EFFECT OF ADDITION OF POTATO ON THE QUALITY CHARACTERISTICS OF MEAT CHIP

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Abstract—**The aim of this study was to investigate the effect of addition of potato on the quality characteristics of meat chip. For samples preparation, chicken meat was mixed with 20% pork backfat, 10% pork backfat/10% potato, or 20% potato, cooked until the innertemperature of 80℃ was attained, and then dried at 50℃/RH 10% for 6 hr. As potato content was increased, the water activity was decreased, but the shear force value was increased (*P*<0.05). Unsaturated fatty acid contents were higher in 20% potato treatment (*P*<0.05) compare to the others. 20% potato-added meat chip was the highest moisture, crude protein,m and crude ash content (*P*<0.05), but the lowest in crude fat content (*P*<0.05). 20% potato meat chip was shown high TBARS value (*P*<0.05), while VBN value was low. In surface color, 20% potato meat chip resulted darker and less red (*P*<0.05). 20% patato treatment marked a low score in sensory evaluation.**

Index Terms—**meat chip, potato, low-fat**

I. INTRODUCTION

High intake of lipid can be a reason of obesity that is interrelated in heart disease, arteriosclerosis, cancer and so on (Bray & Popkin, 1998). As the recent consumption of meat increased, grew apprehension that meat products contain lipids. Consumer demanded the low-fat meat products and industry also tried to develop a fat replacement. But low-fat meat products showed lower quality on the flavor, texture, and juiciness than normal meat products (Warshaw & Franz, 1996). There are carbohydrate-based fat mimetics, protein-based fat mimetics, and fat-based fat mimetics. Modified starch, pectin, malodextrin, gum and dietary fiber are commonly used as a fat replacement. These make high moisture and decreasing drip loss on the meat products because of hydrocolloid that has high water-binding ability (Candogan & Kolsarici, 2003). Dried meat products have high protein and low lipid, so that can be storage in room temperature and transported easily. This is closely related with meat chip. In previous study in dried meat products, the effect of temperature and time on physicochemical properties and effect of rosemary, a-tocopherol and tripolyphosphate compared with nitrate were reported (Lee, Kim, Kim & Kang, 1997). However, there is little information on the effect of potato on the meat chip. Therefore, the aim of this study is to investigate the effect of addition of potato on the quality characteristics of meat chip.

II. MATERIALS AND METHODS

A. Sample preparation and exsperimental design

Chicken breast meat (Cherrybro Co., Ltd., Korea) and peeled potato were chopped by meat chopper (MEW-727, Mado Co., Germany) equipped with 6 mm plate. Three different kinds of meat chip, such as 20% pork backfat for control, 10% pork backfat+10% potato and 20% potato (Table 1), were processed for sample in vacum mixer (Mixer-600, Hyupjin Co., Ltd., Korea). After mixing, the mixtures were stuffed into Φ50 mm of PVDC casing using a stuffer (VF612, Handtmann Co., Germany). The meat chip samples were cooked until the innertemperature of 80℃ was attained, and then held at -20℃ to slice easilly. Those were sliced into 1.8 mm in thickness. After slicing, meat chip dried at 50℃/RH 10% for 6 hr.

B. Water activity

Water activity was measured using an aquaspector (AQS-2, Nagy, Germany).

C. Shear force

Shear force was measured using a texture analyzer (TA-XT2*i*, Stable Micro Systems Ltd., UK) equipped with a 25kg load cell, a flat knife blade, and a test speed setting of 2.0 mm/sec.

D. Fatty acid composition

The total lipids were extracted as described by Folch, Lee & Stanley (1957). The fatty acids were converted to fatty acid methyl esters (FAME) as described by AOAC (1995). Individual FAME peaks were identified by comparing their retention times with those of pure standards (Sigma-Aldrich Co., St. Louis, MO, USA).

E. Proximate composition

The proximate composition was performed as described by AOAC (1995).

F. TBARS

The TBARS (2-thiobarbituric acid reactive substances) value was measured as described by Sinnhuber and Yu (1977). The result was calculated as mg of malonaldehyde (MA) per kg of sample.

G. VBN

The VBN (volatile basic nitrogen) value, an index of protein deterioration, was determined as described by Kohsaka (1975). The amount of VBN was expressed as mg% of nitrogen.

H. Surface color

The samples were wrapped with a low density polyethylene film (oxygen transmission rate=35,273 cc/m^2 · 24hr · atm, 0.01 mm thickness, 3M Co., South Korea). Surface color (L^*, a^*, and b^*) was measured using a chroma meter (CR-400, Konica Minolta Sensing Inc., Japan).

I. Sensory evaluation

Ten-member trained laboratory panels were used to evaluate the sensory evaluation of meat-chip. The samples were served in randomized order on plates for each panelist. The following sensory attributes of appearance, taste, flavor, texture, and overall liking were evaluated using 9-point hedonic scales (9=extremely like, 5=moderately like, and 1-extremely unlike).

J. Statistical analysis

Data was analyzed using General Linear Model (GLM) procedure of SAS (1999) program. Significant differences among means were tested by the Duncan's multiple range tests at the 5% level.

