FLOCK GLUCOSE PROFILES AND PRODUCTIVITY IN BOOROOLA AND RANDOM BRED CONTROL MERINO EWES.

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SUMMARY

Plasma glucose concentrations were determined 95-100 days after mating in flocks of Booroola and control Merino ewes. Ewes with plasma glucose concentrations less than or greater than the flock median value were designated 'Low' (L) or 'High' (H) group ewes respectively. Lambs were weighed at birth. Pregnancy rates in the Booroola flock were **83.0%** (L group) and 33.0% (H group) and in the control flock were 90.5% (L group) and 52.5% (H group). Lambing percentages (lambs born per ewe joined) in the Booroola flock were 203% (L group) and 70% (H group) and in the control flock, 135.7% (L group) and **67.5%** (H group). Number of lambs born per ewe lambing in the Booroola flock ranged from 1 to 4 and for each birth category L group lambs were lighter at birth than H group lambs. In terms of productivity (lamb weight/ewe joined in group), the Booroola flock produced 4.9 (L group) and 2.0 (H group) kg/ewe while the control flock produced 4.9 (L group) and 2.5 (H group) kg/ewe. For both flocks, the glucose test identified a low glucose-high productivity and a high glucose-low productivity sub-flock. This information could enable feed input to be more closely related to lamb output and may help reduce restrictions in fetal growth associated with low maternal blood glucose concentrations in mid to late pregnancy.

INTRODUCTION

The sheep fetus requires glucose as its major energy substrate (Battaglia and Meschia 1973) and shortages of glucose can result in reduced fetal growth (Mellor and Matheson 1979) and affect the energy homeostasis of the ewe (Reid 1968). Glucose is thus a major factor influencing both lamb size at birth and the ewe's well-being during late pregnancy. The concentration of circulating blood glucose in the pregnant ewe represents the balance between glucose entry rate and catabolism in a 3 compartment system consisting of the ewe, placenta and fetus. A recent study by Parr et *al.* (1982) proposed the use of a blood glucose measurement from each ewe at about day 90 after mating to identify the 'high producers', these being ewes with relatively low blood glucose concentrations and likely to need extra feed and management. Subsequent studies (Parr et *al.* unpublished data) have suggested that in some flocks ewes with low glucose concentrations produce smaller lambs than those with high blood glucose concentrations in mid-pregnancy.

The Booroola Merino has been researched greatly in recent years to develop a means of increasing productivity with the use of these highly fecund animals. However, in systems in which one aspect of reproduction is increased (e.g. ovulation rate), management procedures may have to be improved throughout the reproductive process to avoid undue losses. The purpose of the current study was to apply mid-pregnancy glucose testing in a Booroola and a random bred control flock to identify the 'high-producer' portion of the flocks which theoretically should be given extra supplements and more intensive management for the remainder of pregnancy and in the post-natal period.

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MATERIALS AND METHODS

A flock of mixed age (1.5 - 6.5 yr) Booroola Merino ewes (n = 121) and Control Merino ewes (n = 82) were synchronized using MAP vaginal progestagen pessaries (Repromap; Upjohn) and joined over a 5 day period at the second synchronized oestrus. Ewes were single sire joined using 1.5 year old Border Leicester rams. At 95 - 100 days after mating the ewes were yarded overnight. The following morning a jugular blood sample (8-10 ml) was collected with a minimum of disturbance into a heparinized vacutainer and placed in iced water before centrifugation. Ewes that had not been served during the mating period were included. Plasma glucose concentrations were measured by the glucose oxidase-phenylaminophenzone method (Trinder 1969) with a Technicon Autoanalyser and Boehringer reagents. The coefficient of variation of 14 sets of standards measured during the assay was ±1.5%. Ewes in each flock were designated 'High' (H group) or 'Low' (L group) depending on whether their glucose concentration was above or below the point closest to the median value for the flock. Al 1 ewes were injected with 16 mg of 9α-fluro-16-methyl-prednisolone (Sigma) at 1600h on day 144 after mating and lambed under continuous supervision. Lambs were identified with ewes and were weighed within 24h of birth. Analysis of Variance Baker and Nelder (1978) was used to compare L vs H glucose as a main effect on birthweight. The model used was: $y = \mu + Fi + Aj + G_k + LS_l +$ 2 way interactions $+ (error)_{i\,jkl}$.

Where F = Flock (Booroola vs Control), A = Age of ewe (1.5 - 6.5 yr), G = L group vs H group, LS = Litter size (1, 2, 3, 4).

