Short communication: Comparison of 2 methods of assessing calf birth weights in dairy calves

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ABSTRACT

The collection of calf birth weight on US dairies is not a common practice. Calf birth weight was collected on 3 dairies (2 Holstein herds and 1 Jersey herd) over a 6-wk period. All calf birth weights were collected less than 2 h after birth. A total of 872 calves were weighed by a spring scale and their weight was also estimated using a hoof circumference tape, with both weights and sex recorded. The general linear models procedure (PROC GLM; SAS Institute Inc., Cary, NC) was used to estimate least squares means for spring scale birth weight along with sex of the calf and dairy. Calf spring scale versus hoof circumference-estimated birth weight was compared using the regression procedure (PROC REG; SAS Institute Inc.). Calf birth weight was also broken down into increments, and spring scale versus hoof circumference-estimated birth weight was compared by *t*-test. Bull calves had a heavier birth weight compared with heifer calves [36.7 ± 0.4 kg ($n = 450$) vs. 34.6 ± 0.4 kg ($n = 422$), respectively]. The dairy on which calves were born had a significant effect on calf birth weight [dairy 1: 36.8 ± 0.4 kg ($n = 204$); dairy 2: 39.5 ± 0.2 kg ($n = 463$); dairy 3: 25.9 ± 0.4 kg ($n = 205$)]. When the spring scale calf birth weight was linearly regressed by hoof circumference-estimated birth weight, a significant relationship was observed, with an R^2 value of 0.91. For calves weighing less than 31.3 kg, the hoof circumference tape overestimated calf birth weight compared with the spring scale. However, for calves that weighed between 31.3 and 44.9 kg, no significant difference was observed between spring scale and hoof circumference tape-estimated birth weight. For calves weighing greater than 44.9 kg, the hoof circumference tape underestimated birth weight compared with the spring scale. Collection of calf BW by spring scale or estimated by hoof circumference tape appeared to be comparable for most calves because most calves

weighed between 31 and 45 kg, but caution should be used for calves with a light or heavy birth weight.

Key words: dairy calf, birth weight, hoof circumference tape, trait data collection

Short Communication

Size at birth can be used as an indicator of fetal growth, particularly in late gestation. However, fetal growth reductions in early and mid gestation caused by maternal nutrient restriction may not result in a difference in fetal weight at late gestation or at birth (Long et al., 2009, 2010). Heat stress and hypothermia can also be possible insults to fetal growth. In beef cows, heat stress can result in decreased gestation lengths (Wright et al., 2007), and hypothermic environments have been shown to have effects on calf birth weights (Deutscher et al., 1999). In dairy cows, heat stress during the last trimester has been shown to result in altered maternal hormone concentrations and a reduced calf birth weight when compared with cows not exposed to heat stress (Collier et al., 1982). In a subsequent study, the dry period in dairy cows was reduced by 7 d by heat stress when all cows were dried off 46 d before expected parturition, and it also resulted in a 13-kg reduction in calf birth weight (do Amaral et al., 2009).

Calf birth weights are not routinely collected on dairies in the United States. The inclusion of calf birth weight data could allow dairies to make better decisions about calf rearing and even cow management. Swali and Wathes (2006) showed that heifer calves from high-milk-producing dams were more likely to be born with a lighter birth weight compared with heifer calves whose dams produced less than 42 kg of milk/d and that calf sire affected gestation length but not calf birth weight. In dairy cows, increased calf birth weight is related to an increased incidence of dystocia (Sieber et al., 1989; Linden et al., 2009). In addition, the probability of perinatal mortality (death within 48 h of birth) was increased from 2.1% for calves weighing 29 kg at birth to 9.6% for calves weighing 52 kg at birth (Johanson and Berger, 2003). In addition, calves that are born with either a high or a low birth weight

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were more likely to have an incidence of diarrhea at an earlier age compared with calves born at a normal weight (Paré et al., 1993). Increased calf birth weight has been associated with increased odds of lameness in the cow during the following lactation (Linden et al., 2009). Multiple methods are used for collecting calf birth weights. In beef cows, collection of calf birth weight by hoof circumference tape tended to underestimate high-birth-weight calves and tended to overestimate low-birth-weight calves compared with weighing by spring or digital scale (Parish et al., 2009). However, no studies have evaluated methods of calf birth weight collection in dairy calves. Our hypothesis is that the hoof circumference tape will accurately measure calf birth weight on most calves and, considering the ease of use, could result in increased collection of dairy calf birth weights.

Calf birth weight was collected at 3 commercial dairies in the greater Phoenix, Arizona, area over a 6-wk period beginning at the end of November 2011 and ending the first week of January 2012. Dairies 1 and 2 were milking Holsteins and dairy 3 was milking Jerseys. Within 2 h of parturition, calf birth weight was collected using a spring scale (Rubbermaid Co., Huntersville, NC) and estimated using a hoof circumference tape (Calfscale BW Tape; Nasco, Fort Atkinson, WI). Birth weight and calf sex were recorded by dairy employees for all calves born on each dairy. All calves were weighed before colostrum was given. Before the start of the study, all employees were trained in the correct ways to collect calf birth weights using both methods. For collection of calf birth weights by spring scale, the scale was hung by a rope, the calf was placed in a calf weighing sling (Munks Livestock, Anacortes, WA), and the sling was placed on the hook of the scale. The scale weight reading was allowed to stabilize before the weight of the calf was recorded. For calf birth weight estimation by hoof circumference tape, the anterior left hoof of the calf was used, and the tape was placed around the coronary band to take the measurement. The technician ensured that the correct side of the tape was being used for bull and heifer calves according to the manufacturer's instructions.

