BRIEF COMMUNICATION

Should the New Zealand Deer Industry consider ultrasound eye muscle area scanning?

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Introduction

The New Zealand Deer Industry Productivity Strategy (2009-2014) aims to increase deer carcass weight by 10% and introduce a carcass yield module to the industry 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 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) industry performance recording databases. These measurements can be used to estimate carcass characteristics for genetic selection. In cervids (moose, wapiti, mule deer) ultrasonography has previously been used on sedated wildlife to predict body condition, using point measurements of fat and muscle depth (Stephenson *et al*., 1998); but not for livestock selection purposes. This study investigates if farmed deer can be ultrasound scanned while restrained without sedation, what should be measured and whether that measurement 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 and age at slaughter. Deer are generally a more flighty livestock than sheep or cattle. Deer restraint for handling is by squeezing from the sides in hydraulic or pneumatic crushes. Deer are highly seasonal and seasonally their pelage changes markedly, with winter coats containing a greater proportion of thick medulated fibres than summer coats. Venison producers target slaughter at >95kg liveweight at11-13 months old to obtain the highest value for their animals.

Methods and Materials

Initial investigations on anaesthetised animals and dissected carcasses selected a site on the *M longissimus dorsi* (LD) between 12th and 13th rib (as used for beef cattle.) This was the most suitable for deer, due to accessibility, skeletal attachment, muscle dimensions and that the visible muscle was entirely LD (eye muscle). Live animal ultrasound was carried out on 4 farms in Southland and South Canterbury, from September to December in 2008 and 2009, using 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 10-13 months of age (R1), representing 357 red deer from 2 farms and 416 wapiti from 2 farms. Of these, 556 animals from 3 of the farms (2 red and 1 wapiti) were DNA pedigreed, and had been sired by 56 different stags. Four experienced ultrasound operators worked in pairs, with one common operator throughout. Two U-shaped pads 15cm thick were placed 15cm apart on one side of the crush to create 3 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 extra pads, each animal had a patch of hair (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 LD scan site following verbal directions of a second operator viewing the scanner 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 width (A, mm), maximum depth (B, 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 v.11 (VSN international Ltd., Hemel Hempstead, UK). Linear regression procedure was used to analyze the relationship between EMA, A, B and A×B. Heritability for EMA was estimated using linear mixed models procedure.

Results

All deer were able to be successfully ultrasound scanned with good images obtained through September –December. None of the animals required sedation or were rejected from scanning for any behavioural reasons. However other animals, not in this data set, were unable to be scanned from April to July in their winter coats, due to air in hair fibres 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 2 minutes per animal from loading. Mean liveweight of 97.6kg for the 773 mixed sex deer of both breeds reflected target slaughter weight well and, although there was a 20kg difference between breed mean liveweights, there was only 2% EMA difference between breeds (Table 1). Dimensions (B and A) of the LD image were highly correlated with EMA. Correlations between EMA and A, B and A×B were 0.791, 0.773 and 0.896 respectively. A regression model using A+B + (A×B) to explain EMA, accounts for 81.2% of the variation in EMA, while using A×B alone to approximate EMA produced a regression slope of 0.661 (SE 0.002). EMA was then analyzed using a linear mixed model on 556 pedigreed animals. Sex, Liveweight, Breed and Herd nested in Breed were fitted as fixed effects. Sire nested in Herd, nested in Breed and Mob, was fitted as a random effect. This model estimated heritability for EMA of 0.34 (SE 0.16).

Discussion

Farmed R1 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 2 minutes. The cost per animal scanned was estimated as $8-10 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 R1 cohorts for genetic selection/trait recording purposes. There are major seasonal limitations, due to medulated 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 and wapiti mean EMA at a 17% different mean liveweight, most likely is due to wapiti being a slower maturing animal which hence have not developed as much muscle as red deer of the same age. With regression analysis of a product of B and A approximating

EMA and explaining a high 81.2% of the variance, it would be well worth further investigating the value proposition of using a single scan operator, only measuring B and A and approximating EMA, as is done for sheep. The heritability of 0.34 estimated, although only indicative from a small data set, is consistent with literature for sheep (Fogarty 1995) and beef (http://www.gparm.csiro.au) ultrasound live animal EMA heritabilities. This heritability is moderate and it is worthy of further work to obtain data from another 500-1000 pedigreed animals to provide a full genetic evaluation to estimate of this and other genetic parameters.

Conclusion

We believe eye muscle ultrasound scanning has a sound protocol for R1 farmed deer and warrants further progression to collect more data and estimate heritability and other genetic parameters and correlations. This should allow it to be progressed as a carcass selection trait for farmed deer and incorporated in to DEERSelect for whole industry application and advancement.

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TABLE 1. Mean and ranges of 773 farmed 11-13 month old deer (wapiti and red) live weight and ultrasound scan eye muscle area (EMA).

	Liveweight Mean (kg)	SEM	Liveweight Range (kg)	EMA Mean (cm^2)	SEM	EMA Range (cm^2)
All deer	97.6	0.8	37.8-164.0	25.2	0.2	5.9-40.8
Red deer	87.7	0.7	62-118.0	24.9	0.3	18.9-36.1
Wapiti	106.0	1.2	37.8-164.0	25.4	0.2	5.9-40.8