PREDICTION OF RETAIL BEEF YIELD: RELATIONSHIP BETWEEN MEASURES

Yun Ho Choy[1*], Seong Bok Choi[1], Gi Jun Jeon[1], Hak Jae Chung[1], Myung Sik Lee[1], Jong Moon Lee[2], Beom Young Park[2], Sun Ho Lee[3]

[1]Hanwoo Experiment Station, National Institute of Animal Science, RDA, Chahangri 268, Pyongchang-gun

[2]Animal Products Research and Development Division, National Institute of Animal Science, RDA, Chuksan-gil 77, Suwon

[2]Animal Products Grading Service, Dang-dong 424-6, Gyeonggi-do, Republic of Korea

[*]Corresponding author (phone: +82-33-330-0623; fax: +82-33-330-0660; e-mail: ychoy000@korea.kr)

Abstract—A total of 1,141 Hanwoo cattle of three different sex origin were slaughter in a abbatoir located at National Institute of Animal Science, RDA, Korea from 1996 to 2008 to investigate the relationship between carcass and beef cut measures that can be used to make prediction of retail cut percentages. Bulls yielded heavier and leaner carcasses than steers. High correlation coefficients were estimated between the amount of body fat and percent retail cut (-0.82) and between back fat thickness(BF) and percent retail cut (-0.62). The amount of retail cut was, however, highly correlated with body weight before slaugher(BW, 0.95) or with cold carcass weight(CWT, 0.94). Relationship between percent retail cut and measurable beef yield traits, BF, eye muscle area(EMA) or CWT varied by sexes, which has to be considered for prediction model development with high accuracy.

Index Terms—carcass, Hanwoo, retail cur percentage, yield grade

I. INTRODUCTION

Beef carcass grading system in Korea has been put to practice since 1993. The system determines beef carcass grades in two categories. One is yield grade and the other is quality grade. Qaulity grade is assigned by combination of visual degrees in intramuscular fat deposition, muscle color, fat color, texture and maturity. Yield grade predicts the amount of saleable beef cuts and the grade of which is assigned by the index combining measures of cold carcass weight, eye muscle area and back fat thickness. Cattle breeds in Korea that are used for beef production consists of Hanwoo (Korean Native Cattle), Holstein steers and some cross products of these two major breeds. Holstein cattle widely grew as dairy cattle and their male progeny are byproducts. Therefore, breeding objective of Holstein breed is majorily milk production, yield and quality. On the other hand, Hanwoo cattle are mostly bred for their beef production. And the national breeding objectives also focus on their beef yield and quality. As consumers' growing concern on more tasteful beef products, Hanwoo breeding goals now focus more on quality rather than to yield. And this shift in genetic change affect other economically important characteristics such as back fat or retail cut yield, which is directly related to profitability from respect of beef salers.

The objective of this study was, therefore, to investigate the currrent structure of beef carcass products and the relationship between those cuttable parts, which might suggest that prediction equation to predict retail cut yield ought to be changed as genetic structure of beef breeds used in Korea to more accurately predict saleable products.

II. MATERIALS AND METHODS

A total of 1,141 records of Hanwoo (Korean Native cattle) beef cut yield by parts were collected from an abattoir of National Institute of Animal Science, RDA, Korea from 1996 to 2008. Animals were normally fasted at least for a day before shipment to the abattoir. The records consist of body weight (**BW**, kg) upon unloading from shipping trucks, cold carcass weight (**CWT**, kg), retail cut yield (**Retail cut,** kg) and percentage (**%Retail cut**, of carcass weight), total body fat (**Body** fat, kg), bones (**Bone**, kg), back fat thickness (**BF**, mm) and longissimus muscle area (**EMA**, cm^2). The latter two measures (**BF, EMA**) were estimated by a beef carcass grading specialist from Animal Products Grading Service (APGS), Korea. APGS grading specialists determine the final carcass quality and yield grades by sight and measurement on the cut surface between the last rib and the first lumbar vertebrae following the standard carcass grading rules of Korea. Cold carcass weights were measured after slaughter and chilled over a night in a refrigerator. Deboning and partition of carcass were made by the technicians of the same abattoir one day after slaughtering.

Summary statistics and Pearson's simple correlation coefficients between carcass and cut measures were estimated by UNIVARIATE and COR procedures of SAS (2004).

III. RESULTS AND DISCUSSION

All the variables except back fat thickness distributed quite normally. However, back fat thickness was right skewed, which support the evidence of cattle sellers' feeding style to have thinner back fat to get higher yield grades. This was more evident in cases of female carcasses, which also is suggestive of lack of fattening procedure of females, mostly old cows.

Table 1 shows means and standard deviatons of the variables by sexes. Bull carcasses were the heaviest of all sexes and their retail cut percentage was also the highest as was the case of Lee et al. (2008) or of Park et al. (2002). Female carcass yielded higher retail cut percentage than steer carcass even with lighter body or carcass weight. This must be due to thinner back fat thickness of female carcass than of steer carcass.

