.6	93 ± 2.9	98 ± 16	87 ± 2.9	85 ± 4.3
Oysters	100 ± 24	93 ± 11	103 ± 7.1	99 ± 17	69 ± 5.1
Clams	100 ± 5.1	93 ± 7.0	100 ± 6.2	99 ± 1.9	70 ± 0.9
Potatoes	100 ± 6.7	76 ± 15	108 ± 13	110 ± 9.2	76 ± 1.3
Kelp	100 ± 6.9	80 ± 2.0	96 ± 8.1	87 ± 0.6	76 ± 4.0
Water spinach	100 ± 1.5	95 ± 2.9	104 ± 4.6	105 ± 10	30 ± 2.3
Average	100 ± 7.5	90 ± 8.6	101 ± 9.9	97 ± 9.4	77 ± 17
As					
Prawns	100 ± 0.4	63 ± 2.0	81 ± 5.0	95 ± 3.8	71 ± 9.2
Squid	100 ± 3.4	44 ± 4.5	62 ± 3.0	87 ± 7.1	81 ± 5.7
Sea bream	100 ± 2.5	52 ± 4.5	69 ± 2.7	74 ± 1.2	79 ± 8.3
Oysters	100 ± 3.1	79 ± 5.1	76 ± 3	77 ± 3.3	71 ± 6.2
Clams	100 ± 6.9	69 ± 11	93 ± 11	100 ± 1.3	71 ± 4.3
Kelp	100 ± 1.1	88 ± 8.3	97 ± 5.8	95 ± 1.0	56 ± 1.0
Water spinach	100 ± 24	83 ± 6.6	89 ± 16	94 ± 27	26 ± 1.9
Average	100 ± 8.0	68 ± 16	81 ± 14	89 ± 13	65 ± 19

Table S4. The bioaccessibility of Cu, Zn, and As in food ingredients (%)

	raw	boiled	steamed	baked	fried
Cu					
Pork	97 ± 9.0	36 ± 0.7	47 ± 3.9	60 ± 4.1	52 ± 3.4
Beef	81 ± 3.2	27 ± 4.8	33 ± 1.7	38 ± 3.9	56 ± 2.9
Chicken	85 ± 3.5	45 ± 3.5	47 ± 5.6	56 ± 4.6	54 ± 7.7
Prawns	84 ± 4.3	52 ± 2.9	49 ± 7.8	58 ± 5.7	53 ± 4.8
Squid	25 ± 4.2	20 ± 1.7	25 ± 3.9	26 ± 4.9	41 ± 2.8
Grass carp	76 ± 9.6	50 ± 10	60 ± 20	52 ± 16	61 ± 9.9
Sea bream	72 ± 4.3	54 ± 6.0	64 ± 11	62 ± 5.2	59 ± 4.4
Oysters	93 ± 5.6	67 ± 3.5	69 ± 5.7	71 ± 9.0	74 ± 3.0
Clams	75 ± 10	37 ± 5.2	36 ± 0.6	34 ± 2.0	59 ± 4.2
Potatoes	89 ± 5.1	90 ± 5.1	90 ± 5.8	91 ± 7.2	87 ± 4.3
Kelp	44 ± 1.9	34 ± 1.2	29 ± 1.2	26 ± 2.6	38 ± 1.4
Water spinach	88 ± 7.8	81 ± 4.1	84 ± 2.8	86 ± 5.1	94 ± 3.6
Average	76 ± 21	49 ± 21	53 ± 22	55 ± 22	61 ± 17
Zn					
Pork	82 ± 5.8	36 ± 7.2	27 ± 1.3	38 ± 0.6	51 ± 2.6
Beef	61 ± 2.4	41 ± 4.8	42 ± 0.8	38 ± 2.4	45 ± 2.1
Chicken	68 ± 11	34 ± 4.1	25 ± 3.7	29 ± 5.9	59 ± 6.3
Prawns	66 ± 2.3	35 ± 2.6	35 ± 1.1	37 ± 4.2	46 ± 4.5
Squid	72 ± 8.2	70 ± 4.8	64 ± 1.8	70 ± 6.0	62 ± 3.8
Grass carp	91 ± 10	61 ± 25	72 ± 10	70 ± 10	64 ± 7.4
Sea bream	104 ± 1.6	65 ± 9.6	87 ± 7.4	81 ± 5.3	70 ± 5.6
Oysters	91 ± 11	62 ± 1.8	62 ± 4.2	67 ± 5.1	83 ± 3.1
Clams	87 ± 5.0	73 ± 4.0	71 ± 2.6	73 ± 2.7	86 ± 7.2
Potatoes	85 ± 5.7	76 ± 6.8	80 ± 8.5	82 ± 2.1	85 ± 7.6
Kelp	69 ± 1.1	64 ± 9.0	59 ± 3.8	67 ± 3.5	64 ± 4.1
Water spinach	69 ± 5.0	59 ± 3.4	56 ± 2.2	68 ± 2.2	63 ± 3.0
Average	79 ± 14	56 ± 17	57 ± 20	60 ± 19	65 ± 14
As					
Prawns	78 ± 2.0	67 ± 5.3	65 ± 0.9	76 ± 4.1	79 ± 4.6
Squid	89 ± 7.5	39 ± 3.5	56 ± 1.8	66 ± 3.3	40 ± 4.1
Sea bream	79 ± 2.1	84 ± 3.6	82 ± 4.1	91 ± 5.0	72 ± 5.0
Oysters	96 ± 1.4	77 ± 2.1	78 ± 3.0	93 ± 1.6	94 ± 6.4
Clams	66 ± 3.7	55 ± 8.0	53 ± 5.1	55 ± 4.1	65 ± 3.6
Kelp	14 ± 0.5	8.9 ± 0.5	17 ± 1.5	10 ± 1.4	24 ± 3.0
Water spinach	57 ± 1.5	55 ± 4.8	56 ± 4.8	54 ± 4.6	78 ± 9.9
Average	77 ± 14	63 ± 16	65 ± 12	72 ± 16	71 ± 18