III. RESULTS AND DISCUSSION

A. Water activity

Water activity was decreased as the increase of drying time (Fig. 1). 20% potato, and 10% pork backfat+10% potato meat chip were higher in water activity than 20% pork backfat meat chip. Water activity decreased slightly until 4 hr and dropped suddenly after 4 hr. At the end of drying time, 20% potato treatment was the lowest water activity (P<0.05) that was the highest before drying. As the report by Candogan & Kolsarici (2003), a higher water activity was observed in low-fat products.

B. Shear force

The shear force value increased as increasing contents of potato (Fig. 2). 20% potato treatment was more than two times shear force value of 20% pork backfat meat chip (P<0.05). Low-fat meat products had higher shear force values compared to high fat, that already reported by Suman & Sharma (2002).

Table 1. Formula of experimental meat chip

Ingredients (%)	20% pork backfat	10% pork backfat + 10% potato	20% potato
Pork backfat	20.0	10	0
Potato	0	10	20
Chicken breast meat	64.2	64.2	64.2
Soy sauce	0.9	0.9	0.9
Chicken seasoning-K	2.9	2.9	2.9
Starch	3.7	3.7	3.7
Flavor enhancer-G	0.2	0.2	0.2
Water	8.1	8.1	8.1
Total	100.0	100.0	100.0

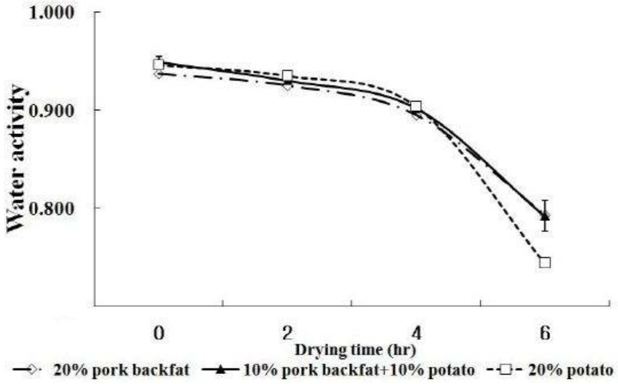

Fig. 1. Effect of addition of potato on the water activity of meat chip during drying.

C. Fatty acid composition

Fatty acid composition is shown in Table 2. 20% potato treatment had significantly lower ($P<0.05$) myristic acid (C14:0), oleic acid (C18:1n9) and cis-11-eicosenoic acid (C20:1n9) than 10% pork backfat and 20% backfat meat chip. Saturated fatty acid (SFA) and mono unsaturated fatty acid (MUFA) decreased as increasing replacement contents of pork backfat by potato, while unsaturated fatty acid (UFA), and poly unsaturated fatty acid (PUFA) increased ($P<0.05$).

D. Proximate composition

Proximate composition of meat-chip after drying is presented in Table 3. 20% potato treatment was the highest level of moisture and crude protein ($P<0.05$). 20% potato treatment was 19.59% and lower than others, 10% backfat treatment was 33.65% and 20% backfat treatment was 36.69% in crude fat. These results were effect by potato that contains about 78.1% of moisture and character of pork backfat that has higher lipid and lower moisture. These results agree with those reported by Choi, Choi, Han, Kim, Lee, Kim, Jeong, & Kim (2009), in which the moisture and protein contents significantly increased with the addition of vegetable oil and rice bran fiber to low-fat meat emulsion system.

E. TBARS and VBN

As shown in Table 3, TBARS value was higher in 20% potato treatment compare to the others (Candogan & Kolsarici, 2003). Unprocessed potato that added to meat chip might effect to increase the TBARS value. 20% potato treatment was much lower than 20% pork backfat treatment in VBN value that was opposite result of TBARS value.

F. Surface color

Surface color of meat chip was shown in Table 4. 20% potato treatment was much lower in lightness (L^*) value, but there were no significant differences between 20% pork backfat treatment and 10% pork backfat+10% potato treatment. 20% potato treatment was lowest in redness (a^*) value, while highest in yellowness (b^*) ($P<0.05$). Milky white color of backfat and yellow color of potato might result those data.

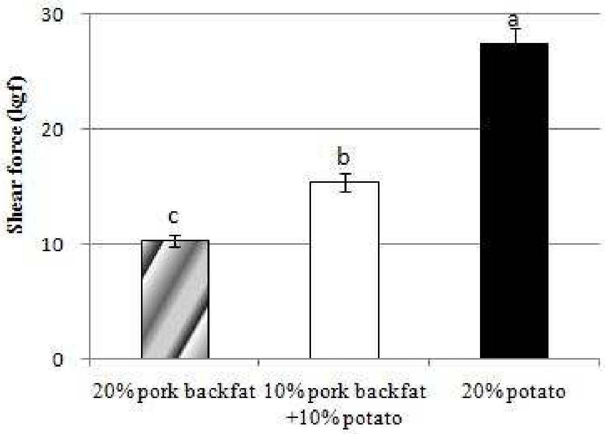

Fig. 2. Effect of addition of potato on the shear force value of meat chip.

