Freezing Effects Of Raw Materials On Threadfin Bream Surimi Gel Quality

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Abstract

Threadfin bream (*Nemipterus* spp.) were bought from the landing pier and used as raw materials for frozen surimi production. The fishes were frozen at -36°C until the center of the fish was cooled to -18°C. The frozen fish were kept at -18±1°C for 0,20,40 days, then the fish were taken and processed to surimi. The frozen surimi were kept at -18±1°C for 0,1$\frac{1}{2}$ and 3 months. The results showed that surimi made from 40 days cold-stored fish have more yellowness in colour than the zero- day fish. Gel forming ability of surimi was affected by the storage time of both frozen fish and frozen surimi. Gel strength of *kamaboko* made from prolonged-storage surimi was lower than zero-month-stored surimi. However, the folding test still registered AA after prolonged storage of surimi made from frozen fish of 21 days to 3 months. It is recommended that frozen threadfin bream can be used for surimi processing; this surimi should be directly processed to fish jelly products as soon as possible in order to obtain good gel-forming ability.

To improve the gel-forming ability of minced fish, ascorbic acid was added at 0.1 and 0.2% by weight during the mixing process. After production, surimi were kept frozen for 1$\frac{1}{2}$ months. It was found that 0.1% by weight of ascorbic acid improved the gel quality of frozen stored surimi. Increasing the amount of ascorbic acid to 0.2% resulted in lowering the pH of surimi. It also lowered the gel strength of prepared *kamaboko*.

Introduction

Threadfin bream (*Nemipterus* spp.) are widely used for surimi production in Thailand. Surimi processors believe that frozen fish cannot be used as raw material for surimi processing. However, in Singapore some processors use frozen blocks of threadfin bream to make mince meat, from which they then produce fish jelly products. Reports from many groups of scientists indicated that iced fish or frozen fish that had undergone prolonged storage showed a decline in *kamaboko*-forming ability. Such experiments were conducted on different species as follows : lizard fish (Yasui *et al*, 1987), sardine (Ichikawa *et al*, 1977, 1978, cited from Harrd and Warren, 1985) Alaska pollock (Scott *et al*, 1988), Atlantic cod (Harrd and Warren, 1985) and *Tilapia* (Somboonyarithi, 1987). The rate at which loss of gel strength occured appears to vary between and within fish species. Recently, there have been reports on the use of reductants ie cysteine, sodium metabisulfite mercaptoethanol and ascorbic acid, to improve gel forming ability of freeze-thawed protein (Jiang *et al*, 1986, Somboonyarithi, 1987). Therefore, it was the purpose of this study to investigate the effect of freezing of threadfin bream on the sub-

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Note: This paper was presented at the Seminar by Dr Wunwiboon.

sequent quality of surimi. The effects of ascorbic acid on the quality of frozen surimi made from 40 days frozen fish were also investigated.

Methods

Threadfin bream were bought from the landing pier in Samutprakarn province. Fish were deheaded, gutted and then block frozen at -36°C by contact plate freezer. The freezing time was 2 hours where the temperature at the center of the fish was lowered to -18°C. The frozen blocks were kept frozen at -18±1°C for 40 days.

Determination Of The Effect Of Freezing Of Threadfin Bream On Surimi Quality

Frozen blocks of threadfin bream were sampled at 0, 20, 40 days of storage and processed to surimi using the process shown in Fig. 1. Surimi were block frozen and kept at -18±1°C for 3 months.

Frozen blocks of surimi were sampled at 0, $1\frac{1}{2}$, 3 months of storage time, and used for surimi quality determination where pH, color, gel strength and folding test were determined. For pH, 1:1 ratio of surimi to distilled water was blended and pH measurement was obtained by Corning pH Meter 120. *Kamaboko* was prepared according to the method of MFRD (1988). The color of *kamaboko* was determined by Macbeth Munsell Disk Colorimeter. An Instron 1000, equipped with a spherical plunger of 10 mm diameter, running at crosshead speed of 50 mm/min, was used to determine *kamaboko* gel strength. Four test pieces were measured. The mean value of work (gm-cm) required to break the test piece was determined. Folding test were conducted according to the method of MFRD (1988) by using 10 test pieces.

