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Effect of Superchilled Storage on Freshness of Mackerel Muscle

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Abstract

The effect of superchilled storage (at about −3℃) on freshness of mackerel muscle was investigated using the K-value and VBN determination. K-value reached 20% after 12 days during storage at −3℃ whereas, this value was exceeded after 3 days stored at 0℃ and after 52 days stored at −10℃. Rate of increase in K-values stored at −3℃ was around 3.48 times lower than that stored at 0℃ and 4.76 times faster than that stored at −10℃. VBN values during superchilled storage were found lower than that during frozen storage at −10℃ up to day 40.

From these results, it might be possibe that the superchilled storage is adopted in place of storage at 0℃ or at frozen storage (−10℃), as a keeping freshness of fish for about two weeks.

Superchilling involves lowering of body temperature to point at which crystallization of water commences thereby minimizing the rupture of muscle cells and keeping the integrity of most cells. By superchilled storage bound water may not be taken out from the organic compound in fish muscle. Superchilled temperatures naturally fall a few degrees below 0℃. In many places of fisheries, storage at 0℃ or icing and frozen storage have generally been used for keeping freshness of fish in fishing vessels after catch, in fish market or in fish processing as a raw material of fish products.

Many researchers have pointed out that it is difficult to prolong the storage life of iced fish from the viewpoint of changes in the post-mortem autodegradation of nucleotides and also bacterial decomposition[1,2]. Freezing in particularly has extensively been used in pelagic fishery such as tuna lining and skipjack purse seining, but it seems that freezing is not necessarily useful to fish cought by trawlers[3].

Experiments were done to establish a new practical method which is used for preserving freshness of fish for 2−3 weeks, in place of iced and frozen storage, since this period seems to be long enough to keep freshness of fish in fishing vessel. This method was partially frozen storage[3,4]. Partially frozen storge has been reported to be useful in terms of K-value, thiobarbituric acid (TBA) value, denaturation of myofibrillar protein and organoleptic evaluation[5,6]. But, the assessment on the freshness of mackerel muscle has not been evaluated.

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The present investigation was undertaken to assess the effect of superchilled storage method at−3℃, compared with the storage at 0℃ and frozen storage at −10℃ on the freshness of mackerel.

Materials and Methods

Mackerel, *Scomber japonicus*, was obtained in fresh condition from local fish market. Fillets were sampled on the ordinary muscle of the anterior dorsal region, and wrapped individually with polyethylene films, and then stored at temperatures of 0, −3 and −10℃, controlled using the electric thermo sensor. After samples were in constant storage temperature, a certain weight of muscle in duplicate were withdrawn at intervals time of storage for chemical analysis. In each sample, two determinations were made.

The K-value was measured by column chromatography[7]. The ionexchanger used was Dowex 1×4, Cl^- type with a mesh of 100 to 200 . The volatile base nitrogen (VBN) value was measured by trichloroacetic acid (TCA) extract, micro diffusion (CONWAY'S method)[7].

Results and Discussion

Fig. 1 . shows the rate of increases in K-value. Samples stored at −3℃ gave the rate of increase in K-value, as shown by the slope of linear regression (b)=1.228, whereas the sample stored at 0℃ gave b=4.040, and at −10℃ gave b=0.258. This rate of increased in K-value stored at −3℃ was around 3.48 times lower than that stored at 0℃, and was around 4.76 times faster than that stored at −10℃.

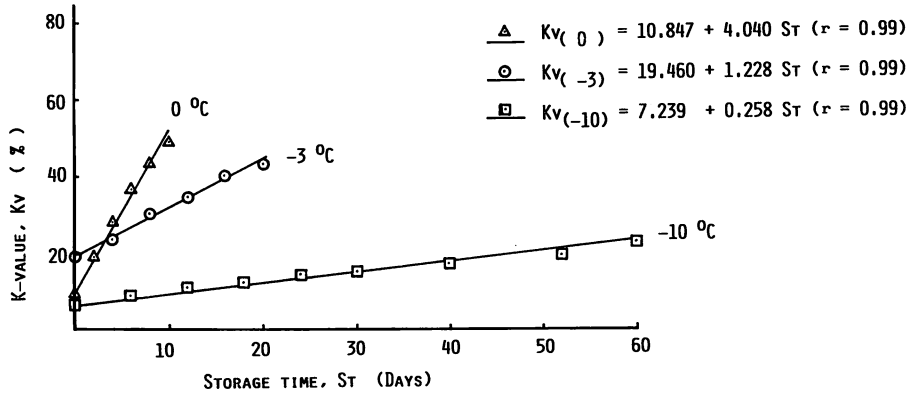

Fig. 1 . Changes in K-value of mackerel muscle during storage at various temperatures.

According to EHIRA[8], instantly killed of pacific mackerel has initial K-value of around 5%. Using this initial value, Fig. 1 . could be interpolated into Fig. 2 .. K-value of 20%

was proposed as a criterion for freshness limit of fresh fish[7,8]. This value was exceeded in 2 days of storage in ice of mackerel muscle[8], and in 2 weeks of storage at −3℃ as a partial freezing[3].

