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Study on the thawing method for frozen spotted mackerel with high freshness

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Introduction

Recently, studies have investigated the production of frozen fish with high freshness for sashimi production in Japan [1]. Although the quality of mackerel meat with high freshness can be maintained after freezing, pH of mackerel meat with high freshness tends to decline markedly after thawing due to the progression of glycolysis [2]. As it is assumed that pH is correlated with the quality deterioration such as generation of drip loss of thawed meat, the development of a suitable thawing method for frozen mackerel without pH lowering is required to improve the quality of thawed meat.

Temperature control before thawing (TCBT), which is the method of storage at -20 to -2°C for several days before thawing, has been proposed as one of the effective methods to prevent a lowering in the pH of frozen fish meat [3-8]. By using TCBT, it is suggested that NAD, one of the coenzyme in glycolysis is reduced [5]. Therefore, it is presumed that the progression of glycolysis is suppressed by TCBT. However, the detailed mechanisms of TCBT have yet to be clarified. The objective of this study was accordingly to elucidate the biochemical changes related to glycolysis in frozen spotted mackerel meat with high freshness during TCBT.

Materials and methods

Sample preparation
Frozen spotted mackerel caught in Kamaishi Bay, Iwate Prefecture on October 2015 and cultivated in a fish tank were used as samples. They were sacrificed instantly and blood was removed using the "Kubiore" procedure. The mackerels were subsequently frozen and maintained at -60°C until use (Fig. 1). We used frozen spotted mackerels whose initial pH of frozen meat was approximately 6.7.

Fig. 1. Frozen spotted mackerel.

Temperature control before thawing (TCBT)
The frozen samples were cut into 2 cm thickness and put into some freezers at -20 to -2°C for several days (TCBT). After TCBT, the samples were maintained at -60°C until use. The method of experimental treatments is shown in Fig. 2.

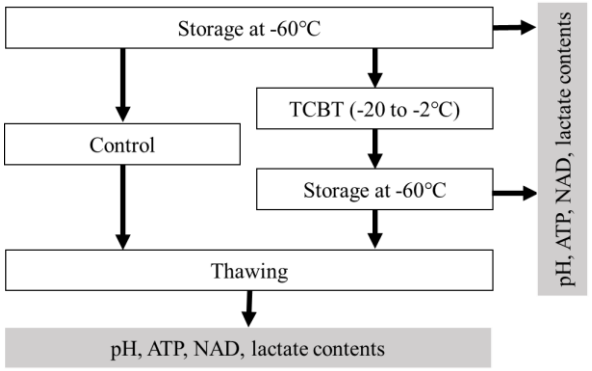

Fig. 2. Schematic of experimental treatments for measurement.

Thawing method
After storage, the frozen samples were thawed at 5°C for 18 h.

pH measurement
One gram of frozen mackerel meat was homogenized in 5 ml of 20 mM sodium iodoacetate solution, and then

pH was measured with a pH meter [6].

Adenosine triphosphate (ATP), nicotinamide adenine dinucleotide (NAD) and lactate contents

One gram of frozen mackerel meat was homogenized in 3 ml of 10% perchloric acid, and then centrifuged at 3,000 rpm for 3 min. The pH of supernatant was adjusted to pH 6.4 to pH 6.5. ATP, NAD and lactate contents in both frozen and thawed dorsal muscle extraction were measured [9-12].

Statistical analysis

Statistical analysis of the data was carried out using Tukey's test.

Results and discussion

In frozen meat without TCBT (control), pH value was less than 6.0 after thawing. In contrast, in frozen meat subjected to TCBT at -10°C for 5 days, the pH was maintained at approximately 6.4 after thawing. Therefore, it was suggested that pH was maintained by using TCBT at -10°C for 5 days (Fig. 3).

ATP contents in frozen meat were stable over 80%. After thawing it, ATP was almost disappeared.

The amount of lactate production during in thawing process was about 50 μmol/g in control, but little lactic acid was produced in the meat with TCBT during thawing process.

NAD in frozen meat was decreased during TCBT. The results obtained in this study of spotted mackerel were as following, in case of samples (TCBT at -10°C for 0 days), the activation of glycolysis was induced by thawing procedure. On the other hands, in case of samples (TCBT at -10°C for 5 days), TCBT suppressed glycolysis during thawing procedure. It thus appears that glycolysis in the meat is suppressed during thawing process as a consequence of TCBT.

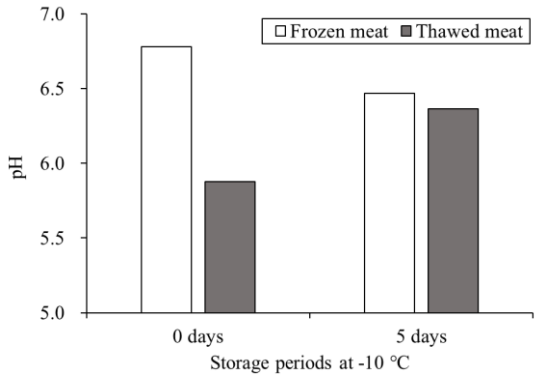

Fig. 3. Changes in pH of frozen spotted mackerel meat by using TCBT at -10°C for 0 and 5 days before and after thawing.

Conclusions

Little lactate content in the meat was produced during thawing process and NAD in frozen meat was decreased during TCBT. Therefore, it was indicated that TCBT was an effective method to prevent a lowering in the pH of frozen spotted mackerel meat.

Acknowledgements

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