

우육의 근육내 및 근육간  
관능적, 생화학적 특성 변이

이 민 석  
(고려대)



# **Variation in Palatability & Biochemical Traits Within & Among Eleven Beef Muscles**

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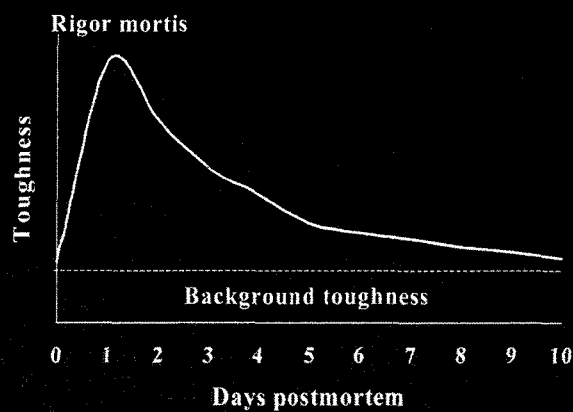
## **Presentation Outline**

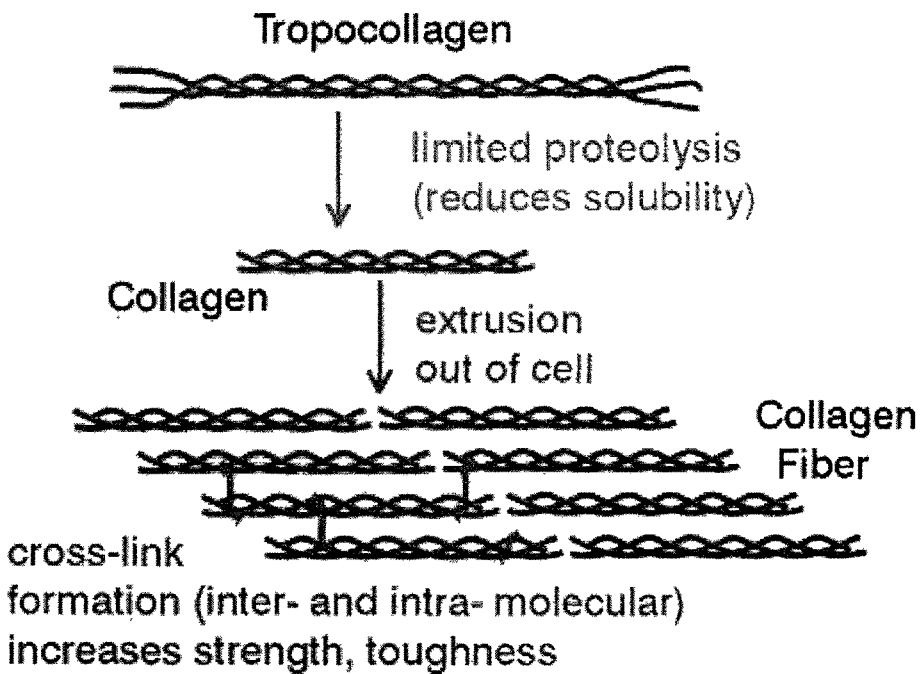
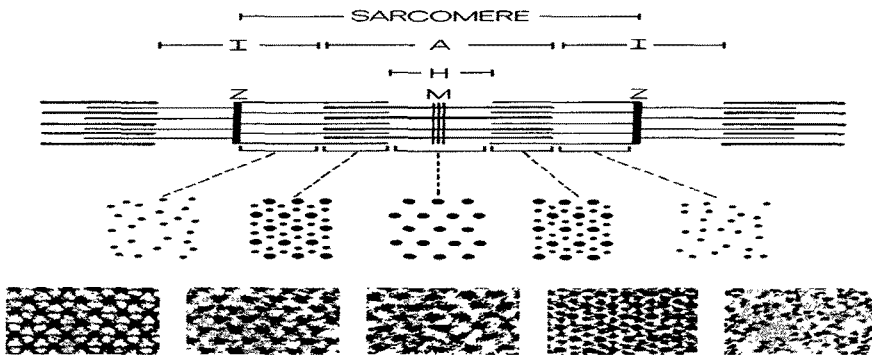
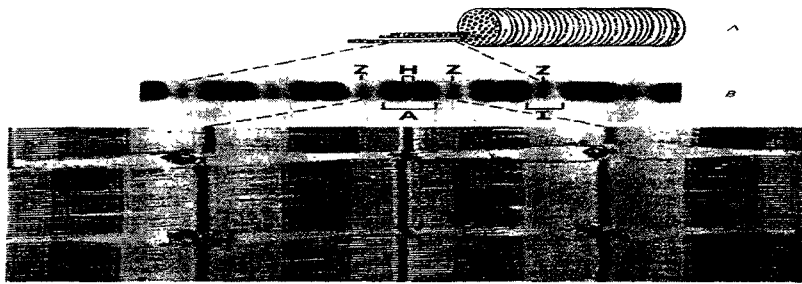
- **Introduction (related beef tenderness)**
- **Objectives**
- **Materials & Methods**
- **Results (tenderness variation)**
- **Conclusions**

