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Brief Communication

DIURNAL VARIATIONS IN PERIPHERAL PLASMA LEVELS OF TESTOSTERONE, ANDROSTENONE AND CORTISOL IN BOARS

Several investigations have indicated that males of most domestic species exhibit a pronounced daily circardian rhythm in the blood plasma level of testosterone.

In the case of the boar, available data are conflicting. *Ellendorff et al.* (1975) reported plasma testosterone to be higher in the morning than in the afternoon and evening in miniature boars. Contrarily, *Claus & Giménez* (1977) found testosterone and 5α-androstenone levels in German Landrace boars to peak in the afternoon and evening, with low levels in the early morning and forenoon. In contrast *Sanford et al.* (1976) found no diurnal variation in testosterone secretion in Yorkshire boars, and *Lapwood & Florcruz* (1978) were unable to demonstrate evidence of any diurnal variation in testosterone levels in either pubertal or post-pubertal Large White × Landrace boars. Furthermore, *Andresen* (1975) found no circardian variation in the plasma levels of 5α-androstenone. One object of this study was to further clarify the diurnal patterns of testosterone and 5α-androstenone in boars.

Various types of stress (sexual arousal and aggressive behaviour) result in an increased corticosteroid secretion and a subsequent increase in the plasma testosterone content (*Liptrap & Raeside* 1978). A similar transient increase in testosterone has also been found after injection of boars with ACTH or cortisol (*Liptrap & Raeside* 1975). Another purpose of this study was to determine whether there is any such hormonal relationship between the adrenal cortex and the testes in the unstressed boar.

Two Swedish Landrace and 2 Swedish Yorkshire boars (age 11—17 months) were studied. All boars had a normal semen picture and 3 had a proven fertility. Blood was collected according to an hourly schedule for 29 h, starting at 10 a.m. (Fig. 1). To minimize stress on the animals during sampling, a permanent vein catheter had previously been inserted into the brachial vein and drawn s.c. to the back of the animal. This procedure did not require any restraint of the animals during sampling. Blood plasma levels of testosterone and 5α-androstenone were determined by RIA and cortisol levels were determined by a competitive protein binding technique.

The effect of animal and the partial correlations between the

hormones were evaluated using least-square analysis with the effect of animal included in the statistical model.

Mean values and s.e.m. for the parameters investigated are given in Fig. 1. Effect of animal was highly significant ($P \leq 0.001$) for all substances studied. The lack of a distinct rhythm in the secretion of testosterone and 5α-androstenone agrees with previous results (*Andresen* 1975, *Sanford et al.*, *Lapwood & Florcruz*). The correlation between testosterone and 5α-androstenone in individual boars was significant in all cases, varying from $r = 0.37$ to $r = 0.72$. The partial correlation after adjustment for the effect of animal for these 2 steroids was $r = 0.35$ ($P \leq 0.001$). These figures are lower than those reported by *Andresen* (1976) but higher than those found by *Lundström et al.* (1978).

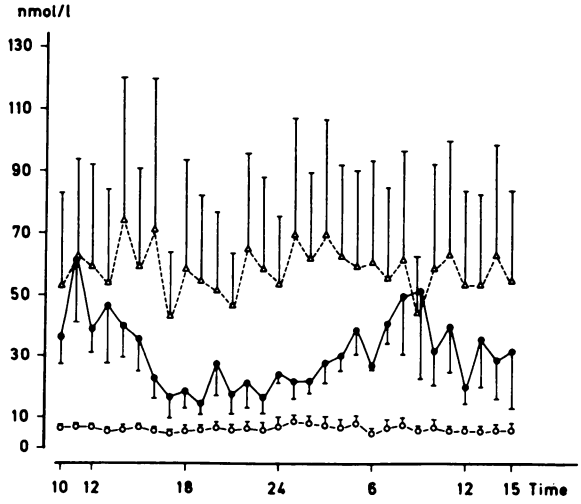

Figure 1. Mean peripheral blood plasma levels of testosterone (○———○), 5α-androstenone (△----△) and cortisol (●———●) in the 4 boars. Vertical bars indicate + or — s.e.m.

The high variation for the mean 5α-androstenone level encountered is due to 1 of the boars having a level (range 90—216 nmol/l) constantly in excess of those in the other 3 boars (range 10—67 nmol/l).

The presence of a pronounced daily rhythm in the secretion of cortisol, with high concentrations in the morning and low concentrations from noon to midnight has been described previously (*Whipp et al.* 1970). The average maximum concentration of cortisol for the 4 boars was about 4 times higher than the lowest mean value. It has previously been demonstrated that

a marked elevation in the blood corticosteroid content of boars is followed by an elevation of the testosterone level (*Liptrap & Raeside* 1975, 1978). In the present study the coefficient of correlation between testosterone and cortisol in individual boars varied between r = —0.47 and r = 0.40. The partial correlation for the 4 boars after adjustment for the effect of animal was non-significant (r = —0.09). Consequently, the small diurnal variation in cortisol did not affect the testosterone level. Thus in order to influence the testosterone concentration the variation in cortisol would need to be more pronounced than the diurnal rhythm recorded here.

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REFERENCES

Andresen, Ö.: 5α-androstenone in peripheral plasma of pigs, diurnal variation in boars, effects of intravenous HCG administration and castration. Acta endocr. (Kbh.) 1975, *78*, 385—391.

Andresen, Ö.: 5α-androstenone and testosterone in peripheral plasma of the boar during and following copulation. Acta vet. scand. 1976, *17*, 475—487.

Claus, R. & T. Giménez: Diurnal rhythm of 5α-androst-16-en-3-one and testosterone in peripheral plasma of boars. Acta endocr. (Kbh.) 1977, *84*, 200—206.

Ellendorff, F., N. Parvizi, K. Pomerants, A. Hartjen, A. König, D. Smidt & F. Elsaesser: Plasma luteinizing hormone and testosterone in the adult male pig: 24 hour fluctuations and the effect of copulation. J. Endocr. 1975, *67*, 403—410.

Lapwood, K. R. & S. V. Florcruz: Luteinizing hormone and testosterone secretory profiles of boars: effects of stage of sexual maturation. Theriogenology 1978, *10*, 293—306.

Liptrap, R. M. & J. I. Raeside: Increase in plasma testosterone concentration after injection of adrenocorticotrophin into the boar. J. Endocr. 1975, *66*, 123—131.

Liptrap, R. M. & J. I. Raeside: A relationship between plasma concentrations of testosterone and corticosteroids during sexual and aggressive behaviour in the boar. J. Endocr. 1978, *76*, 75—85.

Lundström, K., B. Malmfors, I. Hansson, L.-E. Edqvist & B. Gahne: 5α-androstenone and testosterone in boars. Early testing with HCG, sexual stimulation and diurnal variation. Swedish J. agric. Res. 1978, *8*, 171—180.

Sanford, L. M., E. E. Swierstra, W. M. Palmer & B. E. Howland: The profile of LH and testosterone secretion in the boar. Proc. VIIIth Int. Congr. Anim. Reprod., Krakow 1976, *3*, 96—99.

Whipp, S. C., R. L. Wood & N. C. Lyon: Diurnal variation in concentrations of hydrocortisone in plasma of swine. Amer. J. vet. Res. 1970, *31*, 2105—2107.

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