

**RELATIONSHIPS BETWEEN ULTRASONIC ESTIMATES OF CARCASS TRAITS AND BODY MEASUREMENTS OF JAPANESE BLACK BULL**

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**ABSTRACT**

This experiment was done at 292 head of Japanese black bull at Kagoshima and Miyazaki Prefectural Experimental Stations Japan to find out the relationship between ultrasonic estimates of carcass traits and body measurements as one of criteria to select Japanese black bull. The carcass traits of 20 months of age were predicted using the ultrasonic machine. The body dimensions were measured at the end of performance test (12 months of age) and 16 months of age. The ultrasonic evaluation techniques were used to estimate Musculus Longissimus thoracis area between 6–7th and 12-13th ribs (MLTA6-7 and MLTA12- 13), Subcutaneous Fat Thickness (SFT), Intermuscular Fat Thickness (IMFT), Rib Thickness (RT) and Marbling Score (MS). Body measurements were taken on body weight (BW), withers height (WH), hip height (HH), body length (BL), chest girth (CG), chest depth (CD), chest width (CW), rump length (RL), hip width (HW), thurl width (TW) and pin bone width (PBW). Chest girth, chest width and chest depth at 12 and 16 months of age were showed the highest significant and positive correlations among the other body dimensions with ultrasonic estimated of carcass traits at 20 months of age. The ratio of contribution to predict MLTA6-7, MLTA12-13 and SFT at 20 months of age using the body dimensions at 12 months of age were higher than those of 16 months of age.

**Keywords:** Carcass traits, body dimension, ultrasonic estimate, performance test, Japanese black bull, correlation

**HUBUNGAN ANTARA DUGAAN SIFAT KARKAS MENGGUNAKAN ALAT ULTRASONOGRAFI DENGAN DIMENSI TUBUH SAPI JEPANG HITAM JANTAN**

**ABSTRAK**

Penelitian ini dilakukan di Stasiun Penelitian Propinsi Kagoshima dan Miyazaki Jepang menggunakan 292 ekor sapi Jepang jantan. Tujuan penelitian adalah untuk mengetahui hubungan antara sifat karkas sapi saat berumur 20 bulan yang diduga

menggunakan alat ultrasonografi dengan berbagai dimensi tubuh yang diukur saat akhir performans test (sekitar umur 12 bulan) dan saat umur 16 bulan sebagai salah satu kriteria untuk menseleksi sapi Jepang hitam jantan. Sifat-sifat karkas yang diukur adalah luasan *M. Longissimus thoracis area* antara tulang rusuk ke 6~7 (MLTA6-7) dan 12~13 (MLTA12-13), tebal lemak subkutan (SFT), tebal lemak intermuskular (IMFT), tebal tulang rusuk (RT) dan marbling score (MS). Dimensi tubuh yang diukur adalah berat badan, tinggi pundak, tinggi punggung, panjang badan, lingkar dada, dalam dada, lebar dada, panjang kelangkang, lebar punggung, lebar kelangkang, lebar tulang tapis. Hubungan antara lingkar dada, lebar dada dan dalam dada saat sapi berumur 12 dan 16 bulan dengan sifat karkas pada saat berumur 20 bulan yang diduga menggunakan alat ultrasonografi memperlihatkan hubungan tertinggi yang positif dan nyata. Kombinasi beberapa dimensi tubuh sapi saat umur 12 bulan memperlihatkan nilai rasio kontribusi yang lebih tinggi daripada saat berumur 16 bulan untuk menduga MLTA6-7, MLTA12-13 dan SFT saat berumur 20 bulan.