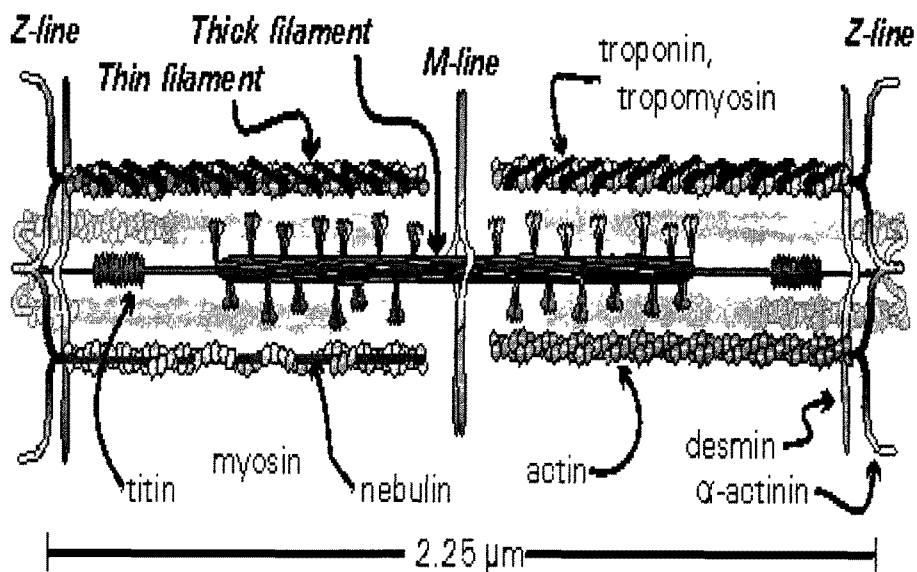
## Beef Tenderness

- Consumers: guaranteed tender beef
- Inconsistency in meat tenderness
- Lower quality cuts
- Most researches on the longissimus
- Variation sources and amounts among and within major beef muscles?

## Effect of Aging on Beef Tenderness







## Objectives

- To determine the extent of variation in biochemical and palatability traits within and among eleven beef muscles
- To determine within and among muscle relationships between biochemical and palatability traits

# Materials & Methods

## Samples

- **Animals:** thirty-one Charolais × MARC III steers

Muscle dissection (72 h PM) & vacuum-packaging



Stored at 2°C until 14 d PM & frozen at -30°C



Cut into 2.54 cm thick steaks & vacuum-packaging



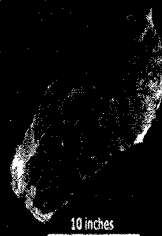
Thawing (5°C) & cooking (belt grill)



