

Correlation between Blood Composition and Meat Quality in Hanwoo Steers

Yea-Hwang Moon^{1*}, Sun-Sik Jang², Eun-Tae Kim², Woong-Gi Cho³, Sung-Sill Lee³

¹ Gyeongnam National University of Science and Technology, Jinju 52725, Korea, ² National Institute of Animal Science, Rural Development Administration, Korea, ³ Gyeongsang National University Department of Animal Science and Biotechnology, Jinju, Korea

Introduction

- In Korea, beef quality is absolutely associated with increasing the amount of intramuscular fat, and beef yield is also very important economically for farmers. To know the relationship between blood profile and carcass traits helps manipulating the feeding strategy.
- Japanese black cattle showing high blood total cholesterol and low vitamin A in the mid-stage resulted in the high marbled beef. And blood glucose and vitamin A levels were significantly ($p < 0.05$) higher in cattle with higher carcass yield in the finishing stage than those with lower one. (Takuro et al., 2006).
- This experiment was conducted to know the relationship between blood chemistry profiles including hormones (insulin, leptin) and carcass traits by monitoring both results from Korean steers.

Materials & Methods

- Animal** : 126 Hanwoo steers (8-30 months of age, 197-703kg body wt.)
- Feeding & Slaughter** : Steers fed concentrates (1.3% of body wt.) and rice straw (30 heads), or TMRs (96 heads) *ad libitum*, and slaughtered at 30 months of age.
- Sampling** : Blood were collected from jugular vein at the growing (8-12 months), the early fattening (13-23 months) and the late fattening (24-30 months) phases.
- Analysis**
 - Insulin & Leptin : Gamma-counter (Hewlett-packard, USA)
 - Glucose et al. : Blood auto analyzer (Ciba Corning Diagnostics Corp., USA)
 - NEPA : Spectrophotometer (Spectronic 601; Milton-roy Co., USA)
- Statistics** : SAS (1999), correlation, regression equation.

Results

Table 1. Changes of compositions of blood during growing and fattening phases of steers

ITEM	Phases			Mean
	Growing	Early fattening	Late fattening	
Retinol, IU/100ml	99.11±3.48 ^c	105.0±2.26 ^b	114.5±1.47 ^a	110.3±1.20
Leptin, ng/ml	25.56±1.53	32.15±3.00	31.17±1.95	30.34±1.37
Insulin, ng/ml	49.37±8.46 ^a	41.95±3.71 ^a	28.11±2.39 ^b	35.35±2.37
AST ¹⁾ , U/L	34.63±7.88 ^b	43.86±7.14 ^b	65.19±3.71 ^a	54.71±3.24
ALT ²⁾ , U/L	47.74±4.69	44.83±3.85	55.66±7.05	51.69±4.31
BUN ³⁾ , mg/100ml	78.44±11.34	64.61±9.90	52.89±8.74	60.20±6.00
GLU ⁴⁾ , mg/100ml	45.48±7.05 ^b	53.50±6.72 ^b	73.99±3.59 ^a	64.07±3.06
TP ⁵⁾ , g/100ml	14.51±1.27 ^a	12.50±0.90 ^a	9.48±0.54 ^b	11.09±0.47
ALB ⁶⁾ , g/100ml	4.71±0.31 ^a	3.93±0.18 ^b	4.05±0.16 ^b	4.14±0.12
CHOL ⁷⁾ , mg/ml	90.66±13.57 ^b	101.0±11.87 ^b	150.29±7.26 ^a	128.0±6.00
TG ⁸⁾ , mg/100ml	7.70±1.08 ^b	7.11±0.99 ^b	11.51±0.50 ^a	9.79±0.45
NEFA ⁹⁾ , uEq/L	256.4±19.76 ^a	140.6±8.77 ^b	277.7±17.83 ^a	223.7±12.41

Means±standard error

^{a,b} Means in the same row with different superscripts differ significantly ($P < 0.05$).

¹⁾ Aspartic acid transaminase; ²⁾ Alanine transaminase; ³⁾ Blood urea-N; ⁴⁾ Glucose; ⁵⁾ Total Protein; ⁶⁾ Albumin; ⁷⁾ Cholesterol; ⁸⁾ Triglyceride; ⁹⁾ Non-esterified fatty acid.

