Comparison of Amino Acid Composition among Various Surimis and Washed Meats

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Abstract : To clarify what is different in the gel forming ability among the fish raw materials or various grades of surimi, amino acid composition of surimis and washed meats were examined. The walleye pollack surimi (SS, SS; 3 years storage, and C grade), white croaker surimi, frozen-washed lizardfish meat and shortfin lizardfish meat were used as samples. The SS grade had more amount in valine, isoleucine and lysine than old SS. The C grade had very similar amino acid composition as old SS grade and washed lizardfish. The results indicated that the amino acid composition of surimis are different among the storage time, surimi grade and fish species. In addition, changes in amino acid composition of shortfin lizardfish during cold storage was also studied. The increase in glutamic acid amount was found in accompanying with the decrease in lysine amount.

Key words : amino acid composition, walleye pollack surimi, white croaker surimi, lizardfish

Introduction

It is well known that there is species difference in gel forming ability and the gel forming ability of walleye pollack surimi is varied with grade.[1)] However, it is still unknown what causes differences in the gel forming ability among fish raw materials or various grades of surimi. Freshness of fish is the important factor for high gel forming ability.[1)] Either a decline in freshness during ice storage or freeze denaturation decrease a gel forming ability, resulting in a poorer quality product.[1-2)]

It has been already reported that endogenous transglutaminase (TGase) in fish flesh forms ε-(γ-glutamyl) lysine crosslinks in fish proteins[3-4)] and participate in textural changes of fish sol during processing,[5-7)] especially in the low temperature setting (25°C).[8)] Therefore, the amount of glutamic acid and lysine in surimi and fish meat should be focused on. In addition, there are some reports about the increase in formaldehyde after death and during frozen storage of fish, especially in lizardfish, walleye pollack and cod.[9-11)] The formaldehyde decreases the solubility and extractability of myofibrillar protein and accelerates cross linking of myosin during freezing and frozen storage. Formaldehyde reacts amino acids with side chain groups, histidine, tryptophane and arginine.[12)] These result in eventual detrimental changes in texture and functional properties.[10-11)]

To study what is different among the fish raw materials or various grades of surimis, the amino acid composition of various kinds and grades of surimi were investigated. In addition, to clarify how the amino acid composition in fish meat changes after death, shortfin lizardfish (Tokage-eso), which has very weak gel forming ability, was used as a model in this experiment.

Materials and Methods

Materials The meat samples used for analysis of amino acids composition were walleye pollack (*Theragra chalcogramma*) surimi SS grade (SS (a)), SS grade (3 years storage; SS(b)), C grade, white croaker (*Argyrosomus argentatus*) surimi, frozen washed lizardfish (*Saulida undosquamis*) meat and raw shortfin lizardfish (*Saulida elongata*).

Meat Washing Surimi were homogenized at 10,000 rpm for 1 min with 10 volumes of water for SS (b), 0.033 M $CaCl_2$ (I = 0.1) for SS (a), C grade and lizard fish and 0.3% NaCl for white croaker surimi to remove cryoprotectants in surimis and sarcoplasmic protein in raw meat. The homogenate was centrifuged at 3,000xg for 10 min and the precipitate was collected. The homogenization and centrifugation were repeated two more times.

Storage of Shortfin Lizardfish After shortfin lizardfish was filleted, the samples were put in the plastic bags and kept in the refrigerator (5°C). The amino acid analysis was performed at 0, 4, 8 and 14 days of the storage. White dorsal muscle was separated from the fillets and minced. The minced meat was homogenized with 10 volumes of deionized water at 10,000 rpm for 1 min and centrifuged at 5,000 rpm for 10 min. The washing process was repeated 3 times and the precipitate was collected. The hydrolysis and amino acid analysis were performed as the same method as mention above.

Amino Acid Analysis The precipitate 0.08 g were hydrolyzed at 110°C for 24h in 6 N HCl. The amino acid analysis was performed with a Hitachi Amino Acid Analyzer model L-8500A using lithium buffer system. The amino acid composition was calculated as 1000 residues in total content.

Results and Discussion

1. Amino acid composition of surimi and lizardfish

Amino acid composition of surimis and lizardfish were shown in Table 1.

1.1 Effect of storage time and surimi grade Even the same fish species as walleye pollack surimi, the amino acid compositions are different between storage time as well as surimi grade. The SS grade (SS (a)) showed more amount of valine, isoleucine and lysine than the old SS grade (SS (b)). However, SS grade appeared lower amount of serine than the old grade. The C grade is very similar composition of amino acid as old SS grade.