## Chuck

### Infraspinatus (IS)

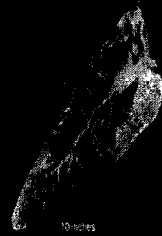
Flat iron, Top blade



Ventral end	
Location 1	
Sensory	
Sensory	
Location 2	
-	
Location 3	
Dorsal end	

### Supraspinatus (SS)

Mock tender, Chuck tender



Ventral end	
Location 1	
-	
Sensory	
Sensory	
Location 2	
-	
Dorsal end	



## Chuck (Cont'd)

### Triceps brachii (TB)

Clod, Outside chuck



Ventral end

Location 1
-
Location 2
Sensory
Location 3

Dorsal end



## Loin

### Gluteus medius (GM)

Top sirloin, Top butt



Posterior end

Location 1
-
Sensory
Sensory
Location 2
-

Anterior end

Posterior end

Location 1
Location 1
Sensory
Sensory
Location 2
Location 2
-
-
Location 3
Location 3

Anterior end

### Psoas major (PM)

Tenderloin, Filet

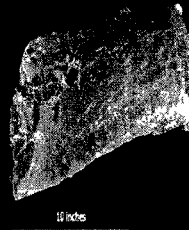






# Loin (+ Rib)

**Longissimus (LD)**  
Ribeye, Strip

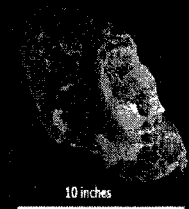


Anterior end
-
-
-
-
-
Location 3
-
-
12 <sup>th</sup> rib
Location 2
Sensory
Sensory
-
-
-
Location 1
-
-
Posterior end

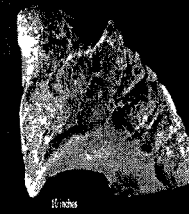


# Round

**Adductor (AD)**  
Inside round



**Biceps femoris (BF)**  
Bottom round



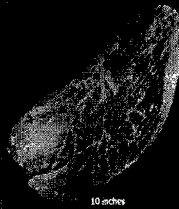
Proximal end
Location 1
Sensory
Sensory
-
Location 2
Distal end
Proximal end
Location 1
-
-
-
Sensory
Location 2
-
-
-
Location 3
Distal end



## Round (Cont'd)

### Semimembranosus (SM)

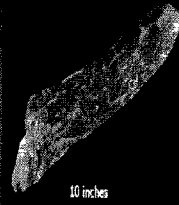
Top round



10 inches

### Semitendinosus (ST)

Eye of round



10 inches

Proximal end

Location 1

-

Sensory

Location 2

-

-

Location 3

Distal end

Proximal end

Location 1

-

Sensory

Sensory

Location 2

-

-

-

Location 3

Distal end



## Round (Cont'd)

### Rectus femoris (RF)

Culotte, Knuckle



Anterior end

Location 1

-

Location 2

Sensory

Location 3

Posterior end

## **Biochemical Traits**

- **Warner-Bratzler shear force (WBS)**
- **Sarcomere length (SL)**
- **Total collagen content (COL)**
- **Immunoblotting (DES)**

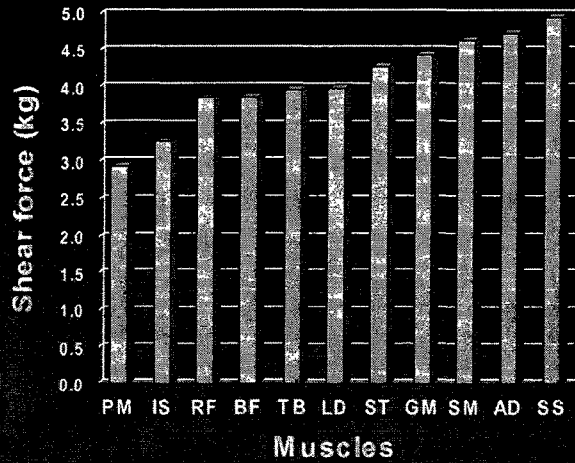
## **Trained Sensory Evaluation**

- **Eight-member trained sensory panel**
- **Overall tenderness, amount of connective tissue, juiciness, beef flavor intensity, off-flavor**