Table 1. Means and standard deviations of measures* by sexes of Hanwoo

	N	BW kg	CWT kg	Retail cut Kg	Retail cut %	Body fat kg	Bone kg	BF mm	EMA cm²
All sexes	1141	576.8±94.6	353.4±66.6	240.5±44.5	68.2±4.2	71.1±26.8	41.1±7.3	8.4±4.5	84.3±12.9
Female	196	479.4±74.1	275.2±46.2	189.6±30.6	69.1±3.9	50.1±20.7	34.9±6.3	8.1±3.7	73.0±10.9
Bulls	378	606.6±85.3	374.4±58.6	264.8±38.9	71.0±4.1	63.6±25.2	45.3±7.2	6.7±4.3	89.4±12.6
Steers	567	590.6±84.9	366.5±57.7	241.8±36.9	66.1±3.2	83.4±23.0	40.5±5.8	9.6±4.5	84.8±11.3

*BW : body weight before slaughter, CWT : cold carcass weight, BF : back fat thickness, EMA : eye muscle area

Table 2 and 3 shows the simple correlation structure between measures by sexes. Regardless of the sexes of carcasses(Table 2), retail cut percentage was highly correlated with body fat reserves and back fat thickness. However, the amount of retail cut was highly correlated with fasted body weight (BW) or with cold carcass weight (CWT).

Table 2. Correlation coefficients (Pearson's) between measures* for all sexes (above diagonals) and for bulls (below diagonals)

Bull/overall	BW kg	CWT kg	Retail cut kg	Retail cut %	Body fat kg	Bone kg	BF mm	EMA cm²
BW	1	0.97	0.95	-0.13	0.63	0.79	0.32	0.69
CWT	0.96	1	0.94	-0.24	0.72	0.72	0.36	0.71
Retail cut	0.93	0.93	1	0.09	0.46	0.85	0.15	0.75
Retail cut %	-0.27	-0.37	0.00	1	-0.82	0.33	-0.62	0.05
Body fat	0.58	0.69	0.38	-0.91	1	0.12	0.66	0.38
Bone	0.76	0.68	0.83	0.26	0.02	1	-0.04	0.57
BF	0.38	0.43	0.19	-0.68	0.72	-0.02	1	0.17
EMA	0.58	0.61	0.64	-0.04	0.31	0.43	0.22	1

*BW : body weight before slaughter, CWT : cold carcass weight, BF : back fat thickness, EMA : eye muscle area

The same trend in correlation was also found in separate analyses by sexes. Higher relationship between the amount body fat and retail cut percentage than that between back fat thickness and retail cut percentage was consistanly observed in all sexes, which is well coincidee with the result of Dikeman et al. (1998) with breeds other than Hanwoo. However, the amount of body fat is not weighed at the time of carcass grading or while on slaughter process. The second important variable that is correlated with percent retail cut was carcass weight (CWT) which is measurable after slaughter before grades are assigned for each carcass. The other variable that is correlated with percent retail cut and is measurable at the time of grading is eye muscle area (EMA). But the relationship was very small for all sexes. Currently in Korea, carcass yield grades are assigned by an index composed of those three measurable variables- CWT, BF and EMA. Therefore, further researches on accuracy of prediction of percent retail cuts should follow because the relationship of the yield values with those three measurable traits were variable by sexes of the carcasses as pointed by Reverter et al. (1999).

Table 3. Correlation coefficients (Pearson's) between measures* for Females (above diagonals) and for steers (below diagonals)

Steer/Female	BW	CWT	Retail cut	Retail cut	Body fat	Bone	BF	EMA

	kg	kg	kg	%	kg	kg	mm	cm^2
BW	1	0.94	0.96	-0.08	0.51	0.61	0.44	0.64
CWT	0.97	1	0.94	-0.28	0.71	0.42	0.51	0.69
Retail cut	0.96	0.95	1	0.05	0.44	0.62	0.37	0.73
Retail cut %	-0.12	-0.24	0.07	1	-0.85	0.54	-0.48	0.11
Body fat	0.70	0.80	0.57	-0.76	1	-0.28	0.59	0.30
Bone	0.84	0.78	0.87	0.22	0.32	1	0.01	0.40
BF	0.38	0.44	0.28	-0.55	0.65	0.09	1	0.27
EMA	0.65	0.67	0.70	0.01	0.44	0.54	0.23	1

*BW : body weight before slaughter, CWT : cold carcass weight, BF : back fat thickness, EMA : eye muscle area

IV. CONCLUSION

Average statistics of carcass and beef cut measures and the relationship between variables were investigated. The investigation was made with Hanwoo carcasses of three different sexual originations. Percentage of carcass that is saleable as edible meat, percent retail cut, was highly correlated with the amount of body fat and back fat thickness while the amount of saleable cut is highly correlated with live body weight before slaughter or with cold carcass weight. We suggest accounting for sexes of the carcass when to predict retail cut percentage with higher accuracy.

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