

# THE RELATIONSHIP BETWEEN SERUM TESTOSTERONE LEVELS, SEX AND TEAT-SEEKING ABILITY OF NEWBORN PIGLETS

L. A. BATE<sup>1</sup>, M. B. KREUKNIET<sup>2</sup>, and R. R. HACKER<sup>1</sup>

<sup>1</sup>*Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario N1G 2W1; and* <sup>2</sup>*Department of Animal Husbandry, Agricultural University of Wageningen, Wageningen, The Netherlands. Received 23 Nov. 1984, accepted 20 Mar. 1985.*

BATE, L. A., KREUKNIET, M. B. AND HACKER, R. R. 1985. The relationship between serum testosterone levels, sex and teat-seeking ability of newborn piglets. *Can. J. Anim. Sci.* **65**: 627-630.

Blood samples were collected from five pregnant sows from day 111 postbreeding to farrowing and from their piglets at regular intervals between birth and 48 h. The time between birth and first suckling (BTS) was recorded for each piglet. Maternal serum testosterone (T) levels were detectable only at the beginning of parturition and were highly correlated ( $r=0.83$ ) with litter BTS. Serum T levels of male and female piglets were similar at birth. In male piglets the T levels increased to a peak 2 h after birth and decreased gradually thereafter. In contrast, the T levels of female piglets declined rapidly after birth to baseline levels. The BTS of female piglets was shorter than that of male piglets. Body weight of males was higher than that of females and was influenced by litter size. These results suggest that the higher serum T levels of male piglets may have a detrimental effect on their teat-seeking ability.

Key words: Serum testosterone, sex, piglets, teat-seeking ability, sow

[Rapports entre la teneur en testostérone du sérum, le sexe et l'aptitude à trouver la mamelle chez les porcelets.]

Titre abrégé: Testostérone, sexe et aptitude à trouver la mamelle chez les porcelets. Nous avons prélevé des échantillons de sang de cinq truies gravides du jour 111 à la mise bas et avons prélevé d'autres échantillons des porcelets, à intervalles réguliers, de la naissance à 48 heures. Nous avons aussi noté le temps écoulé entre la naissance et la première tétée (BTS) pour chaque porcelet. La teneur en testostérone du sérum des truies n'a atteint des niveaux détectables qu'au début de la mise bas. Nous avons par ailleurs observé une forte corrélation entre cette teneur et le BTS des portées ( $r=0,83$ ). Les teneurs en T du sérum des mâles et des femelles étaient comparables à la naissance. Chez les mâles, ces teneurs ont atteint un sommet deux heures après la naissance pour diminuer graduellement par la suite. Par contre, les teneurs en T du sérum des femelles diminuaient rapidement dès la naissance pour atteindre le niveau de base. Le BTS des femelles était plus court que celui des mâles. Le poids des mâles était plus élevé que celui des femelles et dépendait de la taille de la portée. Ces résultats donnent à penser que les teneurs plus élevées en T du sérum chez les porcelets mâles peuvent avoir un effet nuisible sur leur aptitude à trouver la mamelle.

Mots clés: Testostérone du sérum, sexe, porcelets, aptitude à trouver la mamelle, truie

Endocrine activity controls many physiological and behavioral activities in animals. The physical characteristics of the piglet, such as weight (Bereskin et al. 1973), and the series of events taking place during (Randall 1972) and after parturition (Hartsock et al. 1977) have a tremendous influence on survival. The ability of the piglet

*Can. J. Anim. Sci.* **65**: 627-630 (Sept. 1985)

to seek a teat and suckle soon after birth should enhance the chance of survival (Hartsock and Graves 1976). This ability is known to be influenced by estrogens (Bate and Hacker 1982), but no other hormones have been studied in this context.

