# COLLAGEN TYPES OF HANWOO BEEF IN RELATION TO TEXTURE PROPERTIES OF INDIVIDUAL MUSCLES

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**Abstract – The study was conducted to investigate the aging effect on collagen characteristics and texture properties of 10 major beef muscles including *Psoas major* (PM), *Longissimus thoracis* (LT), *Longissimus lumborum (LL), Gluteus medius* (GM), *Semimembranosus* (SM), *Semitendinosus* (ST), *Biceps femoris* (BF), *Triceps brachii (TB), Supraspinatus* (SS), and *Diaphragm* (DP) from Hanwoo steer (n=15) at 3 and 21 day aging. Amount of total collagen and collagen type I and III, WBSF, tensile testing and texture profile analysis of steer varied (P<0.001) between muscles. WBSF and tensile testing parameters (P<0.001) of the muscles were decreased during 21d aging. No significant aging effect was found for collagen characteristics and hardness. From current results it suggested that type I and III collagen and collagen characteristics are related to cooked meat texture properties.**

**Key Words –collagen types, Hanwoo beef, WBSF, tensile testing, texture profile analysis**

## I. INTRODUCTION

The collagen and interrelations between chemical constituents, i.e. proteins and fat content is mainly responsible for meat texture attributes thus, the collagen is a more direct measure of the tenderness and other texture parameters. The collagen fibrillar structure remain as it is up to ten days post-mortem but the advancement of aging structural consistency changes noticeably observable after 14 days of post mortem [1, 2]. Although, several studies reported that the marine animal by-products have been used for the extraction and characterization of collagen and best of our knowledge, none of the work has been reported for the extraction of collagen from bovine meat samples, limited information regarding collagen types of Korean native cattle Hanwoo beef in relation to texture properties of individual muscles is available in the scientific literature. Therefore, the study aimed to evaluate the effect of muscle types and aging on collagen characteristics and texture properties of Hanwoo beef.

## II. MATERIALS AND METHODS

The ten different muscles were collected from 25-30 mon age of Hanwoo steer **(**n=15). The muscles were vacuum-packaged and stored 4ºC for 3 and 21 d of aging.
**The total and heat soluble collagen** was determined using colorimetric method of Kolar [3]. Collagen extraction was performed by the methods of Muralidharan et al., [4] and SDS-PAGE was performed according to the method of Laemmli [5] with a slight modification. The image of SDS-PAGE gel was taken by the Versadoc Imaging system model 3000 Bio–Rad with Quantity One software. The densitometry for collagen protein specific bands was done in Gel Documentation System (Alpha Innotech, USA).
**Texture measurements**; All textural measurements were done on Instron Universal Testing Machine (Model 3342, USA). The WBSF evaluated on 6 pieces core samples with 0.5 inch diameter and sheared at a crosshead speed of 400 mm/min, using a 40 kgf load cell. Tensile testing was conducted on 6 strips with 70x10x10 mm thick per sample. Stretching was performed at 50 mm/min. TPA was done on 3 cuts in a rectangular trapezoid shape with 0.5x1.5x70x60 cm per sample. Each sample underwent 2 cycles of 60% compression at constant speed 50 mm/min. Data were analyzed using the GLM procedure and Duncan's multiple range test of SAS Version 9.3 (SAS Institute, Cary, NC, USA).

## III. RESULTS AND DISCUSSION

Amount of total collagen of steer varied (P<0.001) between muscles. The rather large differences in total collagen content among muscles likely contributed to some of the texture parameters differences among muscles. In terms of collagen type I and III there is significant muscle (P<0.001) effect is found. The high quality muscles have lower proportion of the type III collagen. At 21d aging, collagen type III significantly decreased in all muscle due to type

III collagen preferably destroyed during aging period, while type I collagen did not change significantly for all muscles examined (Table 1). WBSF and tensile testing parameters (P<0.001) of the muscles were decreased during 21d aging. No significant aging effect was found for collagen characteristics and hardness. Moreover the tensile tests or breaking parameters depend on the properties of both the connective tissue and muscle fibres. The maximum stress at a high strain can related to collagen content, and number of links between collagen molecules, there could be a genetic influence in collagen composition and part of the variability in mechanical properties between muscles might be due in part to the distribution of the perimysium. The decrease of tensile parameters subjected to aging was found its reflection in lower values of the WBSF in 21d aged muscles. The compression values were affected by muscle type probably because of genotype differences in the contribution of connective tissue and intramuscular fat content.

