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Evaluation of American Wagyu sires for scrotal circumference by age and body weight¹

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ABSTRACT: Thirty-six percent of American Wagyu bulls do not meet the current minimum standards set by the Society of Theriogenology for the breeding soundness exam. In contrast, only 15% of bulls of domestic breeds do not meet the minimum standards. Scrotal circumference measurements of Wagyu are smaller than those of other breeds. The objective of this research was to describe scrotal circumference of Wagyu bulls as it relates to age and BW. The data set consisted of 190 Wagyu bulls housed at two locations. One hundred forty-one bulls constituted the first set of data (location 1); scrotal circumference was measured one to six times per bull aged between 13 and 70 mo. Ninety-four of the bulls underwent semen evaluation for motility and morphology. Forty-nine bulls constituted the data set for which scrotal circumference and BW was measured one to nine times per bull between 5 and 21 mo of age

(location 2). Mean scrotal circumference of bulls within each age group was as follows: 12 to 14 mo, 29.8 ± 0.2 cm (mean \pm SE); 15 to 17 mo, 31.8 ± 0.2 cm; 18 to 20 mo, 32.9 ± 0.3 cm; 21 to 24 mo, 31.8 ± 0.5 cm; and > 24 mo, 35.5 ± 0.2 cm. Both age and BW were highly correlated to scrotal circumference ($r = 0.81$ and 0.82 , respectively). Within each age group, there were a percentage of bulls that did not meet the minimum standard for scrotal circumference set by the Society of Theriogenology. The percentages were as follows: 12 to 14 mo, 46%; 15 to 17 mo, 25%; 18 to 20 mo, 33%; 21 to 24 mo, 42%; and > 24 mo, 32%. Morphology and motility were $\geq 50\%$ each in 91% of the bulls between ages 12 and 20 mo at location 1. Based on these data, it is recommended that Wagyu bulls be evaluated with the breed-specific minimum standards for scrotal circumference of 26 cm from 12 to 14 mo, 29 cm from 15 to 17 mo, and 30 cm from 18 to 20 mo of age.

Key Words: Age, Cattle Breeds, Weight

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Introduction

Wagyu cattle are becoming more popular in the United States for export use. Cattle producers have told us that a larger percentage of their Wagyu bulls than of their domestic breeds do not meet the current standards set by the Society of Theriogenology for scrotal circumference. Similarly, Chenoweth et al. (1996) reported that an average of 23% of the Brahman bulls examined (< 18 mo of age) fail breeding soundness exams because scrotal circumferences are too small. Average scrotal circumference of Brahman bulls was 19 cm (Morris et al., 1989) and 22 cm (Chase et al., 1997) at 12 mo of age. In Brahman bulls, testes growth is more related to overall body growth than to age (Chenoweth et al., 1996). Gipson et al. (1985) sug-

gested that Simmental bulls be evaluated with higher standards for scrotal circumference than those used by the Society of Theriogenology. Evaluation of two scrotal circumference groups (32 to 38 and < 32 cm) showed Simmental ejaculates had a significant difference in percentage of live sperm and sperm numbers. Percentage of live sperm (as judged by visual appraisal) decreased from 64 to 16%, compared with the smaller decrease (64 to 47%) in Polled Hereford bulls with scrotal circumferences of 32 to 35 and < 32 cm, respectively. Sperm numbers in an ejaculate of Simmental semen decreased from 1.68 billion to 256 million cells (for the 32 to 38 and < 32 cm scrotal circumference groups, respectively) compared with Polled Hereford sperm numbers, which decreased from 1.55 billion to 1.04 billion at scrotal circumferences of 32 to 35 cm and < 32 cm, respectively. These data indicate that Simmental bulls have a decrease in seminal quality at a higher scrotal circumference than Polled Hereford. Evidence of breed differences, particularly those found in non-British breeds such as Brahman and Simmental bulls, led to the objectives of these studies, which were to describe scrotal circumference in a sample of American Wagyu bulls by BW and age.

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Table 1. Distribution of number of scrotal circumference measurements per bull

Location 1		Location 2	
Measurements per bull, no.	Bulls, no.	Measurements per bull, no.	Bulls, no.
1	65	1	9
2	25	2	3
3	23	3	2
4	15	4	2
5	7	5	2
6	4	6	5
		7	8
		8	4
		9	16

Materials and Methods

Animals

The data set was derived from 190 American Black Wagyu bulls. At location 1 (Boise, Idaho), 141 bulls contributed to the data set consisting of scrotal circumference measurements taken between 13 and 70 mo of age by three licensed veterinarians. At location 2 (Ellensburg, Washington), 49 bulls contributed to the data set of scrotal circumference measurements taken between 5 and 21 mo of age by one technician. The frequency of measurements at both locations varied from bull to bull. At location 1, some were measured once, whereas others had as many as six measurements. Scrotal circumference was measured monthly for 1 to 9 mo, depending on the bull, at location 2; the largest single group consisted of 16 animals with nine different measurements. The final data set consisted of a total of 604 measurements (Table 1).

