Plasma gonadotrophins and oestradiol during oestrus in the cow

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Summary. LH values between –2 and +4 h (0 h = LH peak) were higher than baseline. FSH values were also raised at this time and between +16 and +30 h. Oestradiol values between –20 and 0 h were higher than during +4 to +20 h.

Plasma FSH levels during the bovine oestrous cycle have been measured (Akbar, Reichert, Dunn, Kaltenbach & Niswender, 1974; Derivaux, Ectors, Hendrick & Franchimont, 1974; Schams & Schallenberger, 1976), but details of the changes in plasma oestradiol concentration and those of LH and FSH during the oestrous period have not been reported. The following investigation was undertaken to define the temporal relationship between these hormones. Progesterone concentrations are known to remain basal (<0.5 ng/ml) throughout oestrus (Dobson, Cooper & Furr, 1975).

Materials and Methods

Six Friesian heifers, 18–36 months old, were bled (20 ml) from indwelling jugular vein catheters every 2 h for 3 days, starting 1 day before oestrus. Plasma was obtained immediately by centrifugation and stored at –15°C. The radioimmunoassays, used without modification, have been described in detail elsewhere. In the LH assay (Dobson *et al.*, 1975) the antibody to bovine LH was raised in a horse by Dr R. B. Snook. The only significant cross-reaction was with TSH (90%). Purified bovine LH (LER 1072/2) was used as the ¹²⁵I-labelled preparation. The sensitivity of the method was 0.2 ng with inter- and intra-assay coefficients of variation of 10.6 and 8.3% respectively. The plasma results are expressed as ng equivalents of NIH-LH-B8/ml. For the FSH assay (Dobson, 1978) an antibody to rat FSH (S6: obtained from NIAMDD) was used. The only significant cross-reaction was 5% with TSH. Purified bovine FSH (LER-1695-2) was used as the ¹²⁵I-labelled preparation. The sensitivity of the method was 4 ng with inter- and intra-assay coefficients of variation of 15.5 and 14.5% respectively. The plasma results are expressed as ng equivalents of NIH-FSH-B1/ml. The oestradiol assay (Dobson & Dean, 1974) utilized an antibody (R₂B₂) raised against oestradiol-6-(O-carboxymethyl) oxime-bovine serum albumin which had no cross-reactions of >2% with any other oestrogen known to occur in the cow. The sensitivity of the method was <10 pg with inter- and intra-assay coefficients of variation of 12.5 and 7.8%, respectively.

Results

The changes of LH, FSH and oestradiol concentrations in 6 heifers in relation to the time of maximum LH concentration (0 h) are shown in Text-fig. 1. The mean concentration of oestradiol between –20 and 0 h was significantly higher than during the period 4–20 h after the maximum LH concentration (Student's *t* test for 2 groups of unpaired data, *P* < 0.001). The LH values between –2 and +4 h inclusive were significantly higher than baseline concentrations (*P* < 0.001). FSH values between –2 and +4 h were also significantly higher (*P* < 0.001) than those for periods of 10 h before or after this time. However, FSH values 16–30 h after the LH peak were also significantly raised (*P* < 0.001) compared to the period from +4 to +14 h.

Text-fig. 1. Mean plasma concentration ($\pm$ s.e.m.) of LH ($\square$), FSH ($\blacktriangle$) and (oestradiol ($\circ$) for 6 heifers during the oestrous period in relation to the maximum concentration of LH (0 h).

Discussion

The second peak of FSH has not previously been reported, probably because of infrequent sampling. The pattern of plasma hormone concentrations around oestrus in heifers is similar to that reported for ewes (Pant, Hopkinson & Fitzpatrick, 1977), although the FSH values were more variable in heifers.

It has been well established that the synchronous surges of LH and FSH are involved in ovulation and formation of the corpus luteum (Schwartz & McCormack, 1972), but there is less understanding about the function of the second peak of FSH. In ewes and cows it occurs 24 h after the LH peak, i.e. around the time of ovulation (Kiddy & Odell, 1969; Schams & Karg, 1969), but the cause of the peak has not been determined. Plasma oestradiol concentrations are elevated before the dual surge of LH and FSH, but the concentration of this steroid has declined before the surge of FSH alone. Synthetic gonadotrophin-releasing hormone will release LH and FSH in heifers (Akbar *et al.*, 1974), but the evidence presented here suggests that there is a separate mechanism for the release of FSH without LH.

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