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Chemical Composition of *Salicornia Herbacea* L.

– Research Note –

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Abstract

To get basic data for the utilization of *S. herbacea* L. as a raw material in food and Chinese herbs, chemical compositions of its leaves, stem and root were investigated. Leaves had the highest level of moisture and the lowest level of total sugar. The crude protein and crude lipid contents of the stem were similar to those of the root. Crude ash and salt contents (dry basis) in leaves were considerably higher than those of the stem and root. Total amino acid contents of leaves, stem and root were 1,270 mg/100 g, 1,525 mg/100 g, and 1,569 mg/100 g, respectively. Although the amino acid compositions of leaves, stem, and root were different, their major amino acids were glutamic acid, leuicine, isoleucine and aspartic acid. The rich minerals in leaves, stem and root were Na, K and Ca.

Key words: *Salicornia herbacea* L., halophyte, mineral

INTRODUCTION

Halophyte is a salt-resisted plant, having adapting to salinity stress. The habitat which the plant grows is classified as muddy flat, sand dune and rock face by a gradient of soil properties, and divided into flooding of seawater, salt or seawater in soil and saltern by a gradient of salt influence (1,2). *S. herbacea* L. is one of the most salt tolerant species on the western coast of Korea, and is an annual succulent shrub growing on coastal wetlands. *S. herbcea* L. not only tolerates a high level of salinity, but also reaches an optimal level of growth under saline condition (3). In halophytes, the ability to grow in a high level of salt is often accompanied by an increase in plant size and succulence (4) and is dependent on regulation of intracellular ion concentrations (5). Glenn et al. (6) reported that the seeds of *S. bigelvii* Torr contained 26~33% oil and 30~33% crude protein, with low ash and fiber contents. Some studies have worked that *Salicornia* meal is rich in linoleic acid and lysine, and sulfur-containing amino acids (7). Joshi (8) reported that contents of free amino acids and mineral constituents in halophytes changed by seasons. In the present experiment, chemical compositions of *S. herbacea* L. were investigated for use as functional food ingredient.

MATERIALS AND METHODS

Material

Salicornia herbacea L. was purchased from Ham-Cho market in Haenam, Jeollanam-Do, Korea.

General analysis, total sugar and uronic acid

All analyses of moisture, protein, lipid and ash of *S. herbacea* L. were determined by AOAC methods. For the determination of total carbohydrate and uronic acid, the samples were hydrolyzed with 1 M HCl for 3 hr at 105°C and neutralized with 0.5 N NaOH. Total carbohydrate was measured by the phenol sulfuric method using glucose as the standard. Uronic acid was assayed by m-hydroxybiphenyl method (9) using glucuronic acid and galacturnic acid as the standards. To 0.2 mL of the sample containing from 0.5 to 20 μg uronic acid, 1.2 mL of sulfuric acid/tetraborate was added. The tube was refrigerated in crushed ice. The mixture was shaken in a vortex mixer and the tubes heated in a water bath at 100°C for 5 min. After cooling in a water-ice bath, 20 μL of the m-hydroxybiphenyl reagent was added. The tubes were shaken, and their optical densities were observed at 520 nm in a spectrophotometer.

Mineral and total amino acid

Minerals were analyzed with atomic adsorb spectrophotometer (IL video 12, Hitachi, Japan), after hydrolysis with conc. HNO_3. Total amino acids were measured as follows. Ten milliliters of 6 N HCl was added to 0.1 g of sample in a pyrex cap tube, and then heated at 105°C for 20 hr after sealing under nitrogen gas. The hydrolyzed solution was filtered and evaporated to dryness under

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reduced pressure. The volume was adjusted with citrate buffer (pH 2.0) and the final solution was injected into an amino acid analyzer (Model 835-50, Hitachi, Japan).

