

**Selection for growth, muscling and fatness alters the
maternal performance and intermediary metabolism of
Merino ewes**

This thesis is presented for the degree of Doctor of Philosophy of Murdoch
University

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I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

.....

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Abstract

There is growing interest in selectively breeding Merinos with higher growth and muscling and lower fatness. The effects of selection for these traits on ewe intermediary metabolism, body composition, reproduction and milk production and on lamb birthweight, survival and growth were studied in a series of experiments and analyses.

Ewes with higher genetic propensity for early growth had higher mature weight, reproductive rate, lamb birthweight, ewe milk production and lamb growth rate. Ewes with higher growth also had a higher circulating level of growth hormone during lactation.

Ewes with higher genetic propensity for muscling had a higher reproductive rate and produced lambs that were lighter at birth, but this did not result in lower lamb survival. Ewes with higher muscling maintained a higher condition score which may be at least partly attributed to a lower response to adrenaline at the level of the muscle in these higher muscled ewes. Similarly higher muscled ewes had lower growth hormone concentration in lactation which would result in lower mobilisation of tissues. In addition peripheral tissues were less responsive to insulin in high muscled ewes and blood glucose levels were also higher during the non-breeding state in high muscled ewes.

The genetic fatness of ewes was positively associated with lamb birthweight but only when nutrition was restricted suggesting that ewes with a higher genetic propensity for fatness can buffer lamb birthweight under periods of poor nutrition. Ewes with

higher genetic fatness had lower circulating growth hormone and a greater response to insulin providing potential mechanisms for the observed higher fatness. Furthermore, response to adrenaline at the level of liver was greater in ewes with higher fatness suggestive of a higher capacity for gluconeogenesis. The combined results of this work suggest that actively selecting Merino ewes to have higher growth, muscling and fatness is likely to have positive reproduction and therefore economic outcomes.

Table of Contents

Acknowledgements	ix
List of Figures	xi
List of Tables	xii
List of Abbreviations	xvi
Chapter 1 General Introduction	1
Chapter 2 Literature Review	5
2.1 Ruminant energy metabolism	5
2.1.1. Digestion of carbohydrate.....	5
2.1.2. Gluconeogenesis.....	6
2.1.3. Storage of glucose as glycogen.....	8
2.1.4. Storage of energy as fat	10
2.1.5. Fat depots	11
2.1.6. Fat mobilisation	12
2.1.7. Muscle energy metabolism	14
2.2. Hormone regulation of growth and body composition	16
2.2.1. Growth Hormone.....	16
2.2.2. Insulin-like growth factor I.....	19
2.2.3. Insulin	21
2.2.4. Adrenaline.....	23
2.2.5. Leptin	25
2.3. Adaptation to pregnancy and lactation	26
2.3.1. Accumulation of maternal tissues during early pregnancy.....	26
2.3.2. Mobilisation of maternal tissues during late pregnancy	27
2.3.3. Mobilisation of maternal tissues during lactation.....	28
2.3.4. Re-building maternal tissues in late lactation and post weaning.	30
2.4. Measuring and breeding for changes to growth and body composition in sheep	31
2.4.1. Measuring body composition using dual-energy x-ray absorptiometry	32
2.4.2. Condition scoring.....	33
2.4.3. GR tissue measurement for carcass grading	33
2.4.4. C-site muscle and fat depth.....	34
2.4.5. Australian Sheep Breeding Values	34
2.5. The impact of ewe nutrition and selection strategy on body composition and maternal traits.....	36
	iii

2.5.1. Ewe nutrition.....	37
2.5.2. Selection for wool traits	41
2.5.3. Selection for higher growth.....	44
2.5.4. Selection for higher muscling	49
2.5.5. Selection for lower fatness.....	55
2.6. Conclusions	59
2.7. General Aims.....	60
2.8. Hypotheses.....	61
2.8.1. Measurement of body composition and its impact on maternal performance	61
2.8.2. Impact of breeding values on body composition.....	61
2.8.3. Impact of breeding values on reproduction and lamb growth.....	61
2.8.4. Impact of breeding values on regulatory hormones and intermediary metabolism	62
Chapter 3 Implications of selection for meat and wool traits on maternal performance in Merinos.....	63
3.1 Introduction.....	63
3.2 Materials and methods	66
3.2.1. Animal data	67
3.2.2. Animal management and measurement.....	68
3.2.3. Statistical analysis.....	68
3.3 Results	69
3.3.1. Ewe fecundity.....	69
3.3.2. Lamb birthweight	70
3.3.3. Lamb weight at weaning	72
3.3.4. Lamb survival	73
3.4 Discussion.....	74
Chapter 4 Dual-energy X-ray absorptiometry accurately predicts total body fat in live adult Merino ewes with diverse muscling and fatness breeding values.....	81
4.1 Introduction.....	81
4.2 Materials and Methods	83
4.2.1 Animal Details.....	83
4.2.2 Live animal measurements	84
4.2.3 Carcass Measurements.....	84
4.2.4 Statistical Analysis.....	86
4.3 Results	87

