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Effects of Bleeding and Storage Time on Gel Forming Ability of Carp (*Cyprinus carpio*)

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ABSTRACT

The gel forming ability of bled and non bled carp meat which stored in iced for 0, 19, 40 hours was evaluated by gel strength and SDS-PAGE patterns. Carp meat gels were prepared at various heating temperatures of 20°, 30°, 40°, 50°, 60°, 70° and 80°C for 2 hours then further heated at 80°C for 20 minutes. It was found that both bled and non bled carp meat showed the suwari gel (gel setting) at 50°C through the iced storage period. The modori (gel disintegration) was observed from gel heated at 60° and 70°C in both carp meat. The extent of modori increased as ice storage period increase. Probably due to proteinase in blood, the intense degradation of myosin heavy chain was found in non bled carp meat gel.

Key words : gel forming ability, storage time, bleeding, carp meat, degradation of myosin, SDS-PAGE

INTRODUCTION

Gel forming ability is an important property of fish jelly products. The gel-forming process is occured after adding 2-3 % salt and grinding with fish meat. The ground meat will turn into a viscous paste or fish sol and become harder or stronger gel after heating.

The modori-phenomenon (gel disintegration) of fish meat gel occurs around 60°C. The endogenous serine proteinase is a group of strong degrading enzyme which acted on myosin heavy chain (MHC). In addition, biological factors of fish including species, death condition, freshness, size, age, season and nutritional condition were also affected the modori-phenomenon.

Toyohara *et al.* (1990 a, b) reported that bleeding of fish might promote the modori-phenomenon irrespective of the death condition in rainbow trout, tilapia and crucian carp. They also concluded that blood contained some inhibitors for this phenomena.

In case of the fish immediately killed, bled and stored for such period, these effects on gel preparation have not yet been observed. Therefore, the objective of this experiment is to study the effect of bleeding in association with freshness on gel forming ability of carp

MATERIALS AND METHODS

Live carp (*Cyprinus carpio*) of 250 g in average body weight and 18 cm in average body length were used as raw material. The fish were divided into two lots and killed immediately with bleeding and non bleeding. These fish were kept in ice and taken for gel forming determination at selected time intervals of 0, 19 and 40 hours.

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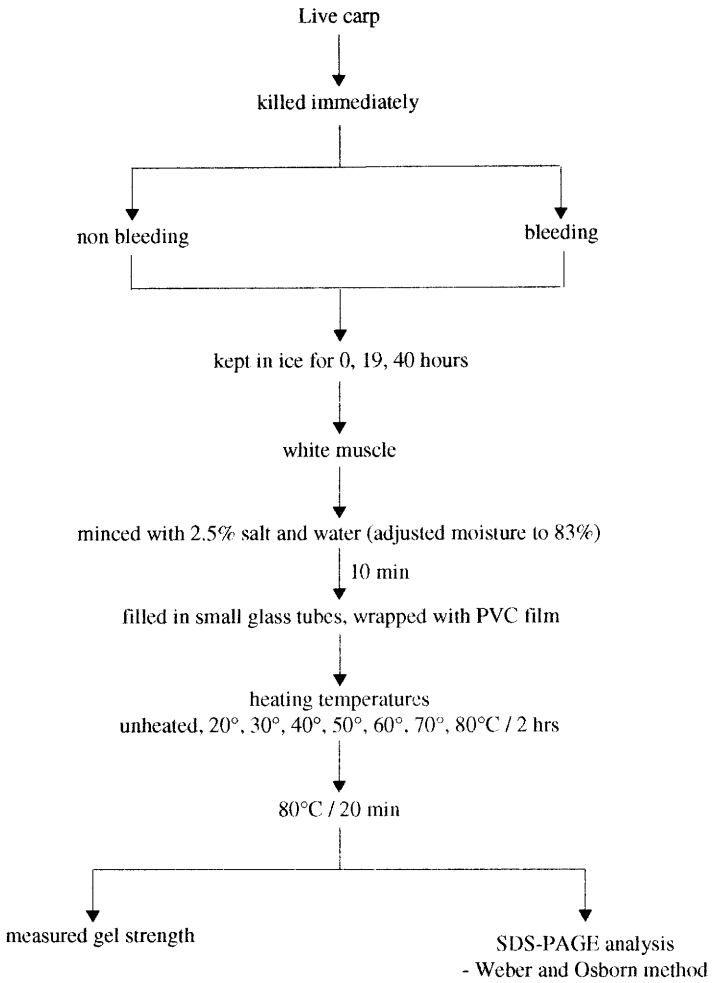