Table S5. The total bioaccessible fraction (TBF) of Cu, Zn, and As in food ingredients

	(%)				
	raw	boiled	steamed	baked	fried
Cu					
Pork	97 ± 3.3	33 ± 1.0	49 ± 2.1	60 ± 7.1	42 ± 2.3
Beef	81 ± 3.4	25 ± 3.9	34 ± 2.8	40 ± 8.7	46 ± 1.0
Chicken	85 ± 2.2	40 ± 2.5	44 ± 5.5	46 ± 1.5	36 ± 6.8
Prawns	84 ± 15	46 ± 4.1	50 ± 2.9	57 ± 1.5	42 ± 2.1
Squid	24 ± 2.0	19 ± 3.1	28 ± 3.7	24 ± 1.0	31 ± 2.6
Grass carp	76 ± 8.8	47 ± 18	60 ± 27	47 ± 9.5	56 ± 8.0
Sea bream	72 ± 10	50 ± 3.7	72 ± 16	59 ± 11	53 ± 3.7
Oysters	92 ± 12	64 ± 1.8	75 ± 19	65 ± 1.2	50 ± 9.1
Clams	76 ± 16	35 ± 4.5	33 ± 2.4	33 ± 3.3	42 ± 2.1
Potatoes	89 ± 4.2	76 ± 9.5	82 ± 5.9	95 ± 11	64 ± 7.5
Kelp	44 ± 2.5	30 ± 1.3	31 ± 6.1	26 ± 2.1	23 ± 0.9
Water spinach	88 ± 9.3	69 ± 5.4	80 ± 3.6	86 ± 2.3	25 ± 0.3
Average	76 ± 22	44 ± 18	53 ± 22	53 ± 22	42 ± 13
Zn					
Pork	82 ± 6.4	33 ± 7.0	29 ± 0.6	38 ± 4	42 ± 2.9
Beef	61 ± 5.9	39 ± 4.3	43 ± 0.8	38 ± 3.4	38 ± 0.8
Chicken	69 ± 13	30 ± 3.6	27 ± 4.1	29 ± 7.9	48 ± 7.7
Prawns	66 ± 3.3	33 ± 1.8	38 ± 2.6	37 ± 3	40 ± 2.0
Squid	72 ± 11	67 ± 5.5	64 ± 3.6	65 ± 1.8	53 ± 2.8
Grass carp	91 ± 11	52 ± 23	63 ± 18	65 ± 9.6	61 ± 5.9
Sea bream	104 ± 6.7	60 ± 9.8	85 ± 7.4	70 ± 5.7	60 ± 7.5
Oysters	89 ± 13	58 ± 5.3	64 ± 8.7	66 ± 7.2	57 ± 4.1
Clams	86 ± 1.3	68 ± 1.6	71 ± 2.0	73 ± 1.4	60 ± 5.8
Potatoes	86 ± 11	57 ± 5.7	86 ± 7.7	90 ± 6.0	65 ± 6.0
Kelp	69 ± 5.8	52 ± 6.6	56 ± 6.6	59 ± 2.6	49 ± 1.2
Water spinach	69 ± 6.0	56 ± 1.5	58 ± 4.9	71 ± 4.7	19 ± 1.1
Average	79 ± 14	50 ± 15	57 ± 20	58 ± 19	49 ± 13
As					
Prawns	78 ± 1.8	42 ± 2.3	52 ± 4	72 ± 6.2	57 ± 10
Squid	89 ± 9.2	17 ± 0.3	35 ± 2.7	57 ± 2.7	32 ± 1.4
Sea bream	79 ± 0.7	44 ± 2	57 ± 4.4	67 ± 4.7	57 ± 2.3
Oysters	96 ± 4.3	60 ± 2.3	60 ± 2.4	71 ± 2.1	67 ± 9.9
Clams	66 ± 8	38 ± 1.7	49 ± 1.9	55 ± 4.4	46 ± 0.7
Kelp	14 ± 0.5	7.8 ± 0.5	16 ± 0.6	9.9 ± 1.4	13 ± 1.8
Water spinach	57 ± 14	46 ± 7.5	50 ± 13	50 ± 13	21 ± 4.1
Average	77 ± 15	41 ± 14	50 ± 9.5	62 ± 10	47 ± 17