**Kata kunci :** Sifat karkas, dimensi tubuh, pendugaan dengan ultrasonografi, performance tes, calon pejantan sapi Japanese black, korelasi

## INTRODUCTION

The bull as a candidate of sire has to pass some selections test such as performance test (for 112 days), progeny test (for 54 weeks), etc (Sri Rachma, 2001). The performance test was done after the bull of 8 months of age (post weaning). In Japan, there are three times to check the quality of bull (at the end of performance test/around 12 months of age, around 16 and 20 months of age). The information is needed before they continue the programmed to the progeny test. Young sires for replacement stock are being selected, thus their carcass abilities are unproven. However, before ultrasound-measured traits of breeding stock are used in beef selection programs, some correlations between body measurement and carcass traits in live stages, which estimated using ultrasound at several stages of ages and also best equation to predict carcass performance on live bulls test at 20 months of age, are needed to emphasize the decision.

Ultrasonography is emphasized within this context as a viable (Frost, et al., 1997), reliable and acceptable cost-effective technique (Houghton and Turlington, 1992). Ultrasound live measurements can be utilized to estimate muscle growth, predict carcass composition (Perry and Fox, 1997; Renand and Fisher, 1997) and yield of commercial meat cuts (Hassen, et al., 1999), as well as to estimate animal body condition score (Busboom, et al., 2000) and can be used to predict ribeye area (REA) and subcutaneous fat thickness (FT) in live animals as compared to carcass measurements (Liliane, et al., 2003; Sri Rachma, 2006; 2008) .

Body measurements and carcass measurements of cattle which estimated using ultrasound are sufficiently correlated to use in research and genetic

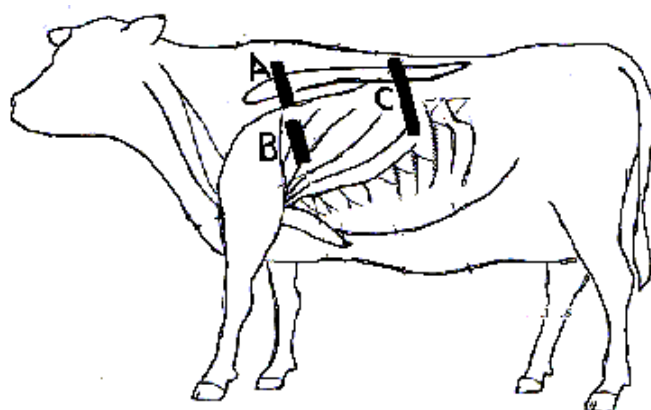
improvement programs (Shepard, *et al.*, 1996) and also making some efficiencies in cost and rearing management. It has been reported that yearling live animal ultrasonic measurements can be used as a selection tool in breeding cattle for the improvement of carcass traits (Stelzleni, *et al.*, 2002). There are few reports showing the growth of carcass traits of live beef cattle of fattening and reports on early prediction of MLTA, SFT, IMFT, RT and MS after fattening (Rahim, *et al.*, 1996).

The objective of this study is to present the reliable of relationships between body measurements at 12 and 16 months of age and carcass traits on live stages which estimated using ultrasound at 20 months of age. The other objective is to estimate the new equations in order to determine the suitable stages for early prediction of the actual values of carcass traits. Finally it could be proposed to be used in the genetic evaluation program.

