EFFECTS OF CHICORY FIBER AND SMOKING TREATMENT ON QUALITY CHARACTERISTICS OF RESTRUCTURED MEAT PRODUCTS

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Abstract - This study was conducted to evaluate the effects of using chicory fiber and smoking treatment as a fat substitute on the quality characteristics of restructured meat products. The experimental design was as follows. (NA: non-additive, C10: pork fat 10% + chicory fiber 10%, C5: pork fat 15% + chicory fiber 5%, SNA: NA + smoking, SC10: C10 + smoking, SC5: C5 + smoking). The addition of chicory fiber and smoking treatment decreased the moisture, fat contents, and pH value. In texture profile analysis, the SC10 had the highest springiness value, and the chewiness and hardness values were decreased by the addition of chicory fiber except for SC10 ($p<0.05$). The redness significantly was increased by the smoking among the treatments. In sensory evaluation, there were no significant differences by the chicory fiber and smoking treatment. Therefore, the addition of chicory fiber and smoking treatment could be helpful to manufacture healthy and improved restructured meat products.

Kew Words- Chicory fiber, Restructured meat products, Smoking

I. INTRODUCTION

Chicory is a major crop in region of northwestern Europe, which has a lot of dietary fiber inulin (Roberfroid, 2007). Chicory contains inulin, which accounts for 65–70% of the chicory dry weight (Lee and Shin, 1997). Inulin, a carbohydrate derived from plant sources, can be classified as a soluble fiber. Additionally, inulin has a bland flavor and a fat-like texture, and it can be incorporated into various food preparations to replace sugar and fat (Davidson *et al*., 1998). Increased inulin intake can be used to increase fecal frequency (Den Hond *et al*., 2000). The addition of 10 g inulin to the daily diets of subjects with moderately high blood lipids significantly reduced insulin levels and triacylglycerol concentrations (Jackson *et al*., 1999). Inulin has been reported to enhance colonic functions and systemic functions and reduce disease risk (Roberfroid, 2007).

Smoking is one of the oldest technologies for processing of meat products (Pöhlmann *et al*., 2012; Toth, 1982). Smoke is produced by the process of incomplete combustion of wood (Goulas and Kontominas, 2005). Smoking enhances the development of smoke color, taste, appearance, flavor, shelf life and bite in eat products (Lingbeck *et al*., 2014). Therefore, this study was conducted to evaluate the effects of fat replacement by chicory fiber addition and smoking treatment on quality characteristics of restructured meat products.

II. MATERIALS AND METHODS

Certified organic grade-vacuum packed, refrigerated lean pork and frozen pork backfat were obtained from Hansalimfood. The dried chicory fiber (Lyntz Inc.) was purchased from sales company. Restructured meat products were processed using 6 treatments: NA (non-additive), C5 (ground pork backfat 15% + chicory fiber 5%), C10 (ground pork backfat 10% + chicory fiber 10%), SNA (NA + smoking), SC5 (C5 + smoking), and SC10 (C10 + smoking). The processing procedure was described in follows. The restructured meat products contained 80% ground pork and 20% ground pork backfat. For comparative experiments, we added 12.5% of ice, 1% of STPP, 1.5% of NaCl, 0.2% of ascorbic acid, and 0.6% of spice. For each treatment, pork loin and backfat were ground using a meat grinder (M-12S, FUJEE), and then NaCl and STPP added to the meat and mixed for 3 min. Then, chicory fiber was added and mixed for 3 min. The temperature of the blended pork meat was maintained below 10℃ during mixture preparation. The mixtures

were stuffed into collagen casing (20-22mm of diameter, Nippi Collagen Industry, Shizuoka, Japan). The non-smoking treatments cooked to an internal temperature of 75℃ in water-bath (SW-90MW, JEIO TECH, Daejon, Korea). The smoking treatments dried (25min), smoked (60℃ for 30min) by sawdust, and then cooked to an internal temperature of 72℃ in smokehouse (Bastramat 1500; Byan & Strackbein Gmbh, Amsberg, Germany). The cooked restructured meat products were cooled with water spray and kept at 4℃. The restructured meat products were evaluated the quality characteristics. The results were analyzed using the SAS package Release 9.4 (SAS Institute, Cary, NC, USA) and the significance was defined at $p<0.05$.

III. RESULTS AND DISCUSSION

In the proximate analysis (Table 1), the restructured meat products containing chicory fiber decreased the moisture contents compared with control ($p<0.05$). The fat contents of restructured meat products were decreased by the addition of chicory fiber. However, the restructured meat products with smoking treatment had higher fat contents than un-treated restructured meat products ($p<0.05$). The ash contents were lower in the restructured meat products with smoking treatment than un-treated restructured meat products ($p<0.05$). In the texture profile analysis (Table 2), the springiness value of smoked meat products with 10 % chicory fiber was a higher compared to C5 and SC5 ($p<0.05$), and no treatments showed significant differences in cohesiveness. Additionally, chewiness and hardness decreased, except for SC10, with the addition of chicory fiber. In the color and pH values (Table 3), the L^* values of restructured meat products with chicory fiber and smoking showed no significant differences with respective control, except SC5, in which a^* values were increased following smoking treatment. The b^* values of C10 and SC10 were significantly decreased compared with the other treatments. The pH values of the NA and SNA were the highest ($p<0.05$) for all treatments, and the addition of chicory fiber significantly decreased the pH values. In the sensory characteristics (Table 4), the addition of chicory fiber and smoking treatment did not affect the sensory parameters including color, flavor, saltiness and total acceptability significantly. Overall, the color results tended to show that the SC10 received the highest score (4.00).

