QUALITY PROPERTIES OF BEEF JERKY CURED WITH SALTED-FERMENTED ANCHOVY AND SHRIMP

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Abstract –The aim of this study is to evaluate the availability of salted fermented anchovy (SFA) including salted and shrimp (SFS) as a marinade of beef jerky. The quality properties of beef jerky including proximate composition, pH, color, shear force, SDS-PAGE and sensory evaluation were investigated. Higher moisture content was found in the beef jerky cured with SFAs and SFSs than the control (p<0.05). SDS-PAGE result no significant differences among the treatment. The SFAs and SFSs had the effect of causing a decrease in shear force (p<0.05). The SFA and SFS also had the effect of decreasing the lightness value. Color score of sensory evaluations were increased by addition of SFA and SFS. Therefore, we conclude the SFA and SFS can improve the quality properties of the beef jerky and SFA and SFS a good ingredient for the curing solution.

Key Words – beef jerky, salt-fermented anchovy, shrimp, quality property

I. INTRODUCTION

Jerky is old meat products and has been sold for many years in the form of snack foods. Jerky is obtained from obtained from sliced whole muscles marinated and dried. Jerky products are characterized by a diversity of raw materials, spices, and other additives, and by the technological procedures such as curing and drying (Konieczny et al., 2007).

Salt is one of the most frequently used ingredients in meat processing. Salt affects the flavor, texture and self-life of meat products (Gillette, 1985). However, an increased effect has been made to reduce the amount of salt in foodstuffs (Costa-Corredor et al., 2009). Salt-fermented fish (SFF) product was added salt and fermentation in muscles and viscera of fishes and shellfishes. Also, SFF and their liquid sauce have been widely utilized in a variety of processed products due to their salty, unique flavor and texture (Kim et al., 2011).

Therefore, the beef jerky was prepared by curing with SFF made of anchovy and shrimp, and the quality properties of beef jerky were investigated.

II. MATERIALS AND METHODS

1. Preparation of SFF and beef jerky

SFF products were purchased from local market. Anchovy and shrimp were washed thoroughly and mixed with salt as a ratio of 20% to raw fish. They were then fermented at room temperature for three months. The salinity of the SFF juice was measured using aconductivity meter and adjusted to 11.5% salt using distilled water.

Beef *semimembranosus* muscles were obtained at 48 h post-slaughter from a local market on three different processing days. All subcutaneous and intermuscular fat and visible connective tissue were removed from the fresh muscles. The sample was sliced to 5 mm thick pieces with a meat slicer. All slices samples were divided randomly into three groups (Control, SFA, and SFS) and cured with different curing solutions in a cold room for 24 h. The salt-water was prepared by dissolving sodium chloride in distilled water and its salinity adjusted to 11.5% salt. The formulation of cure solution is presented in Table 1.

After curing, all samples were dried using a dry-oven (DS80-1, Dasol Scientific Co. Ltd., Korea) at a temperature of 70^{o}C during 8 h to achieve a water activity of 0.82. After drying, all samples were cooling at a room temperature during 12 h. After cooling at a room temperature, proximate composition (%), pH, color, shear force (kg/cm^2),

SDS-PAGE and sensory evaluations were analyzed.

2. Statistical analyzed

Data was analyzed by the procedures of generalized linear model. Duncan's multiple range test was employed to determine the significance between treatments (SAS 9.3, 2014). All data were presented by standard error and significance level of $p<0.05$ was used for statistical analysis of means from treatments.

Table 1. Formulation of the curing solution for making beef jerky

Ingredients (%)	Treatments[1)]		
	C	T1	T2
Salt-water	9.0	-	-
SFA-water[2)]	-	9.0	-
SFS-water[3)]	-	-	9.0
Sugar	3.0	3.0	3.0
Starch syrup	2.5	2.5	2.5
Black pepper	0.2	0.2	0.2
Sodium nitrite	0.024	0.024	0.024
Total	14.724	14.724	14.724

[1)]Control: salt marinated, T1: salt-fermented anchovy (SFA) marinated, T2: salt-fermented shrimp (SFS) marinated.

III. RESULTS AND DISCUSSION

1. Proximate composition (%)

Proximate composition of results presented in Table 2. The moisture content, crude fat and crude protein of beef jerky were significant differences in the treatments ($p<0.05$). SFA and SFS were the lower in protein and fat content. However, the moisture content of beef jerky cured by SFA and SFS were higher than the control jerky.