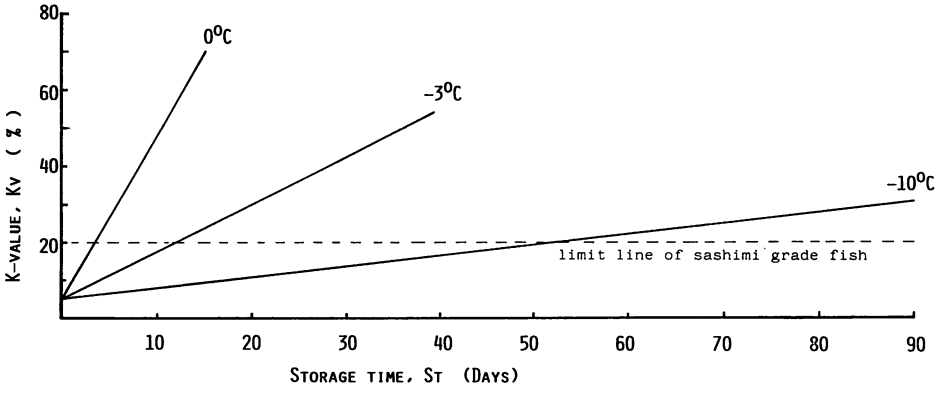

Fig. 2. Changes in K-value of mackerel muscle during storage at various temperatures, with initial K-value of 5%.

As shown in Fig. 2., the 20% level of K-value in mackerel muscle stored at 0, −3 and −10℃ was exceeded in about 3, 12 and 52 days, respectively.

A level of 30 mg VBN/(100 g muscle) has been found to be an useful indicator of fish and shrimp acceptability[9,10].

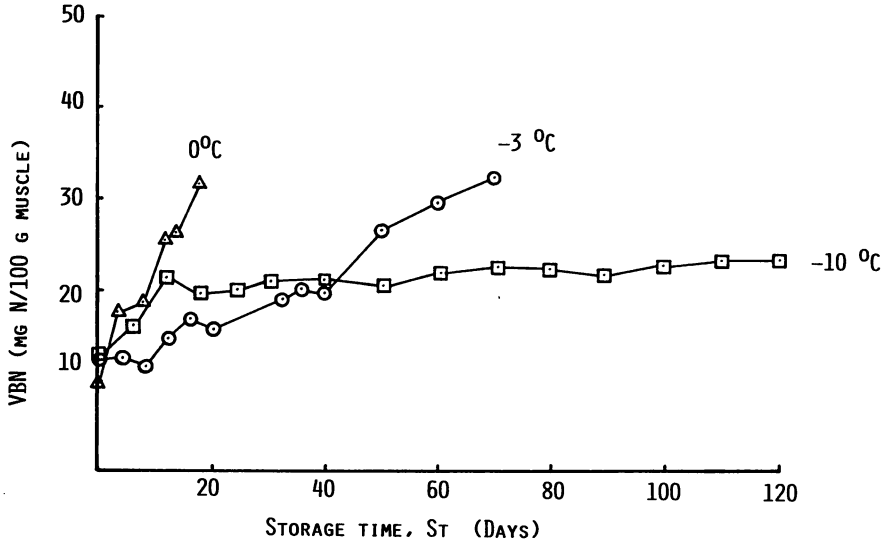

Fig. 3. Changes in VBN of mackerel muscle during storage at various temperatures.

As illustrated in Fig. 3., VBN of mackerel muscle 30 mg N/(100 g muscle) was exceeded in about 62 days at −3℃, in about 17 days at 0℃ and this value was not exceeded during storage at −10℃ up to day 120.

EHIRA and FUJII[4] reported that changes in viable bacterial count of sardine during partially frozen storage at −3℃ were coincided with the changes in trimethylamine of the homogenates. During partially frozen storage, bacterial count gradually decreased to about 1% of the initial level after 1 month, whereas the sample stored at −30℃, it decreased to about 50% of the initial level after 30−50 days.

In the present report as shown in Fig. 3., the VBN value during superchilled storage was found lower than that during frozen storage at −10℃ up to day 40. This fact supports that bacterial activation in samples stored at −3℃ was lower than that stored at −10℃ after some days of storage. The cause of this result may due to the effect of freeze-concentration of muscle fluid, and the lowering of water activity[11].

From the result of K-value determination, it might be possible that the sample stored at −3℃ is adopted in place of storage at 0℃ or at −10℃ as a keeping freshness of fish for about 12 days, and from the result of VBN determination, samples stored at −3℃ being one of the merit of storing methods after about 40 days of storage.

As a conclusion, it might be possible that the superchilled storage is adopted in place of storage at 0℃ or at frozen storage (−10℃) as a keeping freshness of fish for about two weeks, especially in developing fisheries countries.

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