Table 2. The correlation coefficients between blood compositions and carcass traits of steers

ITEM	Carcass weight	Back fat thickness	Eye muscle area	Yield Index	Marbling score	Meat color	Fat color	Texture	Maturity	Meat quality grade	Meat yield grade
Retinol	0.1640	-0.0098	-0.2650**	-0.1850*	-0.4660**	0.1640	0.1900*	0.1123	0.0092	-0.3690**	0.2310**
Insulin	-0.1546	0.0725	0.4630	0.2430*	0.5380	-0.1591	-0.2420	-0.2020*	-0.0087	0.4920	-0.2010*
Leptin	0.1048	0.1800*	-0.3990*	-0.3830*	-0.3850*	0.1509	0.2760	0.1478	-0.0835	-0.3600**	0.0859
AST ¹⁾	0.2040*	0.1110	-0.6710**	-0.5020**	-0.7200**	0.3450	0.4740	0.2720	-0.0312	-0.6990**	0.3980
ALT ²⁾	-0.1820*	-0.0734	0.4640	0.3560	0.5220	-0.3250	-0.4680	-0.1990*	-0.0245	0.5000	-0.2890
BUN ³⁾	-0.2330*	-0.1040	0.5610	0.4460	0.6400	-0.3400	-0.4620	-0.2400	-0.0269	0.6250	-0.3480
GLU ⁴⁾	0.3010*	0.0516	-0.5703	-0.4330*	-0.6720	0.3780	0.4730	0.2690	0.0366	-0.6430	0.4510
TP ⁵⁾	-0.2140**	-0.1155	0.6210*	0.4810	0.6960	-0.3910	-0.5190	-0.2670	0.0187	0.6770	-0.3870*
ALB ⁶⁾	-0.1512	-0.1371	0.4380	0.3810*	0.5060	-0.2730	-0.3650	-0.1960	0.0144	0.4810	-0.2870
CHOL ⁷⁾	0.3860**	0.0750	-0.4530**	-0.4110**	-0.6620**	0.3630	0.4320	0.1920	0.0777	-0.6570**	0.3470**
TG ⁸⁾	0.2540**	-0.1279	-0.1650*	-0.0661	-0.3500**	0.1690	0.1571	0.0811	0.0859	-0.3560**	0.2920**
NEFA ⁹⁾	-0.0616	0.0112	-0.0516	-0.0192	0.0182	0.0205	-0.0081	0.1241	0.0563	-0.2121	-0.0607

* $P < 0.05$, ** $P < 0.01$

¹⁾ Aspartic acid transaminase; ²⁾ Alanine transaminase; ³⁾ Blood urea-N; ⁴⁾ Glucose; ⁵⁾ Total Protein; ⁶⁾ Albumin; ⁷⁾ Cholesterol; ⁸⁾ Triglyceride; ⁹⁾ Non-esterified fatty acid.

Table 3. The correlation coefficients among blood compositions of steers

ITEM	Retinol	Insulin	Leptin	AST	ALT	BUN	GLU	TP	ALB	CHOL	TG	NEFA
Retinol	1											
Insulin	-0.3130**	1										
Leptin	0.1527	-0.2870**	1									
AST ¹⁾	0.4500**	-0.6050**	0.5220**	1								
ALT ²⁾	-0.3160	0.4150**	-0.4550**	-0.6601*	1							
BUN ³⁾	-0.3680	0.5380	-0.5190	-0.8250*	0.8871**	1						
GLU ⁴⁾	0.4161	-0.6161**	0.4490	0.9260	-0.6832**	-0.8261*	1					
TP ⁵⁾	-0.4042	0.6450	-0.5090	-0.8912	0.7391	0.9101**	-0.8912**	1				
ALB ⁶⁾	-0.2954	0.4342	-0.4060**	-0.6341	0.7951	0.8720**	-0.6201**	0.7560	1			
CHOL ⁷⁾	0.4921**	-0.5531	0.3950**	0.8151	-0.5560**	-0.6900	0.8312	-0.7841	-0.4862	1		
TG ⁸⁾	0.3230**	-0.3993*	0.1016	0.4351	-0.0368	-0.1398	0.4871	-0.3300*	0.0715	0.5290**	1	
NEFA ⁹⁾	0.1978	0.0769	-0.0500	0.5782**	0.4060	0.5051**	0.0697	0.5421	0.5191**	0.2536	0.4962**	1

* $P < 0.05$, ** $P < 0.01$.

¹⁾ Aspartic acid transaminase; ²⁾ Alanine transaminase; ³⁾ Blood urea-N; ⁴⁾ Glucose; ⁵⁾ Total Protein; ⁶⁾ Albumin; ⁷⁾ Cholesterol; ⁸⁾ Triglyceride; ⁹⁾ Non-esterified fatty acid.