Table 2. Proximate composition (%) of beef jerky cured with salted and fermented anchovy and shrimp

Treatments[1)]	Moisture	Crude fat	Crude protein	Ash
C	30.49±0.41^{B}	16.24±2.66^{A}	60.52±0.04^{A}	2.13±0.07
T1	34.69±0.07^{A}	14.19±1.69^{B}	57.29±0.72^{B}	2.03±0.11
T2	34.06±0.37^{A}	14.38±1.63^{B}	57.84±0.60^{B}	2.08±0.03

[A-B]Means±SD in the same column with different superscripts are significantly different ($p<0.05$).
[1)]Treatments are the same as Table 1.

2. pH, color and shear force

The results for pH, lightness and shear force of the beef jerky are shown in Table 3. The pH values of jerky generally range from 5.75 to 5.88. The pH value of beef jerky cured by SFA and SFS were higher than the control jerky ($p<0.05$). Kim et al. (2014) reported that beef jerky containing the SFA and SFS has a significantly higher pH value than the salt solution.

Color results indicated that the lightness value was significantly lower in the SFS than the other samples ($p<0.05$). The lightness value was lower in the cured SFA and SFS of beef jerky than the control jerky. According to Konieczny et al. (2007), color of beef jerky can change according to the drying time. However, in the present study, because the same drying conditions were applied to the treatments, the effect of color change was caused by SFA and SFS.

Shear force were significant differences among the control and treatments ($p<0.05$). The shear force of beef jerky cured by SFA and SFS were lower than the control jerky ($p<0.05$). These results agree with the previous report that shear force is an affected by moisture content (Yang et al., 2012) and moisture content increased by salt concentration (Monin et al., 1997).

Table 3. pH, lightness and shear force of beef jerky cured with salted and fermented anchovy and shrimp

Treatments[1)]	pH	Lightness (L^*)	Shear force (kg/cm^2)
C	5.75±0.01^{B}	28.61±1.81^{A}	4.52±1.03^{A}
T1	5.88±0.06^{A}	26.74±1.60^{AB}	3.47±0.95^{B}
T2	5.88±0.01^{A}	25.14±2.71^{B}	3.48±0.93^{B}

[A-B]Means±SD in the same column with different superscripts are significantly different ($p<0.05$).
[1)]Treatments are the same as Table 1.

3. Sensory evaluation of beef jerky

As presented in Table 4, flavor and texture were significantly different between treatments in sensory evaluation ($p<0.05$). The texture of beef jerky showed a similar trend with the result of shear force. Flavor values for treatments cured with SFA and SFS were higher than that for control. The SFA and SFS contain various

compounds, because the fish fermented process induces the transformation of organic substances to various simpler compounds, which are the origins of their unique flavors and aroma (Peralta et al., 2008).

Table 4. Sensory evaluation of beef jerky cured with salted and fermented anchovy and shrimp

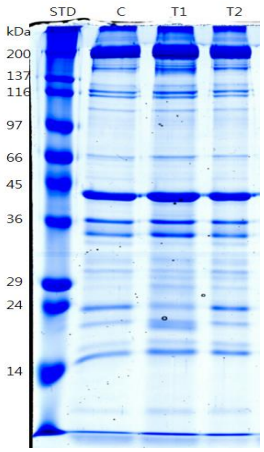
Treatments[1)]	Color	Flavor	Off flavor	Texture	Acceptability
C	7.29± 0.49	4.57± 1.13[B]	1.86± 0.69	5.29±0.53[B]	7.14± 0.49
T1	7.43± 0.79	7.14± 0.69[A]	1.71± 0.76	6.47±0.45[A]	7.43± 0.53
T2	7.43± 0.53	7.14± 0.90[A]	1.86± 0.90	6.48±0.43[A]	7.71± 0.69

[A-B]Means±SD in the same column with different superscripts are significantly different (p<0.05).
[1)]Treatments are the same as Table 1.

4. SDS-PAGE of beef jerky

The Figure 1 was shown SDS-PAGE gel patterns of myofibril of beef jerky treated with salt agent. There were no significant differences among the treatments. The gel pattern was slightly differences on 24 kDa. Because, the protein was disassmebled by SFA. The myofibrillar protein structure does not affected the change by SFF.

Figure 1. SDS-PAGE patterns of myofibrillar protein of beef jerky treated with salt agent.



Control: salt marinated, T1: salt-fermented anchovy marinated, T2: salt-fermented shrimp marinated.

IV. CONCLUSION

The beef jerky cured with SFA and SFS exhibited good moisture content. Also, the SFA and SFS improved the texture and color of the beef jerky. The compounds from SFA and SFS could be good enhancers for the flavor of the beef jerky.

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