2014 International Conference on Food and Nutrition Technology
IPCBEE vol. 72 (2014) © (2014) IACSIT Press, Singapore
DOI: 10.7763/IPCBEE. 2014. V72. 6

Effect of Adlay (*Coxi lachrymal-jobi*) to Increase the Shelf-Life of Low-Fat Frankfurters

Choong-Hee Lee[1+], Youn-Kyung Ham[1], In-Jun Yeo[1], Cheon Jei Kim[1]

[1] Department of Food Science and Biotechnology of Animal Resource, Konkuk University, Seoul 143-701, Korea

Abstract. This study was carried out to investigate the effect of adlay (*Coxi lachrymal-jobi*) to increase the shelf-life of low-fat frankfurters. The pH of low-fat frankfurters significantly increased stored for 20 days ($p<0.05$). The lightness, redness and yellowness were not affect by added adlay ($p>0.05$). TBARS values are increased for 20 days ($p<0.05$) and the low-fat frankfurter by added adlay was the lowest value compared with other samples over 15 days ($p<0.05$). The VBN values of frankfurters are significantly increased for 20 days ($p<0.05$). However VBN values of frankfurters were not affect by the added adlay.

Keywords: Sausage, adlay, *Coxi lachrymal-jobi*, low-fat, shelf-life

1. Introduction

Fat is important constituent of processed meat products because it proves flavour, texture, tenderness, juiciness, and color. Traditional meat products such as frankfurters may contain much fat [1]. However the high intake of much saturated fat and cholesterol is associated with a risk of coronary heart disease [2]. Then, current consumers demand healthful and low-fat meat products. However flavour and texture of low-fat meat products are lower than traditional meat products. Moreover low-fat meat products are used water instead of fat, then the more water in the meat products, the shorter the shelf life [3]. For these reason, meat industry has continuously sought to new technologies to add functional materials such as natural preserved agent. Consequently, adding substitute for synthetic preserved agent to low-fat meat products improves shelf life.

Adlay (*Coxi lachrymal-jobi*) is an annual crop that has long been used in traditional Chinese medicine and as nourishing food [4]. Adlay has a high contain of protein and lipid compared with another grain [5]. Then adlay has a low content of saccharide, however it has a high content of fiber and high water absorption capacity [6]. Recently, many researches have been carried out, the use of adlay such as study on quality characteristics of glutinous rice dasik [5] and characteristics of quality of bread [7] researched, however no research has been done on the improve to low-fat frankfurters shelf-life effect by the use of adlay. Therefore, the aim of this study was to evaluate the effects of adlay to increase the shelf-life of low-fat frankfurters.

2. Materials and Methods

2.1. Manufacturing of Frankfurter Sausage

Fresh pork ham and pork back fat were purchased from a local market. The lean meat and pork fat were cured (1.2% NPS, ascorbic acid 0.02%, sodium phosphate 0.3%) for 24h. The cured meat ground through an 8 mm plate. Frankfurters were produced with three different formulations: Control (only 20% pork fat), LF (only 10% pork fat), LF-A (10% pork fat and 0.5% adlay). Cold water (4℃) , sugar 0.5%, isolated soy protein 1% and spices 0.4% added to the cured meat was mixed for 15min in a paddle mixer, then emulsion (60% pork, 20% fat, 20% ice) was added and mixed for 15 min. After emulsification, the meat batter was

+ Corresponding author. Tel.: +82-2-450-3684; fax: +82-2-455-1044.
E-mail address: dlcndgml88@gmail.com.

stuffed into hog casings using a stuffer. The frankfurters were heated to 65℃ by hot smoke for 30 min and 75℃ by steam cook for 40 min. Then the cooked frankfurters were cooled by shower and cooling for 20 min and stored in vacuum packages at 4℃ for 20 days.

2.2. pH Value

The pH values of the samples were measured using a pH meter (Model 340, Mettler-Toledo GmbH, Schwerzenbach, Switzerland). The pH of frankfurters was measured after blending 5 g of sample with 20 ml of distilled water for 30 s in a homogenizer (Ultra-Turrax SK15, Janke & Kunkel, Staufen, Germany).

