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BRIEF COMMUNICATION: Can ultrasound eye muscle area scanning be used in the New Zealand deer industry?

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INTRODUCTION

The New Zealand Deer Industry Productivity Strategy 2009-2014 (Deer Industry New Zealand, 2009) aims to increase deer carcass weight by 10% and introduce a carcass yield module to their performance recording database DEERSelect. In other livestock species real-time ultrasonography offers a non-invasive, non-destructive, standardised muscle measurement on live breeding stock (Faulkner *et al.,* 1990). Ultrasound scanning allows eye muscle (*M. longissimus dorsi)* dimensions and cross-sectional area to be recorded as traits for genetic evaluation in the Sheep (SIL) and Beef (BREEDPLAN) performance recording databases. These measurements can be used to estimate muscularity for genetic selection. In cervids such as, moose, wapiti, and mule deer, ultrasonography has previously been used only on sedated wildlife to predict body condition, using point measurements of fat and muscle depth (Stephenson *et al*., 1998). This study investigates if farmed deer can be ultrasound scanned while restrained without sedation, what muscle dimensions should be measured and whether those measurements would be useful for genetic selection.

When considering ultrasound eye muscle scanning, deer present a few differences to sheep and cattle including behaviour, restraint systems, pelage, leanness and age at slaughter.

Deer are generally more restive livestock than sheep or cattle, and restraint for handling is by squeezing from the sides in hydraulic or pneumatic crushes. With deer being highly seasonal animals, their pelage changes markedly between winter and summer, with winter coats containing a greater proportion of thick medullated fibre than summer coats. Venison is a very lean meat with producers targeting slaughter at >95 kg live weight at 11 to 13 months-old to obtain the highest value for their animals.

MATERIALS AND METHODS

Initial investigations on anaesthetised animals and dissected carcasses selected a site on the *M. longissimus dorsi* (LD) between the 12th and 13th rib, as used for beef cattle. This was considered the most suitable for deer, due to handling and accessibility considerations, skeletal attachment, muscle dimensions and that the visible muscle was entirely LD, eye muscle. Live animal ultrasound was carried out on four farms in Southland and South Canterbury, between September and December in 2008 and 2009. All scanning used a Medison SA600V ultrasound scanner and 120mm, multi-frequency linear array probe operating at 3.5MHz. Experimentation was approved by the AgResearch Invermay Animal Ethics Committee (Approval #11609). The deer were mixed sex stud animals from 10 to 13 months of age (rising one-year-old), representing 357 red deer from two farms, and 416 wapiti from two farms. Of these, 556 animals from three of the farms, two with red deer and one with wapiti, were DNA pedigreed. They had been sired by 56 different stags. Four experienced ultrasound operators worked in pairs, with one common operator throughout. Two U-shaped pads 15 cm thick were placed 15 cm apart on one side of the crush to create three gaps, which allowed easy access to the scan site on the animal. Once restrained in the crush with the scan site at a gap in the U-shaped pads, each animal had a patch of fur (10 × 15 cm) over the scan site clipped to the skin with a cordless animal clipper (Saphir 7.4V, #10 blades, Heiniger, Switzerland), then mineral oil was applied to the scan site. One operator transversely probed the scan site following verbal directions of a second operator viewing the scan image. Once a good image to measure was obtained, it was captured and the animal was released from the crush. The measurements recorded from the image were the maximum depth (B, mm) and maximum width (A, mm). The eye muscle image was manually traced using these points as a reference, and the internal cross sectional area of the traced eye muscle (EMA) was calculated by the scanning unit. Deer were weighed to 0.5 kg resolution within a week of scanning. Statistical analysis was performed in GenStat, Version 11 (VSN International Ltd., Hemel Hempstead, Hertfordshire, UK). Linear regression procedure was used to analyze the relationship between EMA, A, B and A × B. Heritability for EMA was estimated for the 556 pedigreed animals, using a linear mixed model procedure with, sex, live weight, breed and herd nested in breed, fitted as fixed effects. Sire nested in herd, nested in breed and mob, was fitted as a random effect.