The general linear models procedure of SAS (PROC GLM; SAS Institute Inc., Cary, NC) was used to estimate least squares means for the response variables of spring scale birth weight, sex of calf, and dairy. All interactions were initially included in the model statement but were removed when found to be nonsignificant ($P > 0.26$). Linear and quadratic regressions, with spring scale birth weight as the dependent variable and hoof circumference tape-estimated birth weight as the independent variable, were conducted using the regression procedure of SAS (PROC REG; SAS Institute

Inc.). Calf spring scale birth weight was also broken down into increments (<27.2 , 27.2 – 31.3 , 31.3 – 35.8 , 35.8 – 40.4 , 40.4 – 44.9 , and >44.9 kg), and PROC GLM of SAS was then used to calculate least squares means and standard errors of the mean for both spring scale and hoof circumference tape birth weight for each increment. The t -test P -values were also calculated by comparing the 2 birth weight measurements.

On dairy 1, 263 bull and 200 heifer calves were born during the collection period, with a range in birth weights of 18.1–63.0 and 27.2–49.0 kg, respectively. On dairy 2, 88 bull and 115 heifer calves were born, with a range of birth weights of 28.1–49.3 and 22.2–46.3 kg, respectively. On dairy 3, 99 bull and 106 heifer calves were born during this period of data collection, with ranges in birth weights of 15.4–51.7 and 15.9–55.3 kg, respectively. The dairy on which calves were born had a significant effect ($P < 0.001$) on calf birth weight [dairy 1: 36.8 ± 0.4 kg ($n = 204$); dairy 2: 39.5 ± 0.2 kg ($n = 463$); dairy 3: 25.9 ± 0.4 kg ($n = 205$)]. Overall, bull calves had heavier ($P < 0.001$) birth weights compared with heifer calves [36.7 ± 0.4 kg ($n = 450$) vs. 34.6 ± 0.4 kg ($n = 422$), respectively].

When the spring scale calf birth weight was linearly regressed by hoof circumference tape-estimated birth weight, a significant relationship ($P < 0.01$) was observed, with a R^2 value of 0.91 (Figure 1a). When the model was changed to a quadratic model, a significant relationship ($P < 0.01$) was also observed, and the R^2 value increased to 0.93 (Figure 1a). The breakdown of calf birth weights and a comparison of spring scale and hoof circumference tape-estimated birth weights are shown in Table 1. For calves weighing less than 31.3 kg, the hoof circumference tape overestimated ($P < 0.001$) calf birth weight compared with the spring scale. However, for calves that weighed between 31.3 and 44.9 kg, no difference was observed between the spring scale and hoof circumference tape-estimated birth weight ($P \geq 0.10$). For calves weighing more than 44.9 kg, the hoof circumference tape underestimated ($P = 0.02$) birth weight compared with the spring scale.

Collection of calf birth weight by spring scale or hoof circumference tape appeared to be comparable for the majority of calves because most calves weighed between 31 and 45 kg at birth; however, caution should be used for calves with a light or heavy birth weight. The use of spring scales often requires lifting the calf and reading the scale at the same time and can lead to inaccurate measures. However, the ease of collecting calf birth weights by hoof circumference tape could make collecting birth weight a type of data commonly collected on US dairies. Even with the slight overestimation and underestimation for calves with a light and heavy birth weight, respectively, the data could be of great help to

Table 1. Comparison of spring scale and hoof circumference tape for birth weight determination on production dairies

Weight (kg)	n	Spring scale		Hoof circumference tape		<i>t</i> -test <i>P</i> -value
		Mean	SEM	Mean	SEM	
<27.2	148	23.2	0.2	24.6	0.3	<0.001
27.2–31.2	95	28.9	0.2	29.7	0.2	<0.001
31.3–35.7	135	33.8	0.1	34.0	0.1	0.22
35.8–40.3	242	38.0	0.1	37.8	0.1	0.13
40.4–44.9	165	42.4	0.1	42.2	0.2	0.10
>44.9	87	47.4	0.3	46.5	0.4	0.02

the US dairy industry. The collection of birth weights could allow for the calculation of birth weight and calving ease expected progeny difference similar to what is currently in place in beef breeds. This would allow dairy personnel to begin selecting for less dystocia and its negative effects on calf survivability and cow performance (Sieber et al., 1989; Johanson and Berger, 2003; Linden et al., 2009).

It should not be surprising that calf birth weights were different between dairies in this study; one dairy

was milking a Jersey herd and the other 2 dairies were milking Holsteins. Even in the 2 dairies milking Holsteins, the genetics did not appear similar enough to result in similar calf birth weights. Bull calves were 2.1 kg heavier than heifers in this group of calves. This result is in agreement with some older literature (Vail et al., 1965) and also more current beef cattle results (Parish et al., 2009).

The collection of calf birth weights on commercial dairies could lead to the collection of data that would allow us to better understand the effect of environment on calf birth weight, which can be an indicator of fetal development and also of future calf performance. The supply of nutrients available to the developing bovine fetus is influenced by maternal age and BCS (Long et al., 2009, 2010). In sheep, the size of the placenta also has been shown to affect fetal growth and become rate limiting in late gestation, resulting in decreased weight of the newborn at birth (Kelly, 1992; Ehrhardt and Bell, 1995; McMillen et al., 2001). Cattle subjected to chronic environmental heat stress during the last two-thirds of pregnancy exhibit reduced uterine and umbilical blood flows in association with reduced fetal oxygen and nutrient uptakes as well as decreased fetal size (Reynolds et al., 1985). The use of hoof circumference tape to determine calf birth weight could allow for more data collection on US dairies and thereby give dairy producers a better understanding of environmental, genetic, and physiological factors that affect their herds.

Figure 1. Linear (a) and quadratic (b) regression analysis of hoof circumference tape versus spring scale for calf birth weight determination. Color version available in the online PDF.

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