RESULTS

The median glucose concentration of both flocks was 3.3 mmol/l and the range was 1.7 to 5.9 mmol/l in the Booroola flock and 2.3 to 6.2 mmol/l in the control flock. These data were not adjusted for age of ewe. Prior to lambing, 3 ewes suffered from pregnancy toxaemia (Booroola flock; 2 L group and 1 H group). One of these ewes died (plasma glucose, 1.9 mmol/l; L group) and the other 2 subsequently gave birth to 4 lambs each. The mean pregnancy rate (percentage of ewes pregnant per ewes joined) in the Booroola flock was 58.3% (L group, 83.0%; H group, 33.0%). The mean pregnancy rate in the control flock was 72.0% (L group, 90.5%; H group, 52.5%). In the Booroola flock most non-pregnant ewes (40/50; Table 1) were designated H group at blood sampling while most multiple bearing ewes (42/54) were designated L group. This resulted in a lambing percentage (lambs born per ewe joined) in the L group approximately 3 times that of the H group. Similar distributions existed in the control flock (Table 1) in which litter size was either one or two. Lambs dying at birth or within 24h of birth were mostly in the Booroola flock (26 vs 4) and mostly born to L group ewes of that flock (20 vs 6).

From the analysis of litter birth weight the only interaction that was significant ($P < 0.05$), was age x litter size. Birth weights of L group lambs (Table 2) in the Booroola flock were consistently lower than H group lambs, however these differences failed to reach significance ($P > 0.05$).

TABLE 1 Distribution of ewes and percentage of lambs born of the Booroola and Control Merino flocks having low (L) and high (H) plasma glucose concentrations at Day 95 - 100 of pregnancy

Flock	Plasma Glucose Group	Number of ewes joined (EJ)	Ewes with litter size* 0	1	2	3	4	Number of lambs born (LB)	% LB/EJ
Booroola	L	60	10	8(1)#	19(4)	16(10)	7(5)	122(20)	203.3
	H	60	40	8(1)	6	2	4(5)	42(6)	70.0
	Total	120	50	16	25	18	11	164	136.7
Control Merino	L	42	4	19(1)	19	-	-	57(1)	135.7
	H	40	19	15(3)	6	-	-	27(3)	67.5
	Total	82	23	34	35	-	-	84	102.4

*number of ewes with each litter size; # figures in parentheses are the number of lambs born dead or dying within 24h of birth.

TABLE 2 Mean (±s.e.) birthweight (kg) of single and combined birthweight of multiple lambs of the Booroola and Control Merino flocks born to ewes having Low (L) and High (H) plasma glucose concentrations at Day 95 - 100 of pregnancy

Flock	Group	Litter size at birth 1		2		3		4	
Booroola	*L	2.9	0.38(8)#	5.6	0.31(19)	7.2	0.44(16)	7.5	0.49(7)
	H	3.8	0.36(8)	6.5	0.69(6)	7.8	0.40(2)	7.9	0.63(4)
Control	L	4.1	0.19(19)	6.8	0.30(19)				
	H	4.2	0.24(15)	6.6	0.41(6)				

* Differences between L and H groups for all birth categories in both flocks were not significant ($F = 1.81; F_{0.05(1,117)} = 3.93$).
# Figures in parentheses refer to the number of litters contributing to each mean.

In terms of total lamb weight and productivity (lamb weight per ewe joined) in each group , the ewes designated L group in the Booroola and Control flocks produced 2.4 and 2.0 times respectively the weight of lambs produced in the H groups of both flocks.

TABLE 3. Total lamb weight at birth and lamb weight per ewe joined of the Booroola and Control flocks having low (L) and high (H) plasma glucose concentrations at Day 95 - 100 of pregnancy.

Flock	Group	N	Total lamb weight at birth (kg)	Lamb weight per ewe joined (kg)
Booroola	L	60	292.0	4.9
	H	60	121.4	2.0
Control	L	42	206.0	4.9
	H	40	101.6	2.5

DISCUSSION

These results show that a single blood glucose measurement at mid-pregnancy could be used to partition ewes into a low glucose-high productivity sub-flock and a high glucose-low productivity sub-flock. By dividing ewes into these groups, feed allocations could then be matched to productivity. The differences in productivity between L and H groups of the Booroola flock were greater than for the Control Merino flock which emphasises the application of glucose measurements in a flock where the objective would be to identify both highly fecund and non-pregnant animals. The relatively high number of non-pregnant ewes in both flocks was a consequence of the single sire mating procedures used for other experimental requirements. Ewes that returned (mostly maidens) were not rejoined to ensure a closely synchronized lambing.

The trend for lower birthweights in lambs of L group ewes suggests that fetal growth was restricted and lambs failed to reach their potential birthweight. Mellor and Matheson (1979) demonstrated reductions in fetal growth rate at 110 to 130 days of pregnancy when maternal feed intake and plasma glucose concentrations were reduced. Thus ewes with relatively low blood glucose concentrations at mid-pregnancy may require high feed supplementation to improve nutrient supplies to the fetus and also to avoid metabolic disorders which mostly occur in L group ewes (Parr, et al. 1982).

With the application of low cost (a few cents per ewe) 'on the spot' methods of blood glucose measurement using instruments developed for diabetics, the potential benefits to the producer should be in the form of enhanced productivity from his lambing flocks. This is of particular importance in high fecundity flocks such as the Booroola Merino.

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