2.3. Instrumental Color

The instrumental color analyses of the frankfurter sausages were conducted as follows. The color measurements were acquired using a colorimeter (Chroma meter CR-210, Minolta, Japan; illuminate C, calibrated with a white standard plate CIE L^* = +97.83, CIE a^* = -0.43, CIE b^* = +1.98), which consisted an 8 mm diameter measuring area and a 50 mm diameter illumination area. The color values (CIE L^*, a^*, and b^*) were measured on the sample surfaces and data were collected in triplicate for each sample.

2.4. 2- Thiobarbituric Acid (TBA) Measurements

Lipid oxidation was assessed in triplicates for each sample by the 2-thiobarbituric acid (TBA) method of Tarladgis, Watts, Younathanm, and Dugan [8] with minor modifications. A 10 g sample was blended with 50 ml distilled water for 2 min and then transferred to a distillation tube. The cup used for blending was washed with additional 47.5 ml of distilled water, which was added to the same distillation flask with 2.5 ml 4 N HCl and a few drops of an antifoam agent (KMK-73, Shin-Etsu Silicone Co., Ltd., Korea). The mixture was distilled and a 50 ml distillate was collected. 5 ml of 0.02 M 2-thiobarbituric acid in 90% acetic acd (TBA reagent) was added to test tube containing 5 ml of the distillate and mixed well. The tubes were capped and heated in a boiling water bath for 30 min to develop chromogen and cooled to room temperature. The absorbance was measured at 538 nm, against a blank prepared with 5 ml distilled water and 5 ml TBA-reagents, using a UV/VIS sperctrophotometer (Optizen 2120 UV plus, Mecasys Co. Ltd., Korea). The TBA values were calculated as mg MDA/kg meat. The formula was :

TBA(MDA mg/meat kg) = (optical density of sample – optical density of blank) x 7.8

2.5. Volatile Basic Nitrogen (VBN)

Volatile basic nitrogen (VBN) method was performed to determine the extent of protein deterioration (n=3). VBN values were measured by the modified microdiffusion assay according to the method of Pearson [9].

2.6. Statistical Analysis

Analysis of variance was performed on all the variables measured using the ANOVA (analysis of variance) of the PASW Statistics (ver 18.0, SPSS Inc, Chicago, IL, USA). Duncan's multiple range test (p<0.05) was used to determine the differences between treatment means.

3. Result and Discussion

Table 1. The pH in frankfurters formulated with various amounts of added fat and adlay during refrigerated storage at 4℃

Traits		0 days	5 days	10 days	15 days	20 days
pH	Control[1)]	6.15±0.02^{Ae}	6.19±0.01^{Ad}	6.22±0.01^{Ac}	6.28±0.01^{Ab}	6.36±0.02^{Aa}
	LF	6.07±0.01^{Bd}	6.13±0.03^{Bc}	6.17±0.01^{Bb}	6.17±0.02^{Cb}	6.25±0.00^{Ca}
	LF-A	6.08±0.00^{Be}	6.10±0.01^{Bd}	6.14±0.01^{Cc}	6.19±0.01^{Bb}	6.30±0.03^{Ba}

All values are mean ± SD of the three replicates.

$^{A–C}$Means sharing different letters in the same column are significantly different (p<0.05).

$^{a–e}$Means sharing different letters in the same row are significantly different (p<0.05).

[1)]Control, frankfurter sausage containing 20% of fat, LF, frankfurter sausage containing 10% of fat, LF-A, frankfurter sausage containing 10% of fat and 0.5% of adlay.

Table 2. The color in frankfurters formulated with various amounts of added fat and adlay during refrigerated storage at 4℃

Traits		0 days	5 days	10 days	15 days	20 days
CIE L*	Control[1)]	67.34±1.10^{AB}	67.36±1.02	67.44±1.09	67.48±1.11	67.75±0.57
	LF	67.71±0.51^{A}	67.83±1.08	68.09±0.61	68.13±0.51	68.16±0.62
	LF-A	66.72±1.18^{Bb}	67.24±1.15^{ab}	67.86±0.57^{a}	67.96±0.75^{a}	67.76±0.73^{a}
CIE a*	Control	8.93±1.10	8.95±0.84	8.91±0.54^{A}	8.91±0.51	8.83±0.72
	LF	8.64±0.61	8.45±0.54	8.45±0.30^{B}	8.53±0.49	8.51±0.24
	LF-A	8.59±0.76	8.44±0.34	8.68±0.54^{AB}	8.79±0.50	8.88±0.58
CIE b*	Control	9.87±0.62	9.61±0.64^{B}	9.57±0.34^{B}	9.50±0.32^{B}	9.78±0.43
	LF	9.90±0.85	9.91±0.65^{AB}	9.74±0.67^{AB}	9.80±0.31^{B}	9.76±0.45
	LF-A	10.37±0.78	10.38±0.55^{A}	10.18±0.59^{A}	10.14±0.38^{A}	10.01±0.54

All values are mean ± SD of the three replicates.