Scrotal Circumference Measurements

Bulls were restrained in a squeeze chute while scrotal contents were held in place in the ventral scrotum from the cranial side of the scrotum. A scrotal circumference measuring tape (HCR, Kansas City, MO) was slipped over the contents. At the point of widest circumference, the tape was manually tightened with slight pressure on the scrotum and the measurement was recorded (Foote, 1969). All acceptable standards for humane treatment of animals were followed. Ages were recorded at the nearest 0.25 mo. Body weights were documented monthly on a commercial livestock scale at location 2. No BW were recorded at location 1.

Semen Data

Licensed veterinarians evaluated bulls at location 1 for motility and morphology. Semen was collected by electroejaculation one time per bull (12 to 14 mo, $n = 13$; 15 to 17 mo, $n = 24$; and 18 to 20 mo, $n = 57$).

Statistical Analysis

Scrotal circumference means and standard errors were calculated for each age group. Fitted line plot regression was used to determine the correlation between scrotal circumference and age. The second-order linear equation from this regression analysis was used to adjust scrotal circumference to 12, 15, and 18 mo of age ($y = 2.93895x - 7.86 \times 10^{-2}x^2$). The standard deviation of the adjusted values was used to establish recommended standards for 12, 15, and 18 mo of age in American Wagyu bulls.

Results

Table 2 shows the distribution of the scrotal circumference measurements of bulls aged between 12 and 30 mo in relation to the minimum standards of the Society of Theriogenology (Ball et al., 1983). The mean scrotal circumference of the American Wagyu bulls at 12 to 14 mo ($n = 112$) was 29.8 ± 0.2 cm (mean \pm SE). Of the bulls measured in this age group, 46% did not meet the minimum standard of 30 cm. The age groups of 15 to 17 mo ($n = 109$) and 18 to 20 mo ($n = 73$) had means of 31.8 ± 0.2 cm and 32.9 ± 0.3 cm, respectively. Twenty-five percent (15 to 17 mo) and 33% (18 to 20 mo), respectively, of the bulls in these two age groups did not meet the standards of 31 and 32 cm. The last two age groups, 21 to 24 mo ($n = 12$) and > 24 mo ($n = 197$), had mean scrotal circumferences of 31.8 ± 0.5 cm and 35.5 ± 0.3 cm, respectively. Forty-two percent of the bulls in the 21-to-24-mo group did not meet the standard of 33 cm. Thirty-two percent of those in the group of > 24 mo did not meet the standard of 34 cm.

Of 94 bulls evaluated for semen quality, 86 had $\geq 50\%$ motility and morphology (9 of 13 at 12 to 14 mo; 20 of 24 at 15 to 17 mo; and 57 of 57 at 18 to 20 mo of age). Only one of the eight animals with $< 50\%$ motility and morphology had a scrotal circumference below the Society for Theriogenology minimum standard.

American Wagyu bulls at location 2 weighed an average of 305 kg at 12 mo of age. Figure 1 shows the distribution of scrotal circumference by BW from the 49 bulls that were weighed at various ages. Scrotal circumference was highly correlated with age and BW ($r = 0.81$ and 0.82 , respectively, $P < 0.01$), and, BW and age were also highly correlated ($r = 0.94$, $P < 0.01$).

Scrotal circumference for each individual measurement was adjusted to 12, 15, and 18 mo of age, resulting in equal standard errors and standard deviations for each age adjustment (± 0.13 and 2 cm, respectively).

Discussion

This study evaluated approximately 25% of all American Wagyu bulls in the United States from 1993 to 1997. Thirty-six percent of these were below the

Table 2. Assessment of scrotal circumference (SC) of Wagyu bulls in relation to the minimum standard of the Society of Theriogenology

Age, mo	Observations, no. ^a	Observations below standard, no.	Below standard, % observations	SC \pm SE, cm	Minimum standard, cm ^b
12 to 14	112	52	46	30 \pm 0.2	30
15 to 17	109	27	25	32 \pm 0.2	31
18 to 20	73	24	33	33 \pm 0.3	32
21 to 24	12	57	42	32 \pm 0.5	33
> 24	197	63	32	36 \pm 0.2	34

