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# Effect of Addition of some Hydrocolloids on the Stability of Frozen Minced Fillet of Mackerel

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*ABSTRACT*

*Pectins and alginates were used as additives (0·5%) in ground-fillets of mackerel and their effects on pH, water-holding capacity (WHC), cook drip loss and the formation of dimethylamine (DMA), and formaldehyde (FA) were investigated. Exceptional differences in WHC were observed. The alginate showed the highest values of WHC. The hydrocolloids used did not show any protective effect. All treated samples presented similar increases of DMA and FA contents.*

## INTRODUCTION

Mechanical deboners have been introduced successfully in the beef and poultry industry (Froning, 1981). They have also been engaged in the fish sausage industry with good results (Suzuki, 1981).

The minced fish is less stable in cold storage than the fish or fillets. Changes in texture and water-holding capacity (WHC) were reported to be accelerated in the minced fish (Webb *et al.*, 1976; Da Ponte *et al.*, 1985, 1987).

Several carbohydrates and certain amino acids and related compounds have a preventive effect on the denaturation of fish muscle during frozen storage (Noguchi *et al.*, 1976). More recently, hydrocolloids such as CMC, alginate, pectin, locust bean gum and carrageenan have been proposed as additives to minced fish (CAC, 1983).

In the present study, pectins (low and high methoxylated) and alginates (Kelcogel and Kelcosol) were added to minced fillets made from mackerel. The chemical and physical changes during 2 months of cold storage at $-20°C$ were studied. The idea was to see the effects of these hydrocolloids as cryprotective agents and as modifiers of texture and WHC. Control of these two phenomena, and specially the latter, could be one of the keys to success in commercialization of new products from minced fish (Keay & Hardy, 1978).

## MATERIALS AND METHODS

### Fish

Frozen mackerel was bought at the Zagazig fish market.

### Hydrocolloids

Low-methoxyl pectin (LP) (DE = 38%) and high-methoxyl pectin (HP) (DE = 74·3%) from apple pomace were obtained from Herbstreith (FRG). Alginates (Kelcogel and Kelcosol) from Kelco/AIC (London, UK), were applied.

### Minced fillets

After addition of the hydrocolloids (0·5%) by spread on surface (Da Ponte *et al.*, 1985), the fillet(s) was passed through a meat mincer using a mincing screen with a diameter of 4 mm. Samples of 150 g were packed in plastic bags, blast-frozen and kept at $-20°C$ for 2 months. Before analysis, samples were withdrawn from the cold storage, thawed in cold tap water and kept for 3 h in an ice-bath.

### Analytical methods

A 10-g sample was blended with 20 ml distilled water for 5 min. The pH of the mixture was measured using a pH meter (EIL model 7050). Water-holding capacity in the raw material (WHCR) was determined as described by Hermansson and Lucisano (1982): Minced fish (15 g) was weighed into a 50-ml centrifuge tube and centrifuged in a Sorvall RC 5B at 83 KN for 0·5 h at 0°C. Supernatant was discarded and residue reweighed. The WHC was expressed as a percentage of residue weight. The same procedure was followed to determine the WHC of cooked material (WHCC), except that the tubes with the minced fish were kept in an oven at 100°C for 1 h before centrifuging.

To determine the cook drip loss (CDL), 10 g minced fish was laid in a 25-ml beaker and kept in an oven at 100°C for 1 h. The cake was poured out on S&S filter paper and kept at ambient temperature for 1 h. The difference in weight was calculated and expressed as a percentage of 10 g (Da Ponte, 1986). Dimethylamine (DMA) and formaldehyde (FA) were determined using the colorimetric methods of Dyer and Mounsey (1945) and Sawicki *et al.* (1961), respectively.

## RESULTS AND DISCUSSION

### pH

Changes in pH of the different treatments are shown in Fig. 1. In all the treatments, there is small fall ranging from 0·2 to 0·4 of the pH values during the first 2 weeks of storage, and then a slight increase of the pH with time in cold storage.

Many reactions are still possible at temperatures near −20°C. Formation of lactic acid from glycogen, production of DMA, precipitation of alkaline salts (phosphates) and, after longer periods of the acid salts are some of the possible explanations for the pH variation presented in Fig. 1 (Da Ponte, 1986; Thomsen & Zeuthen, 1989).

### WHC of the raw material

After 2 months of cold storage at −20°C, WHCR decreased about 12% in all treatments (Fig. 2). Blank treatment always showed the lowest

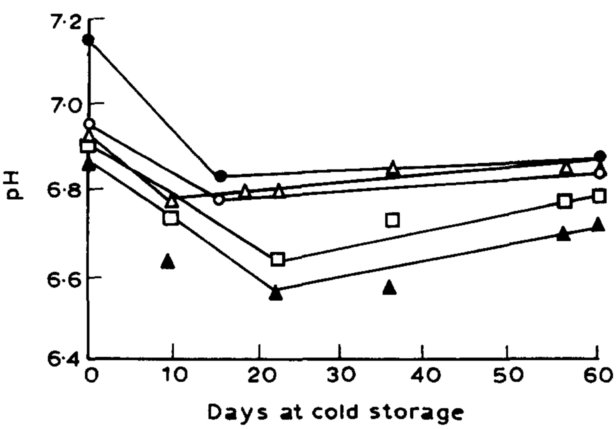


**Fig. 1.** Effect of different hydrocolloids on pH of frozen-stored (at −20°C) minced fish. △, Blank; ▲, LP; □, HP; ○, Kelcogel; ●, Kelcosol.

values and Kelcosol and Kelcogel treatments the highest values. With few exceptions, LP treatment showed values significantly higher than the blank. HP treatment resulted in higher values than the blank, but in general they were not significantly different.