Table S6. The total bioaccessible fraction (TBF) of Cu, Zn, and As in food ingredients

	(µg g <sup>-1</sup> dry weight)				
	raw	boiled	steamed	baked	fried
Cu					
Pork	1.18 ± 0.04 <sup>a</sup>	0.41 ± 0.01 <sup>b</sup>	0.59 ± 0.06 <sup>c</sup>	0.73 ± 0.05 <sup>d</sup>	0.51 ± 0.01 <sup>e</sup>
Beef	2.74 ± 0.13 <sup>a</sup>	0.84 ± 0.13 <sup>b</sup>	1.14 ± 0.11 <sup>c</sup>	1.37 ± 0.29 <sup>cd</sup>	1.55 ± 0.04 <sup>d</sup>
Chicken	0.91 ± 0.05 <sup>a</sup>	0.43 ± 0.01 <sup>bc</sup>	0.47 ± 0.04 <sup>b</sup>	0.49 ± 0.03 <sup>b</sup>	0.38 ± 0.06 <sup>c</sup>
Prawns	6.38 ± 3.42 <sup>a</sup>	3.43 ± 1.47 <sup>bc</sup>	3.64 ± 1.04 <sup>bc</sup>	4.12 ± 1.33 <sup>b</sup>	3.07 ± 0.91 <sup>c</sup>
Squid	0.92 ± 0.19 <sup>a</sup>	0.74 ± 0.22 <sup>b</sup>	1.05 ± 0.28 <sup>ac</sup>	0.92 ± 0.17 <sup>a</sup>	1.18 ± 0.25 <sup>c</sup>
Grass carp	1.00 ± 0.25 <sup>a</sup>	0.58 ± 0.10 <sup>a</sup>	0.82 ± 0.53 <sup>a</sup>	0.64 ± 0.28 <sup>a</sup>	0.75 ± 0.28 <sup>a</sup>
Sea bream	1.03 ± 0.18 <sup>a</sup>	0.70 ± 0.03 <sup>b</sup>	1.03 ± 0.23 <sup>a</sup>	0.84 ± 0.18 <sup>ab</sup>	0.76 ± 0.05 <sup>b</sup>
Oysters	98.2 ± 41.2 <sup>a</sup>	66.5 ± 20.4 <sup>b</sup>	75.0 ± 11.9 <sup>ab</sup>	68.1 ± 18.7 <sup>b</sup>	53.2 ± 24.0 <sup>c</sup>
Clams	4.51 ± 1.30 <sup>a</sup>	2.07 ± 0.42 <sup>b</sup>	1.93 ± 0.09 <sup>b</sup>	1.93 ± 0.21 <sup>b</sup>	2.46 ± 0.11 <sup>b</sup>
Potatoes	4.14 ± 0.23 <sup>a</sup>	3.55 ± 0.55 <sup>a</sup>	3.82 ± 0.22 <sup>a</sup>	4.43 ± 0.66 <sup>a</sup>	2.99 ± 0.37 <sup>b</sup>
Kelp	0.77 ± 0.12 <sup>a</sup>	0.53 ± 0.07 <sup>b</sup>	0.54 ± 0.11 <sup>b</sup>	0.46 ± 0.07 <sup>bc</sup>	0.40 ± 0.02 <sup>c</sup>
Water spinach	9.43 ± 1.16 <sup>a</sup>	7.32 ± 0.69 <sup>b</sup>	8.57 ± 0.53 <sup>ab</sup>	9.13 ± 0.39 <sup>a</sup>	2.68 ± 0.01 <sup>c</sup>
Zn					
Pork	41.3 ± 3.5 <sup>a</sup>	16.5 ± 3.5 <sup>bc</sup>	14.4 ± 0.2 <sup>c</sup>	18.9 ± 2.2 <sup>bc</sup>	21.2 ± 1.4 <sup>b</sup>
Beef	117 ± 18 <sup>a</sup>	75.8 ± 12.2 <sup>b</sup>	83.3 ± 3.7 <sup>b</sup>	72.4 ± 9.6 <sup>b</sup>	72.9 ± 3.5 <sup>b</sup>
Chicken	16.2 ± 4.0 <sup>a</sup>	6.98 ± 1.34 <sup>b</sup>	6.26 ± 1.40 <sup>b</sup>	6.89 ± 1.79 <sup>b</sup>	11.4 ± 2.3 <sup>c</sup>
