GONADOTROPHIN CONTENT OF THE PITUITARIES OF SHEEP OF DIFFERING FERTILITY AT THREE STAGES OF THE OESTROUS CYCLE

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Summary. The pituitaries of Merino × Blackface ewes were found to contain more LH at mid-cycle (Day 10) than Finn × Blackface ewes. The content in purebred Blackface ewes was intermediate. No differences were observed in the relative activities of FSH or LH in the pituitaries of the three breed types around the time of oestrus, or of FSH on Day 10 of the cycle. It is postulated that more LH may be released during mid-cycle by the more highly fertile breed type.

The Finnish Landrace breed is recognized as having a greater prolificity than British breeds of sheep (Maijala, 1966; Donald & Read, 1967). Land (1971) has suggested that a high level of endogenous gonadotrophin stimulation may be a common factor underlying the various aspects of increased reproductive activity in Finnish Landrace sheep.

The gonadotrophin activity in the pituitaries of ewes of differing prolificity was examined in the present study. Three breed types were chosen: purebred Scottish Blackface (Blackface), Finnish Landrace × Blackface (Finn × Blackface) and Tasmanian Merino × Blackface (Merino × Blackface). The characteristics of the two crossbred types have been described by Donald, Read & Russel (1968, 1970) and Land (1970); the mean litter sizes at birth of 3-year-old Finn × Blackface and Merino × Blackface ewes were observed to be 2.30 and 1.16 lambs, respectively. The mean litter size of Blackface ewes under similar conditions was observed to be 1.75 (Wiener, 1967).

A group of ten ewes of each of the three breed types was established at the Animal Breeding Research Organisation Field Laboratory, Roslin, Midlothian. All ewes were kept in the same building and allocated at random to one of three similar pens. The ewes were between 4½ and 6½ years of age at the time of the experiment.

The experimental ewes were tested once a day with a vasectomized ram until all had shown at least one oestrus. Subsequently, testing was carried out thrice daily at 08.00, 14.00 and 23.00 hours; ewes which returned to oestrus 16 to 18 days after their previous oestrus were slaughtered 4 hr, 36 hr or 10 days

after the return to oestrus. For each breed, with two exceptions (Finn $\times$ Blackface—two ewes at 4 hr; Merino $\times$ Blackface—two ewes at 36 hr), three ewes were killed at each of the three time intervals. In this way, nine groups were established.

All ewes were slaughtered between 6th December 1968 and 17th January 1969. The pituitaries were removed, cleaned and frozen on dry ice within 10 min of slaughter. Freeze-drying was commenced within 6 hr of collection and the glands were then stored individually in a vacuum desiccator at -15°C until they were assayed.

Before assay, each gland was weighed and then ground to a fine powder. Assays were performed on pooled material from each group, material from each gland being allocated to the pool in proportion to its dry weight.

The assay used for FSH was the Augmentation Assay (Steelman & Pohley, 1953) and that for LH was the ovarian ascorbic acid depletion assay (Parlow, 1958). Both assays were employed with minor modifications only. In the case of FSH, a three-point design with one dose of unknown and two doses of standard (NIH-FSH-s7, National Institutes of Health, U.S.A.) was employed. In the case of LH, six assays were of a four-point design employing two doses of unknown and two of standard (NIH-LH-sl4, National Institutes of Health, U.S.A.), and three were three-point assays.

The validity of the four-point assays and the relative potency, index of precision (λ) and fiducial limits of error at $P = 0.95$ of all assays were calculated as recommended by Sakiz & Guillemin (1963), employing a KDF9 computer and a programme developed by Dr E. Sakiz.

The weights of the freeze-dried pituitaries did not differ significantly between the breed types or between the stages of the oestrous cycle. The mean values for the Finn and Merino crosses and Blackfaces were 175, 178 and 177 mg, respectively. At the 4-hr, 26-hr and 10-day stages of the oestrous cycle, the mean weights were 190, 180 and 161 mg, respectively.

The FSH and LH concentrations for each of the three breed types are shown in Tables 1 and 2, respectively. The concentration of FSH in the pituitaries of the three breed types can be seen to be similar when each of the stages of the oestrous cycle studied is considered separately. The concentration showed an apparent decline between 4 and 36 hr after the onset of oestrus and remained low 10 days after onset in each case. In no case were these changes significant.

