SIRE EFFECT ON CARCASS TRAITS OF JAPANESE BROWN COW

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SUMMARY

The present research aims to obtain more fundamental knowledge of genetic effect (sire effect) on carcass traits of the Japanese Brown cow. This experiment was done at Kumamoto Prefecture, Japan. The field data of ultrasonic estimates of carcass traits of 9468 heads of Japanese Brown cows, which were born from January 3rd 1988 to December 25th 1993, representing 88 heads of sire were collected. All data was included of pedigree status. Cows data of ultrasonic estimates of carcass traits was taken at the first registration examination (≥15 months of age or ≤ 40 months of age).

The carcass traits were estimated by ultrasound were Musculus *longissimus thoracis area* (MLTA) between the 6th and 7th ribs on the left side of each animal, Subcutaneous Fat Thickness (SFT), Intermuscular Fat Thickness (IMFT), Rib Thickness (RT) and Marbling Score (MS). The data obtained was statistically analyzed by the LSMLMW procedure and the Duncan test.

The average age of cows in this study was 22.7 months. The mean of MLTA was 32.4 cm2 while the means of SFT, IMFT and RT were 10.5 mm, 18.3 mm and 44.9 mm, respectively. The mean of MS was 0.52. Sire effects were significant for all ultrasonic estimates of carcass traits (P<0.01). Cows sired by Mitsushige ET, Mitsutake, Mitsumaru, Dai 5 Harutama, Dai 10 Mitsumaru and Namimaru tended to have large MLTA, high MS and optimum SFT, IMFT and RT compared to other sires. Mitsushige ET had the highest genetic quality and might be considered as a breeding sire in selection.

*Key Word **:** Carcass traits, Ultrasound, Sire effect, Japanese Brown cow*

PENGARUH PEJANTAN TERHADAP SIFAT-SIFAT KARKAS SAPI JEPANG COKLAT BETINA

RINGKASAN

Tujuan dari penelitian ini antara lain untuk memperoleh tambahan informasi

tentang pengaruh faktor genetik terutama faktor pejantan terhadap sifat-sifat karkas (luas penampang loin, tebal lemak subkutan dan intramuskular, tebal tulang rusuk, dan nilai marbling) dari sapi Jepang coklat betina. Penelitian ini dilakukan di Kumamoto Prefecture, Jepang dengan menggunakan data lapangan dari 9468 ekor Sapi Jepang betina (keturunan dari 88 ekor pejantan) yang lahir antara tanggal 3 Januari 1988 hingga 25 Desember 1993 yang diketahui data tetuanya (nenek, kakek, induk dan pejantan dari bangsa sapi Jepang coklat) serta memiliki data sifat karkas hasil dugaan menggunakan alat ultrasonografi pada saat pertama kali pencatatan.

Sifat karkas yang diukur adalah luas penampang loin, tebal lemak subkutan, tebal lemak intramuskular, tebal tulang rusuk, dan *marbling score*. Seluruh data dianalisis dengan menggunakan program LSMLMW dan dilanjutkan dengan uji Duncan.

Umur rata-rata dari Sapi Jepang coklat betina yang diuji adalah 22,7 bulan. Rata-rata luas MLTA adalah 32,4 cm^2, rata-rata tebal SFT, IMFT, dan RT masing-masing 10,5 mm, 18,3 mm, dan 44,9 mm serta rata-rata nilai MS adalah 0,52. Faktor pejantan berpengaruh sangat nyata ($P<0.01$) pada seluruh sifat karkas. Pejantan Sapi Jepang coklat betina yaitu Mitsushige ET, Mitsutake, Mitsumaru, Dai 5 Harutama, Dai 10 Mitsumaru, dan Namimaru ternyata unggul pada nilai MLTA dan MS dan juga memiliki nilai optimum pada SFT, IMFT dan RT jika dibandingkan dengan pejantan lainnya. Namun, Mitsushige ET memiliki kualitas genetik yang paling baik sehingga dapat dijadikan pejantan unggul.

