

Studies on the Nutritional Value of the Edible Earthworm(Ⅲ)

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食用지렁이의 영양가에 대한 연구(Ⅲ)

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要 約

한국산食用지렁이(*Lumbricus terrestris*)를 동결건조시킨 후 분말로하여 chloroform-methanol (2:1, v/v)로 추출한 총지질의 정량 및 silicic acid column chromatography로 중성지질, 당지질, 인지질로 분획하여 gas chromatography에 의하여 이들 각 획분별 지방산 조성을 분석한 결과를 요약하면 다음과 같다.

동결건조 지렁이(수분함량 4.68%)를 추출한 총지질은 10.80%였고, Folch법에 의해 정제된 양은 68.5%였다.

Silicic acid column chromatography로 분획한 결과 중성지질은 35.14%, 당지질이 41.74%였으며, 인지질은 23.12%였다.

각지질 획분별, 지방산 조성을 분석한 결과는 중성지질의 포화지방산은 60.01%, monoene산이 25.38%, polyene산이 11.30%이었으며, 지방산중 lauric acid가 15.63%로 가장 많았고, oleic acid가 13.54%로 되어 있었으며, 당지질은 포화지방산이 58.41%, monoene산이 8.67%, polyene산이 5.39%였고, C수가 10미만인 지방산이 23.22%였다. caproic acid가 25.80%로 가장 많았고 다음이 lauric acid로 11.22%였었다. 또한 인지질은 포화지방산이 44.75%, monoene산이 17.88%, polyene산이 25.24%로 중성당지질보다 polyene산이 많았었다. oleic acid가 16.20%로 가장 많은 양을 나타내었고, 다음이 caproic acid로 12.07%였었다.

Introduction

It has been said that not only the plant kingdom would be destroyed if the earthworms don't exist on the ecosystem, but it is the supreme valuable animal¹⁾. In the United States, England, Japan and so on, the culture of earthworms has been recommended as a soil improving method by feeding industrial waste

materials^{2,3)}. Earthworm's glycoprotein of having the erythrocyte agglutinating activity was isolated and purified recently⁴⁾. And drug metabolizing enzyme, cytochrome p-450, was found in the digestive tract⁵⁾. It suggested that earthworms absorbed the same heavy metals as cadmium and lead in the soil, because metallo-thionein proteins assumed to raise resistance to toxic metals and to maintain essential metal

ions in the cell were induced⁹⁾.

Since ancient times, it has been transmitted that earthworm not only had activities of depressant, anticonvulsion and sedation but was used as remedies for chronic bronchitis and asthma⁷⁾. It reported that the fatty acids from earthworm were palmitic acid, stearic acid and cholesterol⁸⁾. Other studies were revealed that the content of crude lipid was very high⁹⁾, and saturated fatty acids of C₁₀~C₂₂ carbons and unsaturated fatty acids of C₁₂~C₂₂ carbons were detected¹⁰⁾. Proximal compositions, amino acid compositions and protein value of Korean edible earthworms were conducted previously.^{11,12)}

In this studies, lipids of Korean edible earthworms were fractionized to three simple lipid classes-neutral lipid, glycolipid and phospholipid-and those fatty acid compositions were analysed and compared with others.

Experiment

Edible earthworms (*Lumbricus terrestris*) were purchase at Kimhae earthworm farm. The sample was washed with tap water, frozen and lyophilized.

Extraction and purification of lipid: Total lipids were extracted with a mixture of chloroform: methanol (2: 1, v/v) for 12 hrs. in dark place^{13,14)}. Crude total lipid was purified according to the method of Folch et al¹⁵⁾. Crude lipid extract is mixed with 0.2 its volume of water containing 0.88% potassium chloride to remove non-lipid substance in the upper layer.

Fractionation to simple lipid classes and quantitation: Purified total lipid was fractionized to three simple classes according to Rouser et al¹⁶⁾, and Marinetti¹⁷⁾ methods. By means of column chromatography (2.50cm) using silicic acid, neutral lipid was eluted with chloroform and glycolipid with acetone. Finally phospholipid was eluted with methanol. Each lipid class

was evaporated at 35°C and weighed.

Fatty acid compositions of each lipid class: Fatty acid-methyl esters of neutral lipid, glycolipid and phospholipid were prepared with 14% BF₃-methanol¹⁸⁾ and analyzed by gas-liquid chromatography (GLC) with flame ionization detector and column (3m 3mm I.D.) containing 15% DEGS. Injection and column temperature was 230°C and 195°C, respectively. Carrier gas was nitrogen gas with flow rate 50ml/min. Identification of fatty acid constituents was based on the retention times of authentic reference methyl esters, ECL value¹⁹⁻²¹⁾ and separation factors²²⁾. The contents of constituent fatty acids were calculated with the ratio of each peak area to total areas.

