PARAMETER ESTIMATES FOR GENETIC AND ENVIRONMENTAL EFFECTS ON MEAT POTENTIAL OF KOREAN NATIVE (HANWOO) CATTLE

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INTRODUCTION

Carcass traits of cattle have been studied considerably, and most of the traits have been found to be of high or moderate heritability (Robinson *et al*., 1990 ; Arnold *et al.,* 1991 ; Gregory *et al.,* 1994 ; Wheeler *et al.,* 1996). However, the results cannot be easily generalized into Hanwoo population, because most of the studies have involved European beef breeds, which are only of marginal importance in Korea. The estimations of genetic parameters in body weights of Hanwoo were as made by some researchers (Shin and Park, 1990 ; Son *et al.,* 1997). Despite the endeavor to improve Hanwoo, the information on the merit of carcass with the effects of genetic and environment are limited. The aim of this study was to investigate the sire, location and interaction between sire and location factors affecting carcass traits in Hanwoo steers and to estimate heritability, phenotypic and genetic correlations between different carcass traits.

MATERIALS AND METHODS

This experiment was undertaken at the laboratory of Animal Resources and Biotechnology, Chonbuk National University, Korea. A total of 161 progeny reared in two locations i.e. Namwon (NWN) and Taekwanryung (TKG) aged between 657-753 days (average 717 days) belonged to 23 sire groups were used. Meat samples were collected from 13th-14th ribs of the steers within 24 hours of slaughter. The traits studied were carcass weight (CWT), dressing % (DP), cook loss (CL), eye muscle area (EMA), back fat thickness (BFT), and meat tenderness in terms of mastication (MAS), shear force (SFR) and penetration (PEN). Meat tenderness was estimated within 32-36 hours postmortem using Fudo Rheo Meter. CWT was obtained by weighing the weight of slaughtered steers after the removal of lungs, heart, liver, intestine, mesenteries, bladder, reproductive organs and blood. BFT was measured based on the average of three measurements taken at the first rib, last rib and last lumber vertebra. EMA was measured a plastic grid between the 13th and 14th rib.

Statistical analysis. (Co)variance components for CWT, DP, CL, EMA, MAS, SFR, PEN and BFT were analyzed by General Linear Model (GLM) using SAS statistical package (SAS 1991). In the model, all effects were considered as fixed effects except for error effects. The statistical model used for the analysis of carcass traits was as follows :

$$Y_{ijk} = \mu + S_i + L_j + (S\times L)_{ij} + e_{ijk} ,$$

where Y_{ijk} = individual record,
μ = common mean,
S_i = effect of sire (i=1-23),
L_j = effect of location (j=1-2),
$(S\times L)_{ij}$ = interaction effect between sire and location, and
e_{ijk} = residual error.

DMRT was performed to separate means of significant difference among themselves. Values of h^2 and correlations (r_g and r_p) were estimated based on paternal half sib analysis method (Becker 1985) involving 23 sire groups.

RESULTS AND DISCUSSION

Effects of sire, location and interaction between sire x location on carcass traits in Hanwoo steers are presented in Table 1, Table 2 and Table 3, respectively. The effect of individual sire was found to be significant on all the traits except PEN (Table 1).

Table 1. Effect of sire on carcass traits in Hanwoo cattle

Trait	CWT (Kg)	DP	CL (%)	EMA (cm^2)	MAS (g/cm^2)	SFR (g/cm^2)	PEN (g/cm^2)	BFT (cm)
σ^2_s	91.36	0.12	0.16	5.26	31.71	238252	217248	0.01
σ^2_w	885.44	2.46	5.32	67.75	622.30	1286035	3281407	0.20
x	314.88	57.38	6.53	8164	43.30	3858.67	5434.16	0.83
LS	**	*	*	*	*	**	NS	*

LS=level of significance; * = $p<0.05$; ** = $p<0.01$; NS = non-significant.

