EFFECTS ON THE PHYSICOCHEMICAL AND SENSORY QUALITY CHARACTERISTICS OF FROZEN BEEF AND PORK WITH PARTS BY VARIOUS THAWING METHODS

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Abstract – In this study, the difference in physicochemical characteristics by thawing method was examined in electro-magnetic and air blast freezing beef(loin and round) and pork(belly and ham). Thawing methods for frozen meat used thawing by refrigeration (4±1□), room temperature (RT, 25□), cold water (15□) and microwave (2450MHz) and this test thawed meats until its temperature reaches at 0°C. Analysis was carried out drip and cooking loss, water holding capacity (WHC), moisture content and sensory evaluation by thawing. The results showed that meat thawed by microwave indicated low drip loss by thawing and high cooking loss with higher WHC regardless of part of beef and pork which are thawed by each thawing method. Sensory evaluation result was better at thawed beef by microwave regardless of its part, pork showed no difference in sensory evaluation for each thawing method and parts

Key Words – Frozen meat, Physicochemical and sensory properties, Thawing method

I. INTRODUCTION

Most frozen meat below 0°C is able to maintain the freshness by inhibiting the growth and proliferation of most microorganisms excepting psychotropic microbes. The common methods to thaw frozen food include RT thawing, cold water thawing, steam thawing and contact thawing. Changes in thawing processes of frozen meat include growth of microorganisms, weight loss due to drips, color change[1], WHC[2-3], rancidity[4] and softening of tissues, which causes lots of physicochemical changes[5-7].

Recently, various thawing methods are actively studied using high-pressure thawing, microwave thawing, ohmic thawing and acoustic thawing in order to minimize amount of drip occurring at thawing time and deterioration of quality[8-10]. He *et al*.(2013) reported that high voltage electro -static field process for frozen pork is able to reduce the number of bacteria in thawed frozen meat. Magnetic resonance quick freezing is used to minimize quality change. This freezing method maintains excessive freezing state by suppressing ice crystallization vibrating water molecule of inside and outside object simultaneously to prevent the destruction of cellular tissues[12].

II. MATERIALS AND METHODS

SAMPLES TREATMENTS

Samples of this study are used beef(loin and round) and pork(belly and ham) a day after slaughtered. The thickness of samples are cut 5-7cm and packed with aerobic packaging by unit of 500g. Samples are frozen by electro-magnetic freezing and air blast freezing respectively. Thawing methods for frozen meat used thawing by refrigeration (4±1□), RT(25□), cold water (15□) and microwave and this test thawed meats until its temperature reaches at 0°C.

ANALYSIS

Analysis items were drip and cooking loss, WHC, moisture content and sensory evaluation by various thawing. Sensory evaluation was carried out against appearance, flavor, texture, taste and preference with a scale of 9 points by heating the thawed samples.

III. RESULTS AND DISCUSSION

Drip loss

Fig. 1 and Fig. 2 show the change of drip loss of beef and pork after thawing according to different thawing methods. Drip loss after electro-magnetic resonance freezing (Fig 1.) showed significant difference depending on thawing methods ($p<0.05$). Drip loss from loin

and round in beef with microwave thawing indicated the lowest with 0.66% and 1.25% respectively. This showed that there are 17.5~25.0% and 10.1~23.3% of drip loss effect for loin and round in beef compared with thawing by refrigeration, RT and cold water.

In pork, drip loss of belly and ham are thawed by microwave after electro-magnetic resonance freezing are 0.75% and 0.65% respectively. This result are 3.8~20.2% and 4.4~9.7% of drip loss effect for belly and ham in pork compared with other treatments. In this case, drip loss of belly part showed higher than ham (p<0.05). Drip loss by thawing after air blast freezing showed similar pattern to variations depending on thawing after electro-magnetic resonance freezing (P<0.05).

High drip loss means that lots of water soluble substances coming out from muscle fiber indicating nutrition is also lost, which deteriorates nutritional values and cause lots of weight losses.

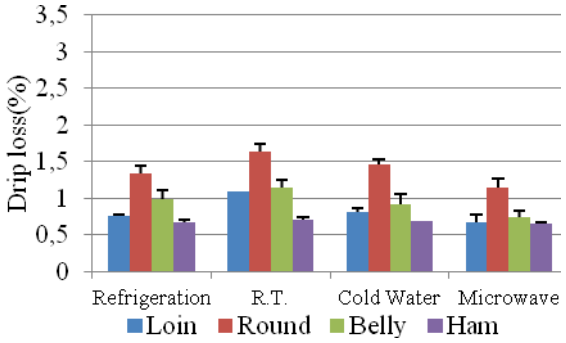

Fig. 1. Drip loss of beef and pork in electro magnetic resonance freezing by thawing methods (R.T. : Room Temperature).