Determination Of The Effect Of Ascorbic Acid On The Quality Of Frozen Surimi

Surimi were prepared from 40-day-frozen-stored fish according to the method shown in Fig. 1. Ascorbic acid was added at 3 different levels, 0, 0.1, 0.2% by weight during mixing process. Frozen surimi were stored at -18±1°C for 1 month. Surimi were subjected to quality assay (pH, color, gel strength and folding test) as described previously.

Statistical Analysis

Completely randomized design (CRD) was employed in the gel strength experiment. Analysis of variance (ANOVA) was used to test for significant differences. Then the differences among mean values were indicated by Duncan's multiple range test (DMRT).

Results And Discussion

Effect Of Freezing Of Threadfin Bream On The Quality Of Surimi

As indicated in Tables 1 and 2, pH of surimi varied from 6.57 to 7.04 but showed no tendency to increase or decrease with storage time. This was true of both frozen fish and frozen surimi.

Munsell color system was used to indicate *kamaboko* colour. In the case of surimi prepared from unstored threadfin bream when making *kamaboko*, the colour hue is green-yellow, with lightness closest to white (10=white). After three months of storage the colour hue of surimi changes to yellow with a little decrease in lightness (from 8.9 to 8.06), and no trend of change for chroma. Freezing of threadfin bream caused very little change in *kamaboko* colour for 20-day stored fish, but the colour of *kamaboko* from 40-day stored fish tends to be more yellow with lightness around 8. These changes in degree of yellowness and lightness are believed to be due to a browning reaction in the surimi during frozen storage. This browning effect was also reported by Harrd and Warren (1985).

Grade of folding test remained AA throughout, except for samples made from 40-day stored fish whose surimi were in cold storage for $1\frac{1}{2}$ and 3 months. The gel strength of samples showed a decrease in value with prolonged storage