## **MATERIALS AND METHODS**

### **Experimental Animals and Traits**

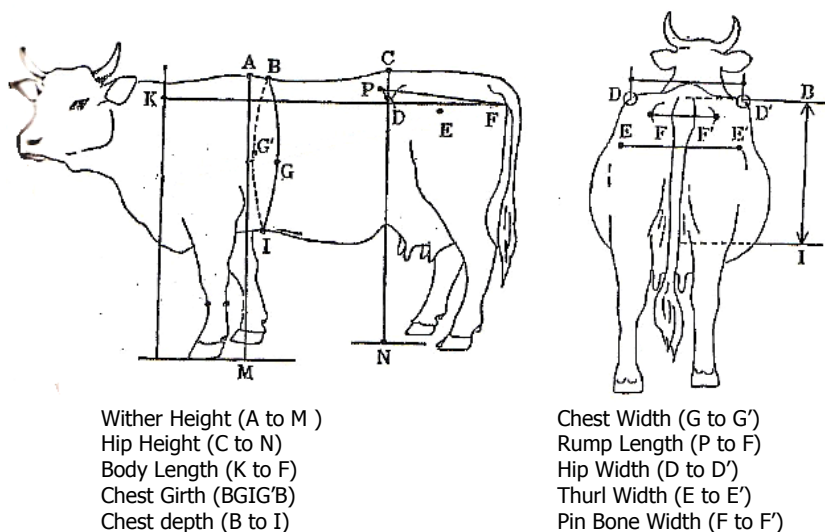
The final data set consisted of real-time ultrasonic and body measurements data of Japanese Black bulls on performance testing at Prefectural Livestock Experimental Station at Kagoshima (n=157 head) and Prefectural Livestock Experimental Station at Miyazaki (n=135 head) Japan. Whole bulls were ultrasonically scanned at 20 months of age while body measurements were measured at the end of performance tests/around 12 months of age and at 16 months of age. Digitized images were interpreted using Super-Eye MEAT (FHK Co. Ltd., Japan) with the electronic linear probe (2 MHz frequency:27x147mm). Scannogram was obtained by use of video-copy machine (Aloka Co. Ltd., SSZ-300 S) and combining with image analysis software. *M.Longissimus thoracis* area between the 6 to 7<sup>th</sup> (MLTA6-7) and 12 to 13<sup>th</sup> (MLTA12-13) rib interface over the longissimus muscle which two-thirds the distance from the spine between the medial and lateral muscle ends corresponding to the Japanese and Canadian carcass grading site, Subcutaneous Fat Thickness (SFT), Intermuscular Fat Thickness (IMFT), Rib Thicknes (RT) and Marbling score (MS) were measured. The perimeter of the longissimus muscle was traced from the digitized image and muscle area was computed by the software. All real-time ultrasound images were taken by a single technician and were subsequently interpreted by a second technician. The scanning positions were shown in Fig.1.



- A = scanning position for measuring MLTA at 6-7<sup>th</sup> rib  
 B = scanning position for measuring SFT, IMFT, RT  
 C = scanning position for measuring MLTA at 12-13<sup>th</sup> rib

**Figure 1.** Scanning position of carcass traits

Body measurements, which is taken by used of a steel rod, calipers and cloth tape calibrated in centimeters contained on body weight (BW), withers height (WH), hip height (HH), body length (BL), chest girth (CG), chest depth (CD), chest width (CW), rump length (RL), hip width (HW), thurl width (TW) and pin bone width (PBW). The locations of measuring body measurements were shown in Fig 2.



**Figure 2.** The position for measuring body measurements

## Statistical Method

All analysis was conducted using partial correlation (Steel and Torrie, 1960). Step-wise multiple regression analysis (Draper and Smith, 1966) in consideration of several variables to select and to adjust appropriate variables in order to predict carcass traits at 20 months of age by use of the body measurement at 12 and 16 months of age.

## RESULTS AND DISCUSSION

### The correlations between ultrasonic estimate of carcass traits and body measurements of Japanese Black bulls at several stages.

The partial regression coefficients between each body measurements and ultrasonic estimates of carcass traits were shown in Table 1.

**Table 1.** Partial correlations coefficients<sup>a</sup> between ultrasonic estimates of carcass traits and body measurements of Japanese Black bulls (weight constant)