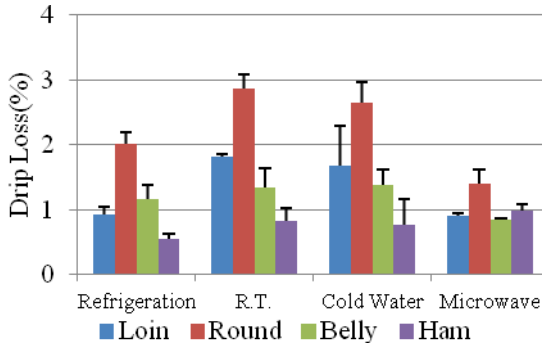

Fig. 2. Drip loss of beef and pork in air blast freezing by thawing methods(R.T. : Room Temperature).

Cooking loss and WHC of beef

Table 1 showed cooking loss and WHC for beef which is thawed by each thawing method after electro-magnetic resonance freezing. Cooking loss of loin showed 43.7% by refrigeration thawing and 52.0% by microwave for round of beef, which showed higher than those of other thawing methods (p<0.05). Cooking loss has fallen on 32.9 % to 35.6% at loin depending on thawing method and 41.0 – 49.1% in round of beef. Cooking loss didn't shown tendency for each part of beef. RT thawing in loin and refrigeration thawing in round of beef showed the lowest value (p<0.05). WHC for each part of beef has no difference. Table 1 showed results of cooking loss and WHC for thawed beef depending on thawing methods after it was frozen by air blast freezing. This result showed similar tendency to frozen beef by electro-magnetic resonance freezing showing opposite trend against results of drip loss by thawing. Yu *et al*. (2010) reported that the higher thawing rate, the myofibril is disrupted, drip and cooking loss by thawing and affect quality of beef.

Cooking loss and WHC of pork

Cooking loss and WHC of pork was evaluated for thawed pork depending on thawing methods after electro-magnetic and air blast freezing respectively. Table 2 shows that cooking loss for pork belly (28.2%, 31.3%, 32.5% and 32.6%) for each thawing method(refrigeration, RT, cold water and microwave) respectively while that of ham indicated 32.9%, 36.5%, 37.2% and 37.4% for each thawing method respectively. Only refrigeration thawed pork by each part showed significant difference (p<0.05). However, among other thawing methods didn't show significant difference. WHC for each thawing method has no difference depending on the range 58.5 - 60.7% for belly and 59.3 - 59.9% for ham part of pork. Table 2 showed cooking loss and WHC for pork by air blast freezing. From this result, cooking loss for each thawing method showed a difference (P<0.05). WHC for each thawing method showed overall 57.3 – 59.5% of range and thawing by microwave and refrigeration tends to show higher than thawing

Table 1 Cooking loss and WHC[1)] of beef with parts by thawing methods after electro magnetic resonance and air blast freezing. (Unit: %)

	Refrigeration		RT[2)]		Cold water[3)]		Microwave	
	Loin	Round	Loin	Round	Loin	Round	Loin	Round
Electro magnetic resonance freezing								
Cooking loss	43.7± 1.1^{c}	41.8± 2.4^{d}	34.7± 0.4^{f}	50.1± 0.7^{b}	35.7± 0.6^{fe}	50.8± 0.5^{ba}	37.0± 0.4^{e}	52.0± 0.7^{a}
WHC	60.7± 0.9^{c}	61.9± 1.9^{bc}	61.6± 0.9^{bc}	61.8± 0.4^{bc}	61.8± 0.3^{bc}	62.0± 0.2^{bac}	62.2± 0.5^{ba}	63.3± 0.4^{a}
Air blast freezing								
Cooking loss	35.2± 1.2^{d}	41.0± 1.2^{c}	33.7± 0.1^{ed}	48.3± 2.0^{a}	32.9± 0.2^{e}	45.5± 0.8^{b}	35.6± 1.6^{d}	49.1± 0.1^{a}
WHC	57.9± 1.0^{c}	57.7± 0.8^{c}	59.8± 0.2^{b}	59.9± 0.1^{b}	58.1± 0.2^{c}	59.8± 0.3^{b}	60.6± 0.0^{b}	61.5± 0.5^{a}

$^{a-f}$Means within row with different superscripts are significantly different (p<0.05).
$^{1)}$WHC : Water holding capacity,
$^{2)}$R.T. : Room temperature, 25±1□ , $^{3)}$ Cold water : 15±1□

Table 2 Cooking loss and WHC[1)] of pork with parts by thawing methods after electro magnetic resonance and air blast freezing (Unit: %)