Figure 1 Gel preparation of carp meat.

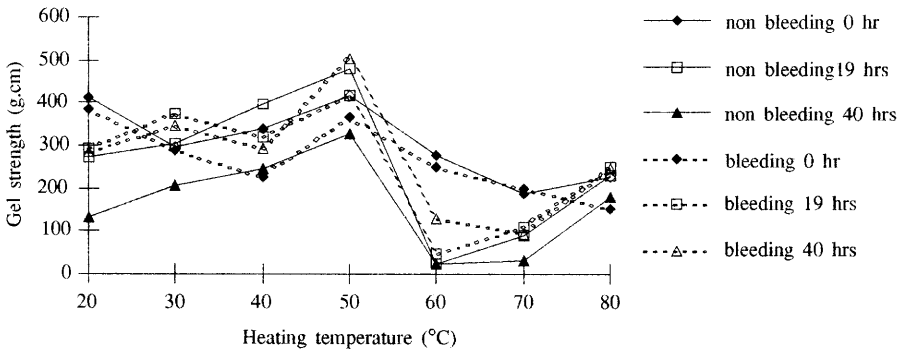

Figure 2 Gel strength (g.cm) of carp meat gels at various heating temperatures.

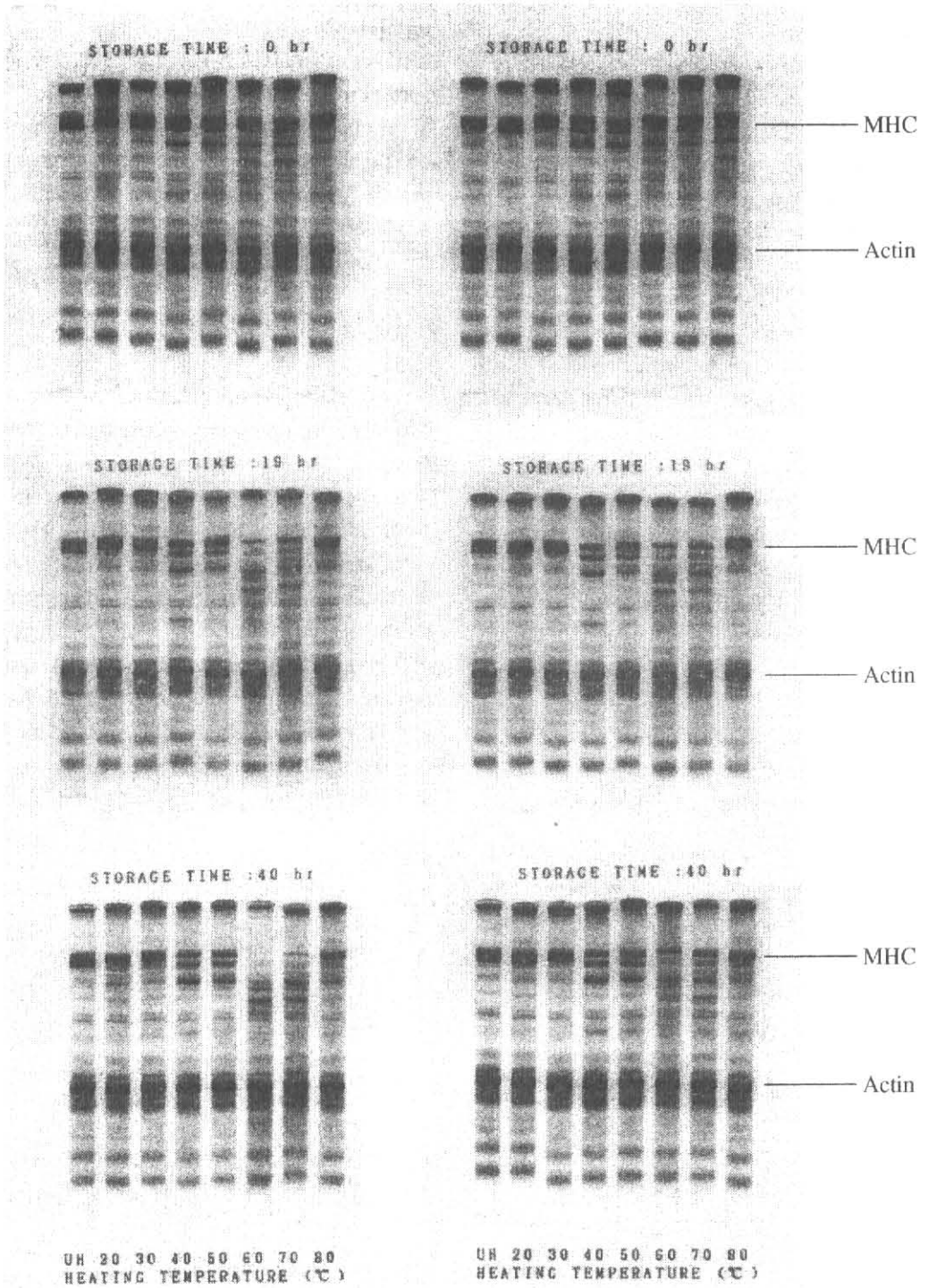

Figure 3 SDS-PAGE patterns of gels of carp meat heated at various temperatures.

Gel preparation :

A portion of white muscle was excised from each fish at selected time intervals, minced, adjusted moisture content to 83% and ground with 2.5% salt for 10 minutes. The salt-ground meat paste was filled in small glass tubes (diameter 15 mm, length 15 mm), wrapped with polyvinylidene chloride film (PVC) and heated in water bath at 20°, 30°, 40°, 50°, 60°, 70° and 80°C for 2 hours. The heated meat gels were further heated at 80°C for 20 minutes and cooled in ice-water. The obtained gels were stored in ice until the gel assessments were carried out (Figure 1).

Assessment of gel properties :

The gel strength of the obtained meat gels were measured with Sun Rheometer CR-200 D (Sun Scientific Co., Ltd) equipped with a spherical plunger (5 mm in diameter) at the speed of 60 mm/min.

SDS-PAGE analysis of fish meat gels :

Each gel of 0.5 g was solubilized with 20 ml of 0.05M sodium phosphate buffer (pH 6.8) containing 8M Urea, 2% SDS and 10% of 2-mercaptoethanol. SDS-PAGE was carried out according to the method of Weber and Osborn (1969), 10 µl of solubilized samples were applied on the 5% polyacrylamide gel. The relative contents of proteins as polymer, MHC and MHC breakdown products were estimated from densitogram scanned at 640 nm on a Shimadzu CS-900 Chromatoscanner.

RESULTS AND DISCUSSION

Gel strength of fish gels prepared from bled and non bled fish during iced storage is shown in Figure 2. At all heating temperatures of 20°, 30°, 40°, 50°, 60°, 70° and 80°C, almost of gel strength from immediately killed fish of non bled fish showed slightly higher than bled fish. After longer iced storage of 19 hr and 40 hr, gel strength of both fish decreased respectively by bled fish had more higher gel strength than non bled fish. However, at heating temperature of 50°, both bled and non bled fish gels showed the highest gel strength throughout the iced storage from 0 hr to 40 hr. This suggested that the suwari (gel setting) of carp fish