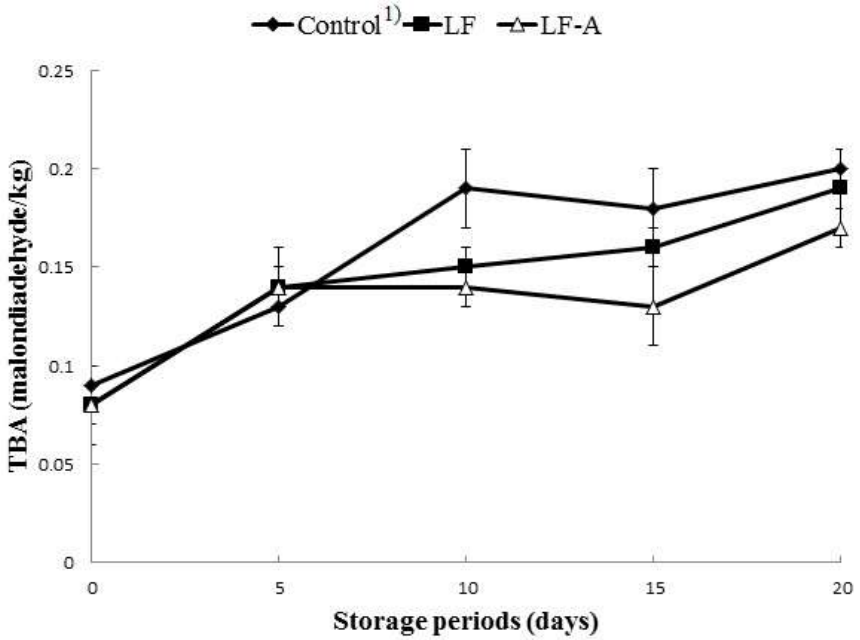
[A,B]Means sharing different letters in the same column are significantly different (p<0.05).

[a,b]Means sharing different letters in the same row are significantly different (p<0.05).

[1)]Treatment are the same as in table 1.

The pH and color of frankfruters formulated with various amounts of added fat and adlay stored for 0, 5, 10, 15 and 20 days at 4℃ are shown in Table 1 and Table 2. The pH of frankfurters is significantly increased stored for 20 days (p<0.05). Georgantelis *et al*. [10] reported that protein and amino acid degradation resulting in formation of ammonia and consequent pH increase. The pH of low-fat frankfurter was significantly higher than low-fat frankfurter by added adlay for 10 days (p<0.05) then, the pH of low-fat frankfurter by added adlay is significantly higher than the low-fat frankfurter for 15 and 20 days (p<0.05). The lightness of low-fat frankfurter by added adlay was significantly increased stored for 10 days (p<0.05). However other samples were not affect by added fat content for stored for 20 days except 0 days (p>0.05). The redness of all samples were not increased for 20 days (p>0.05). The redness of low-fat frankfurter was the lowest value the other samples for 10 days (p<0.05). The yellowness of low-fat frankfurter by added adlay was the highest value than other sample for 5, 10 and 15 days (p<0.05).

Fig. 1. TBARS values of frankfurters formulated with various amounts of added fat and



adlay during refrigerated storage at 4 ℃. [1)]Treatment are the same as in Table 1.

Table 3. VBN in frankfurters formulated with various amounts of added fat and adlay during refrigerated storage at 4 ℃

Traits		0 days	5 days	10 days	15 days	20 days
VBN (mg%)	Control[1)]	6.54±1.17[b]	8.22±1.62[ab]	8.82±0.59[b]	8.68±0.40[ab]	10.93±0.40[a]
	LF	7.66±0.32[b]	8.68±1.22[ab]	8.68±0.40[ab]	8.96±1.19[ab]	10.51±0.20[a]
	LF-A	7.66±0.32[b]	8.22±0.32[b]	8.68±0.40[b]	8.12±0.79[b]	10.37±0.40[a]

All values are mean ± SD of the three replicates.