Results and Discussion

Crude lipid content of lyophilized earthworm (moisture content: 4.68%) was 10.80% and purified total lipid by Folch method was 68.50% of the crude lipid.

The results of lipid fractionation by using of silicic acid column chromatography were 35.14% neutral lipid, 41.74% glycolipid and 23.12% phospholipid.

Fatty acid compositions of lipid of earthworm are shown in table 1.

Fatty acid compositions of neutral lipid were 60.01% saturated, 25.38% monoene and 11.30% polyunsaturated fatty acid. Saturated fatty acids were very higher than the report of Roy et al.²³⁾ The content of lauric acid was high (15.63%) whereas is generally present in very small quantities in animal fats and in plant lipid²⁴⁾. Tomas et al²⁵⁾, suggested that lauric acid inhibited the formation of carcinogen nitrosamine from N-nitrosomethylamine. Roy et al. observed the marked difference of lauric acid level between in spring (25.7%) and in winter (5.9%). Palmitic acid was found to constitute about 3% of each lipid. By contrast,

Table 1. Fatty acid composition of total lipid and three lipid classes in Korean edible earthworm (area %)

FA	TL	NL	GL	PL
10 : 0	4.56	3.52	25.80	12.07
11 : 0	4.78	3.43	7.18	3.73
12 : 0	17.42	15.63	11.22	—
iso-13 : 0	1.56	2.54	2.42	0.84
13 : 0	2.48	3.19	1.39	1.44
14 : 0	8.67	10.87	3.31	2.61
15 : 0	1.44	1.56	0.46	1.26
16 : 0	2.19	3.93	3.39	2.15
17 : 0	2.01	2.48	—	1.04
18 : 0	7.38	9.24	2.40	7.27
20 : 0	1.72	0.16	—	0.67
21 : 0	0.63	1.40	—	1.99
22 : 0	2.20	2.06	0.84	9.67
total	57.04	60.01	58.41	44.75
10 : 1	9.67	9.82	—	0.73
16 : 1	0.28	2.02	0.33	0.95
18 : 1	8.86	13.54	8.34	16.20
total	18.81	25.38	8.67	17.88
16 : 2	0.72	3.03	0.32	0.79
18 : 2	4.67	5.15	4.10	7.48
18 : 3	6.07	1.75	0.32	9.77
20 : 2	1.82	0.30	—	2.23
20 : 3	1.08	1.07	0.65	4.97
total	14.36	11.30	5.39	25.24
unknown	4.47	2.69	23.22	6.29

FA: fatty acid, TL: total lipid,
 NL: neutral lipid GL: glycolipid,
 PL: phospholipid

the content of this acid of other animals was of the order of 25% the total fatty acids in the fats of the rabbit, fresh and marine fishes, grass²⁶⁻²⁸⁾ grub and was 9.4% in a sample of mixed pasture²³⁾. As shown in table 1, comparatively high levels of n-odd-numbered fatty acids were observed too in Korean edible earthworm similar in New Zealand product²⁴⁾.

Fatty acid compositions of glycolipid were 58.41% saturated, 8.67% monoene, 5.39% polyunsaturated acid and 23.22% unknown fatty acid below C₁₀ carbon. In glycolipid, the content of caproic acid was the highest (25.80%) and then lauric acid was 11.22%. New Zealand earthworm was also high of lauric acid but

trace content of caproic acid in all lipid classes. Polyunsaturated fatty acids were low level. Fatty acid compositions of phospholipid were 44.75% saturated, 25.24% monoene and 25.24% polyunsaturated fatty acid. Oleic acid content was the highest (16.20%), and caproic acid and linolenic acid were comparatively high level to other two lipid classes.

Abstract

This study was carried out to obtain an information for the earthworms (*Lumbricus terrestris*) as total lipid, three lipid classes and their fatty acid compositions. Total lipids of earthworm consisted of 35.14% of neutral lipids, 41.74% of glycolipids and 23.12% of phospholipids. A wide variety of fatty acid esters ranging from C₁₀ to C₂₂ were identified and lower fatty acids than C₁₀ detected but not identified. In the neutral lipid, the major fatty acids were lauric acid, oleic acid, myristic acid and caproenoic acid. The fatty acid composition in the glycolipid was specific, so caproic acid content was 25.8% and unknown lower fatty acids than that were 23.22%. In the phospholipids, the major fatty acids were oleic acid, caproic acid, linolenic acid and behenic acid. Unsaturated fatty acid contents in the phospholipids were higher than in the neutral and glycolipids.

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