EFFECT OF INJECTION LIQUID EDIBLE TALLOW WITH DIFFERENT BINDER AGENTS ON BEEF *M. semimembranosus* STEAK QUALITY

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Abstract – The effect of injecting liquid edible tallow into beef steaks. About 10% of the tallow in the meat injected, with binders, plasma powder 4% (T1), transglutaminase (TGase) 0.5% (T2), plasma powder 2% and TGase 0.25%(T3) for the liquid edible tallow. Proximate analysis revealed tallow-injected steaks had 11.6~13.9% more (*P*<0.05) tallow and 11.3~14.2% less (*P*<0.05) moisture than control steaks. The pH values were lowest in T2 than the other steaks (*P*<0.05). The yellowness (CIE b*) was significantly lower in T3 relative to the other steaks (*P*<0.05). Shear Force values of T2 and T3 were significantly lower than the other steaks (*P*<0.05). Cooking loss and TBARS values increased for tallow-injected steaks than controls (*P*<0.05). Hardness and gumminess decreased for tallow-injected steaks than controls (*P*<0.05). In summary, tallow-injected steaks had increased cooking loss and TBARS values, but improved texture properties.

Key Words – Marbling, Inject tallow, Tenderness

I. INTRODUCTION

A beef steak with adequate marbling is generally perceived to be the tender, juicy and flavorful. Consumers rate tenderness, juiciness and flavor as important sensory attributes when consuming beef steaks [1]. Generally, beef quality is determined by the marbling, color, firmness and texture of meat. Especially, marbling is an important factor in the Korean beef industry because consumers judge meat quality on the basis of the degree of marbling [2]. Hanwoo beef (Korean native cattle) 1+ grade fat content was loin 17.69% and top round 7.30% [3]. It has been shown that intramuscular fat improves eating quality upon 15% in its extractable level [4], and explains approximately 10 ~ 15% of variations in palatability [5]. One method to improve these attributes is through enhancement. A technique has been developed for injecting liquid tallow into beef steak. Durham *et al.* [6] was technique injection lipid for marbling beef carcasses.

The binding agents can be use of various ingredients, such as, alginate, polysaccharide, fibrinogen, and transglutaminase (TGase). Plasma proteins contain a complex mixture of proteins, of which serum albumin, globulins and fibrinogen are the most important. [7]. Also, TGase catalyzes an acyl transfer reaction between the γ-carboxylamide group of a peptide-bound residue and a primary amine [8].

Injection technology has not been adopted for widespread commercial use by the beef industry but could be very effective for enhancing beef tenderness, juiciness, and flavor [9]. The objective of this study was to evaluate the effect of injecting liquid edible tallow with different binding agents on the chemical composition, physicochemical properties and textural properties of beef *M. semimembranosus* for steaks.

II. MATERIALS AND METHODS

The muscle of beef *semimembranosus* was dissected from carcass 48 h postmortem. Excess fat and visible connective tissue were removed from the fresh muscles. Internal and subcutaneous tallow was coarse ground (1.27 cm plate) and melted tallow was cooked to >70°C then shortening filter cones to remove solids. Strained tallow was stored in a aluminum container maintained at 40°C, added 4% plasma powder (T1), 0.5% TGase (T2), 2% plasma powder and 0.25% TGase (T3) at tallow.

Muscles were injected with prepared and filtered 40°C edible tallow using a mechanical injector.

About 10% of the tallow in the meat injected with binders. Treated and control loins were vacuum packaged and stored in a freezer at -29°C during 72h and 4°C during 24h.

For pH determination, 3 g of sample were homogenized with 90 ml of distilled water. The pH value of the sample was determined using a pH meter (MP230, Mettler Toledo, Switzerland). The color (CIE *L**, *a**, *b**) were determined using Chromameter (CR-300, Minolta Co., Japan). Cooking loss (%) was recorded for each sample by weighing before and after cooking at 90°C until an internal endpoint temperature of 71°C was reached. Shear force was determined by using an Instron 3343 (US/MX50, A&D Co., MA, USA) equipped with plunger No. 3(ø 0.2 mm). 2-Thiobarbituric acid-reactive substance (TBARS) was determined according to the method of Buege and Aust [10]. Textural analysis were obtained with a 20 kg load cell applied at a cross-head speed of 2 mm/s using of Rheo-meter (Compac-100, Sun scientific Co., Tokyo, Japan). The statistical analysis was performed by SAS program [11]. The data were subjected to analysis of variance (ANOVA) and Duncan's test to compare the sample means. The significance level was P>0.05.

III. RESULTS AND DISCUSSION

Marbling fat is an adipose tissue embedded in a connective tissue matrix with a muscle [6]. In the control beef (C), there was a lack of visible marbling fat because the muscle was relatively lean with less than 10% total lipid finely distributed in the muscle (Fig. 1).