[a,b]Means sharing different letters in the same row are significantly different (p<0.05).

[1)]Treatment are the same as in table 1.

Fig. 1 is TBARS values of frankfurters stored for 0, 5, 10, 15 and 20 days. The TBARS values are increased stored for 20 days (p<0.05). The low-fat frankfurter by added adlay showed the lowest TBARS values than other samples on 15 days for 20 days (p<0.05). Park *et al*. [11] also reported that adlay have antioxidant activities. Table 3 showed VBN values of frankfurters with various amounts of added fat and adlay during refrigerated stored for 0, 5, 10, 15 and 20 days at 4 ℃. VBN values of all samples were significantly increased for 20 days (p<0.05). However VBN values of frankfurters was not affect by the added adlay (p>0.05).

In conclusion, frankfurter of added adlay was effect on TBARS during refrigerated storage at 4 ℃ and have no effect on the pH and color. Then the adlay improve shelf-life in low-fat frankfurters during storage periods.

4. Acknowledgements

This study was supported by Development of well-being meat products containing regional specialties using low-valued pork cuts (2013-A012-0075), Republic of Korea.

5. References

[1] Y. S. Choi, K. S. Park, H. W. Kim, K. E. Hwang, D. H. Song, M. S. Choi, S. Y. Lee, H. D. Paik and C. J. Kim. Quality characteristics of reduced-fat frankfurters with pork fat replaced by sunflower seed oils and dietary fiber extracted from *makgeolli* lees. *Meat Sci*. 2013, 93(3): 652-658.

[2] E. G. Garcı á and A. Totosaus. Low-fat sodium-reduced sausages: Effect of the interaction between locust bean gum, potato starch and j-carrageenan by a mixture design approach. *Meat Sci*. 2008, 78(4): 406-413.

[3] Y. M. Lee and K. B. Chin. Effects of phosphate addition alone or in combined with dipping in trisodium

phosphate solution on product quality and shelf-life of low-fat sausages during refrigerated storage. *Korean J. Food Sci. Ani. Resour*. 2012, 32(1): 84-90.

[4] T. T. Wu, A. L. Charles and T. C. Huang. Determination of the contents of the main biochemical compounds of Adlay (*Coxi lachrymal-jobi*). *Food Chemixtry*. 2007, 104(4): 1509-1515.

[5] K. Y. Chae. Quality characteristics of glutinous rice dasik by the addition of job's tears flour. *Koean J. Food Cookery Sci*. 2009, 25(1): 1-7.

[6] K. Y. Chae and J. S. Hong. The quality characteristics of jeolpyon with different amounts of job's tears flour. *Korean J. Food Cookery Sci*. 2007, 23(5): 770-776.

[7] G. S. Park and S. J. Lee. Effects of job's tears powder and green tea powder on the characteristics of quality of bread. *Korean J. Food & Nutr*. 1999, 28(6): 1244-1250.

[8] B. G. Tarladgis, B. M. Watts, M. T. Younathanm, and L. Dugan. A distillation method for the quantitative determination of malonaldehyde in rancid foods. *Journal of American Oil Chemistry Society*, 1960, 37(1): 44–52.

[9] D. Pearson. Assessment of meat freshness in quality control employing chemical techniques. A review. *Journal of Food Science*, 1968, 19(7): 357–363.

[10] D. Georgantelis, I. Ambrosiadis, P. Katikou, G. Blekas and S. A. Georgakis. Effect of rosemary extract, chitosan and a–tocopherol on microbiological parameters and lipid oxidation of fresh pork sausages stored at 4 ℃. *Meat Sci.* 2007, 76(1): 172-181.

[11] T. S. Park, S. Y. Lee, H. J. Kim, K. T. Kim, Y. J. Kim, I. H. Jung, W. N. Do and H. J. Lee. Extracts of adlay, barley and rice bran have antioxidant activity and modulate fatty acid metabolism in adipocytes. *Korean J. Food & Nutr*. 2009, 22(3): 456-462.