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RESEARCH NOTE

THE USE OF PLASMA LUTEINIZING HORMONE AS AN INDICATOR OF PROLIFICACY IN SHEEP

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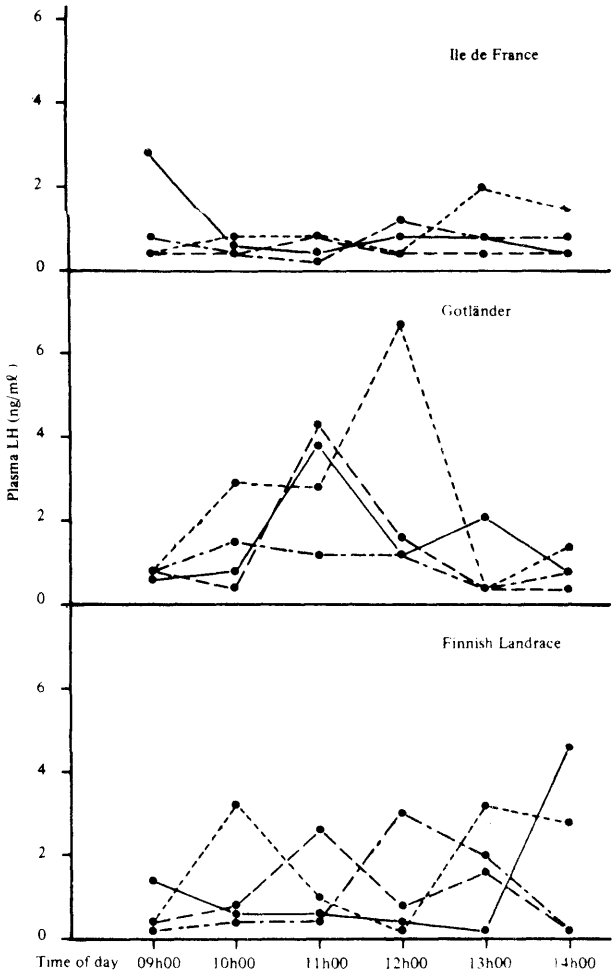
Ovulation rate exerts an important influence on female fertility and sets the upper limit to reproductive efficiency (Bindon, Ch'ang & Turner, 1971). Ovarian activity is a reflection of the endocrine variables involved, in the release and the reaction of the ovaries to gonadotrophins (Land, 1974). Thus, correlation of basal plasma LH concentrations in prepubertal lambs of different breeds or strains with the reproductive efficiencies of these types proved significant (Land, 1974). However, the accurate evaluation of the LH status of individuals is complicated by the marked fluctuation of plasma LH concentration with time (Carr & Land, 1975). Attempts to overcome the problem resulting from such fluctuations by measuring the release of LH following the intravenous administration of gonadotrophin releasing hormone (GnRh) and using the release as an indicator of fecundity, yielded variable results (Bindon, Ch'ang & Evans, 1974). A series of experiments were therefore performed to study the problem of the accurate evaluation of the LH status of individual lambs.

In the first experiment six sequential blood samples were taken at one hour intervals from Ile de France, Gotländer and Finnish Landrace ewe and ram lambs. Plasma LH concentration was then determined by the method of Niswender, Reichert, Midgley & Nalbandov (1969). From these results the breed differences in mean plasma LH concentration (Table 1) were masked by the large variation between samples from the same animal. This pulsatile behaviour of plasma LH concentration has been described before (Katongole, Naftolin & Short, 1974; Carr & Land, 1975). Although the arithmetic mean of the LH concentrations of a number of sequential blood samples of lambs can be related to the prolificacy of the breed or strain (Land, 1974) the fluctuation of plasma LH concentration hampers the accurate evaluation of the LH status of the individual. However, both in this (Fig. 1) and previous studies (Carr & Land, 1975) breeds of high fertility tended to show greater fluctuations in their plasma LH concentration.

If the degree of fluctuation is a characteristic of gonadotrophin status the arithmetic mean of a series of sequential samples of the same animal will incorporate the pulsatile peaks in LH, and an increase in fluctuation (magnitude and frequency) will be reflected by an increase in the mean. The arithmetic mean is therefore determined by the frequency and magnitude of the LH peaks. On the other hand, the fluctuation in plasma LH concentration hampers the accurate estimation of circulating LH levels. A further possibility was therefore considered.

Fig. 1. *Plasma LH concentration of sequential blood samples taken at one hour intervals from two ram and two ewe lambs of Ile de France, Gotländer and Finnish Landrace breeds.*



The relationships of basal LH and the response in LH release to GnRh stimulation to breed prolificacy were studied in nine South African Mutton Merino (S.A. M.M.), eight Merino and ten Dohné Merino lambs varying in age between 26 and 34 days. The lambs were bled three times at 20 minute intervals, whereafter an intravenous injection of 5 µg GnRh (Abbot) was administered and two more blood samples collected at 20 minute

Table 1

Mean age, bodymass and basal plasma LH concentration of Ile de France, Finnish Landrace and Gotländer lambs

