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Studies on the Preservation of Korean Rice by Gamma-radiation (IV)

On the free amino acids contents in gamma-irradiated rice

by

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감마선 조사에 의한 쌀저장에 관한 연구 (제 4 보)

—— 감마선 조사쌀의 유리 아미노산 함량에 관하여 ——

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요 약

경기도 수원 지방에서 수확한 벼 팔달 품종을 1969년 3월에 현미와 백미로 표준도정하여 kraft paper bag에 1.5kg식 포장하여 Co-60 감마선 조사기로 500, 800, 1,000 Krad를 조사한후 실온에 저장하면서 6월과 10월에 쌀중의 유리아미노산 함량을 amino acid autoanalyzer (Yanogimoto. LC-5)로 분석한 결과는 다음과 같다.

1) 쌀의 감마선 조사에 있어서 비교적 고선량인 500, 800, 1,000 Krad의 조사로도, 대조구와 조사구간에 유리아미노산 함량은 별로 차이를 볼 수 없다.
2) 쌀중의 유리 아미노산 함량은 저장중 감소경향이고 특히 glutamic acid가 현저하다.

I. Introduction

Authors previously presented three reports[1] [2] [3] about the chemical and biological changes in the Co-60 gamma-irradiated polished and brown Korean rice of Paldal variety which was stored at the room temperature. Free amino acids close relations with the taste of rice, therefore, in this research, the developing changes of free amino acids in the gamma-irradated rice was traced by the amino acid autoanalyzer.

By means of the paper chromatography, Kondo and Sasaoka[4] detected 13 kinds of amino acids and by the microbiological method or column chromatography, total 19 kinds of them. In 1970, Tajima et al.[5] sampled the polished and brown rice of the Japanese Koshihikari variety and examined the contents of free amino acid in them during the storage with the application of 20-90 Krad irradiation by Co-60.

II. Materials and Methods

1) Sampling

The sampled Paldal variety was harvested of Suwon,

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Korea in 1968 and was milled into 92% polished rice and brown one by the common method at the Agricultural Products Inspection Station of Korea. On the 18th of April, 1969, each 1.5kg of the samples in the sealed kraft paper bags was exposed to the 700Ci Co-60 irradiator, the respective doses being 500, 800 and 1,000 Krad, and was stored at room temperature.

2) Quantitative determination of amino acids[6]

Into the exact 50g of rice powder, 150 ml of 75% ethanol was added, and the mixture was heated at 80°C for 20 minutes and centrifuged. The same process was repeated with the additional pourings of 100ml and 50ml of ethanol and the whole extracts were extracted with 40ml of ether. The ether layer was discarded and the rest was vacuum evaporated to condense to 2-3ml, which was diluted again to the final volume of 10ml. One millilitter of this sample solution was injected into the long column of the analyzer and 0.5 ml in the short column, respectively.

Analyical conditions of analyzer

	Acidic and neutral amino acid	Basic amino acid
Sample volume	1.0ml	0.5ml
Resin	Amberlite CG-120	Amberlite CG-120
Column	0.9×70cm	0.9×15cm
Column temp.	55°C	55°C
Flow rate, a) buffer	100ml/hr	100ml/hr
b) ninhydrin	50ml/hr	50ml/hr
Buffer change time	55-57min.	—
second buffer	130min.	—
shut down	140min.	60min.
PH of buffer	3.32, 4.25	5.28

III. Results and discussion

The general chemical composition of the sample rice of Paldal variety by the usual analytical methods were as follows.

Samples	Moisture	Crude protein	Crude fat	Crude ash	N-free extract
Brown rice	14.3%	8.23%	2.8%	1.34%	72.24%
Polished rice	14.9%	7.56%	1.08%	0.67%	75.79%

The contents of free amino acids in the sample rice were determined by the amino acid autoanalyzer (Yanagimoto, Japan, LC-5 type) and are shown in the table I and II. The former is for the free amino acid contents in the brown rice and the latter is for the case of polished one. All values are average of two or three times of experiments. Cystine and methionine contents were traces and tryptophan could not be detected by this analyzer.

Table 1. Free amino acid contents in gamma-irradiated brown rice during storage (mg %)

Dose	Control		500Krad		800Krad		1,000Krad	
Time of test / Amino acid	June	October	J	O	J	O	J	O
LYS	0.25	0.20	0.19	0.17	0.25	0.17	0.24	0.15
HIS	0.77	0.43	0.56	0.38	0.70	0.47	0.67	0.40
ARG	1.12	0.78	0.90	0.80	1.08	0.75	0.86	0.72
ASP	1.10	0.91	1.04	0.82	1.06	0.80	0.98	0.89
THR	0.49	0.43	0.45	0.44	0.46	0.40	0.43	0.41
SER	3.06	2.54	2.90	2.58	2.94	2.37	2.90	2.42
GLU	2.69	1.36	2.65	1.17	2.70	1.01	2.58	1.07
PRO	0.90	0.87	0.88	0.86	0.89	0.84	0.81	0.88
GLY	0.75	0.61	0.68	0.66	0.79	0.62	0.69	0.60
ALA	3.60	3.45	3.79	3.65	3.59	3.45	3.70	3.60
CYS	△	△	△	△	△	△	△	△
VAL	0.47	0.45	0.48	0.46	0.46	0.43	0.45	0.42
MET	△	△	△	△	△	△	△	△
I-LEU	0.19	0.18	0.18	0.20	0.18	0.16	0.15	0.15