Testosterone (T) is known to be present in male piglets during fetal gonad differentiation (Reaside and Sigman 1975) and close to parturition (Colenbrander et al. 1978). Its anabolic characteristics (Ashdown and Hancock 1980) influence postnatal growth rate (Dvorak 1981) and could also influence fetal body weight. Testosterone is known to influence male sexual (Michael et al. 1984) and aggressive behavior (Haupt and Wolski 1982). Whether or not the teat-seeking behavior of piglets is modified by T during the immediate postnatal period is not known; neither is the effect of fetal T on many of the physical characteristics of the piglet. In view of this lack of information, the present study was designed to describe the postnatal serum T levels and to examine the relationship between serum T concentration, sex and the teat-seeking ability of the newborn piglet.

## MATERIALS AND METHODS

Five pregnant Yorkshire sows from the Arkell Research Station of the Ontario Ministry of Agriculture and Food were used. On day 110 postbreeding, the sows were cannulated through the ear vein (Bate and Hacker 1985) and placed in farrowing crates in a room at 18°C. The sows were fed 2.5 kg/day of a corn soybean meal diet (16% protein) and had continuous access to water. From day 111 postbreeding the sows were

bled twice daily, between 0800 and 0900 h and 2000 and 2100 hours. A final sample was collected when farrowing commenced.

At parturition the piglets were taken from the sow, weighed, identified and bled (2 mL) from the suborbital sinus with a 2.5-cm × 20-gauge disposable needle. Handling lasted less than 2 min and the piglets were released in the same location as they were taken. Teat-seeking activity was visually monitored by the attendant and the time from birth to secure a teat and suckle (BTS) was recorded for each piglet. Subsequently the piglets were bled 2, 6, 12, 18, 24 and 48 h after birth and weighed at 24 and 48 h.

Blood samples were cooled at 4°C within 30 min of collection, allowed to clot for 24 h and centrifuged at 1720 × *g* for 10 min. The serum was transferred to plastic vials and stored at -17°C until assayed for T. Testosterone levels were determined using a coated tube RIA kit (Diagnostic Products Corporation, Los Angeles, Calif.). In our laboratory, the assay had 2.4% and 18.4% intra- and inter-assay coefficients of variation, respectively, and a sensitivity of 0.10 ng/mL. Overall serum T levels and BTS between sex were compared by a two-way ANOVA with litter and sex as main effects. Mean litter values for each sex were used in the analysis. Data were analyzed using a general linear models procedure from a SAS package (Goodnight 1979).

## RESULTS

The sow's serum T concentration between days 111 and 115 of pregnancy fell below the sensitivity of the assay. Only at the time of parturition was serum T detectable (Table 1). There were litter differences ( $P < 0.05$ ) in serum T and BTS. After removal of the litter effect, there was an overall effect of sex of piglet on serum T con-

Table 1. Serum testosterone concentration (pg/mL) in sows at parturition, number of piglets per litter and birth to suckling interval (min) according to sex of piglet

Sow number	Testosterone (pg/mL)	Birth to suckling			
		Females		Males	
		<i>n</i>	Mean ± SE	<i>n</i>	Mean ± SE
1	170	2	40.5 ± 4.5	7	50.4 ± 10.7
2	188	3	52.0 ± 12.8	3	52.7 ± 17.8
3	101	5	20.6 ± 2.2	10	33.3 ± 5.9
4	131	6	22.2 ± 3.2	5	47.6 ± 13.8
5	119	2	19.5 ± 5.5	6	26.1 ± 1.8
Overall	142 ± 36	18	28.4 ± 3.7	31	39.9 ± 4.3

centration. Specific comparisons between sex at each sampling time indicate that at birth the serum T concentrations of newborns (Fig. 1) were similar. After birth, however, the concentration of serum T in females decreased ( $P < 0.05$ ) from 4.67 ng/mL to about 1.7 ng/mL at 12 h, and was maintained at this level until 48 h. In males there was an increase from 4.47 ng/mL at birth to a peak of 6.54 ng/mL at 2 h, declined rapidly to 4.78 ng/mL at 6 h and slowly thereafter, to 3.5 ng/mL at 48 h. There was a high correlation ( $r = 0.83$ ) ( $P < 0.05$ ) between the average litter BTS and the maternal serum T concentration at the beginning of farrowing. The BTS of females was shorter than in males ( $P < 0.07$ ) but was not influenced by body weight. Females were lighter ( $P < 0.05$ ) than males at birth weighing 1163 and 1283 g, respectively. These differences were not significant at 24 h and by 48 h the males and females were 1532 and 1519 g, respectively. Birth weight of piglets was influenced by litter size ( $P < 0.05$ ). The frequency of birth of subsequent piglets was not influenced by the sex of the later-born piglet. There was no correlation between the number or percentage of males in the litter and maternal T levels.