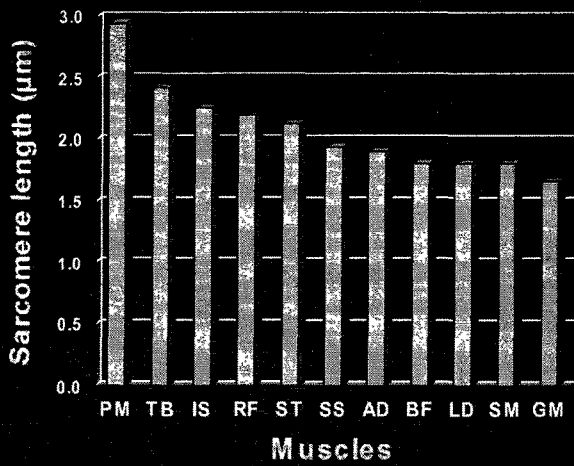
## **Statistical Analyses**

- **Completely randomized design (main effect: muscle)**
- **Split plot design (location within muscle)**
- **PROC GLM, PROC CORR, PROC VARCOMP**

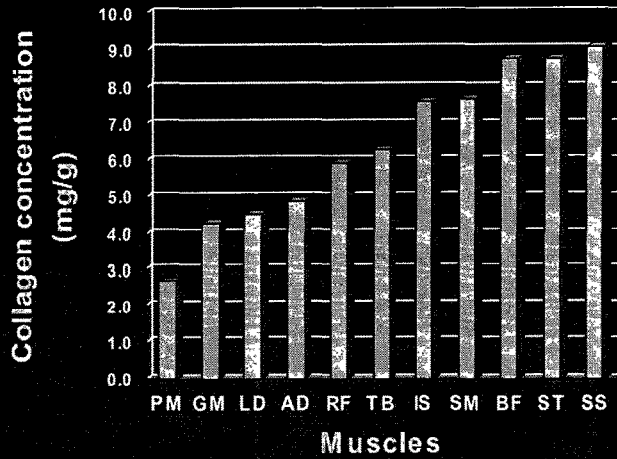
## Shear Force (kg)



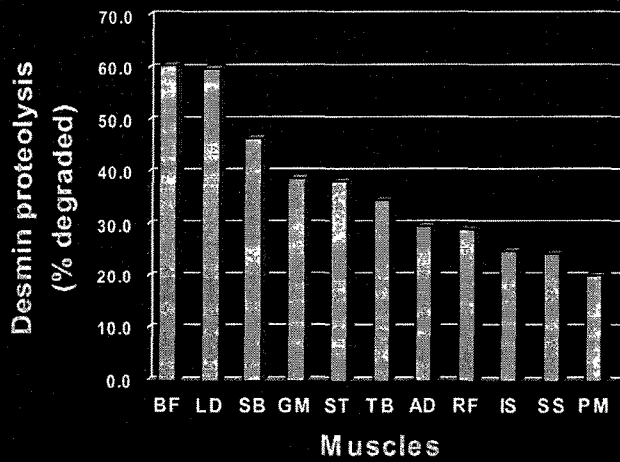
## Sarcomere Length ( $\mu\text{m}$ )



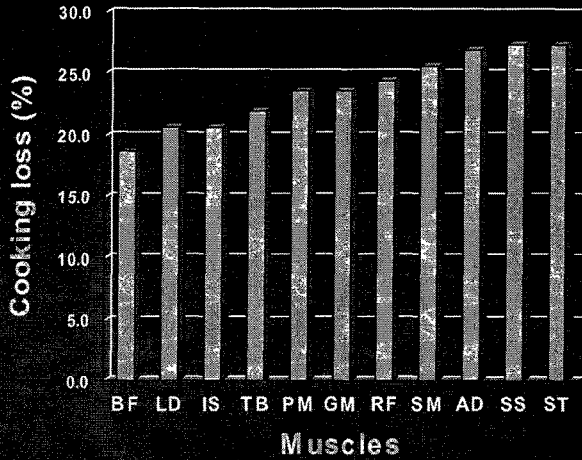
## Collagen Concentration (mg/g)