Table 1. Proximate analysis (%) of smoking (or not) restructured meat products following addition of chicory dietary fiber

Treat-ments*	Moisture	Protein	Fat	Ash
NA	65.44±0.95^{a}	21.23±0.32^{c}	11.72±0.36^{b}	2.53±0.08^{a}
C5	59.44±0.64^{c}	26.38±0.35^{a}	10.78±0.35^{c}	2.43±0.08^{ab}
C10	62.31±0.71^{b}	26.78±0.23^{a}	8.56±0.19^{e}	2.33±0.04^{b}
SNA	64.54±1.06^{a}	19.43±0.34^{d}	14.25±0.34^{a}	1.76±0.01^{d}
SC5	60.77±0.83^{bc}	23.85±1.11^{b}	13.43±1.03^{a}	1.92±0.08^{c}
SC10	61.91±1.51^{b}	26.66±0.12^{c}	9.55±0.16^{d}	1.86±0.05^{cd}

*NA: Ground pork backfat 20%, C5: Ground pork backfat 15% + Chicory fiber 5%, C10: Ground pork backfat 10% + Chicory fiber 10%, SNA: NA + Smoking, SC5: C5 + Smoking, SC10: C10 + Smoking.

$^{a-e}$Means±SD with different superscripts in the same column differ significantly($p < 0.05$).

Table 2. Texture profile analysis of smoking (or not) restructured meat products following addition of chicory dietary fiber

Treat-ments*	Springiness (%)	Cohesiveness (%)	Chewiness (kg)	Hardness (kg)
NA	78.88±3.08^{ab}	56.33±9.83	0.77±0.13^{a}	0.56±0.07^{ab}
C5	73.92±3.32^{b}	56.20±9.58	0.52±0.07^{b}	0.38±0.06^{c}
C10	78.78±2.22^{ab}	56.50±1.65	0.51±0.05^{b}	0.40±0.03^{c}
SNA	77.99±6.18^{ab}	58.92±6.94	0.61±0.09^{b}	0.51±0.07^{b}
SC5	66.79±4.99^{c}	49.48±2.19	0.51±0.10^{b}	0.32±0.05^{c}
SC10	81.43±2.37^{a}	59.89±6.17	0.80±0.05^{a}	0.65±0.05^{a}

*NA: Ground pork backfat 20%, C5: Ground pork backfat 15% + Chicory fiber 5%, C10: Ground pork backfat 10% + Chicory fiber 10%, SNA: NA + Smoking, SC5: C5 + Smoking, SC10: C10 + Smoking.

$^{a-c}$Means±SD with different superscripts in the same column differ significantly($p < 0.05$).

Table 3. Color and pH of smoking (or not) restructured meat products following addition of chicory dietary fiber

Treat-ments*	Color$^{1)}$			pH
	L	a	b	
NA	62.10±2.92^{bc}	12.30±0.68^{b}	11.01±0.36^{b}	6.03±0.00^{b}
C5	63.31±2.12^{b}	12.53±0.55^{b}	11.07±0.23^{b}	5.85±0.02^{e}
C10	60.22±1.00^{c}	12.41±0.75^{b}	10.48±0.17^{c}	5.92±0.03^{d}
SNA	63.55±1.31^{b}	13.99±0.65^{a}	11.61±0.35^{a}	6.09±0.00^{a}
SC5	69.29±1.88^{a}	13.01±1.11^{ab}	10.89±0.30^{b}	5.90±0.02^{d}
SC10	62.94±2.13^{bc}	12.96±1.13^{ab}	10.46±0.32^{c}	5.98±0.02^{c}

*NA: Ground pork backfat 20%, C5: Ground pork backfat 15% + Chicory fiber 5%, C10: Ground pork backfat 10% + Chicory fiber 10%, SNA: NA + Smoking, SC5: C5 + Smoking, SC10: C10 + Smoking.

a-eMeans±SD with different superscripts in the same column differ significantly($p < 0.05$).

1)L: lightness, a: redness, b: yellowness.

Table 4. Sensory characteristics of smoking (or not) restructured meat products following addition of chicory dietary fiber

Treat-ments*	Color	Saltiness	Flavor	Juiciness	Total acceptability
NA	3.33 ±0.57	3.33 ±1.15	3.33 ±0.57	3.33 ±0.57	3.33 ±0.57
C5	3.00 ±0.00	2.66 ±0.57	3.66 ±0.57	2.66 ±0.57	3.50 ±0.50
C10	3.66 ±0.57	3.33 ±1.52	4.00 ±1.00	3.33 ±0.57	4.00 ±1.00
SNA	3.66 ±1.15	2.66 ±1.15	3.00 ±1.00	3.00 ±1.00	3.16 ±0.76
SC5	3.33 ±0.57	2.33 ±0.57	3.33 ±1.15	2.66 ±0.57	2.66 ±1.52
SC10	4.00 ±1.00	2.00 ±0.00	3.33 ±1.52	3.33 ±0.57	3.00 ±1.00

*NA: Ground pork backfat 20%, C5: Ground pork backfat 15% + Chicory fiber 5%, C10: Ground pork backfat 10% + Chicory fiber 10%, SNA: NA + Smoking, SC5: C5 + Smoking, SC10: C10 + Smoking.

V. CONCLUSION

As a result, the addition of chicory fiber and smoking treatment had a positive effect on quality characteristics of restructured meat products. The fat content of meat products was decreased by the addition of chicory fiber, whereas the pH, chewiness and hardness values were reduced by the addition of chicory fiber. However, the decreased quality characteristics were compensated with the smoking treatment. Therefore, it was determined that the reduced quality characteristics by the addition of chicory fiber could be compensated with the smoking treatment, and manufacture healthy meat products.

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