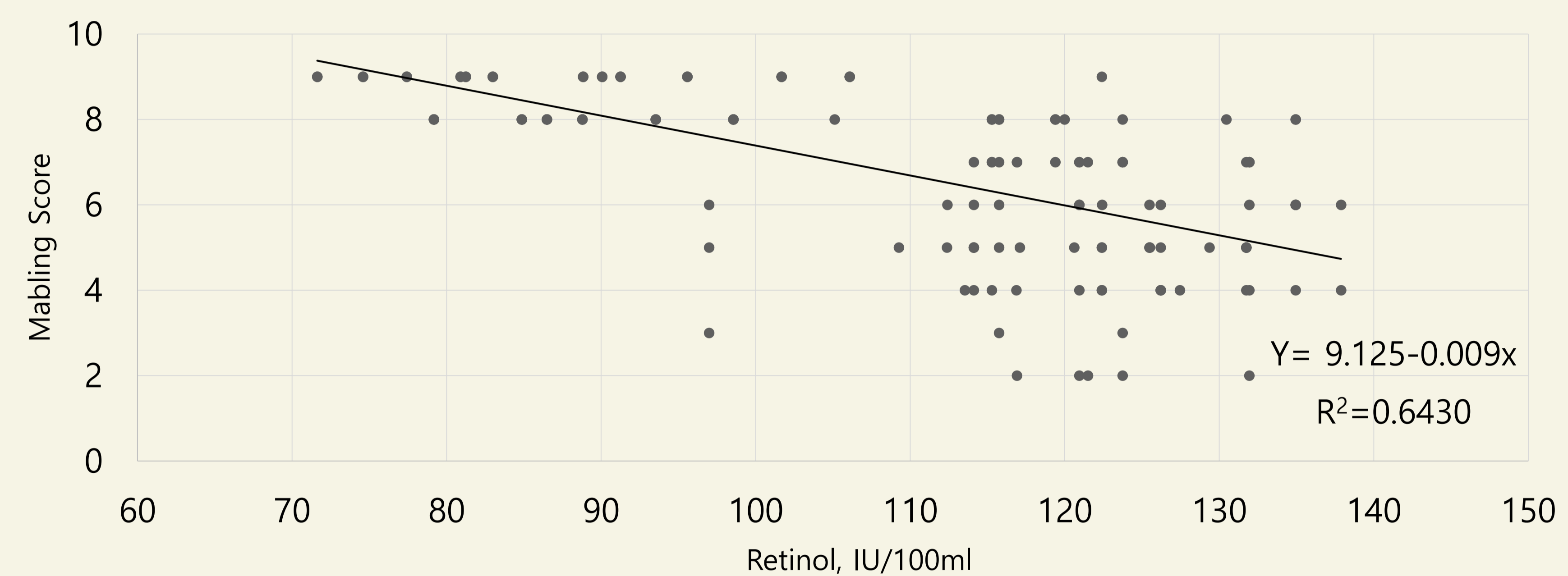


Fig 1. The distributions and regression equation between blood retinol and beef marbling score.

Conclusion

- Average contents of retinol, insulin and leptin were 1.10IU, 30.34ng and 235.35ng per ml of blood plasma, respectively, and blood retinol has negative correlations significantly ($p < 0.01$) with insulin and leptin.
- With the age of steers, blood insulin and total protein decreased, but blood retinol, AST, glucose, cholesterol and triglyceride were increased ($p < 0.05$). Blood NEFA was abruptly decreased at early fattening phase.
- At the late fattening phase, significant ($P < 0.01$) negative correlations occurred between blood retinol concentration and marbling score, and also blood total protein and *longissimus* muscle area of 13th rib, and obtained the regression equations as follows;

- Marbling score(1-9) = - 0.009 × retinol(IU/100ml) + 9.125 ($R^2 = 0.643$)

- Ribeye muscle area(cm^2) = - 0.250 × T-protein(g/100ml) + 112.498 ($R^2 = 0.450$)

From the results obtained in the current study, it might be possible to make a high marbled beef by control the blood retinol content during the fattening phase in steers.

References

- Takuro O., M. Namiko, M. Shunsuke and M. Yuriko. 2006. Relationship between carcass and blood chemistry profile in growing beef cattle. J. Livestock Med. 53. 277-285.

Acknowledgement

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