Table 2. Effect of addition of potato on the fatty acid composition of meat chip

Traits	Treatments		
	20% pork backfat	10% pork backfat + 10% potato	20% potato
C14:0 (Myristic acid)	1.26±0.01^a	1.18±0.01^b	0.58±0.01^c
C16:0 (Palmitic acid)	23.22±0.09^b	23.34±0.06^a	21.23±0.08^c
C16:1n7 (Palmitoleic acid)	4.03±0.02^b	4.38±0.03^a	4.06±0.04^b
C18:0 (Stearic acid)	10.03±0.10^a	9.42±0.04^b	6.41±0.10^c
C18:1n9 (Oleic acid)	43.85±0.18^a	43.11±0.09^b	35.49±0.18^c
C18:2n6 (Linoleic acid)	15.28±0.12^c	16.25±0.08^b	28.53±0.18^a
C18:3n6 (γ-Linolenic acid)	0.05±0.00^c	0.08±0.01^b	0.19±0.01^a
C18:3n3 (Linolenic acid)	0.78±0.01^c	0.81±0.01^b	2.32±0.02^a
C20:1n9 (*cis*-11-eicosenoic acid)	0.90±0.01^a	0.85±0.03^b	0.42±0.01^c
C20:4n6 (Arachidonic acid)	0.48±0.03^b	0.46±0.02^b	0.62±0.02^a
C22:4n6 (DTA)	0.13±0.01^b	0.13±0.00^b	0.15±0.01^a
SFA	34.50±0.14^a	33.94±0.06^b	28.22±0.11^c
UFA	65.50±0.14^c	66.06±0.06^b	71.78±0.11^a
MUFA	48.77±0.17^a	48.33±0.08^b	39.97±0.22^c
PUFA	16.72±0.14^c	17.73±0.10^b	31.81±0.21^a
n6/n3	20.55±0.29^b	20.94±0.32^a	12.71±0.05^c

$^{a-c}$ Means±S.D. in the same row within different superscripts are significantly different ($P<0.05$).

Table 3. Effect of addition of potato on the proximate composition, TBARS value and volatile basic nitrogen value of meat chip

Traits	Treatments		
	20% pork backfat	10% pork backfat +10% potato	20% potato
Proximate composition (%)			
Moisture	17.62±1.16[b]	17.84±0.84[b]	19.86±0.51[a]
Crude fat	36.69±1.22[a]	33.65±0.68[b]	19.59±0.80[c]
Crude protein	28.95±0.92[b]	29.57±1.15[b]	32.71±1.05[a]
Crude ash	2.49±0.10[c]	2.67±0.17[b]	3.37±0.15[a]
TBARS(mg MA/kg)	1.45±0.22[c]	2.46±0.41[b]	8.49±0.92[a]
VBN (mg%)	110.61±3.82[a]	106.23±5.93[a]	81.36±3.92[b]

[a-c] Means±S.D. in the same row within different superscripts are significantly different ($P<0.05$).

Table 4. Effect of addition of potato on the color and sensory evaluation of meat chip

Traits	Treatments		
	20% pork backfat	10% pork backfat +10% potato	20% potato
L^* (Lightness)	60.6±1.6[a]	60.7±1.7[a]	59.8±1.6[b]
a^* (Redness)	9.3±0.9[a]	9.4±0.7[a]	7.1±0.9[b]
b^* (Yellowness)	20.7±1.1[b]	20.1±1.4[c]	22.1±1.2[a]
Sensory evaluation			
Appearance	8.1±0.3[a]	7.8±0.4[a]	6.0±1.2[b]
Taste	7.8±0.8[a]	6.8±0.8[a]	4.8±1.9[b]
Flavor	7.8±0.8[a]	6.7±1.4[a]	4.8±1.8[b]
Texture	8.1±0.6[a]	6.8±1.2[b]	4.3±1.6[c]
Overall liking	8.1±0.6[a]	7.0±0.9[b]	4.7±1.6[c]

[a-c] Means±S.D. in the same row within different superscripts are significantly different ($P<0.05$).

G. Sensory evaluation

The sensory evaluation of meat chip is presented in Table 4. 20% potato treatment scored the lowest in all category ($P<0.05$). These were as same as work by Warshaw & Franz (1996). No significant differences found between 20% pork backfat meat chip and 10% pork backfat meat chip in appearance, taste, and flavor.

IV. CONCLUSION

Potato addition into low-fat meat chip formulation resulted in products with lower water activity as compared to pork backfat meat chip. Respectively water activity increased in potato meat chip. Shear force value and unsaturated fatty acid content higher in potato meat chip than pork backfat meat chip. As the potato content increase, moisture, crude protein, and crude ash increased, while crude fat decreased. 20% potato meat chip was the highest in TBARS value, while the lowest in VBN value. 20% potato meat chip had low lightness and redness, and high yellowness. The sensory evaluation of 20% potato treatment produced low scores in appearance, taste, and flavor evaluation, while there were no significant differences among 20% pork backfat treatment and 10% pork backfat+10% potato treatment.

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