QUALITY CHARACTERISTICS OF LOW-FAT EMULSION SAUSAGES WITH *MAKGEOLLI* LEES FIBER

Yun-Sang Choi[1], Kwaon-Sik Park[2], Hyun-Wook Kim[2], Ko-Eun Hwang[2], Dong-Heon Song[2], Ji-Hun Choi[2], Ju-Hui Choe[2], Cheon-Jei Kim[2]

[1] Food and Biological Resources Examination Division , Korean Intellectual Property Office, Daejeon, South Korea; [2] Department of Food Science and Biotechnology of Animal Resources, Konkuk University, Seoul, South Korea

Abstract – The effects of reducing pork fat levels by partially substituting pork fat with a *makgeolli* lees fiber were investigated based on quality characteristics of low-fat emulsion sausages. The moisture and ash contents were higher in low-fat emulsion sausages samples containing *makgeolli* lees fiber than in the control. With increasing fat levels, samples displayed higher sensory evaluation, while displaying lower cooking loss and total expressible fluid separation. The results of this study show that fat levels of emulsion sausages with added *makgeolli* lees fiber can be successfully reduced. Thus, 20% fat emulsion sausages with the addition of 2% *makgeolli* lees fiber can improve the quality characteristics of low-fat emulsion sausages, similar to control emulsion sausages.

Key Words – low-fat, dietary fiber, *makgeolli* lees fiber, emulsion sausages, quality characteristics.

I. INTRODUCTION

Normally, traditional emulsion sausages may contain up to 30% fat. Therefore, low-fat meat products are of health interest. However, fat is a major importance as a source of energy and essential fatty acids, and as carriers of fat soluble vitamins (Choi et al., 2009). In general, overcoming consumer reluctance has involved partial substitution animal fat by water and dietary fiber low-fat meat processing. Adding dietary fibers of meat products helps improve the textural properties and emulsion stability of meat products.

Considerable quantities of *makgeolli* lees result from the *makgeoll* brewed using *nuruk* or *koji Makgeolli* lees is the most important by-product, and provides dietary fiber, energy, proteins, minerals, vitamins, alcohol, and organic acids required for human health. Thus, *makgeolli* lees is a outstanding source of dietary fiber and confers high nutritive value (Choi et al. 2010).

The objective of this study was to evaluate the effects of various low-fat levels and the addition of *makgeolli* lees fiber on the quality characteristics of low-fat emulsion sausages.

II. MATERIALS AND METHODS

1. Preparation and processing of makgeolli lees fiber extract

Dietary fiber was extracted using the modified AOAC enzymatic-gravimetric method (AOAC, 2000).

2. Emulsion sausages preparation and processing

Fresh chicken breast meat and pork back fat were purchased from a local processor. Seven different emulsion sausages were produced (Table 1). The emulsion sausage was processed using Choi et al. (2010) methods.

Table 1. Emulsion sausages with varying percentage of added fat and *makgeolli* lees fiber

Ingredients	Treatments[A]						
	30/0	20/0	20/1	20/2	15/0	15/1	15/2
Chicken meat	50	50	50	50	50	50	50
Back fat	30	20	20	20	15	15	15
Ice	20	30	29	28	35	34	33
Makgeolli lees fiber	-	-	1	2	-	1	2
Total	100	100	100	100	100	100	100
Salt (NaCl)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Phosphate	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Vit. C	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Sugar	0.5	0.5	0.5	0.5	0.5	0.5	0.5

[A] The first letter refers to the fat levels and the second to the added to the *makgeolli* less fiber, 30, 20, and 15: added fat level, 0, 1, and 2: added *makgeolli* lees fiber, 30/0: control with pork back fat (30%).

3. Proximate composition

Compositional properties of the frankfurters were performed using AOAC (2000).

4. Cooking loss and emulsion stability

The cooking loss was calculated from difference before and after cooking. The meat batters were analyzed for emulsion stability using the method of Bloukas and Honikel (1992) with the following modifications.

5. Sensory evaluation

A trained thirty-member panel consisting of researchers of the Department of Food Sciences and Biotechnology of Animal Resources at *Konkuk* University in Korea was used to evaluate chicken emulsion sausages at the time. Each chicken emulsion sausage was evaluated in terms of color, flavor, juiciness, tenderness, and overall acceptability (Choi et al., 2012).