RESULTS

All deer were able to be successfully ultrasound scanned between September and December. No animals required sedation or were rejected from scanning for any behavioural reasons. However from April to July, other animals, not in this data set, were unable to be scanned, due to air trapped between hair fibres in their winter coats preventing ultrasonic wave penetration, even when shaved to skin level with a razor. The multiple pad system provided good access to animals within the crush and facilitated fast loading and restraining. The entire procedure generally took less than two minutes per animal from loading. A mean live weight of 97.6 kg for the 773 mixed sex deer of both breeds, reflected the target slaughter weight. Although there was a 20 kg difference between breeds in their mean live weight, there was only a 2% difference in EMA between breeds (Table 1). Dimensions (A and B) of the LD image were highly correlated with EMA. Correlations between EMA and A, B and A×B were 0.79, 0.77 and 0.90 respectively. A regression model using A + B + (A × B) to explain EMA, accounted for 81.2% of the variation in EMA. Using A × B alone to approximate EMA produced a regression slope ± standard deviation of 0.661 ± 0.002. Heritability ± standard deviation for EMA was estimated as 0.34 ± 0.16.

DISCUSSION

Farmed rising one-year-old deer can be ultrasound eye muscle scanned unsedated while crush restrained. A site between the 12th and 13th ribs measuring only *M longissimus dorsi*, as for beef cattle, is recommended. It is no more onerous or time consuming than many other deer handling procedures involving crush restraint. The protocol, with two scanner operators easily processed an animal every two minutes. The cost per animal scanned was estimated at $8 to $10 allowing for scan operators only. Given the relative ease of the procedure, the cost, and that it can be done on farm, we believe it is a viable option for stud breeders to scan entire rising one-year-old cohorts for trait recording purposes. There are major seasonal limitations, due to medullated hair fibres in winter coats. However, at around 12 months of age, when deer are in summer coat, is probably the most useful time to select deer breeding stock for carcass traits, as that is when the majority of farmers target their slaughter. The 2% difference between red deer and wapiti mean EMA at a 17% different mean live weight, is most likely is due to wapiti being a later maturing animal, which have a lower muscle to bone ratio than red deer of the same age (Drew & Adam, 1984). With regression analysis of a product of A and B approximating EMA and explaining a high 81.2% of the variance, it would be well worth investigating the proposition of using a single scan operator to measuring A and B and then approximating EMA, as is done for sheep. The sheep EMA approximation uses A × B × 0.77, which indicates a different cross-sectional muscle shape than the A × B × 0.66, obtained for deer by our regression analysis. This may be due to sheep being scanned for these measurements in the lumbar region. The estimated heritability of 0.34 for ultrasound live animal EMA in deer, although only indicative being from a small data set, is consistent published estimates for sheep (Fogarty, 1995) and beef cattle (Association for the Advancement of Animal Breeding and Genetics, 2010). This heritability is moderate and hence is worthy of further work to estimate genetic parameters, including correlations with other production traits and the development of facilities to provide genetic evaluation of carcass yield to deer breeders.

CONCLUSION

We believe eye muscle ultrasound scanning has a sound protocol for rising one-year-old farmed deer and warrants further progression as a carcass yield selection trait to be incorporated in to DEERSelect for whole industry application and advancement.

TABLE 1: Mean ± standard deviation and range of live weight and ultrasound scan eye muscle area for 773 farmed 11 to 13 month-old red deer and wapiti.

Deer type	Live weight (kg)		Ultrasound scan eye muscle area (cm^2)	
	Mean	Range	Mean	Range
Red deer	88 ± 12	62 - 118	24.9 ± 3.7	18.9 - 36.1
Wapiti	106 ± 25	38 - 164	25.4 ± 5.5	5.9 - 40.8
All deer	98 ± 22	38 - 164	25.2 ± 4.7	5.9 - 40.8

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