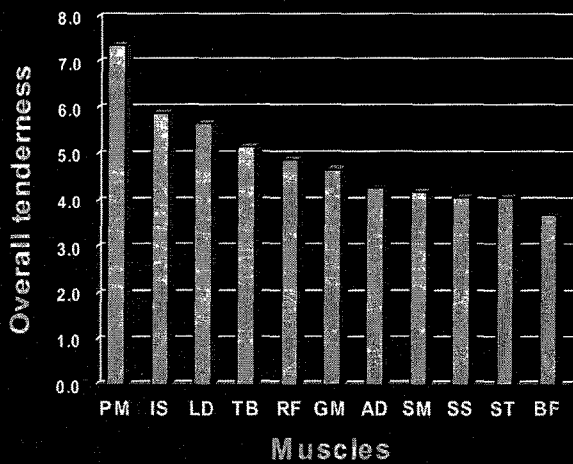
## Desmin Proteolysis (% degraded)



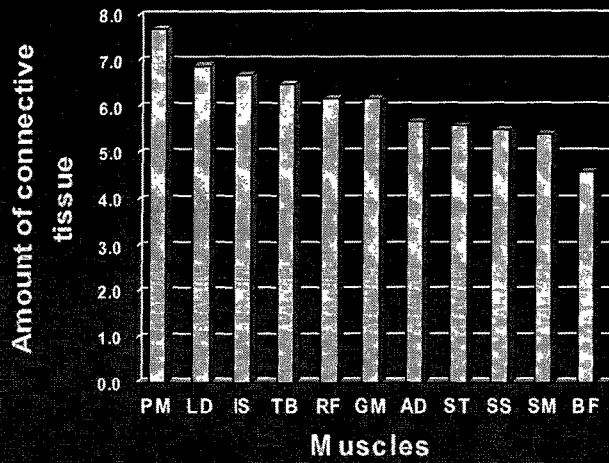
## Cooking Loss (%)



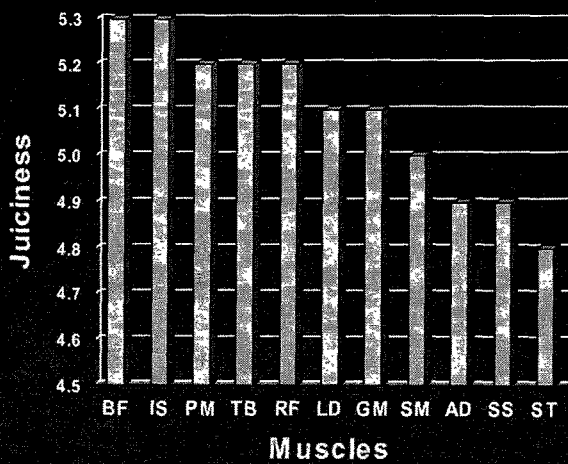
## Overall Tenderness



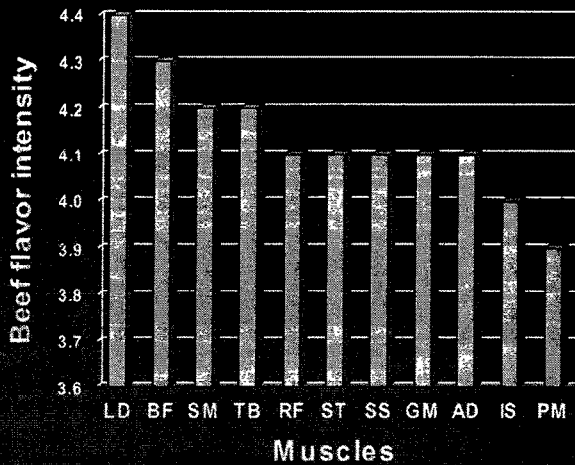
## Amount of Connective Tissue



## Juiciness



## Beef Flavor Intensity



## Psoas Major

Location	WBS	SL	COL	DES	CL	Posterior end		
						Location 1	Location 3	Sensory
L1	3.08 <sup>a</sup>	2.90 <sup>b</sup>	3.20 <sup>a</sup>	15.0 <sup>b</sup>	25.2 <sup>a</sup>	Sensory	Location 2	Location 2
L2	2.77 <sup>b</sup>	2.99 <sup>a</sup>	2.52 <sup>b</sup>	21.1 <sup>ab</sup>	22.8 <sup>b</sup>	-	-	-
L3	3.01 <sup>a</sup>	2.95 <sup>a</sup>	2.30 <sup>b</sup>	24.6 <sup>a</sup>	23.1 <sup>b</sup>	Location 3	Location 3	Location 3
						Anterior end		



