THE REDUCTION OF FISHY ODOR IN SALMON SKIN BY WASHING WITH SALT SOLUTIONS

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Abstract

Canned salmon processing has considerable amounts of salmon skin leftover. Salmon skin contain a rich of protein and oil content. Since the nitrogen containing compounds are easily to breakdown and unsaturated fatty acids in skin that are susceptible to oxidized during handling and storage, the fishy odors occurred could limit the skin utilization. The use of sodium acetate (SA), sodium bicarbonate (SB) and sodium chloride (SC) at 0.5 % 1.0% and 1.5% (w/v) on fishy odor reduction in salmon skin was investigated. The determination of trimethylamine (TMA), total volatile base nitrogen (TVB-N) and thiobarbituric acid (TBA) were used to monitor the degradation of nitrogenous compounds and oxidized lipids in the salmon skin, and reduction of fishy odors was confirmed by sensory scoring test. A decrease of TVB-N and TBA values in salmon skin occurred after washing with those salt solutions. The lowest of TVB-N and TBA values in salmon skin was obtained after washing with SC solutions. In addition, washing salmon skin with 1 % (w/v) of SC solution received the lowest scores for the fishy odor, while the control (washing with water) received significantly higher scores for fishy odor. Therefore, SC solution may have a potential to improve quality by reduction the fishy odors in salmon skin, which could be utilized for further product.

Keywords: Fishy odor, Salmon skin, Sodium salts**,** TVB-N

Introduction

The production and export of seafood products in Thailand had increased with the expecting growth of 15.4% by the year 2012 (Bank of Thailand 2012). For the canning industry, tuna and salmon are major raw material imported from around the world.

Generally, tuna and salmon byproduct from processing account for 40% of raw material, it consisted of head, skin, bones, fin and viscera. Salmon skin can be further utilize as raw material for collagen, gelatin and fish oil production. Salmon skin has high protein 30 - 35 % on dry weight basis (Xinrong *et al*. 2010) and a rich source of omega-3 polyunsaturated fatty acids (PUFAs), mainly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Ackman 1990; Sargent *et al*. 2001). However, the high content of polyunsaturated lipids in salmon skin (Alberta and Benjamin 2009) is cause of lipid oxidation that generally contributes to the development of especially fishy odors (Maqsood and Benjakul 2011). Primary products of oxidation (lipid hydroperoxides) are break down to secondary lipid oxidation compounds such as alcohol, aldehydes, ketone and furan (Huss 1995; Ashton *et al*. 2002) that are normally reported as thiobarbituric acid (TBA) value. This value is not fit for human consumption if it higher than 8 mg/kg oil sample (Huss 1988). Moreover, spoilage in fish produced by microbial degradation and processing, which total volatile base nitrogen (TVB-N) content is used to evaluate the quality of fish and seafood (Li 2004). This value is a result of endogenous (raw material enzyme) and exogenous (microbial enzyme) enzyme functions. The fish or fish products containing TVB-N more than 30 mg/100 g sample are generally classified as unfit for human food (Ozogul and Ozogul 2000).

Sodium salt such as sodium acetate (SA), sodium bicarbonate (SB) and sodium chloride (SC) are used in food processing. SA containing flavor improving property, have been proposed for prolonging the shelf life of fish muscle (Zhuang *et al*. 1996). SB is commonly used in Chinese cuisine (Hsieh *et al*. 1980) and has been used for masking of typical aromas in meat from terrestrial farmed animals (Sindelar *et al*. 2003). SC has been traditionally used in curing processes. SC acts as preservative and modifies water holding capacity of the proteins. One of the functions of SC in meat products is to improve the quality and texture (Sofos 1986). Due to the fishy odor in salmon skins derived from lipid oxidation and protein and/or non-protein nitrogen, washing with various salt solutions may reduce this problem. The objectives of this study were to reduce fishy odor in salmon skin by washing with sodium acetate, sodium bicarbonate and sodium chloride solutions.

Methodology

Materials and preparation

Salmon skins were obtained from skin removing step during salmon processing of canning factory in Songkhla, Thailand. The residual meat was removed manually and cleaned salmon skin was washed with tap water. The skin was cut into small pieces (4.0 × 7.0 cm^2), placed in polyethylene bag and stored at -20°C for 3 months. The salt solutions that used in this experiment were sodium acetate, sodium bicarbonate and sodium chloride and obtained from Lab-Scan (Bangkok, Thailand). Salt solutions were prepared by dissolve each salt at 0.5, 1.0 and 1.5% (w/v) in tap water. All chemicals used were analytical grade.