	MLTA 7	MLTA 13	SFT	IMFT	RT	MS
BW	<sup>a</sup> 0.12*	0.21**	0.02	0.07	0.13*	0.02
	<sup>b</sup> 0.01	0.13*	0.01	0.12*	0.19**	0.02
WH	- 0.11	- 0.01	- 0.07	- 0.05	- 0.06	- 0.15*
	- 0.12*	- 0.06	- 0.09	0.04	0.03	- 0.12*
HH	- 0.06	0.03	- 0.21**	- 0.05	- 0.04	- 0.13*
	- 0.08	- 0.03	- 0.18**	- 0.03	- 0.02	- 0.17**
BL	- 0.05	0.07	- 0.01	- 0.01	0.08	- 0.02
	- 0.09	- 0.01	- 0.14*	0.05	0.05	- 0.10
CG	0.04	0.13*	0.14*	0.06	0.13*	0.05
	0.07	0.17**	0.12*	0.14*	0.21**	0.11
CD	0.03	0.19**	0.08	0.08	0.12*	0.09
	- 0.07	0.12*	0.06	0.06	0.13*	0.04
CW	0.16*	0.16**	0.14*	0.09	0.09	0.10
	0.08	0.09	0.06	0.05	0.15**	0.15*
RL	0.05	0.15*	0.08	0.01	0.02	0.03
	- 0.09	0.03	- 0.01	0.06	0.09	0.03
HW	0.09	0.17**	0.09	0.08	0.09	0.06
	- 0.01	0.11	0.05	0.09	0.19**	0.06
TW	0.12	0.17**	- 0.09	- 0.01	0.07	0.01
	0.02	0.10	- 0.14*	0.03	0.12*	- 0.01
PBW	0.01	0.12*	0.07	0.06	0.10	0.02
	0.05	0.18**	0.03	0.07	0.19**	0.03

MLTA 6-7 and 12-13: M. *Longissimus thoracis area* at 6~7<sup>th</sup> and 12~13<sup>th</sup> rib; SFT: Subcutaneous fat thickness; IMFT: Intermuscular fat thickness; RT: Rib thickness; MS: Marbling score; BW: body weight; WH: withers height; HH: hip height; BL: body length; CG: chest girth; CD: chest depth; CW: chest width; RL: rump length; HW: hip width; TW: thurl width; PBW: pin bone width

<sup>a</sup> Upper : Correlations between body measurements at 12 months of age and ultrasonic estimates of carcass traits at 20 months of age ; <sup>b</sup> Lower : Correlations between body measurements at 16 months of age and ultrasonic estimates of carcass traits at 20 months of age

The positive and significant correlations were shown by the correlations between chest girth at both of 12 and 16 months of age and MLTA12-13 ( $r=0.13$  and  $0.17$ ), SFT ( $r=0.14$  and  $0.12$ ) and RT ( $r=0.13$  and  $0.21$ ) which is estimated at 20 months of age. Chest width at 12 months of age were shown the positive and significant correlations with MLTA 6-7 ( $r=0.16$ ), MLTA 12-13 ( $r=0.16$ ) and SFT ( $r=0.14$ ), respectively while those at 16 months of age was positive and significant with RT ( $r=0.15$ ). Chest depth at both of 12 and 16 months of age were shown the positive and significant correlations with MLTA12-13( $r=0.19$  and  $0.12$ ) and RT ( $r=0.12$  and  $0.13$ ). The result indicated that bull with wide the chest at 12 months of age tended to have bigger MLTA and thicker of subcutaneous fat at 20 months of age. Bull with wider of the chest at 16 months of ages tended to be better of MS at 20 months of age.

MLTA12-13 has positive and significant correlations with rump length ( $r=0.15$ ), hip width ( $r=0.17$ ) and thurl width ( $r=0.17$ ) at 12 months of age, respectively. Beside that hip width, thurl width and pin bone width at 16 months of age were shown the positive and significant correlations with RT ( $r=0.19$ ,  $0.12$  and  $0.19$ ).

The bulls with short of wither height ( $r=-0.15$  and  $-0.12$ ) and hip height ( $r= -0.13$  and  $-0.17$ ) at both of 12 and 16 months of age tended to have better MS at 20 months of age while the bull with short of hip height at 12 and 16 months of age ( $r=-0.21$  and  $-0.18$ ) tended to be fatter at 20 months of age.