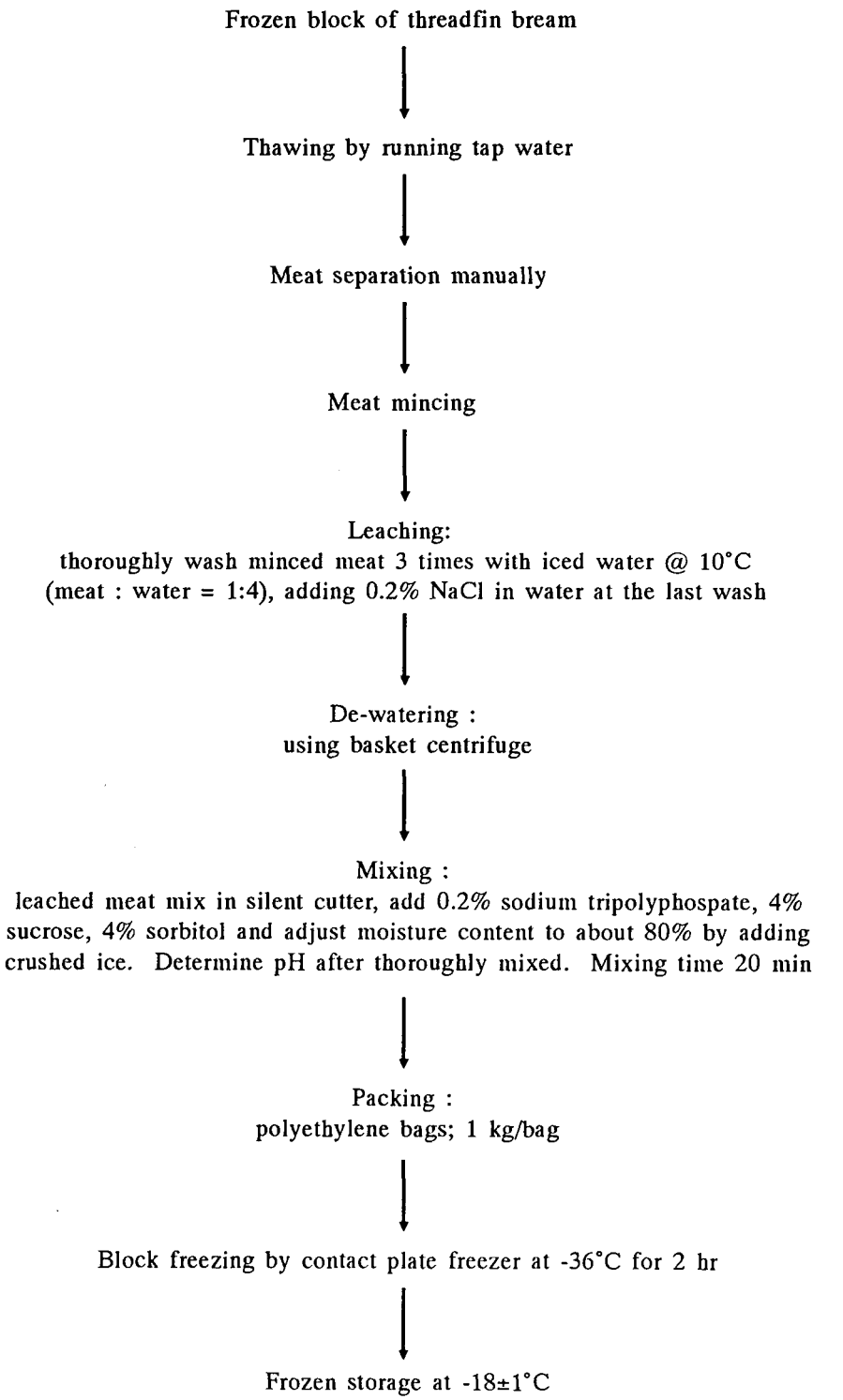

Fig. 1. Diagram showing surimi processing steps used.

Table 1. Effect of freezing of threadfin bream on the quality of frozen surimi.

Storage Time of Surimi (month)	pH of Surimi			Colour of *Kamaboko*[1]			Folding Test[2]		
	Storage Time of Fish (day)			Storage Time of Fish (day)			Storage Time of Fish (day)		
	0	20	40	0	20	40	0	20	40
0	6.57	6.91	6.87	7.25GY 8.90/0.22	7.50GY 8.75/1.23	10.00Y 8.76/1.52	AA	AA	AA
1.5	6.64	6.98	6.84	-	5.00GY 8.82/0.55	10.00Y 8.05/3.43	AA	AA	A
3.0	6.60	7.04	6.93	5.15Y 8.06/2.86	0.40Y 8.28/1.69	-	AA	AA	B

[1] colour value of *kamaboko* reported as hue value and chroma in Munsell Color System.
"-" means missing data.
[2] grade of folding test.
AA = no breakage in any of five samples when folded in quarter.
A = slight tear in anyone of five samples when folded in quarter.
B = slight tear in any of five samples when folded in half.

Table 2. Effect of freezing of threadfin bream on the gel strength of frozen surimi.

Storage Time of Surimi (month)	Gel Strength (gm-cm)		
	Storage Time of Fish (day)		
	0	20	40
0	3398.2 a[1]A[2]	2942.8 bA	1739.7 cA
1.5	2928.0 aB	2392.8 aB	1284.0 bB
3.0	2202.1 aC	2255.2 aB	773.4 bC

[1]values bearing unlike lowercase letters in the same row differ significantly P≤0.05.
[2]values bearing unlike uppercase letters in the same column differ significantly P≤0.05.

of fish and surimi. It has been shown that some fish, once frozen, can never be used for high-quality surimi products due to the denaturation of muscle proteins during freezing and frozen storage (Jiang *et al*, 1986).

On the basis of data obtained in Tables 1 and 2, it is concluded that threadfin bream for surimi processing can be kept frozen at -18±1°C for up to 30 days. When such fish are made into surimi, the produced surimi should be directly processed to fish jelly products as soon as possible in order to get good quality products.

Effect Of Ascorbic Acid On The Quality Of Frozen Surimi Made From 40 Days Stored Fish

According to Tables 3 and 4, the addition of ascorbic acid in surimi caused a small drop of pH of surimi. When 0.2% level was added, the surimi

Table 3. Effect of ascorbic acid on the quality of frozen surimi made from 40 days frozen stored fish.