Salmon skin washing procedure

Washing processes as according to Kittiphattanabawon (2004) were applied for salmon skin. Samples were washed with water (control) and 0.5, 1.0 and 1.5 % w/v of each salt solution for 5 min with the continuous stirring. The ratio of the sample to each solution was 1:2. Then the sample was rinsed with water for 5 min for 3 times with the continuous stirring (ratio of the sample to water was 1:2) to remove salt solutions from salmon skin. The washed samples were brought to scald with water at 50°C for 1 minute. The samples were subjected to determination of volatile compounds (Hasegawa, 1986) and TBA (Egan *et al*. 1981) as followings.

Determination of volatile compounds

Trimethylamine (TMA) and Total volatile base nitrogen (TVB-N) contents were determined using the Conway microdiffusion assay as according to the method of Hasegawa (1986). Sample (2 g) was extracted with 8 ml of 4% trichloroacetic acid (TCA). The mixtures were filtered using Whatman filter paper No. 41 then the filtrate was used for analysis. To determine the TMA content, formaldehyde was added to the filtrate to fix dimethylamine (DMA) and ammonia present in the sample. TMA and TVB-N were released after addition of saturated K_2CO_3 and diffused into the boric acid solution. The titrations of solution were performed and the amount of TMA or TVB- N was calculated as mg nitrogen/100 g sample.

Determination of thiobarbituric acid value

Thiobarbituric acid (TBA) value was determined as according to the procedure of Egan *et al.* (1981). Comminuted fish skin (10 g) was thoroughly homogenized with 50 ml of distilled water and 2.5 ml of HCl (4N) along with 6-7 droplets of antifoaming. The mixture was subjected to the distillation process for 10 minutes. The obtained liquid (5 ml) was added to 4 ml of a solution containing 0.0288 g thiobarbituric acid and 90% acetic acid. The mixture was heated in a water bath at 100ºC for 30 min and then cooled down to 30ºC. The mixture was measured the absorbance at 532 nm and TBA value was calculated as TBA (mg malonaldehyde/kg sample) = 7.8×D, where D is the absorbance of the solution against the blank prepared by adding 5 ml of distilled water and 5 ml of TBA solution.

Sensory evaluation

The fishy odor intensity of each sample was determined by sensory scoring test. This was conducted by using 30 panelists as according to the method Lovell and Sackley (1973). The scale used was 1-5 where 1 (extremely light odor), 2 (lightly odor), 3 (moderate odor), 4 (strong odor) and 5 (extremely strong odor).

Statistical analysis

The data obtained from one batches of materials (three replicates) and a completely randomized design (CRD) was used. For sensory evaluation used randomized complete block design (RCBD). Data were subjected to analysis of variance (ANOVA). Comparison of means was carried out by Duncan's multiple range tests. Significance was declared at $P<0.05$ using the statistical software.

Results and Discussion

Change in TMA and TVB-N content

TMA content of salmon skin was undetectable neither before nor after washing with salt solutions. TVB-N content of salmon skin decreased after washing with all salt solutions. TVB-N content could reduce from 13.36 mg nitrogen/100 g of salmon skin down to 4.55 mg nitrogen/100 g of salmon skin by washing with SC solutions. From the result, it showed that concentration and type of salt solution had affected to reduce of TVB-N content, which SC could reduce TVB-N content more than SC and SA, respectively. These results were in accordance with Hari *et al.* (2003) that using SC in shredded tuna washing could improved the physical and chemical properties by reducing the TMA, TVB-N content. This may due to the dissolved SC increased high polarity of water that could show the leaching effect by interact with hydrophilic volatile base nitrogen as TMA, DMA, TVB-N, ammonia and other amines (Ryuzo *et al.* 1987; Magnusson and Martinsdttir 1995). The values of total volatile basic nitrogen (TVB-N) in washed salmon skin were shown in Figure 1.

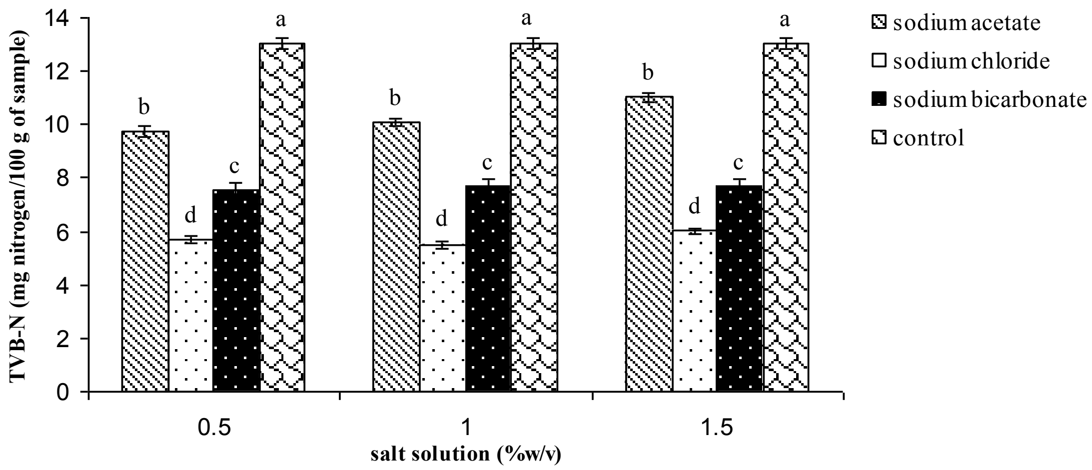

Figure 1 TVB-N contents in salmon skin after washing with salt solutions. Bars represent standard deviation from triplicate determinations. Different letters within the same concentration indicate significant differences ($p<0.05$).

