Modelling subcutaneous fat deposition in growing South African lambs (#146)

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Introduction

The fat deposition characteristics of different sheep breeds vary according to the selection pressures applied to the breed, as well as its potential for growth . With regard to the value of lamb carcasses, the degree of fat cover of the carcass is one of the main determining factors. It is thus important to be able to predict the rates of fat deposition so as to determine an ideal slaughter weight with optimal fat cover for different sheep breeds. By incorporating ultrasound (US) technology, subcutaneous fat depth can be measured on the live animal, so that fat deposition can be monitored in growing lambs. The aim of this study was thus to develop mathematical models that can be used to predict subcutaneous fat depth of lambs from seven breeds that are popular in South African sheep production systems.

Methods

From an initial body weight of 20 kg, the back fat depth of 69 ewe and 63 ram lambs from six South African sheep breeds was scanned at two week intervals, until the lambs attained mature body weights at about 1 year of age. The breeds included were Dohne Merino (DH), Dormer (DM), Dorper (DP), Meatmaster (MM), South African Mutton Merino (SAMM) and White Dorper (WD). The lambs were reared in a feedlot under optimal growth conditions. Scanning of the subcutaneous back fat depth of the *longissimus lumborum* muscle at the 13th rib was performed using a Mindray DP 30V ultrasound scanner, with a linear transducer. Measurements were taken at the midpoint of the width of the muscle. The US measurements were regressed with the accompanying body weights of the lambs at sampling in order to fit appropriate regression equations to describe the change in ultrasound fat depth with body weight as the lambs grow. The exponential function in the form of $Y = A \cdot exp(B \cdot W)$, where Y is the fat depth at body weight W and the coefficients A and B are the model parameters, was found to be most appropriate in describing the datasets. The parameter estimates of the models were compared to determine any differences between breeds and sexes. In order to correct for any measurement error of the US scanner, a calibration was set up using data collected from 310 lambs, of different breeds, that were slaughtered between 4–12 months of age with varying degrees of fatness. The back fat depths of these lambs were measured with the scanner two days prior to slaughter; the fat depth of a chop excised at the same position was then measured using a calliper 24 hours after slaughter. A linear regression was then fitted to the relationship between ultrasound fat depth and calliper fat depth to determine the calibration.

Results

Moderate to high R^2 values were obtained between the observed and expected values, with 61.1-75.2% of the variation being accounted for in the various production groups. The parameter values of the exponential function, fitted to the back fat curves, were compared between the breeds and sexes (Table 1). No interactions were observed between the main effects of breed and sex. Rams presented significantly higher A parameter values, with lower B parameter values, than ewes. The A parameter (initial fat depth, when W=0) values did not vary between breeds (P >0.05). The DP, WD and DH breeds presented significantly higher B values that that of the SAMM breed, though no differences were observed between the remaining breeds. The Dorper breeds are known to be early maturing and exhibit high levels of fat deposition. It is thus expected that these early maturing breeds would have higher rates of fat deposition (B values) than late maturing breeds such as the SAMM. As ewes also mature earlier than rams, they would also exhibited a higher rate of fat deposition.

Table 1. Comparison of the effects of sex and breed on estimates of model parameters of the exponential function fitted to describe the back fat deposition of growing lambs.

Main effect		Parameter#	
A	B		
Sex	Ram	0.2290^{a} ± 0.0170	0.0198^{a} ± 0.0010
	Ewe	0.1527^{b} ± 0.0179	0.0320^{b} ± 0.0009
	P-value	0.003	<0.0001
Breed	Dohne Merino	0.1416 ± 0.0309	0.0272^{ab} ± 0.0017
	Dormer	0.1632 ± 0.0307	0.0245^{abc} ± 0.0017
	Dorper	0.2596 ± 0.0309	0.0300^{a} ± 0.0017
	Meatmaster	0.2200 ± 0.0249	0.0245^{abc} ± 0.0014
	SA Mutton Merino	0.1940 ± 0.0326	0.0215^{c} ± 0.0018
	White Dorper	0.1669 ± 0.0286	0.0277^{ab} ± 0.0016
	P-value	0.081	0.010

$^{a-c}$ Column means within main effect with different superscripts vary (P <0.05).

#Exponential function fitted: ($Y = A \cdot exp(B \cdot W)$), where Y denotes back fat depth (cm) at body weight W (kg).

For the correction of US measurements, the linear model of y=1.8531x-0.1029

Notes

(R^2 =0.730), where x is US fat depth and y is the actual fat depth, was derived between measured and actual fat depths. This regression can be incorporated with the above models in order to determine the actual fat depth from the predicted fat depth with reasonably high accuracy.

Conclusion

Lamb producers can utilise the models developed in order to run simulations that can be used to accurately predict the fat cover of the different breeds at specific a specific weight. This will then aid producers in establishing an ideal slaughter weight for different breeds, to achieve optimal profitability.

Notes