	Refrigeration		RT[2)]		Cold water[3)]		Microwave	
	Belly	Ham	Belly	Ham	Belly	Ham	Belly	Ham
Electro magnetic resonance freezing								
Cooking loss	28.2± 3.4^{c}	32.9± 1.3^{b}	31.3± 0.5^{b}	36.5± 0.7^{a}	32.5± 1.0^{b}	37.2± 0.7^{a}	32.6± 0.6^{b}	37.4± 0.1^{a}
WHC	60.7± 3.6^{a}	59.9± 1.9^{a}	58.5± 0.4^{a}	59.3± 0.8^{a}	58.6± 0.7^{a}	59.3± 0.8^{a}	58.6± 0.3^{a}	59.8± 0.3^{a}
Air blast freezing								
Cooking loss	35.2± 1.2^{d}	41.0± 1.2^{c}	33.7± 0.1^{ed}	48.3± 2.0^{a}	32.9± 0.2^{e}	45.5± 0.8^{b}	35.6± 1.6^{d}	49.1± 0.1^{a}
WHC	57.9± 1.0^{c}	57.7± 0.8^{c}	59.8± 0.2^{b}	59.9± 0.1^{b}	58.1± 0.2^{c}	59.8± 0.3^{b}	60.6± 0.0^{b}	61.5± 0.5^{a}

$^{a-c}$Means within row with different superscripts are significantly different (p<0.05).
$^{1)}$WHC : Water holding capacity
$^{2)}$R.T. : Room temperature, 25±1□ , $^{3)}$ Cold water : 15±1□

Sensory evaluation of beef

The results of sensory evaluation summarized in Table 3. for thawed beef depending on thawing methods after electro-magnetic and air blast freezing respectively. Texture of beef loin for each thawing method after electro magnetic resonance freezing indicated 8.0 for thawing by microwave, 8.0 for cold water and 7.9 for RT thawing higher value than thawing by refrigeration (P<0.05). Round part showed higher value in texture indicating 7.9 for microwave, 6.6 for cold water, 6.4 for RT and 4.7 for thawing by freezing(p<0.05). Preference showed that loin has no significant difference among treatments. However, round indicated significant difference (P<0.05). Therefore, it's showed that thawing by microwave gives better sensory evaluation. In air blast freezing, texture of loin indicated 6.7 for RT and 7.3 for thawing by refrigeration while that at round showed 6.0 for thawing by refrigeration and 7.3 for microwave thawing (p<0.05). Its preference at loin showed 6.3 for RT thawing and 7.3 for thawing by refrigeration indicating same

Sensory evaluation of pork

Sensory evaluation(Table 4) was evaluated for thawed pork depending on thawing methods after electro-magnetic freezing and air blast freezing respectively. Texture of pork belly for each thawing method after electro magnetic resonance freezing indicated 7.4 for thawing by refrigeration, 7.4 for cold water, 7.2 for microwave and 6.4 for RT (P<0.05). However, texture at ham indicated no difference for each treatment showing for microwave(7.9), for cold water(8.0), for RT(8.1) and for refrigeration(6.7). Although preference is better for thawing by microwave, there is no significant difference for each thawing method. The results indicate no significant difference for each thawing method by air blast freezing. Texture at pork belly showed 6.4 for RT thawing and 7.4 for cold water thawing while that at ham shows 6.6 for thawing by cold water and 7.3 for thawing by microwave. Preference also showed same tendency as texture indicating 6.6 at pork belly for RT thawing and 7.1 for microwave thawing.

Table 3 Sensory evaluation of beef with parts by thawing methods after electro magnetic resonance and air blast freezing (points)

	Refrigeration		RT[1)]		Cold water[2)]		Microwave	
	Loin	Round	Loin	Round	Loin	Round	Loin	Round
Electro magnetic resonance freezing								
Appearance	6.6± 1.3^{b}	6.1± 1.5^{b}	8.0± 0.0^{a}	7.6± 1.1^{ab}	7.6± 0.5^{ab}	7.9± 0.3^{a}	7.6± 0.7^{ab}	7.6± 0.5^{ab}
Texture	5.7± 2.1^{bc}	4.7± 2.0^{c}	7.9± 0.6^{a}	6.4± 1.5^{b}	8.0± 0.5^{a}	6.6± 1.1^{b}	8.0± 0.5^{a}	7.9± 0.8^{a}
Taste	6.3± 2.0^{b}	5.2± 1.9^{b}	7.4± 0.7^{ab}	7.0± 1.0^{ab}	7.9± 0.6^{a}	7.6± 0.9^{ab}	7.6± 0.5^{ab}	7.9± 1.2^{a}
Preference	6.3± 1.8^{b}	4.8± 1.9^{c}	7.4± 0.7^{ab}	6.9± 0.9^{ab}	7.9± 0.6^{a}	7.6± 0.9^{ab}	8.0± 0.5^{a}	7.9± 1.2^{a}
Air blast freezing								
Appearance	7.5± 0.5^{a}	7.0± 0.9^{ab}	7.0± 0.7^{ab}	7.6± 0.5^{a}	7.1± 0.6^{ab}	7.3± 0.9^{e}	6.7± 0.7^{b}	7.6± 0.5^{a}
Texture	7.3± 0.9^{a}	6.0± 0.7^{b}	6.7± 0.9^{ab}	7.0± 1.0^{a}	7.1± 0.9^{a}	7.0± 0.5^{a}	7.1± 1.1^{a}	7.3± 1.0^{a}
Taste	7.1± 0.4^{a}	6.1± 0.9^{b}	6.0± 0.7^{b}	7.1± 0.8^{a}	6.1± 0.6^{b}	7.6± 0.5^{a}	6.9± 0.9^{ab}	7.6± 0.5^{a}
Preference	7.3± 0.5^{a}	5.8± 0.7^{b}	6.3± 0.9^{b}	7.1± 0.8^{ab}	6.6± 0.7^{ab}	7.6± 0.5^{a}	7.0± 0.7^{ab}	7.6± 0.7^{a}