The highest, positive and significant correlations were shown between chest depth at 12 months of age with MLTA 12-13 ( $r=0.19$ ) and between chest girth at 16 months of age with RT ( $r=0.21$ ). This result indicated that bull with deep of the chest at 12 months of age tended to have bigger MLTA12-13 at 20 months of age.

### **Prediction of carcass traits of bulls at several stages**

Step-wise regression analyses to predict of carcass traits of bulls using body measurements were presented in Table 2.

**Table 2.** Multiple regression analysis for predicting carcass traits of Japanese Black bull

Dependent Variable*	Independent variables for predicting carcass traits (Standard partial regression coefficients)					Ratio of Contribution (%)
MLTA 6-7	<sup>a</sup> WH (-0.23)	TW (0.19)	CW (0.16)	PBW (-0.12)		6.2
	<sup>b</sup> CG (0.22)	WH (-0.19)	CD (-0.19)	TW (0.12)		5.5
MLTA 12-13	WH (-0.17)	BW (0.13)	CD (0.15)	TW (0.11)		9.4
	WH (-0.16)	CG (0.14)	BW (0.11)	PBW (0.11)		7.2
SFT	HH (-0.53)	WH (0.24)	CG (0.19)	RL (0.11)		11.6
	TW (-0.24)	CG (0.18)	HW (0.17)	HH (-0.16)		9.0
IMFT	WH (-0.09)	CD (0.08)	CW (0.05)	HW (0.05)		1.9
	HH (-0.22)	WH (0.14)	CG (0.11)	BW (0.09)		3.8
RT	WH (-0.19)	CG (0.11)	BL (0.09)	CD (0.09)		3.8
	BW (0.15)	HH (-0.15)	CG (0.12)	PBW (0.07)		6.8
MS	WH (-0.22)	CD (0.21)	CW (0.13)	PBW (-0.11)		6.0
	HH (-0.25)	CW (0.12)	CG (0.10)	TW (0.08)		7.1

Abbreviation are same as Table 1.

\* : ultrasonic estimate of carcass traits at 20 months of age

<sup>a</sup> Upper : Body measurement at 12 months of age

<sup>b</sup> Lower : Body measurement at 16 months of age

Ratios of contribution to predict the carcass traits of bulls at 20 months of age were ranged between 1.9% and 11.6% (using the 12 months of age measurement) and between 3.8% and 9.0% (using the 16 months of age measurement). SFT could be estimated using the combination of body measurement at 12 months of age with the highest one of ratio of combination ( $R=11.6\%$ ).

The MLTA6-7, MLTA12-13 and SFT at 20 months of age could be estimated more accurate while using the body measurements at 12 months of age than those of 16 months of age. Conversely, IMFT, RT and MS at 20 months of age could be predicted well by use of data at 16 months of age than those at 12 months of age. However, predictions of carcass traits using only body measurements were lower in accuracy. Brethour (2000<sup>a,b</sup>) reported a relative accuracy of 76 to 78% in predicting carcass marbling within one-third of the USDA quality grade. Therefore other information, such as using ultrasonic estimates of carcass traits data or combination of body measurements and ultrasonic estimates of carcass traits maybe raise the ratio of contribution.

WH at 12 months of age, as one of independent variable, has the highest relationship almost all carcass traits estimated. Height of body at both stages of age has the highest relationships with almost all carcass traits and it could be indicated that height of body is the best indicator for predicting carcass traits using only body measurements.

## CONCLUSIONS

1. The highest correlation was shown between chest depth (at 12 months of age) and MLTA12-13 ( $r=0.19$ ) at 20 months of age and between chest girth (at 16 months of age) and RT ( $r=-0.21$ ) at 20 months of age.
2. MLTA7, MLTA 13 and SFT of the Japanese Black bull at 20 months of age could be estimated more accurate since 12 months of age.
3. Height of body is the best indicator for predicting carcass traits using only body measurements.

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