1.2 Effect of fish species Walleye pollack, white croaker and lizardfish are well known in high gel forming ability and mainly used for surimi and surimi-based products in Japan. The SS (a) grade and white croaker showed higher amount in valine, isoleucine and lysine than lizardfish. However, shortfin lizardfish had the highest amount in lysine and histidine. The SS and lizardfish had higher amount in serine and glutamic acid than white croaker and shortfin lizard fish. However, white croaker noted the highest amount in glycine.

These results showed that the amino acid compositions of surimi are different among the fish species.

Table 1. Amino acid composition of surimis and lizardfishes

Amino acids	White Croaker Surimi	SS (a) Surimi	SS (b) Surimi	C Grade Surimi	Lizardfish	Shortfin Lizardfish
Aspartic acid	104.5	105.5	107.2	107.1	107.1	105.4
Threonine	50.9	50.8	51.6	51.6	51.6	52.4
Serine	53.1	57.2	59.6	59.5	59.6	54.1
Glutamic acid	161.1	164.0	165.5	165.5	165.5	159.6
Glycine	69.9	63.6	65.3	65.3	65.3	66.1
Alanine	86.2	85.1	84.9	84.8	84.8	85.0
Valine	55.0	55.4	51.6	51.9	51.7	54.7
Cystine	4.0	3.5	4.8	4.5	4.6	1.8
Methionine	32.6	31.3	29.5	29.3	29.4	29.6
Isoleucine	46.1	46.6	42.0	42.1	42.0	45.6
Leucine	84.2	85.5	85.5	85.4	85.4	84.4
Tyrosine	29.0	29.7	30.0	30.0	30.0	29.4
Phenylalanine	30.6	28.3	29.5	29.6	29.5	31.0
Lysine	91.5	93.1	88.4	88.5	88.5	96.0
Histidine	14.7	16.0	16.0	16.0	16.0	18.2
Arginine	50.5	51.1	50.6	50.6	50.6	50.2
Hydroxyproline	0.0	0.0	2.5	2.5	2.5	0.0
Proline	36.5	33.8	35.8	35.8	35.8	36.8
Total	1000.0	1000.0	1000.0	999.9	999.9	1000.0

2. Changes in amino acid composition of shortfin lizardfish during cold storage

Changes in amino acid composition of shortfin lizardfish during cold storage for 2 weeks were shown in Table 2.

It was interesting that glutamic acid amount increased continuously accompanying with the gradual decrease in lysine amount (Fig. 1). Threonine increased after 8 days of the storage in contrast with the decrease in methionine. Valine changed in the similar manner that is decrease in the initial days and gradually increase after 4 days of the storage (Table 2).

Table 2. Changes in amino acid composition of shortfin lizardfish during cold storage

Amino acids	0 Day	4 Days	8 Days	14 Days
Aspartic acid	105.4	105.6	106.1	105.9
Threonine	52.4	52.3	52.3	55.0
Serine	54.1	54.6	54.6	54.0
Glutamic acid	159.6	162.7	164.0	166.0
Glycine	66.1	66.5	65.0	66.4
Alanine	85.0	84.7	84.5	85.3
Valine	54.7	52.8	53.0	54.8
Cystine	1.8	1.3	1.5	2.0
Methionine	29.6	29.5	29.9	23.1
Isoleucine	45.6	44.6	45.0	46.5
Leucine	84.4	84.7	86.1	85.1
Tyrosine	29.4	29.1	29.8	28.2
Phenylalanine	31.0	30.5	30.9	29.9
Lysine	96.0	95.4	92.3	92.3
Histidine	18.2	17.6	17.4	17.7
Arginine	50.2	50.5	50.2	51.0
Hydroxyproline	0.0	0.7	0.3	0.3
Proline	36.8	37.2	36.9	36.3
Total	1000.0	1000.1	1000.0	999.8