Kata Kunci **:** *Sifat karkas, Ultrasonografi, Pengaruh pejantan, Sapi Jepang coklat betina*

INTRODUCTION

Investigations from many approaches have been carried out to reach accurate genetic improvements of meat production performance of Japanese cattle. Nevertheless, it has taken a long time and money to obtain superior breeding sires with good meat quality and quantity by performance and progeny testing. In order to solve these problems, carcass traits of live beef cattle have been estimated using ultrasonic techniques. The ability of ultrasonic measurements for predicting carcass traits is on be accurate estimate in live animals (Faulkner *et al*., 1990). Ultrasonic techniques have been demonstrated to be quite satisfactory to predict and direct selection of Musculus

Longissimus Thoracis Area (MLTA), Subcutaneous Fat Thickness (SFT), Intramuscular Fat Thickness (IMFT), Rib Thickness (RT) and Marbling (Forrest *et al*., 1989; Herring *et al*., 1994).

Great attention has also been paid to improve the meat quality and quantity of the Japanese Brown cow by selecting the best breeding cows and heifers and then mating them with best sires. Japanese Brown cattle, especially Kumamoto strain, have a larger mature size than other domestic breeds but its meat quality is lower relative to Japanese Black cattle (Namikawa, 1992). Therefore, the potential to improve the quality of carcass traits of Japanese Brown cow needs to be evaluated.

The purposes of this study were to obtain the information of genetic and environmental factors effecting meat production performance of Japanese Brown cow and also to determine the best Japanese Brown sire.

MATERIALS AND METHODS

Experimental Animals and Traits

This study was conducted by using of ultrasonic estimates of carcass traits of Japanese Brown cows, that were ultrasonically scanned at first registration examination (≥15 months of age or ≤ 40 month of age), which born from January 3rd, 1988 to December 25th, 1993 at Kumamoto prefecture Japan. The data consisted of records of 9468 head of cows (representing by 88 sires) after removing records with missing or abnormal data, pedigree and ultrasonic estimates of carcass traits records. Carcass traits were measured for MLTA, SFT, IMFT, RT and MS between the 6th and 7th ribs on the left side of each animal. Scanning equipment was Super-Eye MEAT (FHK Co. Ltd., Japan) with the electric liner probe (2 MHz frequency, 27 mm x 147 mm). Each scanogram was interpreted by the use of computer systems for estimating all carcass traits.

Statistical Method

The cows, which are considered in the selection and analysis for sire model and maternal grand sire model, were born from both the sire and MGS that have at least five offspring. The linear and quadratic regressions of age were included in the model. Data were analyzed by LSMLMW procedures of Harvey (1990) with the model as follows :

$$\hat{Y}_{ijklm} = \mu + m_i + g_{ij} + Y_k + S_l + (YS)_{kl} + a_1 (U_{ijkl} - \bar{U}) + a_2 (U_{ijkl} - \bar{U})^2 + \varepsilon_{eijklm}$$

Where,

$\hat{Y}_{ijklm}$ = the ultrasonic estimates of carcass traits

μ = overall mean

m_i = random effect of i^{th} sire (I = 1, 2, …, 88)

g_{ij} = random nested effect of j^{th} MGS within i^{th} sire (j = 1, 2, …, 235)

Y_k = effect of the kth birth year (k = 1988, …, 1993)

S_l = effect of the lth birth season (l = winter(Dec-Feb), spring (March-May), Summer (June-Aug) and autumn (Sept-Nov)

$(YS)_{kl}$ = interaction effect of the k^{th} birth year with the l^{th} birth season

a_1, a_2 = coefficients of linear and quadratic regression of cow's age

$\bar{U}$ = mean of cow's age

ε_{eijklm} = residual error of the dependent variable

In the main model, sire and MGS within sire effects were treated as random effects and the other sources of variances were considered as fixed effects. Replacement of 38 head of good sires, those having at least 50 progenies (total progenies: 8474 head of Japanese Brown cow), to be fixed effect from model was used to get the best sire of the Japanese Brown cattle. The Duncan test was used to test for differences.

RESULTS AND DISCUSSION

Basic statistic of ultrasonic estimates of carcass traits of Japanese Brown cow

The means, standard of deviations and coefficient of variations of ultrasonic estimates of carcass traits of Japanese Brown cows are shown at Table 1.