Table 2. Effect of location on carcass traits in Hanwoo cattle

Trait Location	CWT (Kg)	DP	CL (%)	EMA cm^2	MAS (g/cm^2)	SFR (g/cm^2)	PEN (g/cm^2)	BFT (cm)
NWN (n=96)	329.71[a]	57.66[a]	6.60	82.95[a]	47.66	3788.42	6123.04	0.86
TKG (n=65)	307.66[b]	55.96[b]	6.42	80.76[b]	39.31	3938.95	6618.33	0.80
LS	**	**	NS	*	NS	NS	NS	NS

Means with different superscript in the same column differ significantly.
LS=level of significance; *= $p<0.05$; ** = $p<0.01$; NS = non-significant.

Table 3. Interaction effect of bull x location on carcass traits in Hanwoo cattle

Trait	CWT (Kg)	DP	CL (%)	EMA cm^2	MAS (g/cm^2)	SFR (g/cm^2)	PEN (g/cm^2)	BFT (cm)
CV	9.46	2.64	36.75	10.13	57.61	30.03	36.71	35.71
LS	*	*	NS	NS	NS	NS	NS	NS

CV=coefficient of variation; LS=level of significance. * = p<0.05; NS = non-significant.

CWT and DP were also significantly affected both by location (p<0.01) (Table 2) and by interaction effect of sire and location (p>0.05) (Table 3). However, Parkkonen *et al*. (2000) showed that carcass quality of Finnish Ayrshire and Holstein-Friesian was significantly affected by genotype and environment interaction. From Table 4, it has been observed that CL was negatively correlated with MAS, SFR and PEN. The correlations between all other traits were positive. CWT was highly and positively correlated with EMA, indicating that a greater EMA is associated with a higher production of CWT. The phenotypic correlations were lower than the genetic correlations but they were in the same direction. Estimated heritability especially for MAS, SFR and CWT were relatively high (Table 4). In Hereford and some other beef breeds, h^2 of carcass traits were found to be moderate (Lamb *et al.,* 1990 ; Arnold *et al.,* 1991 ; Gregory *et al.,* 1994 ; Wheeler *et al.,* 1996), which partially supports the present findings. Heritability estimates for DP and EMA were very close to those by Lee *et al*. (2000).

Table 4. Heritabilities (± SE), phenotypic and genetic correlations of carcass traits in Hanwoo cattle

Trait	CWT	DP	CL	EMA	MAS	SFR	PNT	BFT
CWT	**0.37**	0.62	0.38	0.82	0.58	0.18	0.32	0.42
	±**0.02**	±0.03	±0.05	±0.07	±0.03	±0.02	±0.03	±0.05
DP	0.21	**0.19**	0.35	0.68	0.59	0.48	0.54	0.52
	±0.02	±**0.01**	±0.02	±0.06	±0.02	±0.03	±0.04	±0.05
CL	0.11	0.12	**0.05**	0.32	-0.43	-0.73	-0.52	0.11
	±0.01	±0.01	±**0.02**	±0.02	±0.01	±0.06	±0.01	±0.03
EMA	0.52	0.38	0.15	**0.18**	0.37	0.22	0.61	0.38
	±0.06	±0.04	±0.02	±**0.01**	±0.01	±0.02	±0.03	±0.02
MAS	0.24	0.18	-0.11	0.12	**0.64**	0.23	0.52	0.72
	±0.03	±0.02	±0.01	±0.01	±**0.01**	±0.03	±0.03	±0.04
SFR	0.05	0.19	-0.28	0.06	0.07	**0.52**	0.11	0.14
	±0.01	±0.01	±0.01	±0.01	±0.01	±**0.03**	±0.01	±0.01
PNT	0.17	0.19	-0.14	0.28	0.11	0.05	**0.25**	0.35
	±0.01	±0.01	±0.01	±0.02	±0.01	±0.01	±**0.03**	±0.03
BFT	0.15	0.34	0.04	0.11	0.39	0.05	0.12	**0.07**
	±0.02	±0.02	±0.01	±0.01	±0.04	±0.01	±0.01	±**0.02**

Heritability on the diagonal; r_P and r_G respectively below and above the diagonal.

CONCLUSION

Significant variation between the progeny performances of individual sire groups in several carcass traits– CWT, DP, CL, EMA, BFT, MAS, SFR– indicates the scope for sire selection to improve meat potential of Koran native cattle. However, there are variations in carcass quality due to both genetic and environmental effects. Positive genetic correlations between EMA and other important carcass traits suggest sire selection for EMA does also lead to an increase in CWT, DP and BFT.

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