Table 1 Effects of muscle and aging on collagen characteristics, texture parameters

| Muscle | Total collagen, g/100g | | Collagen solubility, g/100g | | Type I collagen | | Type III Collagen | | WBSF | | Tensile maximum force, kgf | | Hardness, kgf | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3d | 21d | 3d | 21d | 3d | 21d | 3d | 21d | 3d | 21d | 21d | 3d | 21d | |
| PM | 0,21d | 0,20d | 0,11d | 0,13d | 11,6i | 12,7i | 2,15jx | 1,93jy | 2,77c | 2,87d | 2,9ex | 2,4bcy | 4,0cd | 4,0d |
| LT | 0,29d | 0,27d | 0,15d | 0,16cd | 11,8h | 12,6i | 2,63ix | 2,38iy | 3,89bx | 2,72dy | 2,7ex | 1,0gy | 5,6de | 5,2c |
| LL | 0,29d | 0,28d | 0,14d | 0,14cd | 12,6g | 13,7h | 2,91hx | 2,55hy | 5,38ax | 2,77dy | 2,8ex | 1,1gy | 4,9bc | 4,6cd |
| GM | 0,50bc | 0,43cd | 0,24cd | 0,19bc | 15,5e | 15,8f | 3,93fx | 3,72fy | 4,52bx | 3,08cy | 3,1cdx | 1,4gfy | 6,3bc | 6,2b |
| SM | 0,37cd | 0,34d | 0,18d | 0,18bc | 13,4f | 14,7g | 3,20gx | 3,01gy | 4,09bx | 3,85bcy | 3,9bcx | 1,8fey | 7.0ab | 6,6ab |
| ST | 0,61b | 0,51bc | 0,29ab | 0,25ab | 16,2c | 16,8d | 4,36dx | 3,95dy | 4,27bx | 4,71aby | 4,7ax | 2,2cdy | 7,7a | 7,2a |
| BF | 0,64b | 0,60b | 0,24bc | 0,33a | 17,3a | 18,7a | 5,11ax | 4,67ay | 4,28bx | 3,35aby | 3,4cdx | 1,7efy | 7,6a | 7,5a |
| TB | 1,02a | 0,85a | 0,30a | 0,33a | 16,5b | 17,2c | 4,26ex | 3,90ey | 5,48ax | 4,38ay | 4,4abx | 2,6aby | 7,1ab | 6,9ab |
| SS | 0,53bc | 0,52bc | 0,22bc | 0,23bc | 15,7d | 16,4e | 4,47cx | 4,06cy | 4,38bx | 3,95aby | 4.0bcx | 2,1cdy | 7,6ax | 6.5by |
| DP | 0,65b | 0,60b | 0,29ab | 0,26ab | 16,6b | 17,4b | 4,60bx | 4,34by | 4,10bx | 3,68cy | 3,78cdx | 3.0ay | 4,8bc | 4,8cd |
| SEM | 0.03 | 0.04 | 0.07 | 0.07 | 0.001 | 0.001 | 0.05 | 0.07 | 0.001 | 0.006 | 0.06 | 0.06 | 0.33 | 0.29 |
| M df 1) 13/146 | 16.7*** | 11.1*** | 3.8*** | 6.2*** | 17.9*** | 17.3*** | 715*** | 557*** | 10.2*** | 11.6*** | 8.7*** | 13.5*** | 18*** | 18*** |
| A df 2) 1/29 | 0.3 | | 0.5 | | 0.3 | | 37.8*** | | 45.3*** | | 27.9*** | | 0.8 | |

a-I, means within column with different superscripts are significantly different; X, Y, means within row with different superscripts are significantly different; *** P<0.001, ** P<0.01, * P<0.05; M df 1), degree of freedom-muscle effect; A df 2), degree of freedom-aging effect

## IV. CONCLUSION

The results reported here for ten muscles from two groups of aging procedure suggest that the percentage of type I and III collagen might be a possible indicator of texture properties between different muscles of same carcasses as more have been found in locomotive muscles than in postural muscles. Type I and III collagen are more closely correlated to beef tensile and TPA parameters than WBSF. The WBSF values may related to the myofibrillar component of toughness than to the connective tissue component. The type III collagen was more susceptible to proteolysis during aging than type I collagen.

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