III. RESULTS AND DISCUSSION

The proximate composition of the low-fat emulsion sausages formulated with different amounts of fat and *makgeolli* lees fiber are given in Table 2. The moisture and ash content of the low-fat emulsion sausages samples containing *makgeolli* lees fiber was higher than the samples without *makgeolli* lees fiber, but did not differ significantly between treatments ($P > 0.05$). Also, the moisture content of low-fat emulsion sausages samples was higher than the control 30% fat treatment without *makgeolli* lees fiber ($P < 0.05$). Regardless of the low-fat emulsion sausages treatments with added *makgeolli* lees fiber, the protein content of low-fat emulsion sausages samples were did not display a statistically significant difference compared to the control ($P > 0.05$). The fat content was significantly lower in the emulsion sausages formulated with low-fat and *makgeolli* lees fiber compared to control ($P < 0.05$). The cooking loss and emulsion stability of low-fat emulsion sausages with various concentrations of fat and 1% and 2% *makgeolli* lees fiber are shown in Table 3. Decreasing the fat levels from 30% to 10% significantly increased cooking loss ($P < 0.05$), and increasing the *makgeolli* lees fiber levels significantly decreased cooking loss ($P < 0.05$).

The fat separation was the highest in the treatment with 20% fat and without *makgeolli* lees fiber ($P < 0.05$), and the trends showed that meat batter with reducing fat levels treatments and added increasing *makgeolli* lees fiber treatments decreased fat separation ($P < 0.05$).

Table 2. Proximate composition of low-fat emulsion sausages formulations with varying percentages of added fat and *makgeolli* lees fiber

Traits	Treatments[A]						
	30/0	20/0	20/1	20/2	15/0	15/1	15/2
Moisture (%)	55.98^{d}	59.29^{c}	64.54^{b}	65.47^{b}	62.39^{b}	68.62^{a}	69.53^{a}
Protein (%)	12.36	13.19	13.22	13.01	12.76	12.83	12.98
Fat (%)	28.48^{a}	19.92^{b}	18.73^{b}	17.38^{b}	15.89^{c}	15.45^{c}	14.42^{c}
Ash (%)	2.23^{e}	2.33^{d}	2.37^{d}	2.44^{b}	2.43^{bc}	2.47^{b}	2.52^{a}

[a-d]Means within a row with different letters are significantly different ($P < 0.05$).

[A] The first letter refers to the fat levels and the second to the added to the *makgeolli* less fiber, 30, 20, and 15: added fat level, 0, 1, and 2: added *makgeolli* lees fiber, 30/0: control with pork back fat (30%).

Table 3. Effects of various percentages of added fat and *makgeolli* lees fiber on the textural attributes of low-fat emulsion sausage formulations

Traits	Treatments[A]						
	30/0	20/0	20/1	20/2	15/0	15/1	15/2
CL	8.50^{e}	13.17^{b}	11.05^{c}	8.13^{e}	15.22^{a}	12.18^{c}	9.67^{d}
ES							
FS	0.62^{d}	2. 09^{a}	1.59^{b}	0.74^{d}	1.58^{b}	0.98^{c}	0.61^{d}
TEFS	3.59^{f}	8.98^{b}	5.74^{d}	3.94^{f}	10.07^{a}	6.12^{c}	4.63^{e}

[a-d]Means within a row with different letters are significantly different ($P < 0.05$).

[A] The first letter refers to the fat levels and the second to the added to the *makgeolli* less fiber, 30, 20, and 15: added fat level, 0, 1, and 2: added *makgeolli* lees fiber, 30/0: control with pork back fat (30%).

