The JSFS 85th Anniversary-Commemorative International Symposium
"Fisheries Science for Future Generations"

*Symposium Proceedings, No. 10017*

*Original article*

# Effect of salting and frozen storage on the quality of tuna meat

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**Keywords:** Quality; Water holding capacity; Salting; frozen storage; Tuna meat.

Received: 15 July 2017 / Accepted: 8 September 2017


## Introduction

It is well known that as a processing and preservation method, salting has a long tradition. The operation of salting is very simple, but there are many factors affecting the quality of the final products during processing, such as the fish species, freshness, with freezing-thawing or not, salting methods, concentration, time and temperature, and so on [1-4]. The processing after salting and storage conditions also have an effect on the characteristics of the products [5,6]. However, most of the processes used today, are based on trial and error and dominated by empiricism. Therefore, more information is needed to get a better understanding and make good use of salting.

Recently, lightly salted fish products have become increasingly popular because of not only the unique mouthfeel and texture characteristics of the products, but also the increasing demand of ready-to-eat foods and high attention paid to health problems caused by excess intake of sodium [7,8]. Because these lightly salted products have high water content and low salt content, they need to be kept frozen storage to maintain good quality and have a long shelf-life. However, little information is available on the quality changes of salted fish meat during frozen storage.

Water-holding capacity is one of the crucial attributes to the quality of meat and meat products, and of great importance to both the industry and consumers [9]. The loss of water-holding capacity will not only affect the mouthfeel, taste, textural and nutritional properties of the products, but also cause an economic loss to the industries.

Therefore, the purpose of this study was to clarify the effect of salting and frozen storage on the quality changes of tuna meat, aiming to provide theoretical instructions for the producing and storage of salted fish products.

## Materials and methods

*Sample preparation*

Dorsal part of frozen bigeye tuna was cut into 2 cm thick slices, then packaged in polyethylene bags and kept at -80°C until use. The method of sample preparation is shown in Fig. 1. The above mentioned frozen tuna slices were thawed at 4°C overnight and only the ordinary meat from the central part was cut into small pieces (3 cm×2 cm×0.5 cm). The specimens were soaked in NaCl solution with different concentrations at 4°C with a fish meat to salting solution ratio of 1:3 (w/w). The control was without salting. After salting, each piece of samples was packaged in polyethylene bags separately and kept at -20°C for frozen storage.

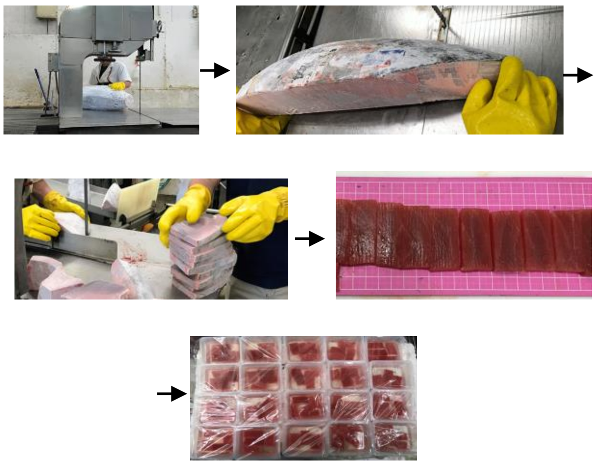

**Fig.1.** Sample preparation.

*Weight changes after salting*

The weight of samples was measured before and after salting with different salting conditions. The weight changes were calculated by the weight difference before and after salting.

*Water content and salt content*

Water content of the samples was measured by the weight loss after heating at 105°C to constant weight.

For salt content measurement, 10 times of ion exchange water was added to the minced meat. After homogenizing and filtrating, the salt content of the samples was measured by a pocket salt meter.

*Thawing drip loss*
The samples were thawed at 4℃. The thawing drip loss of tuna meat was calculated by the weight difference before and after thawing as an index of water-holding capacity of tuna meat after salting and frozen storage.

*Texture characteristics*
The effect of salting and frozen storage on the texture of tuna meat was measured by textural profile analysis. Each sample was compressed twice using a flat-ended cylindrical plunger (80 mm in diameter) at a constant test speed of 1 mm/s until it reached 50% deformation. The compression force was perpendicular to the muscle fiber orientation.

*Microscopic observation*
After salting and freezing-thawing, samples for light microscopic observation were fixed in Carnoy's fixative (75% absolute ethanol, 25% v/v acetic acid) at 4°C for 24 h. For frozen samples, the samples were fixed at -20°C for 1 w to observe the ice crystals. Then the fixed samples were dehydrated using a graded series of ethanol solutions, followed by substitution by xylene. The specimens were embedded in paraffin wax, and the cross-sections (5 μm in thickness) were achieved with a microtome. Consecutively, the sections were reshaped in water, mounted on glass slides, dried for 24 h on a dryer, dewaxed, stained with eosin solution, and then observed and photographed using an optical microscope.

## Statistical analysis

Data were subjected to a variance analysis (ANOVA) with OriginPro 8.5. Means comparison was performed using the Tukey method with a statistical significance of $p<0.05$.

## Results and discussion

The water content increased initially and then decreased with the increasing salting concentration. The salt content increased continually with the increase of salting concentration. The highest weight increase was obtained in 1 M NaCl salted samples after both salting and frozen storage. Salt content had a great effect on the water-holding capacity of tuna meat. Salting with a proper salt solution could increase the yield of tuna meat and provide a sticky texture. Salting also had an effect on the morphology of the ice crystals in tuna meat during frozen storage. The changes in the protein properties and microstructure were thought to be the main factors which affected the quality characteristics of tuna meat.

## Conclusions

Salting had a significant effect on the water-holding capacity and texture characteristics of tuna meat. A product with a high yield and unique mouthfeel can be obtained by salting with proper conditions. Salting and the subsequent freezing affected the microstructure of tuna meat and the morphology of ice crystals during frozen storage, which had a crucial effect on the quality attributes of the products.

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