## Semitendinosus

Location	WBS	SL	COL	DES	CL	Proximal end		
						Location 1	Sensory	Location 2
L1	4.74 <sup>a</sup>	1.81 <sup>c</sup>	8.71	38.2	28.4 <sup>a</sup>	-	Sensory	-
L2	4.03 <sup>b</sup>	2.06 <sup>b</sup>	8.63	40.0	28.1 <sup>a</sup>	-	Sensory	-
L3	4.10 <sup>b</sup>	2.50 <sup>a</sup>	8.94	37.2	25.2 <sup>b</sup>	-	Location 2	-
							Location 3	-

Distal end

## Biceps Femoris

Location	WBS	SL	COL	DES	CL	Proximal end		
						Location 1	Sensory	Location 2
L1	3.70 <sup>b</sup>	1.84 <sup>a</sup>	9.59 <sup>a</sup>	70.7 <sup>a</sup>	20.2 <sup>a</sup>	-	Sensory	-
L2	4.04 <sup>a</sup>	1.80 <sup>b</sup>	9.16 <sup>a</sup>	53.4 <sup>b</sup>	17.2 <sup>b</sup>	-	Location 2	-
L3	3.87 <sup>ab</sup>	1.80 <sup>b</sup>	7.46 <sup>b</sup>	58.1 <sup>b</sup>	19.6 <sup>a</sup>	-	Location 3	-

Distal end

## Semimembranosus

Location	WBS	SL	COL	DES	CL	Proximal end
L1	3.69 <sup>c</sup>	1.83 <sup>a</sup>	7.43 <sup>b</sup>	68.2 <sup>a</sup>	25.1 <sup>c</sup>	Location 1 -
L2	4.57 <sup>b</sup>	1.82 <sup>a</sup>	8.51 <sup>a</sup>	41.8 <sup>b</sup>	27.3 <sup>a</sup>	Sensory Location 2 -
L3	5.65 <sup>a</sup>	1.76 <sup>b</sup>	7.10 <sup>b</sup>	30.6 <sup>c</sup>	26.2 <sup>b</sup>	Location 3 -
						Distal end

## Rectus Femoris

Location	WBS	SL	COL	DES	CL	Anterior end
L1	3.62 <sup>a</sup>	2.24 <sup>a</sup>	4.46 <sup>a</sup>	11.7 <sup>a</sup>	23.3 <sup>a</sup>	Location 1 -
L2	3.71 <sup>a</sup>	2.22 <sup>a</sup>	5.66 <sup>b</sup>	22.2 <sup>b</sup>	24.7 <sup>b</sup>	Location 2 Sensory
L3	4.25 <sup>b</sup>	2.11 <sup>b</sup>	7.58 <sup>c</sup>	53.3 <sup>c</sup>	25.4 <sup>b</sup>	Location 3 Posterior end

## Correlation Coefficients Among Muscles for WBS

	AD	BF	GM	IS	PM	RF	SM	SS	ST	TB
LD	.38*	.57***	.50**	.20	.27	.48**	.57***	.28	.50**	.73***
AD		.53**	.61***	.30*	.16	.41*	.58***	.49**	.38*	.54**
BF			.60***	.31	.06	.74***	.76***	.42*	.50**	.58***
GM				.28	.31	.47**	.76***	.40*	.43*	.56**
IS					.25	.35	.36*	.73***	.30	.41*
PM						.12	.16	.24	-0.05	.15
RF							.75***	.32	.45*	.59***
SM								.42*	.56***	.59***
SS									.39*	.51**
ST										.61***

\*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$

## Conclusions

- Tenderness-related traits are highly variable within and among major beef muscles.
- Cut specific strategies will likely be needed to implement technology for improving tenderness of lower quality cuts.
- The relative contribution of various factors to variation in tenderness in each muscle so that appropriate tenderizing strategies can be developed on a muscle-by-muscle basis.