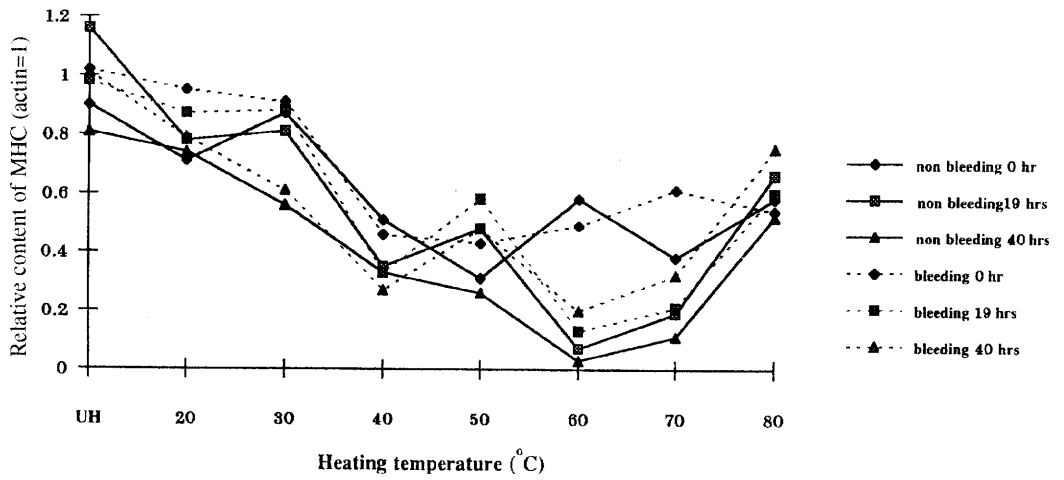

Figure 4 Relative content of MHC (actin=1) of carp meat gels at various heating temperatures.

gel tended to occur when heated at 50°C. On the other hand, gel prepared from either bled or non bled fish heated at 60°C and 70°C were very weak and gel strength became lower as the iced storage period increased from 0 hr to 19 and 40 hr respectively. This result indicated that modori (gel disintegration) of carp fish gels occured at 60°C and 70°C when the iced storage period increased.

The SDS-PAGE patterns of fish gels at various heating temperatures (Figure 3) were well coincided with that of gel strengths. At the begining of storage, there was no difference of protein patterns in both bled and non bled fish. The decrease of MHC and the increase of degraded MHC products which appeared under MHC band were observed in fish meat gels heated at 60°C and 70°C from both fish after 19 hr and 40 hr of iced storage. Therefore, the modori of carp meat gel at these temperatures was due to the proteolytic gel-degrading factor in fish muscle as well as in fish blood. This result was in accordance with Cheng *et al.* (1979) who found the good correlation between MHC degradation by SDS-PAGE and the activity of proteinase measured in gray trout and Atlantic croaker.

In addition, longer storage of fish in ice affected the increase of MHC degraded products of all heated gels. The relative content of MHC (actin=1) by densitometric scanning on electrophoretograms also confirmed these conditions (Figure 4). The decrease of the relative content of MHC (actin=1) was correlated with the MHC degradation patterns from SDS-PAGE analysis. The highest degradation of MHC was found from 60°C heated gel of non bled fish. Therefore, these observations could indicate that the proteolytic gel-degrading factor in fish muscle and blood may involved in modori phenomenon of gel and the highest activity was found at 60°C. Makinodan and Ikeda (1969, 1971) reported that the existence of heat stable alkaline proteinase purified from muscle of carp showed optimum pH activity at 60°C.

According to the bleeding effect on degradation of MHC, it appeared that degradation of MHC in gels from bled fish was higher than that of non bled fish which coincided with Toyohara *et al.* (1990a). They reported that the serum fraction of blood from rainbow trout suppressed the modori-phenomenon as well as the breakdown of MHC.

In conclusion, bleeding, iced storage and heating temperature around 60°C affected the degree of the modori phenomenon of fish meat gel.

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