LEU	0.20	0.19	0.19	0.16	0.19	0.16	0.17	0.13
TYR	0.31	0.24	0.31	0.27	0.26	0.21	0.27	0.21
PHE	0.19	0.19	0.16	0.15	0.20	0.19	0.18	0.18
Total	15.99	12.83	15.34	12.72	15.75	12.03	15.08	12.13

△ : trace

Table 2. Free amino acid contents in gamma-irradiated polished rice during storage (mg %)

Dose	Control		500Krad		800Krad		1,000Krad	
Time of test / Amino acid	June	October	J	O	J	O	J	O
LYS	0.08	0.06	0.09	0.06	0.08	0.08	0.09	0.08
HIS	0.33	0.28	0.34	0.25	0.30	0.24	0.28	0.24
ARG	0.35	0.36	0.37	0.32	0.32	0.27	0.35	0.28
ASP	1.08	0.80	1.06	0.81	0.98	0.80	0.90	0.68
THR	0.25	0.21	0.23	0.22	0.25	0.20	0.28	0.24
SER	2.49	2.20	2.54	2.33	2.47	2.30	2.51	2.21
GLU	2.10	0.71	2.06	0.78	2.08	0.84	2.02	0.73
PRO	0.64	0.50	0.63	0.40	0.52	0.47	0.55	0.48
GLY	0.48	0.39	0.45	0.32	0.43	0.40	0.44	0.36
ALA	1.86	1.62	1.79	1.58	1.80	1.71	1.90	1.75
CYS	△	△	△	△	△	△	△	△
VAL	0.26	0.28	0.26	0.24	0.25	0.25	0.28	0.22
MET	△	△	△	△	△	△	△	△
I-LEU	0.12	0.09	0.13	0.08	0.09	0.09	0.12	0.08
LEU	0.13	0.12	0.14	0.14	0.11	0.10	0.13	0.10
TYR	0.15	0.14	0.15	0.12	0.13	0.12	0.15	0.11
PHE	0.10	0.12	0.12	0.10	0.12	0.13	0.11	0.13
Total	10.42	7.88	10.36	7.70	9.94	7.97	10.11	7.69

△ : trace

Although the irradiation doses to the sample rice were those of higher values for the disinfection ranging 500—1,000 Kard, there couldn't be found any critical distinction between the control and irradiated lots in terms of the contents of free amino acids. This trend was concordant with the report by Tajima et al[5]; when the above researchers determined the free amino acid contents, after 80 days of storage, in the sample rice of Koshihikari variety by the amino acid autoanalyzer (Hitachi, Japan, KAL-3AO), they found the same trends in the polished rice and brown one irradiated with 20 Krad and 40 Krad doses.

The contents of free amino acids in the brown rice were higher than those in the polished one and the parallel decreases of contents were shown in both samples in the lapse of storage duration. For both samples, the decreasing rate of the contents of glutamic acid was high irrespective of the irradiation dosage. Okasaki et al.[4] reported that the free amino acid contents in rice had the tendency of gradual decrease through the storage and it was more apparent in the brown rice than in the unhulled one. However, they reported, contrary to the author's experiment, that there was a small decrease of glutamic acid contents and a remarkable decrease of lysine, aspartic acid and serine on the other hand.

As a significant fact, the sum of alanine, serine and glutamic acid showed itself to be more than the half of the free amino acids content in rice, and Tamura et al.[4] had agreed with this. Lee et al.[7] analyzed the total amino acid composition in the Korean Paldal variety by the column chromatography and showed it as follows.

In the above results, the composition rate of glutamic acid is prominently high but alanine and serine take a less part in the composition. It is uncertain, however, by our present results alone that the contents of alanine and serine made a larger portion in the

The amino acid composition of Paldal rice (1961)[7]

Amino acid	ASP	THR	SER	GLU	PRO	GLY	ALA	CYS	VAL	MET
Grams of amino acid per 16.0 g of N	7.59	3.64	6.73	21.78	4.43	4.47	4.95	1.34	6.56	1.63

Amino acid	I-LEU	LEU	TYR	PHE	LYS	HIS	ARG	NH_3	Total
Grams of amino acid per 16.0 g of N	5.05	10.63	4.71	6.53	3.85	2.32	6.01	(1.91)	104.20

free amino acid contents of Paldal variety rice.

IV. Summary

The Korean rice of Paldal variety was milled, in March, 1969, into brown rice and 92% polished one and each 1.5kg sample was packed in the kraft paper bags. With Co-60 gamma-irradiation, the samples were treated in the various ranges of 500, 800 and 1,000 Krad, and then they were stored at the room temperature. The changes of the contents of free amino acids in the samples were determined by the amino acid autoanalyzer (Yanagimoto, Japan, LC-type). The results obtained in June and October of the year were as follows.

1) In the disinfecting irradiation of rice by the higher doses of 500, 800 and 1,000 Krad, there wasn't any particular distinction between the control lot and irradiated lot in respect to the free amino acid contents.

2) The contents of free amino acids in rice during storage had the decreasing tendencies, and especially prominent in case of glutamic acid.

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