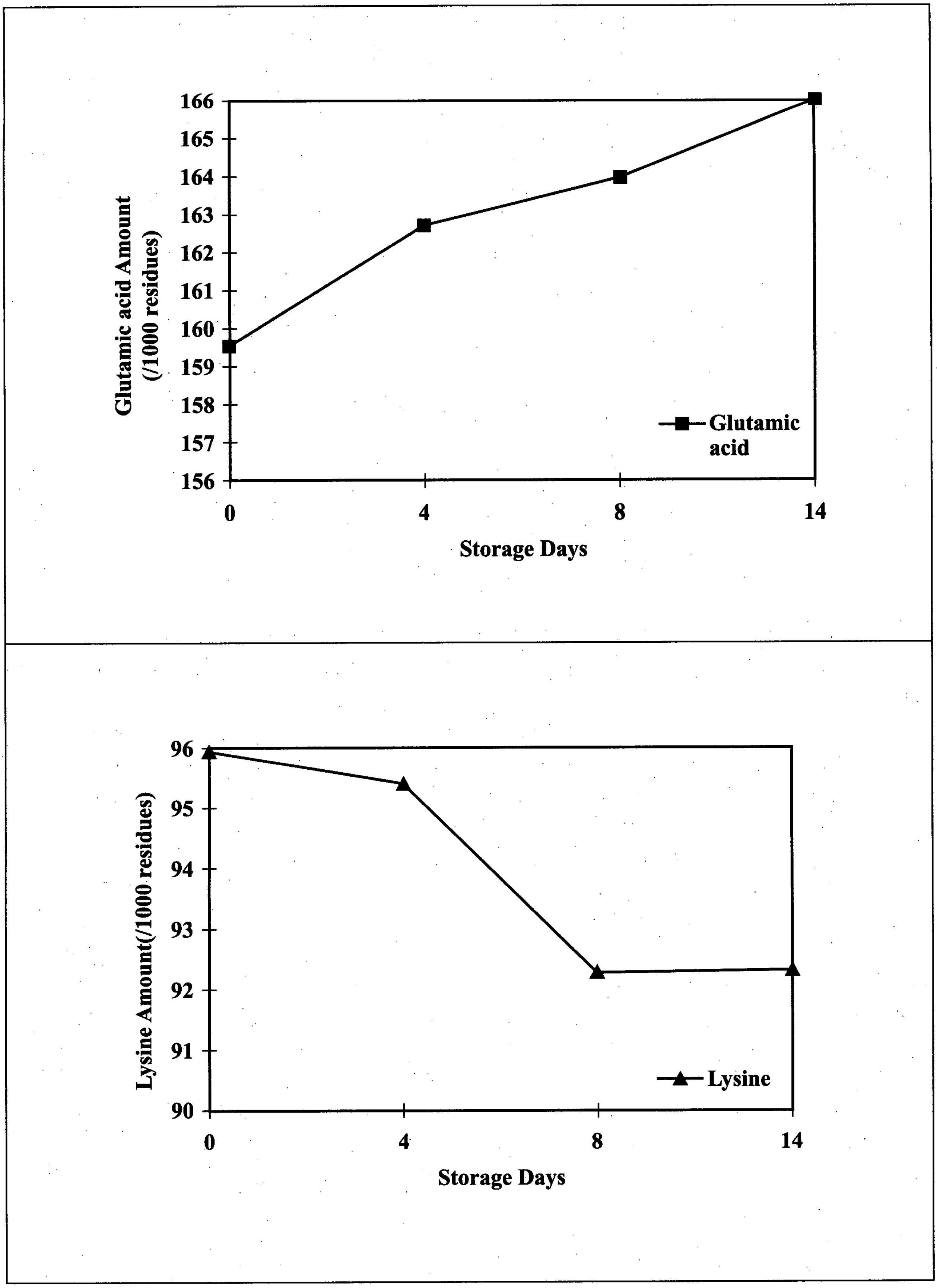

Fig. 1. Changes in glutamic acid and lysine amount of shortfin lizardfish during cold storage.

It was found that the increase in glutamic acid is accompanying with the decrease in lysine during cold storage of shortfin lizardfish. The decrease in lysine might be involved with the decrease in the TGase activity and resulted in low gel forming ability after loss of fish freshness. During ice storage of lizardfish as well as walleye pollack formaldehyde is produced, resulting in the lowering in gel forming ability due to the modification of protein by formaldehyde.[9]

Conclusion

The amino acid compositions of surimi are different among the storage time, surimi grade and fish species. In addition, the C grade has very similar composition of amino acid as old SS grade.

During the cold storage of shortfin lizardfish, the increase in glutamic acid amount was found to be accompanying with the decrease in lysine amount.

It was supposed that the gel forming ability might be concerned with amino acid composition of washed meat.

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