% Ascorbic acid	pH		Colour of *Kamaboko*[2]		Folding Test[1]	
	Storage Time of Surimi (months)		Storage Time of Surimi (months)		Storage Time of Surimi (months)	
	0	1.5	0	1.5	0	1.5
0	6.53	6.59	8.45Y8.38/1.60	3.43Y8.74/1.65	AA	AA-A
0.1	6.51	6.40	8.33Y8.34/1.43	6.44Y8.29/2.03	AA	AA
0.2	6.47	6.13	7.50Y8.36/1.47	7.50Y8.44/1.44	AA-A	A

[1] folding test of 10 test pieces showed 3 test pieces as A grade and 7 test piece as AA grade.
[2] colour value of *kamaboko* reported as hue value and chroma in Munsell Colour System

Table 4. Effect of ascorbic acid on the gel strength of *kamaboko* prepared from frozen surimi. Surimi were made from 40 days stored fish[1].

% Ascorbic acid	Gel Strength (gm-cm)	
	Storage time of surimi (months)	
	0	1.5
0	2796.4 a[2] AB[3]	1337.6 b A
0.1	3228.6 a A	1799.4 b B
0.2	2433.6 a B	1166.0 b A

[1] Fish used for these data were obtained from frozen fish industry.
[2] Values bearing unlike lowercase letters in the same row differ significantly $P<0.05$.
[3] Values bearing unlike uppercase letters in the same column differ significantly $P<0.05$.

pH dropped more than 0.1% level (Table 3). The colour hue of *kamaboko* tended to increase in redness after $1\frac{1}{2}$ months storage of surimi, with addition of ascorbic acid 0.1%, compared with freshly made surimi with no addition of ascorbic acid. However, addition of 0.1% ascorbic acid improved the colour hue of *kamaboko* made from prolonged-stored surimi. The folding test grades of *kamaboko* samples were maintained at AA at $1\frac{1}{2}$ months in storage when adding 0.1% ascorbic acid. Addition of 0.2% ascorbic acid in surimi did not improve grade or gel strength. It is speculated that the higher acid content may cause some denaturation of fish protein. The gel-strength of samples treated with 0.1% ascorbic acid differed significantly from that of no-ascorbic-acid samples

($P \leq 0.05$) after $1\frac{1}{2}$ months in frozen storage. The increasing gel-strength of samples with 0.1% ascorbic acid suggested that ascorbic acid at 0.1% level can improve gel-forming ability of fish protein when subjected to freezing and frozen storage. As stated by Jiang (1986) the addition of reducing agents during surimi processing recovered the reactive SH- group and subsequently increased the gelation of freeze-thawed fish meat.

Conclusion

Threadfin bream can be stored in the frozen state (-18±1°C) for approximately 30 days before being processed to surimi. High quality *kamaboko* can be prepared from freeze-thawed threadfin bream by adding 0.1% ascorbic acid during the early stage of mixing. Surimi thus processed can be kept frozen for about one month; however the gel strength of *kamaboko* decreases gradually with storage time.

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Discussion

In response to a comment that gel strength is correlated to fish freshness and asked whether fish freshness was considered in the study, Dr Garnjanagoonchorn said that the freshness of the raw material was assessed organoleptically.

A participant wanted to know what sampling procedure for gel strength was used in the study. Dr Garnjanagoonchorn replied that one gel strength reading was obtained from each sausage and that four sausages were prepared for each treatment.

Asked why the effect on the gel strength of 0.1% ascorbic acid was better than that produced by 0.2% ascorbic acid, she said that perhaps high acidity affected the protein property of the fish meat.

Regarding the basis for selecting ascorbic acid as an additive in the study, the author informed that recent scientific papers had reported that adding reductants caused an increase in the gel strength of frozen storage surimi. For this reason, ascorbic acid, as a common food processing reductant, was selected.

In this study, the pH values of the three treatments were different. It was recommended that in future studies the final pH of the surimi from the different treatments be made equal to reduce the influence of pH on the gel-forming ability of surimi.

It was also recommended that a survey of the stability of gel-forming ability be made in both iced storage and frozen surimi on a large number of species of fish.