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EFFECT OF BODY WEIGHT GAIN DURING PRE-SLAUGHTER REALIMENTATION PERIOD ON INTRAMUSCULAR COLLAGEN SOLIBILITY IN AGED GOATS.

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Background:

Collagen is a major constituent in connective tissues of muscle, and is considered to be associated with meet tenderness. The heat stability of intramuscular collagen is increased with age of cattle (Judge and Aberle, 1982). Because of inferior palatability of meat from aged animals, their marketing options are limited. If their meat tenderness could be improved by intensive feeding prior to slaughter, marketing flexibility of meat from aged animals would be increased. Feeding of high energy diet for pre-slaughter period increased intramuscular fat deposition and improved stake palatability of culled cows with an increased rate of newly protein synthesis in muscles (Cranwell *et al*, 1996). Although several studies have been indicated that body weight gain of aged animals during realimentation by high concentrate feeding improves meet tenderness, effect of body weight gain during pre-slaughter period on intramuscular collagen characteristics in aged animals is unclear.

Objective:

This study was conducted to evaluate intramuscular collagen solubility, meat tenderness and water-holding capacity in aged goats fed either ad libitum or a restricted amount of feed.

Methods:

Ten, 4 or 5 years old castrated goats (37.0 $\pm$ 0.8 kg BW) were used. Each of 5 goats was assigned to one of two treatment groups on the basis of body weight and were kept in a pen to each treatment. One group of goats was given ad libitum access to a concentrate (TDN70%, CP15%) and Italian ryegrass hay (ADLIB group), and the other group of goats was fed restricted amounts of the concentrate and hay to maintain their body weight (REST group, concentrate ; 0.5% of BW/day, hay ; 1.5% of BW/day).

Immediately after slaughter, *Longissmus*, *Psoas major*, *Biceps femoris*, and *Gastrocemius* muscles were removed from the both side of each carcass, and were frozen at -20℃ until analyses. Meat samples were thawed overnight at 4℃ and free drip loss was determined. The samples were trimmed of external fat, tendon and fascia after thawing. Two pieces of each *Longissmus* and *Biceps femoris* samples were removed to determine Warner-Bratzler shear force value. Ground samples of all muscles were used analyses for water, fat and protein contents, collagen solubility and water-holding capacity.

Warner-Bratzler Shear Force Value The pieces separated from *Longissmus* and *Biceps femoris* samples were wrapped plastic bags and were cooked in a water bath at 70℃ for 1 hr. After cooling in running tap water, a core (1cm^2 in section area) was removed from each cooked meats parallel to the muscle fiber orientation. Each core was sheared using a Warner-Bratzler shear machine.

Collagen Analysis Soluble collagen was extracted from duplicate 3 g of ground sample by heating at 77℃ for 70 min in 0.25 strength Ringer's Solution (Hill, 1966). Sample was then homogenized and centrifuged at 6,000 $\times$ g for 10 min. The whole supernatant fraction and 1 g of ground meat sample (non-heated to determine total collagen) were hydrolyzed by placing in 6 *N* HCl and autoclaving at 121℃ for 7 hr. Hydroxyproline content of hydrolyzed samples was determined by spectrophotometric methods as described by Bergman and Loxley (1963). Total and soluble collagen contents were calculated by multiplying the hydroxyproline content of the fresh sample by 7.25 and the hydroxyproline content in supernatant by 7.52. Percentage of insoluble collagen was calculated to subtract soluble collagen from total collagen.

Water-Holding Capacity Water-holding capacity of ground samples was determined by centrifuging method (1700 $\times$ g for 1.5 hr) as described by Penny (1975).

Result and Discussion:

The ADLIB goats gained their weight at a faster rate (0.21 kg/day) and had a heavier slaughter body weight (57.1 ± 1.1 kg). The REST goats maintained their body weights through the experimental period (body weight gain ; 0.02 kg/day, slaughter body weight ; 37.1 ± 1.4 kg).

Protein contents in the muscles were not affected by the treatments. The ADLIB goats had lower ($p < 0.05$) moisture contents and higher ($p < 0.05$) fat contents in the muscles than REST goats (Table 1). Total and insoluble collagen per muscle protein in ADLIB goats were lower ($p < 0.05$) than that in REST goats. However soluble collagen per muscle protein were similar for both groups (Table 1). As a consequences, percentage of soluble collagen in total collagen was higher in ADLIB goats than in REST goats. Increased body weight gain during pre-slaughter realimentation period may have increased the collagen solubility through a reduction in proportion of insoluble collagen in aged goats.

Free drip loss in ADLIB goats was lower ($p < 0.05$) than in REST goats, however water-holding capacity was not affected by the treatments (Table 1). The decrease of drip loss in body weight gained goats may be a reflection of the decrease in water content. Relationship between water-holding capacity and intramuscular collagen solubility was not observed. Thus, the increased intramuscular collagen solubility by body weight gain during pre-slaughter realimentation period would not affect water-holding capacity.

Shear force values of *Longissmus* and *Biceps femoris* muscles were decreased ($p < 0.05$) by pre-slaughter realimentation (Table 1). Shear force value was negatively ($p < 0.05$) correlated ($r = -0.755$) with fat content in *Longissmus* muscle, however the relationship between shear force value and fat content was not significant in *Biseps femoris* muscle. Positive correlation ($p < 0.05$) between insoluble collagen and shear force value was observed in *Longissmus* ($r = 0.640$), and *Biceps femoris* ($r = 0.696$). These results indicate that body weight gain of aged goats by pre-slaughter intensive feeding could improved meat tenderness resulting from the decreased proportion of insoluble collagen and increased fat deposition.

Conclusions:

The body weight gain by pre-slaughter intensive feeding decreased intramuscular insoluble collagen and improved meat tenderness and drip loss in aged goats.

The improvement of meat tenderness with increased body weight gain during pre-slaughter realimentation would be attributed to the increases in collagen solubility and fat deposition.

Pertinent literature:

Bergman, I. and Loxley, R. (1963). Two improved and simplified methods for the spectrophotometric determination of hydroxyproline. Analytical chemistry, 35, 1961-1965.

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Table 1. Chemical composition, collagen characteristics, shear force value and water-holding capacity in *Longissmus and Biseps femoris* muscle of ADLIB and REST goats

Item	*Longissmus*			*Biceps femoris*		
	REST	ADLIB	p-value	REST	ADLIB	p-value
water, %	77.6	69.2	0.001	79.2	75.0	<0.001
fat, %	1.33	9.62	0.005	1.43	4.45	0.012
protein, %	19.8	19.8	0.944	19.3	19.8	0.418
Total collagen, % protein	4.99	2.84	0.016	7.00	4.51	0.005
Soluble collage, % protein	0.28	0.34	0.301	0.34	0.36	0.562
Insoluble collagen, % protein	4.71	2.50	0.014	6.66	4.15	0.004
Soluble collagen, % total collagen	6.09	11.9	0.003	5.00	8.22	0.001
Shear force value, kg	19.1	10.8	0.011	18.1	12.0	0.003
Water-holding capacity, %	40.5	38.4	0.431	41.4	40.2	0.366