Table 1. Basic statistics of carcass traits of Japanese Brown cows (n = 9,468 head), based on sire

Traits	Mean ± S.D	C.V (%)	Minimum	Maximum
Age (month)	22.7 ± 2.9	12.8	16.0	36.9
MLTA	32.4 ± 4.9	15.1	13.0	53.0
SFT	10.5 ± 4.6	43.8	0.7	40.5
IMFT	18.3 ± 7.1	38.8	3.1	63.5
RT	44.9 ± 10.1	22.5	17.1	99.3
MS	0.52 ± 0.35	66.8	0.00	2.00

MLTA:M.*Longissimus thoracis area* (cm^2); MS:Marbling score;
RT, SFT, IMFT:Thickness of rib, subcutaneous and intermuscular fat (mm)

Mukai *et al*. (1993) and Oyama *et al*. (1996) found higher results compared to of this study of MLTA of 48.3 cm^2 and 47.8 cm^2, SFT of 31.0 mm and 27.0 mm, RT of 73.0 mm and 65.0 mm, MS of 1.70 and 1.35 for carcass traits of Japanese Black female on average of 28.2 and 20.8 months of age, respectively. It is indicated that carcass traits of Japanese Brown cow were lower than those of Japanese Black cow although the Japanese Black was measured more younger than Japanese Brown one. However, very few reports were presented to compare the carcass traits characteristics of Wagyu cattle.

Culling out several cows without MS (0,00) could raise the mean of MS and also could rouse the quality of MS of Japanese Brown cow. The coefficient of variation of

MLTA is lower than those of other carcass traits. It is indicated that quality of MLTA is more homogenous than the other carcass traits. The coefficient variation of MS is higher than other carcass traits. However, the coefficient of variation of age also indicated that the variation of data was small.

The effect of some factors on ultrasonic estimates of carcass traits of the Japanese Brown cow

The result of least squares analysis of variance for ultrasonic estimates of carcass traits of Japanese Brown cow are shown in Table 2.

All effects were significant ($P<0.05$ and 0.01) for all carcass traits except MGS within sire effect for SFT, RT and MS which were not significant. High significance of sire effect for all ultrasonic estimates of carcass traits indicated that the additional genetic variance is large enough to allow substantial genetic improvement of Japanese Brown cow.

Table 2. Analysis of variance for ultrasonic estimates of carcass traits of Japanese Brown cow (based on sire)

Source of Variation	Df	Mean Squares				
		MLTA (cm^2)	SFT (mm)	IMFT (mm)	RT (mm)	MS
Sire	87	54.8**	72.7**	99.9**	182.8**	0.34**
MGS : Sire	2876	22.6*	16.3	38.2**	80.7	0.10
Place	10	323.8**	263.2**	401.8**	937.7**	1.06**
Birth Year (Y)	5	546.9**	899.0**	4655.9**	4366.3**	2.25**
Birth Season (S)	3	146.5**	127.2**	778.4**	226.7*	0.61*
(Y) X (S)	15	109.6**	63.8**	455.8**	347.3**	0.35**
Regression						
Age (Linear)	1	651.0**	195.8**	3115.6**	3918.1**	0.96**
Age (Quadratic)	1	554.5**	583.9**	210.0*	1636.9**	2.00**
Residual	6469	21.1	16.6	35.0	80.6	0.10

Abbreviations of carcass traits are same as in Table 1.

** P<0.01, * P<0.05

Sire Effect

As shown in Table 3, the differences of the least squares means between sire lines were varying from 30.4~33.7 cm^2 for MLTA, 8.2~12.3 mm for SFT, 15.7~21.1 mm for IMFT, 40.9~48.3 mm for RT and 0.41~0.68 for MS, respectively. The famous sire lines of Japanese Brown cattle (Mitsushige ET, Mitsutake, Mitsumaru, Dai 5 Harutama, Dai 10 Mitsumaru and Namimaru) were higher of MLTA, MS and optimum of SFT and IMFT than the other sires. The MLTA of cows that were produced by Mitsushige ET were 0.6 cm^2 bigger than Mitsutake, 0.2 cm^2 than Mitsumaru, 0.7 cm^2 than Dai 5 Harutama, 0.8 cm^2 than Dai 10 Mitsumaru and 1.4 cm^2 than Namimaru, respectively. The MS of cows that representing by Mitsushige ET were the highest (0.68±0.03), namely 0.04, 0.05, 0.06 and 0.08 higher than Mitsutake, Mitsumaru, Dai 10 Mitsumaru and Namimaru, respectively. The cows represented by Mitsushige ET have the best MS and also the largest MLTA. The sires that have progenies with big size and good MS should be promoted and used as superior breeding sires to improve the meat quality and quantity of Japanese Brown cattle.