	Body mass (kg)	Age (days)	LH concentration (ng/mℓ) Mean	Median	Lambing rate of Mothers
Ile de France	21,1 ± 4,1[a]	130,7 ± 7,7[a]	1,82 ± 1,07[a]	1,45 ± 0,67[a]	2,0 ± 0,67[a]
Finnish Landrace	18,0 ± 4,7[a]	145,6 ± 1,5[b]	2,02 ± 0,67[a]	1,95 ± 0,79[a]	3,00 ± 0,81[b]
Gotländer	21,3 ± 4,0[a]	142,2 ± 4,5[b]	2,95 ± 1,05[b]	2,85 ± 1,22[b]	2,20 ± 0,06[ab]

[a b] Within each column, means having the same superscript do not differ significantly from eachother.

intervals. Mean basal LH levels were found to be related to the prolificacy of the breed (Table 2). However, the response to intravenous GnRh, measured in terms of LH release (both in quantity and highest value) varied greatly between individuals and was not related to either the mean basal LH or the prolificacy of the breeds. These results are in agreement with previous reports (Land, Pelletier, Thimonier Mauleon, 1973; Thimonier, Pelletier & Land, 1972; Bindon & Turner, 1974; Carr & Land, 1975). Clearly, a method is still needed by which the observed values can be used to obtain a reliable estimate of the true circulating level of gonadotrophines in the lamb.

In order to investigate the accuracy and repeatability of gonadotrophin status, twenty Merino ewe lambs, 30 days of age were bled five times at 15 minute intervals and the LH content of the plasma was determined. Individual basal LH concentrations were expressed either as a mean of the five samples, which incorporated the periodic pulsatile peaks, or as the median value which eliminated the peak values. The animals were then ranked according to *mean* LH values and also according to the *median* LH values. At sixty days of age the procedure was repeated. The ranking orders for the two periods were then correlated and it was found that although the *mean* basal LH levels maintained their position in the rank significantly ($r = 0,51$; $P < 0,05$), the repeatability of the *median* value was not significant ($r = 0,41$; $P < 0,01$).

In addition, although not significant, the mean LH value of an individual lamb tended to increase with an increasing coefficient of variation of the sequential samples taken from each animal ($r = 0,46$).

From this study it appears that the pulsatile release of LH in the lamb is an integral part of the gonadotrophin status of the indivdual since it proves to be a fairly repeatable characteristic and increases with increasing prolificacy. Therefore, should the gonadotrophin status of a lamb be a significant indicator of its future gonadal activity, the *mean* LH concentration could be used as a useful selection criterion. However, since the magnitude and frequency of LH peaks to increase with increasing prolificacy, the accuracy of the selection criterion will depend on the number of sequential samples analysed and the time interval between samples.

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Table 2

Mean age, bodymass, basal LH and LH release following GnRh in Merino, Dohne Merino and South African Mutton Merino lambs

	Age (days)	Bodymass (kg)	Basal LH concentration (ng/mℓ) Mean	Median	Maximum LH level in response to GnRh (ng/mℓ)	Lambing rate of flock
Merino	35,7 ± 1,05[a]	10,0 ± 0,83[a]	1,04 ± 0,38[a]	1,00 ± 0,28[a]	7,7 ± 3,3[a]	1,20 ± 0,31[a]
Dohne Merino	29,8 ± 2,1 [b]	11,35 ± 0,76[a]	1,90 ± 0,64[b]	1,78 ± 0,17[b]	7,29 ± 3,0[a]	1,50 ± 0,27[b]
S.A. Mutton Merino	30,5 ± 2,01[b]	11,55 ± 0,93[a]	2,20 ± 1,12[b]	2,25 ± 0,34[b]	4,81 ± 3,6[a]	1,90 ± 0,41[c]

[a b] Within each column, means having the same superscript do not differ significantly from each other.

References

BINDON, B.M., CH'ANG, T.S. & TURNER H.N., 1971. Ovarian response to gonadotrophin by Merino ewes selected for fecundity. *Aust. J. Agr. Res.* 22, 809.

BINDON, B.M., CH'ANG, T.S. & EVANS, R., 1974. Genetic effects on LH release by oestradiol and gonadotrophin releasing hormone in prepubertal lambs. *J. Reprod. Fert.* 36, 477.

BINDON, B.M. & TURNER, H.N., 1974. Plasma LH of the prepubertal lamb: A possible early indicator of fecuntity. *J. Reprod. Fert.* 39,85.

CARR, W.R. & LAND, R.B., 1975. Plasma luteinizing hormone levels and testes diameters of ram lambs of different breeds. *J. Reprod. Fert.* 42, 325.

KATONGOLE, C.B., NAFTOLIN, F & SHORT, R.V., 1974. Seasonal variation in blood luteinizing hormone and testosterone levels in rams. *J. Endocr.* 60, 101.

LAND, R.B., 1974. Physiological studies and genetic selection for sheep fertility. *Anim. Breed. Abstr.* 42, 325.

LAND, R.B., PELLETIER, J., THIMONIER, J. & MAULEON, P., 1973. A quantitative study of genetic differences in the incedence of oestrus, ovulation and plasma luteinizing hormone concentrations in the sheep. *J. Endocr.* 58, 305.

NISWENDER, G.D., REICHERT, L.E., MIDGLEY, A.R. & NALBANDOV, A.V., 1969. Radio-immunoassay for bovine and ovine luteinizing hormone. *Endocrinology.* 84, 1166.

THIMONIER, G., PELLETIER, J & LAND R.B., 1972. Concentration of plasma LH in male and female lambs of high and low prolificacy breed types. (Abst. in) *J. Repr. Fert.* 31, 498.