RESULTS AND DISCUSSION

Proximate composition, total sugar and uronic acid

Proximate compositions of *S. herbacea* L. are shown in Table 1. Moisture contents of leaves, stem and root were 90.9%, 73.9% and 66.2%, respectively. The contents of crude protein in the stem and root were similar, while that in leaves was lower than those in the stem and root. The crude protein of *S. herbacea* L. was lower than those of terrestrial vegetables (10). The contents of crude fat and crude ash in the stem were similar to those in the root, and crude ash content in leaves was lower than those of the stem and root. *S. herbacea* L. contained a large amount of salts. These results imply that *S. herbacea* L. inhabiting in the sea beach has a salt accumulating system in its tissue and maybe has a peculiar physiological function. Total sugar contents of leaves, stem and root were 2.2%, 13.4% and 22.8%, respectively (Table 1).

Contents of total amino acid

Table 2 shows total amino acid content of *S. herbacea L.* The contents of total amino acid in *S. herbacea L.* were 1,525 mg/100 g in the stem, 1,569 mg/100 g in the root, and 1,270 mg/100 g in leaves. Abundant amino acids in the root were glutamic acid, lysine, aspartic acid, leucine, and those in its stem were lysine, isoleucine, glutamic acid, valine and aspartic acid. And abundant amino acids in the leaves were glutamic acid, aspartic acid, leucine and isoleucine. Cystine was detected in the root, while it was not detected in the leaves and stem. And tyrosine was 10.8 mg/100 g in leaves, but it was not contained in the stem and root. These results suggest that amino acid compositions of *S. herbacea* L. show considerable differences according to its portions. The richness of acidic and neutral amino acids such as glutamic acid, aspartic acid, leucine and glycine in *S. herbacea* L. is similar to other edible plants (10,11). However, the content of lysine lacked in other vegetables was higher in *S. herbacea* L. (12) as about 7% among the total amino acid. Their proline contents were similar to those of *Hizikia fusiforme, Laminaria japonica* and *Undaria pinnatifida* (13).

Table 1. Chemical compositions and salt content of *S. herbacea* L. (%)

Items	Leaf	Stem	Root
Moisture	90.9	73.9	66.2
Crude protein	1.7	2.0	2.0
Crude lipid	0.2	0.3	0.3
Crude ash	4.7	6.1	6.2
Salt	3.3	3.9	2.8
Total sugar	2.2	13.4	22.8
Uronic acid	0.3	1.4	1.9

Table 2. Amino acid compositions of *S. herbacea* L. (mg/100 g)

Amino acids	Leaf	Stem	Root
Taurine	7.6	21.4	37.7
Aspartic acid	137.1	140.2	165.5
Threonine	70.9	69.8	81.2
Serine	67.5	72.7	94.8
Glutamic acid	144.8	160.5	182.3
Glycine	76.9	80.4	122.9
Alanine	79.9	88.7	98.2
Cystine	-[1)]	-	11.1
Valine	72.9	126.1	94.7
Methionine	23.2	52.2	23.3
Isoleucine	110.7	107.5	94.7
Leucine	115.5	98.1	128.4
Tyrosine	10.8	-	-
Pheylalanine	73.2	63.3	67.7
Lysine	79.8	310.2	178.9
Histidine	34.0	79.3	54.4
Arginine	77.0	36.1	57.0
Proline	88.5	18.4	86.8
Total	1,270	1,525	1,569

[1)]Not detected.

Table 3. Mineral contents of *S. herbacea* L. (mg/100 g)

Minerals	Leaf	Stem	Root
Na	1003.4	1218.1	1333.8
Ca	237.5	158.8	22.1
K	650.1	740.1	741.1
Mg	46.5	54.0	52.5
Zn	13.4	29.6	2.4
Fe	31.5	66.2	84.8
Cu	3.1	1.1	2.1
Ni	1.1	0.7	0.4
Mn	7.2	3.9	3.0

Mineral composition

Mineral compositions are presented in Table 3. Mineral components of *S. herbacea* L. were rich in Na (1,003.4~1,333.8 mg/100 g), Ca (22.1~237.5 mg/100 g) and K (650.1~741.1 mg/100 g). Among the portions of *S. herbacea* L., Na content was slightly higher level in the root than those of leaves and the stem. There were significantly differences in the Ca content among the portons of *S. herbacea* L., and especially Ca content of leaves was higher about 10 times than that of the root. K content of the root was similar to that of the stem, but K content of leaves was lower than those of the stem and root. These results were similar to those of William et al. (14).

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