Table 3. Least-squares means and standard errors of ultrasonic estimates of carcass traits of Japanese Brown cow, by sire lines (n = 38 head).

No	Sire's names	Cow's records	MLTA (cm^2)	SFT (mm)	IMFT (mm)	RT (mm)	MS
1	Mitsushige ET	123	33.7±0.4^{a}	10.4±0.3^{c}	18.0±0.6^{c}	45.5±0.8^{cd}	0.68±0.03^{a}
2	Mitsutake	92	33.1±0.5^{abc}	10.9±0.4^{bc}	18.7±0.6^{bc}	46.8±0.9^{abc}	0.64±0.03^{ab}
3	Mitsumaru	88	33.5±0.5^{a}	10.5±0.4^{c}	18.0±0.6^{c}	45.6±0.9^{cd}	0.63±0.03^{abc}
4	Dai 5 Harutama	131	33.0±0.4^{abc}	10.4±0.3^{c}	18.7±0.5^{bc}	45.8±0.8^{abcd}	0.63±0.02^{abc}
5	Ginboshi	56	32.3±0.6^{cde}	9.8±0.5^{c}	17.8±0.8^{c}	44.1±1.2^{d}	0.63±0.04^{abc}
6	Dai 10 Mitsumaru	964	32.9±0.2^{bc}	10.2±0.1^{c}	18.1±0.3^{c}	45.1±0.3^{cd}	0.62±0.01^{bc}
7	Dai 7 Harutama	52	32.6±0.6^{bcd}	8.9±0.6^{cd}	17.1±0.9^{c}	42.8±1.3^{e}	0.60±0.04^{bcd}
8	Namimaru	1184	32.3±0.2^{bcde}	11.0±0.1^{bc}	17.6±0.3^{c}	45.2±0.2^{cd}	0.60±0.01^{bc}
9	Kouyo	121	33.0±0.4^{bc}	12.0±0.3^{ab}	21.1±0.6^{a}	48.3±0.8a	0.59±0.03^{bcd}
10	Dai 6 Mitsutake	54	32.8±0.6^{bcd}	11.3±0.5^{bc}	18.2±0.8^{c}	46.5±1.2^{abcd}	0.59±0.04^{bcd}
11	Shigenami 1	99	32.2±0.5^{cde}	10.1±0.4^{c}	17.7±0.6^{c}	44.4±0.9^{d}	0.59±0.03^{bcd}
12	Dai 3 Mitsumaru	1019	32.3±0.2^{cde}	10.0±0.1^{c}	17.1±0.3^{c}	44.4±0.3^{d}	0.58±0.01^{bcd}
13	Tamao	58	30.8±0.6^{ef}	8.7±0.5^{d}	16.5±0.8^{cd}	42.5±1.2^{f}	0.58±0.04^{bcd}
14	Dai 2 Shigenami	312	31.1±0.3^{def}	8.7±0.2^{d}	16.3±0.4^{cd}	43.4±0.6^{d}	0.56±0.02^{bcd}
15	Dai 5 Tamanami	239	30.4±0.3^{ef}	8.5±0.3^{d}	16.2±0.5^{d}	42.2±0.7^{fg}	0.56±0.02^{bcd}
16	Dai 4 Sakae	51	31.9±0.6^{cde}	8.6±0.5^{d}	17.6±0.9^{c}	42.9±1.3^{de}	0.55±0.04^{cd}
17	Dai 5 Mitsumaru	177	32.2±0.3^{cde}	10.5±0.3^{c}	17.2±0.5^{c}	45.7±0.7^{cd}	0.54±0.02^{cd}
18	Dai 28 Shigekawa	63	31.0±0.6^{ef}	10.4±0.5^{c}	16.2±0.8^{d}	43.2±1.2^{d}	0.54±0.04^{cd}
19	Mitsuhata	208	33.4±0.4^{ab}	11.1±0.3^{bc}	18.9±0.6^{bc}	46.0±0.8^{abcd}	0.53±0.02^{cd}
20	Mitsuhisa	55	32.1±0.6^{cde}	9.3±0.5^{cd}	17.5±0.8^{c}	44.6±1.2^{cd}	0.53±0.04^{cd}
21	Dai 1 Kusafuku	65	32.5±0.5^{bcde}	11.6±0.5^{abc}	19.7±0.7^{bc}	47.6±1.1^{ab}	0.52±0.04^{de}
22	Yuusen	83	32.3±0.5^{cde}	10.1±0.4^{c}	17.1±0.7^{c}	44.4±1.0^{d}	0.52±0.03^{d}