4.3.1 Prediction of total body fat, lean and bone	87
4.3.2 Prediction of carcass traits from estimated breeding values	90
4.3.3 Carcass traits predicted by GR depth, condition score and liveweight	93
4.4 Discussion	94
Chapter 5 Merino ewe muscling and growth breeding values impact on lamb birthweight and growth and on ewe fatness and milk production.....	101
5.1 Introduction	101
5.2 Material and Methods	104
5.2.1 Animals.....	104
5.2.2 Sample analysis	106
5.2.3 Body composition measurement	107
5.2.4 Statistical Analysis	108
5.3 Results.....	109
5.3.1 Ewe liveweight and condition score	109
5.3.2 Ewe body composition.....	110
5.3.3 Ewe milk production and quality	115
5.3.4 Lamb birth and weaning weights.....	115
5.3.5 Ewe hormones and metabolites	116
5.4 Discussion	119
Chapter 6 Lamb birthweight is buffered by maternal reserves of genetically fat ewes during restricted nutrition.....	127
6.1 Introduction	127
6.2 Materials and Methods.....	129
6.2.1 Experimental details	130
6.2.2 Plasma sample analysis.....	132
6.2.3 Body composition measurement	133
6.2.4 Statistical Analysis	134
6.3 Results.....	135
6.3.1 Ewe liveweight and condition score	135
6.3.2 Body composition	137
6.3.3 Lamb birthweight.....	142
6.3.4 Lamb weight at weaning.....	144
6.3.5 Ewe milk production and quality	145
6.3.6 Hormones and metabolites.....	147
6.4 Discussion	152

Chapter 7 Merino ewes selected for rapid lean growth have higher circulating growth hormone.....	166
7.1 Introduction.....	166
7.2 Materials and Methods	168
7.2.1 Animals	168
7.2.2 Plasma sample collection.....	172
7.2.3 Measurements	173
7.2.4 Body composition measurement.....	176
7.2.5 Statistical Analysis.....	177
7.3 Results	178
7.3.1 Liveweight, fatness and wool measurements.....	178
7.3.2 Plasma albumin, urea nitrogen, and non-esterified fatty acid	181
7.3.3 Plasma glucose and lactate.....	181
7.3.4 Growth hormone	182
7.3.5 Insulin-like Growth Factor 1	184
7.3.6 Insulin.....	186
7.3.7 Leptin.....	186
7.4 Discussion.....	187
Chapter 8 Lamb energy metabolism at birth is altered by maternal genotype and lamb gestation length.	197
8.1 Introduction.....	197
8.2 Materials and Methods	200
8.2.1 Animals	200
8.2.2 Experimental procedures.....	201
8.2.3 Sample analysis.....	203
8.2.4 Statistical Analysis.....	204
8.3 Results	205
8.3.1 Lamb metabolites at birth.....	205
8.3.2 Ewe milk production and quality	206
8.3.3 Lamb weights and gestation length.....	207
8.4 Discussion.....	207
Chapter 9 Ewes selected for high muscling mobilise less muscle glycogen and ewes selected for leanness release less glucose in response to adrenaline.	213
9.1 Introduction.....	213
9.2 Materials and Methods	216
9.2.1 Experimental Design.....	216