Change in TBA values

The TBA values of salmon skin after washing with three types of salt solutions were shown in Figure 2. Salmon skin containing high unsaturated lipids lead to lipid oxidation (Alberta and Benjamin 2009) however, the result showed that TBA values in the salmon skin decreased significantly after washing with salt solutions compared to control. Due to washing process has been reported to be an important process to remove lipids and undesirable materials such as blood, pigment and odourous substances (Kristinsson *et al.* 2005). Decreasing of TBA values of washed sample with SC was the highest (Figure 2). This may due to the Na^+ from SC could interact with the polar head of phospholipid to form a sodium-phospholipid complex in the same fashion as Ca^{2+} (Hrynets *et al*. 2011) and leached out with water. The reduced level of phospholipids may explain the reduction in thiobarbituric acid levels (Kristinsson and Hultin 2004). Therefore, the samples washed with SC solution were selected for the sensory analysis.

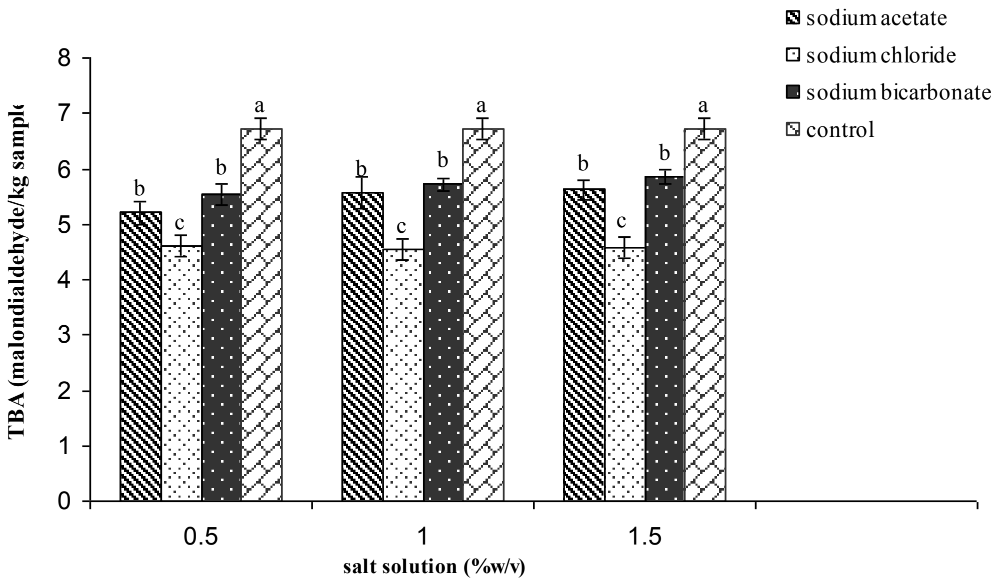

Figure 2 TBA value in salmon skin after washing salt solutions. Bars represent standard deviation from triplicate determinations. Different letters within the same concentration indicate significant differences (p<0.05).

Sensory Analysis

The sensory test of washed salmon skin with SC solution was presented in Table 1. The sensory panelists detected significant differences in fishy odor of washed salmon skin with SC and control. Control samples received significantly higher scores for strong odor to extremely strong odor, while washed salmon skin with 1 % w/v of SC solution received the lowest scores for light odor to moderate odor.

Table 1 Fishy odor score of washed salmon skin with sodium chloride solutions and control.

	Sodium chloride solution (%w/v)			
	Control	0.5	1.0	1.5
fishy odor score	4.2±0.85^{a}	3.2±1.08^{b}	2.67±0.71^{c}	3.13±1.04^{b}

a-c Mean within a row within the each condition with different letters are significantly difference (p<0.05).

These results are in accordance with the use of sodium chloride solutions at various concentrations and activated carbon in the fish skin before gelatin extraction. Kawahara and Tanihata (2005) shown that the samples washed with 1% w/v of sodium chloride solution could well reduced fishy odor. In Atlantic cod fillets, treating with a combination of sodium chloride and sodium bicarbonate could improve flavor, texture and reduced formation of volatile lipid compounds (Magnus and Turid 2012). This research demonstrated that type of salt solutions affected to reduce TVB-N, TBA value in salmon skin. Therefore, salmon skin may be further utilized as product if washing with suitable salt solution.

Acknowledgments

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