CL (%), cooking loss; ES (%), emulsion stability; FS (%), fat separation, TEFS (%), total expressible fluid separation

Table 4. Effects of various percentages of added fat and *makgeolli* lees fiber on the sensory evaluations of low-fat frankfurter formulations

Traits	Treatments[A]						
	30/0	20/0	20/1	20/2	15/0	15/1	15/2
Co	8.58^{a}	7.62^{b}	7.87^{ab}	7.95^{ab}	7.57^{b}	7.59^{b}	7.58^{b}
Fl	8.26^{a}	7.64^{b}	7.77^{b}	7.85^{ab}	7.62^{b}	7.64^{b}	7.76^{b}
Te	8.18^{ab}	7.95^{ab}	8.15^{ab}	8.32^{a}	7.64^{b}	7.98^{ab}	8.08 ^{ab}
Ju	8.21^{a}	7.72^{b}	8.15^{ab}	8.36^{a}	7.52^{b}	7.85^{b}	7.98^{b}
OA	8.05^{a}	7.49^{b}	7.96^{ab}	8.07^{a}	7.14^{bc}	7.38^{b}	7.52^{b}

[a-c]Means within a row with different letters are significantly different ($P < 0.05$).

[A] The first letter refers to the fat levels and the second to the added to the *makgeolli* less fiber, 30, 20, and 15: added fat level, 0, 1, and 2: added *makgeolli* lees fiber, 30/0: control with pork back fat (30%).

Co, color; Fl, flavor; Te, tenderness, Ju, juiciness; OA, overall acceptability.

Total expressible fluid separation had the lowest control treatments with 30% fat and without *makgeolli* lees fiber ($P < 0.05$), similar to treatments with 20% fat and with 2% *makgeolli* lees fiber of total expressible fluid separation. The sensory scores for low-fat emulsion sausages at different fat and *makgeolli* lees fiber levels are presented in Table 4. The control with 30% fat emulsion sausage samples was significantly higher in color and flavor scores compared to low-fat frankfurters ($P < 0.05$). The juiciness and overall acceptability scores were greatest with 30% fat emulsion sausage samples and treatment with 20% fat and 2% *makgeolli* lees fiber emulsion sausage samples ($P < 0.05$). Increasing fat levels were associated with emulsion sausages that displayed higher tenderness, juiciness, and overall acceptability scores.

IV. CONCLUSION

Reducing animal fat levels and adding *makgeolli* lees fiber has an important effect on the quality of low-fat emulsion sausages. These results indicate that *makgeolli* lees fiber is a potentially excellent dietary fiber source that can be used as a functional ingredient for emulsion sausages. Fat levels of emulsion sausages with added *makgeolli* lees fiber can be successfully reduced. Emulsion sausages with 20% fat and 2% *makgeolli* lees fiber had higher textural properties and sensory characteristics similar to regular-fat control (30% fat). Therefore, 20% fat emulsion sausages with the addition of 2% *makgeolli* lees fiber can improve the quality characteristics of low-fat emulsion sausages to acceptable levels.

ACKNOWLEDGEMENTS

This work was supported by Ministry for Food, Agriculture, Forestry and Fisheries funded by the Korean Government (608001-05-2-SB310). The authors were also partially supported by the Brain Korean 21 (BK 21) Project from Ministry of Education and Human Resources Development (Republic of Korea).

REFERENCES

1. AOAC. (2000). Official methods of analysis of AOAC. Vol. 41. (17th ed.). Washington DC: Association of Official Analytical Chemists.
2. Bloukas, I. & Honikel, K. O. (1992). The influence of additives on the oxidation of pork back fat and its effect on water and fat binding in finely comminuted batters. Meat Science 32: 31-43.
3. Choi, Y. S., Choi, J. H., Han, D. J., Kim, H. Y., Lee, M. A., Kim, H. W., & Kim, C. J. (2009). Characteristics of low-fat meat emulsion systems with pork fat replaced by vegetable oils and rice bran fiber. Meat Science 82: 266-271.
4. Choi, Y. S., Park, K. S., Choi, J. H., Kim, H. W., Song, D. H., Kim, J. M., Chung, H. J., & Kim, C. J. (2010). Physico-chemical properties of chicken meat emulsion systems with dietary fiber extracted from *makgeolli* lees. Journal of Korean Society for Food Science of Animal Resources 30: 910-917.
5. Choi, Y. S., Choi, J. H., Kim, H. W., Kim, H. W., Song, D. H., Lee, M. A., Chung, H. J., & Kim, C. J. (2012). Effects of *Laminaria japonica* on the physic-chemical and sensory characteristics of reduced-fat pork patties. Meat Science 91: 1-7.