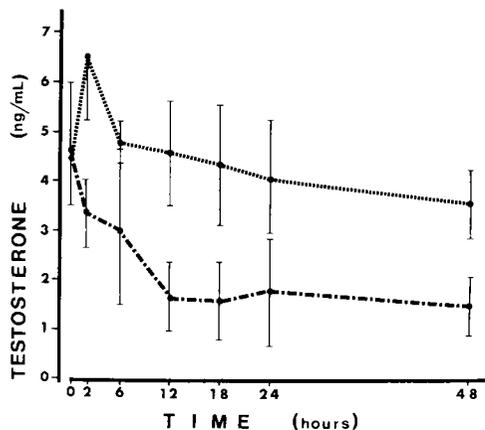


Fig. 1. Serum testosterone concentrations in male (----) and female (— . — . —) piglets. Bars indicate SD.

## DISCUSSION

Similar concentrations of T in both male and female piglets at birth represent the situation during parturition. The rapid decrease in serum T of females following birth reflects normal hormonal catabolism accompanied by a lack of hormonal synthesis. In the male, however, the testes are capable of producing T in early (Stewart and Reaside 1976), and late fetal development as well as in early postnatal life (Colenbrander et al. 1978). There are reports of large differences in serum T concentrations between newborn male and female rats (Slob et al. 1980) which are consistent with the higher T levels of the male piglets after birth.

Collu et al. (1984) demonstrated that subjecting rats to immobilization stress resulted in an increase in circulating catecholamines, which exerted an inhibitory effect on the biosynthesis of T. A similar phenomenon could have occurred in male piglets, whereby the stress of parturition caused a temporary reduction in T production which is reinitiated after parturition resulting in the postnatal T increase observed.

The rapid increase of male piglet serum T concentration with the concurrent rapid decrease of female piglet serum T concentration following birth, could create a substantial hormonal differential even before suckling takes place. This reasonable speculation and the high positive correlation between sow T and BTS, plus the slower BTS observed in males would suggest a detrimental effect of T on the teat-seeking ability of the piglet.

The higher birth weights of male pigs could be a consequence of the anabolic effects (Ashdown and Hancock 1980) of testosterone upon the fetus. A high birth weight is considered an advantage to survival, but it was found that females, although having a lighter birth weight, suckled earlier than males. This was also noted by Bate and Hacker (1982) and is consistent with the finding of Bereskin et al. (1973), who reported that females, despite having

lighter birth weight than males, had a better survival rate. Moreover, these latter authors showed a significant decrease in male survival rate with increasing litter size. This decrease could be attributed to the lower teat-seeking ability of males, which becomes crucial when competition for a suckling position increases. Although, body weight is undoubtedly a determining factor in resolving agonistic interactions (Hartsock et al. 1977) it should be an advantage in gaining or retaining a position (Scheel et al. 1977) in the nursing order. However, body weight did not correlate with BTS in the present study and does not appear to influence the ability of the piglet to locate and suckle a teat for the first time.

The presence of circulating T increases the potential for aggressive behavior in males (Haupt and Wolski 1982) whereas females, with low T concentration, escape this influence. It is possible that under the influence of T males dedicate more time to agonistic interactions with other littermates. If this occurs, females would be capable of securing a teat sooner than males, since they would concentrate more on teat-seeking activity.

In conclusion, this study has shown that the levels of circulating T in female piglets declines rapidly after birth whereas male piglets can sustain elevated levels for at least 48 h. Despite having a lighter body weight females are capable of securing a teat to suckle in a shorter period of time than males.

#### ACKNOWLEDGMENTS

This study was carried out with the support of the Ontario Pork Producers Marketing Board and Natural Sciences and Engineering Research Council of Canada Grant no. 82147.

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