$^{a-c}$Means within row with different superscripts are significantly different (p<0.05).
$^{1)}$WHC : Water holding capacity
$^{2)}$R.T. : Room temperature, 25±1□ , $^{3)}$ Cold water : 15±1□

Table 4. Sensory evaluation of pork with parts by thawing methods after electro magnetic resonance and air blast freezing (points)

	Refrigeration		RT[1)]		Cold water[2)]		Microwave	
	Belly	Ham	Belly	Ham	Belly	Ham	Belly	Ham
Electro magnetic resonance freezing								
Appearance	7.8± 1.5^{a}	7.6± 1.2^{a}	7.6± 0.9^{a}	7.6± 0.9^{a}	7.6± 0.9^{a}	7.6± 0.9^{a}	7.6± 0.7^{a}	7.6± 0.5^{a}
Texture	7.4± 1.6^{ab}	6.7± 1.5^{ab}	6.4± 1.3^{b}	8.1± 0.8^{a}	7.4± 1.1^{ab}	8.0± 0.5^{a}	7.2± 1.3^{ab}	7.9± 0.3^{a}
Taste	7.2± 1.5^{ab}	6.8± 1.5^{ab}	6.9± 0.9^{ab}	7.4± 1.2^{ab}	7.4± 1.0^{ab}	7.6± 0.9^{a}	7.9± 0.8^{a}	7.9± 0.6^{a}
Preference	7.1± 1.6^{ab}	6.8± 1.6^{ab}	7.0± 0.9^{ab}	7.2± 1.1^{a}	7.6± 0.9^{a}	7.6± 0.9^{a}	7.6± 0.7^{a}	7.9± 0.6^{a}
Air blast freezing								
Appearance	7.4± 0.8^{ab}	7.9± 0.8^{a}	7.7± 0.5^{a}	7.4± 0.5^{ab}	7.3± 0.5^{ab}	7.4± 0.5^{ab}	7.0± 0.5^{ab}	7.4± 0.5^{ab}
Texture	7.1± 0.8^{a}	7.0± 0.9^{a}	6.4± 0.5^{ab}	7.0± 0.5^{a}	7.4± 0.9^{a}	6.6± 1.0^{ab}	6.9± 1.2^{a}	7.3± 0.7^{a}
Taste	7.1± 1.0^{a}	7.2± 0.8^{a}	6.6± 0.7^{a}	6.9± 0.3^{a}	7.3± 0.9^{a}	7.0± 0.8^{a}	7.4± 0.7^{a}	7.0± 0.7^{a}
Preference	7.0± 0.8^{a}	7.1± 1.0^{a}	6.6± 0.7^{a}	6.7± 0.5^{a}	7.1± 0.8^{a}	6.9± 0.8^{a}	7.1± 0.8^{a}	7.0± 0.7^{a}

$^{a-d}$Means within row with different superscripts are significantly different (p<0.05).
$^{1)}$WHC : Water holding capacity
$^{2)}$R.T. : Room temperature, 25±1□ , $^{3)}$ Cold water : 15±1□

IV. CONCLUSION

The difference in physicochemical characteristics by thawing method was examined in electro-magnetic and air blast frozen beef(loin and round) and pork(belly and ham). The results showed that microwave thawing was indicated low drip loss and high cooking loss with higher WHC regardless of beef and pork which are thawed by each thawing method. Sensory evaluation result was better at thawed beef by microwave, pork showed no difference for each thawing method and parts. Therefore, assignment of freezing and thawing conditions is showed to be important when meat is frozen or thawed.

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