Prawns	41.1 ± 2.9 <sup>a</sup>	20.5 ± 0.8 <sup>b</sup>	23.6 ± 1.3 <sup>bc</sup>	23.3 ± 1.5 <sup>bc</sup>	25.0 ± 0.7 <sup>c</sup>
Squid	50.8 ± 11.7 <sup>a</sup>	47.5 ± 8.3 <sup>a</sup>	44.5 ± 1.4 <sup>ab</sup>	45.7 ± 5.4 <sup>a</sup>	37.5 ± 5.0 <sup>b</sup>
Grass carp	12.6 ± 2.0 <sup>a</sup>	7.23 ± 3.7 <sup>b</sup>	8.74 ± 3.09 <sup>b</sup>	8.79 ± 0.62 <sup>ab</sup>	8.42 ± 1.50 <sup>b</sup>
Sea bream	14.1 ± 2.0 <sup>a</sup>	8.19 ± 1.06 <sup>b</sup>	11.6 ± 1.9 <sup>c</sup>	9.62 ± 1.52 <sup>b</sup>	8.08 ± 0.51 <sup>b</sup>
Oysters	570 ± 208 <sup>a</sup>	358 ± 66 <sup>b</sup>	396 ± 67 <sup>b</sup>	419 ± 143 <sup>b</sup>	360 ± 109 <sup>b</sup>
Clams	43.3 ± 2.0 <sup>a</sup>	34.1 ± 2.1 <sup>b</sup>	35.5 ± 2.8 <sup>b</sup>	36.5 ± 2.5 <sup>b</sup>	30.1 ± 3.4 <sup>c</sup>
Potatoes	15.1 ± 3.0 <sup>a</sup>	9.90 ± 1.07 <sup>b</sup>	15.1 ± 1.4 <sup>a</sup>	15.8 ± 1.5 <sup>a</sup>	11.3 ± 0.6 <sup>b</sup>
Kelp	28.5 ± 4.4 <sup>a</sup>	21.2 ± 2.6 <sup>bc</sup>	23.1 ± 3.44 <sup>bc</sup>	24.0 ± 1.0 <sup>b</sup>	20.1 ± 1.3 <sup>c</sup>
Water spinach	19.8 ± 2 <sup>a</sup>	15.9 ± 0.6 <sup>b</sup>	16.5 ± 1.5 <sup>b</sup>	20.1 ± 1.1 <sup>c</sup>	5.41 ± 0.34 <sup>d</sup>
As					
Prawns	2.43 ± 0.05 <sup>a</sup>	1.32 ± 0.07 <sup>b</sup>	1.63 ± 0.12 <sup>bc</sup>	2.25 ± 0.20 <sup>a</sup>	1.77 ± 0.31 <sup>c</sup>
Squid	3.22 ± 0.33 <sup>a</sup>	0.61 ± 0.01 <sup>d</sup>	1.26 ± 0.10 <sup>c</sup>	2.07 ± 0.10 <sup>d</sup>	1.17 ± 0.05 <sup>c</sup>
Sea bream	2.24 ± 0.02 <sup>a</sup>	1.25 ± 0.06 <sup>d</sup>	1.61 ± 0.12 <sup>c</sup>	1.91 ± 0.13 <sup>d</sup>	1.63 ± 0.06 <sup>c</sup>
Oysters	11.5 ± 0.5 <sup>a</sup>	7.27 ± 0.27 <sup>b</sup>	7.17 ± 0.29 <sup>b</sup>	8.57 ± 0.25 <sup>c</sup>	8.08 ± 0.95 <sup>bc</sup>
Clams	7.97 ± 1.46 <sup>a</sup>	4.48 ± 0.21 <sup>b</sup>	5.85 ± 0.23 <sup>cd</sup>	6.61 ± 0.53 <sup>c</sup>	5.49 ± 0.40 <sup>d</sup>
Kelp	5.1 ± 0.2 <sup>a</sup>	2.93 ± 0.24 <sup>b</sup>	5.98 ± 0.29 <sup>c</sup>	3.72 ± 0.59 <sup>d</sup>	4.96 ± 0.71 <sup>a</sup>
Water spinach	0.78 ± 0.39 <sup>a</sup>	0.60 ± 0.14 <sup>a</sup>	0.68 ± 0.35 <sup>a</sup>	0.68 ± 0.33 <sup>a</sup>	0.27 ± 0.05 <sup>b</sup>

Different letters (a, b, c, d, e) represent significant differences between different treatment groups ( $p < 0.05$ )