9.2.2 Animals.....	216
9.2.3 Preparation of animals	219
9.2.4 Experimental Procedure.....	219
9.2.5 Chemical Analysis.....	221
9.2.6 Calculation of the response to adrenaline	221
9.2.7 Statistical Analysis	222
9.3 Results.....	223
9.3.1 Liveweight and condition score	223
9.3.2 Basal substrate concentrations	223
9.3.3 Glucose response to adrenaline	225
9.3.4 Lactate response to adrenaline	229
9.3.5 NEFA response to adrenaline.....	234
9.4 Discussion	237
Chapter 10 Breeding for increased muscling and reduced fatness decreases the response to insulin in reproducing Merino ewes.	249
10.1 Introduction	249
10.2 Materials and Methods.....	251
10.2.1 Experimental Design	251
10.2.2 Animals.....	252
10.2.3 Preparation of animals	253
10.2.4 Experimental Procedure.....	253
10.2.5 Body composition measurement	255
10.2.6 Chemical Methods	256
10.2.7 Statistical Analysis	256
10.3 Results.....	257
10.3.1 Liveweight, condition score and whole body fat percentage	257
10.3.2 Effect of physiological state, liveweight and condition score on basal glucose	258
10.3.3 The effect of muscling group on SSGIR	259
10.3.4 The effect of HFAT on SSGIR	260
10.3.5 The effect of HWT on SSGIR	262
10.4 Discussion	264
Chapter 11 General Discussion	273
11.1 Growth.....	273
11.2 Muscling.....	275
11.3 Fatness	276

11.4 Associated changes in muscle metabolism	277
11.5 Future breeding direction in the Australian Merino	278
11.6 Reflection on methodologies used	279
12. Bibliography	281

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List of Figures

Figure 3.1 Predicted response (\pm s.e.) of lamb survival to the Australian sheep breeding value (ASBV) for percentage increase in ewe hogget-age clean fleece weight (HCFW) for single and twin born lambs.	74
Figure 4.1 Relationships between Dual-energy X-ray Absorptiometry (DXA) determined tissue masses and weighed and chemically determined value for a) total fat (carcass plus internal fat), b) carcass fat, c) carcass lean and d) carcass bone weight. Equations for lines of best fit are presented in Table 4.1.	89
Figure 5.1 Live weight a), and condition score b), of ewes across the experiment in relation to day 0 (7 February 2006).	110
Figure 5.2 The effect of eye muscle depth (EMD) Australian sheep breeding value (ASBV) on dual-energy X-ray absorptiometry (DXA) measured fat tissue (liveweight included in the model).	112
Figure 5.3 The effect of eye muscle depth (EMD) Australian sheep breeding value (ASBV) on dual-energy X-ray absorptiometry (DXA) measured lean tissue (corrected to constant liveweight).....	113
Figure 6.1 Live weight a), and condition score b), of ewes fed high (black line filled in circles) or low (grey line open circles) nutrition across the experiment in relation to day 0 (13 February 2006).	136
Figure 6.2 The effect of Australian sheep breeding value (ASBV) for ewe fatness (HFAT) on DXA fat when measured at conception (---), pre-lambing (....), mid-lactation (—) and weaning (—). Liveweight was included in the analysis. The relationship is significant ($P < 0.05$) only at conception and post weaning measurements.	139
Figure 6.3 The effect of ewe fatness (HFAT) Australian sheep breeding value (ASBV) on lamb birthweight when ewes are managed on low or high nutrition during pregnancy.....	143
Figure 7.1 Australian Sheep Breeding Values (ASBV) at hogget age for subcutaneous fat depth (HFAT) and eye muscle depth (HEMD) of single bearing ewes used in the experiment (n=55).	170
Figure 7.2 Liveweight profile and experimental time line from day 0 (7 March 2007), arrows under the line represent blood sampling time points.	178
Figure 7.3 The relationship between plasma growth hormone concentration and the Australian sheep breeding value (ASBV) fat depth at hogget age (HFAT) at a hogget-weight ASBV (HWT) of 2, 5 or 8 when ewes were pregnant (a), lactating (b) and non-breeding (c).	183
Figure 9.1 Subcutaneous fat depth (HFAT) and eye-muscle depth (HEMD) Australian Sheep Breeding Value (ASBV), calculated 21 March 2008, for 8 ewes in each of the high, medium and low muscling groups.	218