The chemical composition of tallow-injection beef steaks is shown in Table 1. Tallow-injected steaks had 51.65~54.55% moisture and 18.72~21.02% fat which was different (P<0.05) than controls that 65.86% moisture and 7.16% fat. All steaks no significantly different in protein content 21.43 ~24.62% and ash content 0.95~1.03%.

The effect of injecting liquid edible tallow with different binding agents on physic-chemical properties of beef steaks is shown Table 2. The pH values were lowest in T2 than the other steaks (P<0.05). The yellowness (CIE *b**) was significantly lower in T3 relative to the other steaks (P<0.05).

Shear Force values of T2 and T3 were significantly lower than the other steaks (P<0.05). This indicated that the injection of tallow when compared with control increased tenderness of beef steaks. Brewer *et al.* [12] reported that when marbling increased from less than 1% to approximately 3.5%, sensory tenderness scores for pork increased. Texture properties of tallow-injection beef steaks are shown in Table 3. Hardness and gumminess decreased for tallow-injected

C T1 T2 T3

Fig. 1. Beef *M. semimembranosus* skesks

[1)] C, control; T1, tallow injection with plasma powder 4%; T2, tallow injection with TGase 0.5%; T3, tallow injection with plasma powder 2% and TGase 0.25%. Tallow injection at an average of 10% by meat weight.

Table 1. Chemical composition of tallow-injection beef steaks

	Treatments[1)]			
	C	T1	T2	T3
Moisture (%)	65.86±0.23^{A}	53.52±1.87^{BC}	51.65±0.74^{C}	54.55±1.60^{B}
Fat (%)	7.16±0.76^{B}	18.72±1.01^{A}	21.02±2.56^{A}	20.48±2.66^{A}
Protein (%)	22.19±0.12	21.43±0.36	24.62±1.56	23.51±1.70
Ash (%)	0.95±0.06	0.96±0.02	1.03±0.05	0.98±0.04

[1)] C, control; T1, tallow injection with plasma powder 4%; T2, tallow injection with TGase 0.5%; T3, tallow injection with plasma powder 2% and TGase 0.25%. Tallow injection at an average of 10% by meat weight.

[A-D] Means with different superscript in the same row significantly differ at P<0.05.

Table 2. Comparison of physicochemical properties of tallow-injection beef steaks

	Treatments[1)]			
	C	T1	T2	T3
pH	5.47±0.02^{A}	5.47±0.04^{A}	5.36±0.02^{B}	5.41±0.04^{AB}
L*	37.82±0.79	39.09±3.36	39.04±1.06	39.51±1.68
a*	20.97±1.16	20.49±0.67	20.50±1.57	19.87±1.31
b*	9.63±0.41^{A}	8.98±0.43^{AB}	9.20±1.05^{AB}	8.37±0.90^{B}
Shear force (kg/cm^2)	3.09±0.29^{A}	2.52±0.25^{B}	1.96±0.19^{C}	1.99±0.46^{C}
Coking loss (%)	36.72±1.61^{B}	41.85±1.73^{A}	41.39±1.91^{A}	42.06±1.81^{A}
TBARS (mgMA/kg)	0.51±0.02^{B}	0.79±0.11^{A}	0.81±0.16^{A}	0.82±0.07^{A}

$^{A\text{-}C}$ Means with different superscript in the same row significantly differ at P<0.05.

[1)] Treatments are the same as in Table 1.

Table 3. Texture properties of tallow-injection beef steaks

	Treatments[1)]			
	C	T1	T2	T3
Hardness (N)	123.30.02±12.83^{A}	57.31±12.10^{C}	99.62±8.94^{B}	80.28±17.74^{BC}
Cohesivness (%)	30.74±5.26	29.06±5.03	29.54±4.57	27.50±2.25
Springness (%)	54.15±3.92	61.56±3.64	61.06±11.92	55.57±9.85
Gumminess (g)	710.47±113.90^{A}	336.79±161.60^{B}	477.69±155.50^{AB}	363.87±139.40^{B}

$^{A\text{-}C}$ Means with different superscript in the same row significantly differ at P<0.05.

[1)] Treatments are the same as in Table 1.

steaks than controls (P<0.05). T1 was lowest hardness and gumminess (P<0.05). Cooking loss was 4.67~5.34% greater (P<0.05) for tallow-injected steaks than controls. Holmes *et al.* [13] reported that when fat-injected steaks increased cooking loss by 8.6% than non-enhanced control. It suggest that the lower the cooking loss by adding a binder. TBARS values increased 0.28~0.31mgMA/kg for tallow-injected steaks than controls (P<0.05).

The injected tallow gives a slightly pearl-like appearance, but can be distributed in any manner desired.

IV. CONCLUSION

The results demonstrated that marbling-like intramuscular fat could be created in beef through the injection of liquid edible tallow. The incorporation of tallow in the liquid allowed the injected product while more fat content, tender, cooking loss, TBARS values than control. Further research is needed to evaluate the sensory attributes and consumer acceptance of the products.

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