The pituitary LH concentration of the Finn $\times$ Blackface ewes was significantly less than that of the Merino $\times$ Blackface ewes on Day 10 of the oestrous cycle, that of the Blackface group being intermediate. During oestrus, however, there were no significant differences between the breed types when either of the stages was considered separately. The concentration showed an apparent decline from 4 hr to 36 hr in each case, although this was only significant in the case of the Blackface group.

The present results show that the known difference in the fertility of Finn $\times$ Blackface and Merino $\times$ Blackface ewes is associated with a difference in the concentration of LH in their pituitaries at Day 10 of the oestrous cycle. The Finn $\times$ Blackface ewes, the litter size of which was almost twice that of the Merino $\times$ Blackface ewes, had an LH concentration less than half that of the

latter at this stage of the cycle. This difference could be attributed either to a greater release of LH from the pituitaries of the Finn $\times$ Blackface ewes before Day 10 or to a lower rate of synthesis after pituitary depletion at oestrus. The observation that the LH activity in the urine of Finn $\times$ Blackface ewes was over three times ($P < 0.05$) that of Merino $\times$ Blackface ewes during Days 9, 10

TABLE 1
THE FSH CONTENT OF THE PITUITARIES OF EXPERIMENTAL EWES

<i>Time after onset of oestrus</i>	<i>Breed type</i>	<i>Pituitary FSH content*</i> ($\mu\text{g NIH-FSH-S7/mg dry weight}$)	λ
4 hr	Finn $\times$ Blackface	11.49 (5.14 to 18.20)	0.18
	Blackface	13.44 (0.37 to 33.49)	0.31
	Merino $\times$ Blackface	12.69 (5.87 to 20.74)	0.18
36 hr	Finn $\times$ Blackface	6.10 (2.77 to 9.61)	0.19
	Blackface	7.95 (2.68 to 13.97)	0.20
	Merino $\times$ Blackface	6.67 (3.22 to 10.56)	0.19
10 days	Finn $\times$ Blackface	6.28 (2.92 to 9.92)	0.19
	Blackface	8.79 (4.90 to 14.38)	0.19
	Merino $\times$ Blackface	6.08 (2.73 to 9.56)	0.19

* Figures in parentheses are fiducial limits of error at $P = 0.95$.

TABLE 2
THE LH CONTENT OF THE PITUITARIES OF EXPERIMENTAL EWES

<i>Time after onset of oestrus</i>	<i>Breed type</i>	<i>Pituitary LH content*</i> ($\mu\text{g NIH-LH-S14/mg dry weight}$)	λ
4 hr	Finn $\times$ Blackface	30.64 (25.09 to 38.12)	0.08
	Blackface	26.34 (21.56 to 32.56)	0.08
	Merino $\times$ Blackface	29.01 (23.61 to 36.16)	0.08
36 hr	Finn $\times$ Blackface	19.32 (11.46 to 36.08)	0.26
	Blackface	14.21 (9.29 to 21.52)	0.21
	Merino $\times$ Blackface	17.13 (10.24 to 31.00)	0.26
10 days	Finn $\times$ Blackface	21.16 (15.26 to 29.34)	0.15
	Blackface	27.39 (20.34 to 36.90)	0.15
	Merino $\times$ Blackface	44.37 (34.85 to 56.48)	0.12

* Figures in parentheses are fiducial limits of error at $P = 0.95$.

and 11 of the oestrous cycle (R. B. Land & H. A. Robertson, unpublished data) indicates that the differences in pituitary concentration observed reflect different rates of release. The urinary LH estimations are also compatible with the present data in that no differences were observed between breed types in urinary LH activity at oestrus.

It appears, therefore, that Finn $\times$ Blackface ewes which have a greater litter size when compared with Merino $\times$ Blackface ewes exhibit a greater LH release during part of the oestrous cycle but not during the oestrous period itself. Evidence has thus been obtained for a higher level of gonadotrophin stimulation in Finn $\times$ Blackface ewes at one stage of the cycle. The significance of these observations in terms of the control of the development of ovarian follicles and ovulation rate merits further investigation.

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