Figure 9.2 Glucose concentration area under curve between 0 and 10 minutes (AUC10) relative to adrenaline dose in: a) pregnancy; b) lactation; and c) non-breeding ewes with breeding values for subcutaneous fat over the loin at hogget age (HFAT) of -0.5, 0.5 and 1.5mm.	228
Figure 9.3 Lactate concentration area under curve between 0 and 10 minutes (AUC10) relative to an adrenaline dose in: a) pregnancy; b) lactation; and c) non-breeding ewes from high, medium and low muscling groups.	231
Figure 9.4 Area under curve (AUC) of lactate concentration between 0 and 10 minutes relative to adrenaline challenges in: a) pregnant; b) lactating; and c) non-breeding ewes from high, medium and low muscling groups and with a range in hogget-age subcutaneous fat depth (HFAT) Australian sheep breeding value (ASBV). Values presented are averages across all levels of adrenaline challenge.	233
Figure 9.5 NEFA concentration area under curve between 0 and 10 minutes (AUC10) relative to adrenaline doses in pregnant, lactating and non-breeding ewes.	236
Figure 10.1 The effect of ewe muscle group on steady state glucose infusion rate (SSGIR; 50% glucose solution) at insulin infusion rates of 0.6 and 6.0mU/kg.min. Values are predicted means \pm s.e. and are averaged across pregnant, lactating and non-breeding states. Muscle groups are not significantly different ($P>0.05$) at the 0.6 infusion rate but are all significantly different ($P<0.05$) at the 6.0 rate.	260
Figure 10.2 The effect of ewe fat breeding value (HFAT ASBV) on steady state glucose infusion rate (SSGIR; 50% glucose solution). Predicted means \pm se at insulin infusion rates of 0.6 (grey line, open squares) and 6.0mU/kg.min (black line, closed squares) during (a) pregnant, (b) lactating, and (c) non-breeding. Symbols are adjusted raw data and each represent an experiment on a single sheep.	261
Figure 10.3 The effect of ewe weight breeding value (HWT ASBV) on steady state glucose infusion rate (SSGIR; 50% glucose solution). Predicted means \pm s.e. at insulin infusion rates of 0.6 (grey line, open squares) and 6.0mU/kg.min (black line, closed symbols) during (a) pregnancy, (b) lactation, and (c) non-breeding. Closed and open symbols are adjusted raw data for 0.6 and 6.0mU/kg.min insulin infusion rates, each represents an experiment on a single sheep.	263

List of Tables

Table 3.1 Generalised linear regression model parameter estimates for the effect of birth type, ewe age, year, and ewe Australian sheep breeding value (ASBV) for hogget-age eye muscle depth (HEMD), weight (HWT) and clean fleece weight (HCFW) for the proportion of ewes having multiple lambs and the proportion of lambs surviving to weaning. Parameters for factors are differences compared with the reference level of ewe age = 2 years old, year = 2000 and in the case of lamb survival, birth type = single.	70
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Table 3.2 <i>F</i> values for the effect of lamb birth type or rear type, sex, sire, ewe age at birth, year of birth, and ewe Australian sheep breeding values (ASBVs) for hogget-age eye muscle depth (HEMD), weight (HWT), clean fleece weight (HCFW), coefficient of variation of fibre diameter (HFDCV) and significant interactions between terms on lamb weight at birth and weaning.....	72
Table 4.1 Regression coefficients (\pm s.e.), model <i>F</i> values and correlation coefficients for Dual-energy X-ray Absorptiometry (DXA) estimates of fat (DXA fat), lean tissue (DXA lean) and bone (DXA bone) compared with chemically determined and weighed measures of total fat, carcass fat, carcass lean and carcass bone. All terms are significant ($P < 0.05$).....	90
Table 4.2 Predicted means and regression coefficients (\pm s.e.), model <i>F</i> values and correlation coefficients for models of carcass traits predicted by 15 month old weight (WT EBV), depth of eye muscle (EMD EBV) and subcutaneous fat at the C site (FAT EBV) estimated breeding values. Coefficients are shown with and without carcass weight (CW) or liveweight (LW) included. Only significant terms ($P < 0.05$) are included.....	92
Table 4.3 Regression coefficients (\pm s.e.), model <i>F</i> values and correlation coefficients for models of carcass traits predicted by GR depth, condition score and liveweight. All terms are significant ($P < 0.05$) unless marked otherwise.	94
Table 5.1 <i>F</i> values for the effect of time, the number of lambs born and reared (rear type) and breeding values for weight (HWT) and eye muscle depth (HEMD) at hogget age, on ewe liveweight and condition score.	109
Table 5.2 Liveweight, condition score, and total mass of fat, lean, and bone tissue measured by dual-energy x-ray absorptiometry (DXA) of ewes at conception, pre-lambing, lactation and post-weaning.....	111
Table 5.3 <i>F</i> values for the effect of physiological state, breeding values for weight (HWT), subcutaneous fat depth (HFAT), eye muscle depth (HEMD) at hogget age, and interactions of physiological state with HWT, HFAT and HEMD on total mass of fat, lean, and bone tissue measured by dual-energy x-ray absorptiometry (DXA).	114
Table 5.4 <i>F</i> values for the effect of breeding values for weight (HWT), and eye muscle depth (HEMD) at hogget age, lamb birth type, lamb sex on lamb weights at birth and weaning and for the effect of breeding values for weight (HWT), and eye muscle depth (HEMD) at hogget age, time of milking and interaction between time of milking and HWT on ewe milk production.	116
Table 5.5 Plasma concentration of leptin, insulin-like growth hormone-1 (IGF-I), urea nitrogen and albumin in ewes during conception, mid-pregnancy, late-pregnancy, lactation, and post-weaning.	118
Table 5.6 <i>F</i> values for the effect of physiological state, breeding values for weight (HWT), sub-cutaneous fat depth (HFAT), eye muscle depth (HEMD) at hogget age, and interactions of physiological state with HWT and HEMD on ewe plasma concentrations of leptin, insulin-like growth factor-I (IGF-I), urea nitrogen and albumin.....	119