^aBulls < 12 mo of age are not included in this table.^bSociety of Theriogenology (Ball et al., 1983).

minimal scrotal circumference requirements set by the Society of Theriogenology (Ball et al., 1983). The semen data collected from the bulls at location 1 indicated acceptable motility and morphology. The findings in this study are supported by those of Tatman et al. (2001), who described scrotal circumference of Wagyu bulls as substantially smaller (24.5 ± 0.8 cm at 320 ± 14 d) at puberty (≥ 50 million cells and $\geq 10\%$ motility) compared with 28.1 ± 0.8 cm at 373 ± 14 d for Angus and 28.0 ± 0.7 cm at 427 ± 12 d for Brahman, showing breed differences. In addition, the Wagyu bulls were the lightest, weighing 259 ± 14 kg compared with 291 ± 15 kg for Angus. Coulter et al. (1987) evaluated six breeds of bulls (*Bos taurus*) for scrotal circumference and concluded that each breed should have its own minimum standard for scrotal circumference based on the large differences between them.

Wagyu bulls in this study weighed an average of 305 kg at 365 d of age with an average scrotal circumference of 29.8 ± 0.2 cm. For these data, correlations for scrotal circumference:age and BW and for age:BW were high ($r = 0.81$, 0.82 , and 0.94 , respectively, $P < 0.01$). These correlations indicate that scrotal circum-

ference is equally related to age and to BW, which agrees with the high correlation between age and BW. According to the breeding soundness examination manual from the Society of Theriogenology (Ball et al., 1983), BW has a greater correlation to scrotal size than does age. Chenoweth et al. (1996) found similar results in Brahman bulls.

With support from the data in this study and evidence that Wagyu reach puberty at an earlier age and a lighter BW than Angus (Tatum et al., 2001), we propose that Wagyu bulls be evaluated in reference to a breed minimum standard for scrotal circumference rather than to that set by the Society of Theriogenology. Prediction of scrotal circumference at 12, 15, and 18 mo was a necessary reference point for the establishment of a new breed standard for scrotal circumference. Age was chosen as the predictor for scrotal circumference. Best-fit line regression analysis determined that scrotal circumference in relation to age had a quadratic trend. This quadratic equation ($y = 2.93895x - 0.0786x^2$) was used to adjust scrotal circumference to 12, 15, and 18 mo of age for all bulls that also had BW measurements. The averages for adjusted scrotal circumference at these three ages (28.4, 30.9, and 31.9 cm, respectively) were used as the points of reference for the extrapolation of the proposed breed standard. The recommended standard was defined by subtracting the standard deviation (2 cm) from the predicted averages (28.4, 30.9, and 31.9 cm), resulting in a standard of 26 cm (12 to 14 mo), 29 cm (15 to 17 mo), and 30 cm (18 to 20 mo). Extrapolation beyond 18 mo was not mathematically possible because the quadratic line no longer described the data accurately after this point and the number of measurements were too few to support an accurate prediction.

Implications

Results from this study confirm that American Wagyu have smaller scrotal circumferences than other domestic *Bos taurus* breeds of cattle. This smaller size is highly correlated to their smaller BW. Our results suggest that the minimum standards for scrotal circumference in Wagyu bulls be lower than those for other breeds due to their lighter weight and earlier age

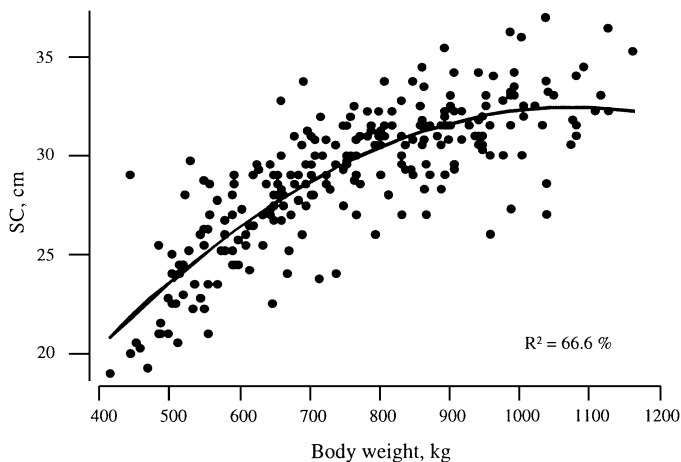


Figure 1. Scrotal circumference (SC) by body weight (mean square error = ± 10.9 kg) for 49 Wagyu bulls (141 observations). The two traits are positively correlated ($r = 0.82$).

at puberty. This recommendation allows for a greater percentage of Wagyu bulls to remain in the gene pool.

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