This variation of WHC may be attributed to several features. The hydrocolloids used have different viscosities. This viscosity influences the fluid drainage when fish cakes are submitted to pressure. The hydrocolloids used have ionic groups which are capable of interacting with other groups of other compounds in the ground fish muscle (Imeson *et al.*, 1977; Stainsby, 1980).

Differences in pH may be another factor influencing the WHCC. LP and HP treatments showed pH values normally lower (0·2) than other treatments.

## WHC of cooked material and cook drip loss

WHCC and CDL along the 2 months of cold storage at −20°C are presented in Fig. 3a and b. There was a decrease of CDL and an increase of WHCC in the first 3 weeks, and then a slight increase of CDL and decrease of WHCC until the end of cold storage.

It is difficult to find a satisfactory explanation for this. In a previous study, Moledina *et al.* (1977) found an increase of CDL determined in samples of minced fish stored at −25°C for 8 weeks with 3%. Obviously, Patashnick *et al.* (1976) found a decrease of 3% in CDL in the first 4 weeks in samples of minced fish stored at −18°C.

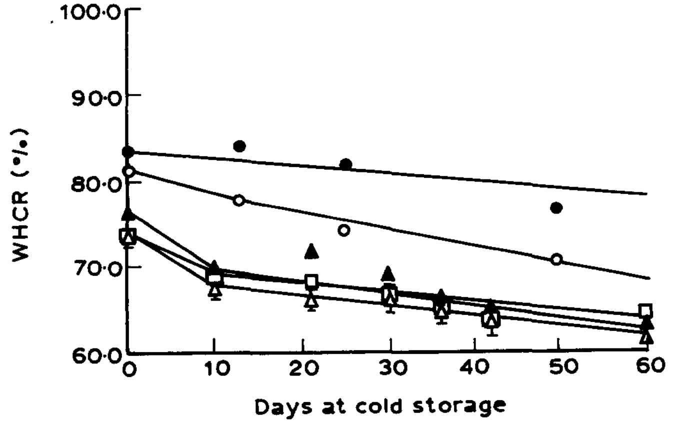


**Fig. 2.** Effect of different hydrocolloids on WHCR of frozen-stored (at −20°C) minced fish. (For symbols see Fig. 1.)

It is possible that the proteolytic activity of alkaline protease is the reason for the variations of WHCC and CDL in each of the treatments.

## Dimethylamine and formaldehyde

There was a decrease on DMA and FA formation in all studied treatments (Table 1).

The lower values of DMA and FA were determined in the Kelcogel treatment, while in the blank treatment the values of 59 and 27 $\mu g/g$ were found as DMA and FA, respectively. However, the HP treatment showed relatively higher values than the LP treatment which slightly slowed the formation of DMA and FA.

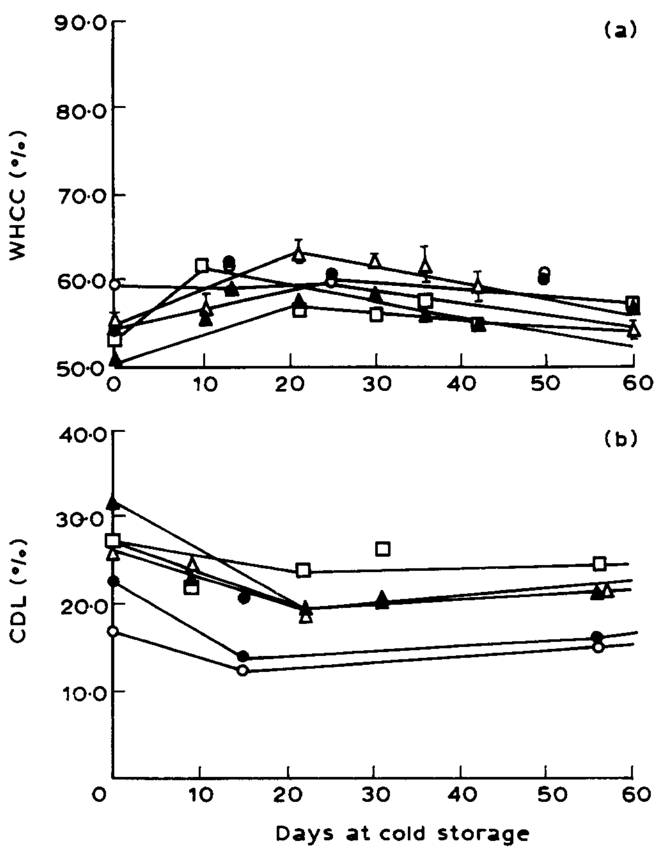


**Fig. 3.** Effect of different hydrocolloids on WHCC(a) and CDL(b) of frozen-stored (at $-20°C$) minced fish. (For symbols see Fig. 1.)

**TABLE 1**
Formation of DMA and FA in frozen minced fish at the end of 2 months storage[a]

| *Treatments* | *DMA* ($\mu g/g$) | *FA* ($\mu g/g$) |
|---|---|---|
| Blank | 59 | 27 |
| LP | 51 | 21 |
| HP | 56 | 23 |
| Kelcogel | 49 | 15 |
| Kelcosol | 52 | 17 |

[a]DMA, dimethylamine; FA, formaldehyde.

From the results obtained in the present study, it can be confirmed that the addition of alginates (0·5%) to minced fish is suggested as a modifier of texture and WHC.

At the end of the 2 months of storage, the blank sample had very intense off-flavors. This fact was not obtained in samples treated with hydrocolloids. Other analysis should be considered to give a better understanding of this fact.

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