Table 6.1 <i>F</i> values for the effect of ewe nutrition treatment, time, the number of lambs born and reared (rear type), and breeding values for fat (HFAT), eye muscle depth (HEMD) and weight (HWT) at hogget age and significant interactions between terms on ewe liveweight and condition score.	137
Table 6.2 Total mass of fat, lean, and bone tissue measured by dual-energy x-ray absorptiometry (DXA) of ewes from low and high nutritional treatments at conception, pre-lambing, lactation and weaning.	138
Table 6.3 <i>F</i> values for the effect of nutrition treatment, physiological state, the number of lambs carried (birth type), Australian sheep breeding values for sub-cutaneous fat depth (HFAT), eye muscle depth (HEMD), and weight (HWT) at hogget age, and interactions of physiological state with nutrition, HWT, HFAT and HEMD on total mass of fat, lean, and bone tissue measured by dual-energy x-ray absorptiometry (DXA).....	140
Table 6.4 <i>F</i> values for the effect of ewe nutrition, lamb birth type, lamb sex, ewe breeding values for weight (HFAT), and eye muscle depth (HEMD) at hogget age, and the significant interactions between terms on lamb weights at birth and weaning.	144
Table 6.5 <i>F</i> values for the effect of nutrition treatment, milking occasion (time), the number of lambs carried (birth type), breeding values for sub-cutaneous fat depth (HFAT) and eye muscle depth (HEMD) at hogget age, and significant interactions between terms on ewe milk production, and the percentage of fat, protein and lactose in the milk.....	146
Table 6.6 Plasma concentration of leptin, insulin-like growth factor-I (IGF-I), urea nitrogen and albumin from ewes in low and high nutrition treatments at conception, mid-pregnancy, pre-lambing, lactation and at lamb weaning.....	149
Table 6.7 <i>F</i> values for the effect of nutrition treatment, physiological state, the number of lambs carried (birth type), breeding values for sub-cutaneous fat depth (HFAT) and eye muscle depth (HEMD) at hogget age, and significant interactions between terms on plasma concentrations of leptin, insulin-like growth factor-I (IGF-I), albumin and urea nitrogen.....	151
Table 7.1 <i>F</i> values for the effect of day of experiment, breeding values for weight (HWT), sub-cutaneous fat depth (HFAT), eye muscle depth (HEMD) at hogget age and condition score on ewe liveweight (LW), condition score (CS) and fat amount measured by Dual-energy x-ray absorptiometry (DXA fat).....	179
Table 7.2 Ewe liveweight (LW), condition score (CS), and plasma concentrations of albumin, urea nitrogen (Urea N), glucose, non-esterified fatty acids (NEFA) and lactate across the breeding cycle.	180
Table 7.3 <i>F</i> values for the effect of physiological state, its interaction with time of sample, breeding values for weight (HWT), subcutaneous fat depth (HFAT) and eye muscle depth (HEMD) at hogget age on ewe plasma concentrations of albumin, urea nitrogen (urea N), glucose, non-esterified fatty acids (NEFA) and lactate.	180
Table 7.4 Mean \pm s.e. of plasma concentrations of growth hormone, insulin like growth-factor-1 (IGF-I), insulin and leptin across a physiological states.....	185

