

## Research Note

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# Relationship between Japanese Beef Marbling Standard and Intramuscular Lipid in the *M. longissimus thoracis* of Japanese Black and American Wagyu Cattle

P. J. Cameron,<sup>a</sup> M. Zembayashi,<sup>b</sup> D. K. Lunt,<sup>c</sup> T. Mitsuhashi,<sup>d</sup>  
M. Mitsumoto,<sup>d</sup> S. Ozawa,<sup>d</sup> & S. B. Smith<sup>a\*</sup>

<sup>a</sup> Department of Animal Science, Texas Agricultural Experiment Station,  
Texas A&M University, College Station, TX 77843, USA

<sup>b</sup> Faculty of Agriculture, Kyoto University Livestock Farm, Kyoto University,  
Tanba-cho, Kyoto 629-04, Japan

<sup>c</sup> McGregor Research Center, Department of Animal Science, Texas Agricultural  
Experiment Station, Texas A&M University, McGregor, TX 76657, USA

<sup>d</sup> Department of Animal Production, Chugoku National Agricultural  
Experiment Station, Ministry of Agriculture, Forestry and Fisheries,  
Oda, Shimane 694, Japan

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### ABSTRACT

*Japanese Black and American Wagyu steers (n = 155) were slaughtered and graded under typical Japanese production conditions, and then analyzed for percentage ether-extractable fat at the 6th thoracic vertebra. The percentage of intramuscular lipid was used to develop a prediction equation for the Japanese beef marbling standard (BMS) with R<sup>2</sup> = 0.7619.*

### INTRODUCTION

The Japanese grading system includes a quality grade which incorporates marbling score, color of lean, texture of lean and quality of fat (JMGA, 1989). The marbling score or standard of the *longissimus dorsi* muscle is subjectively evaluated at the 6th–7th rib interface, as compared to the USDA marbling score, which is evaluated at the 12th–13th rib interface. Japanese Black (Wagyu) cattle and the American Wagyu, red or black crossbred cattle that usually con-

\* To whom correspondence should be addressed.

tain both Japanese Black and Japanese Brown breeding, have the genetic ability to deposit greater amounts of marbling than other cattle breeds. As trade between Japan and the USA increases, and consumers become more concerned with the amount of fat in their diet, the percentage of lipid which is associated with each of the Japanese beef marbling standards will become more important. Therefore, in this study, Japanese Black and American Wagyu steers ( $n = 155$ ) were slaughtered at 15–35 months of age and graded by Japanese standards. The amount of lipid associated with each of the grades was determined by ether extraction and a prediction equation was calculated from these data. A prediction equation for the percentage of ether-extractable fat for USDA marbling scores at the 12th–13th rib has already been determined by Savell *et al.* (1986).

## MATERIALS AND METHODS

Japanese Black ( $n = 146$ ) and American Wagyu ( $n = 9$ ) steers were slaughtered serially after 210–710 days on feed (15–35 months of age). Carcasses from Japanese Black steers were graded by official Japanese graders according to the Japanese grading standards (JMGA, 1989). Carcasses from American Wagyu steers were graded by an experienced American grader after he received training in Japan in the application of Japanese standards. Samples were taken from the *longissimus dorsi* muscle at the 6th–7th rib interface. The samples were totally trimmed of subcutaneous fat and quick frozen in liquid nitrogen. AOAC (1980) procedures were followed to determine the percentage of ether-extractable lipid in each sample. Approximately 2 g of each muscle sample was placed on an oven-dried filter paper, weighed, and heated to 100°C for a minimum of 24 h. Samples were weighed again for determination of moisture loss (data not shown), and the lipid was extracted for 16 h using Soxhlet apparatus and diethyl ether. Samples were air-dried and placed in drying ovens for at least 8 h. When the ether had evaporated, the samples were weighed to determine the amount of lipid extracted. All samples were run in duplicate.

SAS (1982) was used to calculate the means and standard deviations for the percentage of ether-extractable fat for each beef marbling standard (BMS), and a regression equation was calculated to allow prediction of the percentage of ether-extractable fat present in the *longissimus thoracis* muscle at the 6th rib when the BMS is known.

## RESULTS AND DISCUSSION

Beef marbling standards ranged from 1, which contains no visible marbling, up to 12, which is heavily marbled. The higher marbling standards are more desirable to the Japanese. The mean ether-extractable intramuscular lipid percentages for each BMS from 1 to 12 are listed in Table 1, along with the standard deviations and minimum and maximum values. The means ranged from 3.0–7.4% for a BMS of 1 to 29.9–38.1% for a BMS of 12. When the beef marbling standard is known, the percentage of ether-extractable fat can be predicted using the following equation: percentage ether extractable fat =  $(\text{BMS} \times 2.3058) + 3.6813$  with an  $r$ -square value of 0.7619.

**TABLE 1**  
Mean Ether-Extractable Intramuscular Lipid Percentages of Beef *M. longissimus thoracis* (R6) across Japanese Beef Marbling Standards (BMS No.)

BMS No.	n	Mean	SD	Minimum	Maximum
12	2	34.0	5.80	29.9	38.1
11	3	31.5	3.00	28.0	33.3
10	4	26.1	2.70	23.6	28.7
9	5	23.0	4.66	16.1	28.7
8	5	20.9	4.33	15.9	27.6
7	7	18.6	5.49	10.0	27.2
6	7	16.9	4.56	10.8	24.1
5	6	13.9	3.81	11.2	21.5
4	30	14.2	3.40	4.8	20.5
3	38	10.4	2.53	5.6	15.5
2	42	8.3	2.70	3.8	13.9
1	6	5.1	1.70	3.0	7.4

The consist of USDA quality grades (Lorenzen *et al.*, 1993) and Japanese quality grades (JMGA, 1989) are listed in Table 2. In the current study, 96% of the samples had a BMS number that was 2 (8.3% ether-extractable fat) or greater. This compares favorably with the Japanese consist (JMGA, 1989), which indicated that for all breed types raised in Japan from April 1988 to March 1989, 90.8% had a BMS number 2 or greater (Table 2). By comparison,

**TABLE 2**  
Percentage Distribution of Carcasses for Each Quality Grade in the Japanese and USDA Grading Systems

Japanese quality Grade/BMS No. <sup>a</sup>	Percent graded carcasses
5/8-12	8.7
4/5-7	13.2
3/3-4	33.7
2/2	35.2
1/1	9.2
USDA quality grade <sup>bc</sup>	Percent graded carcasses
Prime	2.3
Choice	52.9
Select	36.9
Standard	7.5

<sup>a</sup> Cumulated records on graded carcasses April 1988-March 1989 (JMGA, 1989).

<sup>b</sup> Records from the National Beef Quality Audit—1991 (Lorenzen *et al.*, 1993).

<sup>c</sup> Commercial, Utility and Cutter grades were not included as the marbling score in these quality grades is confounded with age.

for cattle raised in the United States, only 2–3% of the carcasses produced in the United States graded USDA Prime (8.56% ether-extractable fat or greater) (Savell *et al.*, 1986; Lorenzen *et al.*, 1993; Table 2). The marked difference in carcass fatness reflects the different production goals of the United States and Japan, and the predominance of Wagyu cattle in Japanese beef cattle production (JMGA, 1989).

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