The use of ultrasound for assessment of muscle area and depth in postmortem preweaned Holstein dairy calves

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Introduction

Real-time ultrasound is a noninvasive, quantifiable method of measuring body composition in livestock (Houghton and Turlington, 1992). Ultrasound has not been used to document changes in body composition in preweaned calves. The prewean growth period is a critical stage of calf development. An assessment of growth may include weighing of calves or postmortem evaluation of fat deposits in the perirenal area and coronary groove (Schoonderwoerd et al., 1986). None of these parameters offer real-time information, and an antemortem evaluation of body condition is needed. The purpose of this study was to validate the use of ultrasound for the measurement of the *longissimus dorsi* muscle (ribeye) linear depth and the *external carpi radialis* (front) and the *semitendinosus* (hind) muscle area in postmortem preweaned Holstein calves. Our objective was to determine the relationship between the carcass and ultrasound measurements for the ribeye depth and the front and hind muscle area. If validated, ultrasound may be used antemortemly in future scientific studies to assess muscle deposition in preweaned calves.

Materials and Methods

This study was conducted between April and July 2013 at University of California, Davis Veterinary Medicine Teaching and Research Center. One hundred ninety-one postmortem calves were collected from two calf ranches. Two operators scanned using an Aloka SSD-500V with a 5-cm, 7.5-MHz linear transducer with an Ultrasound Image Capture System. Scanning sites included: ribeye between the 12th and 13th ribs, front at the point of the right elbow, and hind at the point of the right femoropatellar joint. The ribeye was dissected and measured for depth. The front and hind muscles were dissected and the cross-sectional planes were traced onto acetate paper. The acetate paper was photocopied and muscle tracings were cut out and weighed. The weights of the muscle tracings were converted to areas using the known area of 8.5 x 11-inch paper (Cruz et al., 2013). One operator processed the ultrasound images using the Centralized Ultrasound Processing Software (v. 2.0, 2007).

Descriptive statistics and absolute mean bias values were analyzed. Pearson correlations were calculated using the CORR procedure. R^2 and RMSE were calculated to further describe the variability in both the carcass and ultrasound values (SAS Inst. Inc., Cary, NC).

Results

Calf age had a right skewed distribution (20.7 ± 17.3 days) with over 50% of the population less than 10 d of age. Calf age and weight were not correlated, and some older calves weighed less than younger calves (r^2=0.13, slope=0.11, P<0.01). The hind muscle had the largest correlation (r=0.84, 0.79; Operator 1 and 2, respectively). The front muscle had a lower correlation (r=0.68, 0.65; Operator 1 and 2, respectively). The ribeye had the lowest correlation (r=0.53, 0.59; Operator 1 and 2, respectively). The absolute mean bias for ribeye, front, and hind all indicate a slight underestimation when using ultrasound to predict carcass values (bias=0.19, 0.82, 0.45, respectively). Results show that there is a large amount of inherent error within the ribeye, front, and hind carcass measurements (RMSE=0.37, 1.76, 1.86, respectively). However, adding independent variables improved the amount of variability accounted for by the model (ultrasound). The r^2 for ribeye was improved when age, weight, gender were added to the model (r^2=0.34). The r^2 for front was improved when weight and operator were added (r^2=0.47). The r^2 for hind was improved when weight and operator were added (r^2=0.55). When calves were grouped by age, improvement in r^2 for hind was seen in young calves when compared to old calves (r^2=0.61).

Significance

The purpose of this study was to validate the use of ultrasound for the measurement of the ribeye muscle depth and the front and hind muscle area in postmortem dairy calves. Carcass values were successfully predicted using ultrasound, with the hind muscle demonstrating the highest correlation. Future research should aim to document ultrasound muscle measurements from healthy, live calves and provide reference values.