Table 7.5 <i>F</i> values for the effect of physiological state, its interaction with time of sample, breeding values for weight (HWT), subcutaneous fat depth (HFAT), eye muscle depth (HEMD) at hogget age, on ewe plasma concentrations of growth hormone, insulin-like growth factor-1 (IGF-I), insulin, and leptin.	185
Table 8.1 Concentrations of glucose, albumin, urea nitrogen, non-esterified fatty acids (NEFA) and lactate in lamb plasma collected 1 hour and 24 hours post birth.	206
Table 9.1 <i>F</i> values for the effect of physiological state, muscle group, ewe Australian sheep breeding values (ASBVs) for sub-cutaneous fat depth (HFAT) and weight (HWT), adrenaline challenge and condition score and significant interactions on basal glucose concentration, maximum glucose concentration, time to maximum glucose concentration and area under curve of glucose response between 0 and 10 minutes relative to administering adrenaline (AUC10).....	226
Table 9.2 <i>F</i> values for the effect of physiological state, muscle group, ewe Australian sheep breeding values (ASBVs) for subcutaneous fat depth (HFAT) and weight (HWT), adrenaline challenge and condition score and significant interactions on basal lactate concentration, maximum lactate concentration, time to maximum lactate concentration and area under curve of lactate response between 0 and 10 minutes relative to administering adrenaline (AUC10).	230
Table 9.3 Time to reach maximum NEFA concentration (minutes) following an adrenaline challenge in Merino ewes of high, medium and low muscling during pregnancy, lactation or non-breeding.....	234
Table 9.4 <i>F</i> values for the effect of physiological state, muscle group, ewe Australian sheep breeding values (ASBVs) for subcutaneous fat depth (HFAT) and weight (HWT), adrenaline challenge and condition score and significant interactions on basal non-esterified fatty acid (NEFA) concentration, maximum NEFA concentration, time to maximum NEFA concentration and area under curve of NEFA response between 0 and 10 minutes relative to administering adrenaline (AUC10).	235
Table 10.1 Predicted means of steady state glucose infusion rate (SSGIR) at insulin infusion rates (IIR) of 0.6 and 6.0mU/kg.min, basal blood glucose, liveweight, adjusted liveweight (adjusted for conceptus and wool weights where appropriate) and condition score across three physiological states. Average standard error of means across states are presented.....	258
Table 10.2 <i>F</i> values and regression coefficients (\pm s.e.) for the effect of physiological state, muscle group, insulin infusion rate, hogget weight (HWT) and fat depth (HFAT), Australian sheep breeding values (ASBV) and condition score (CS) and liveweight (LW) on steady state glucose infusion rate (SSGIR; 50% glucose solution) and basal glucose.	259

List of Abbreviations

AUC10	Area under the concentration curve between 0 and 10 minutes relative to administering adrenaline
ASBV	Australian Sheep Breeding Value
CS	Condition Score
CW	Carcase Weight
DXA	Dual-energy X-ray absorptiometry
DXA fat	Total fat tissue mass measured by dual-energy X-ray absorptiometry
DXA lean	Total lean tissue mass measured by dual-energy X-ray absorptiometry
DXA bone	Total bone mineral mass measured by dual-energy X-ray absorptiometry
EBV	Estimated Breeding Value
EMD	Eye Muscle Depth - The depth of the <i>m. longissimus lumborum</i> muscle at the C- site, defined as a point between the 12 th and 13 th ribs and 45mm from the dorsal midline
FAT	Subcutaneous fat depth at the C-site, defined as a point between the 12 th and 13 th ribs and 45mm from the dorsal midline
HWT	ASBV for weight at hogget age (15 months old)
GLUT1	Glucose transporter-1
GLUT4	Glucose transporter-4
HEMD	ASBV for eye muscle depth at hogget age (15 months old)
HFAT	ASBV for C-site fat depth at hogget age (15 months old)
HCFW	ASBV for clean fleece weight at hogget age (15 months old)
HFD	ASBV for mean fibre diameter at hogget age (15 months old)
HFDCV	ASBV for the coefficient of variation of fibre diameter at hogget age (15 months old)
IGF-I	Insulin-like growth factor -I
IIR	Insulin infusion rate
LW	Liveweight
NEFA	Non-esterified fatty acid
SSGIR	Steady-state glucose infusion rate
Urea N	Plasma urea nitrogen concentration
VFA	Volatile fatty acid