23	Mitsutake 3	193	32.2±0.4^{cde}	10.8±0.3^{bc}	19.1±0.5^{bc}	44.7±0.7^{cd}	0.52±0.02^{d}
24	Dai 2 Shigemitsu	415	32.2±0.2^{cde}	10.6±0.2^{c}	18.3±0.3^{c}	45.7±0.4^{cd}	0.52±0.01^{de}
25	Dai 8 Mitsutake	301	32.1±0.3^{cde}	10.2±0.2^{c}	17.8±0.4^{c}	45.5±0.5^{cd}	0.52±0.01^{de}
26	Shigetamanami	73	31.4±0.5^{def}	9.4±0.5^{cd}	16.8±0.7^{cd}	42.2±1.1^{fg}	0.52±0.04^{de}
27	Koujugawa	442	32.3±0.2^{cde}	10.9±0.2^{bc}	18.6±0.3^{bc}	44.8±0.4^{cd}	0.51±0.01^{de}
28	Dai 8 Mitsumaru	240	31.5±0.3^{de}	11.1±0.2^{bc}	17.9±0.4^{c}	44.2±0.6^{d}	0.51±0.02^{de}
29	Shigeshigekawa	85	31.4±0.5^{de}	11.1±0.4^{bc}	17.8±0.7^{c}	44.4±1.0^{d}	0.51±0.03^{de}
30	Shigetaka	143	32.6±0.4^{bcd}	11.7±0.3^{ab}	17.6±0.6^{c}	43.6±0.7^{d}	0.49±0.02^{de}
31	Dai 3 Kyu sen	214	31.3±0.4^{def}	9.2±0.3^{cd}	17.9±0.5^{c}	43.9±0.7^{d}	0.49±0.02^{de}
32	Dai 10 Toegawa	98	31.8±0.4^{de}	11.8±0.4^{ab}	18.4±0.6^{c}	45.8±0.9^{bcd}	0.47±0.03^{de}
33	Fujitamanami	100	30.6±0.5^{ef}	9.5±0.4^{c}	15.9±0.7^{d}	41.8±1.0^{fg}	0.47±0.03^{de}
34	Takeshige	214	32.4±0.4^{bcde}	12.3±0.3^{a}	19.7±0.6^{ab}	46.7±0.7^{abc}	0.46±0.02^{e}
35	Shigeminami	72	31.5±0.5^{de}	10.6±0.4^{bc}	17.9±0.7^{c}	46.4±1.0^{abcd}	0.45±0.03^{e}
36	Shigekawamaru	60	32.6±0.6^{bcd}	11.1±0.5^{abc}	15.7±0.9^{d}	43.2±1.2^{d}	0.42±0.04^{e}
37	Shigekuma	417	31.4±0.4^{de}	9.4±0.3^{c}	17.1±0.5^{c}	43.2±0.6^{d}	0.42±0.02^{e}
38	Shigeo	113	30.5±0.5^{ef}	8.2±0.4^{d}	15.8±0.6^{d}	40.9±0.9^{g}	0.41±0.03^{e}

Figures with different superscript within each columns differ significantly (P<0.05) from each other. Abbreviations of carcass traits are the same as in Table 1.

CONCLUSION

1. Sire line was an important source factor for improving the meat performance production of the progeny. Therefore, sire selection has to be done to improve the carcass quality of the next generation of the Japanese Brown cattle.
2. The cows that were represented by Mitsushige ET, Mitsutake, Mitsumaru, Dai 5 Harutama, Dai 10 Mitsumaru and Namimaru had good quality in carcass traits, especially MLTA and MS. Therefore, they were recommended as good breeding cows for the Japanese Brown cattle.

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