PERIPHERAL PLASMA TESTOSTERONE CONCENTRATIONS IN BULLS AROUND PUBERTY

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It is now well established that dairy bulls attain their mature rate of spermatogenesis by 1 year of age (Attal & Courot, 1963; Macmillan & Hafs, 1968) and that gonadotrophins and steroid hormones are involved in the process of initiation and maintenance of spermatogenesis (Steinberger & Steinberger, 1969). Already by this age, testosterone is the most important androgen secreted by the interstitial tissue (Lindner, 1969). Rawlings, Hafs & Swanson (1972) observed an increase in the plasma levels of testosterone in five bulls up to 11 months of age and then a drop the following month. Since the levels found were highly variable, it was apparent that data from quite a large number of animals would be required to establish whether there is a significant increase or decrease in the plasma levels.

Blood samples were collected from the jugular veins of fifty-one French Friesian bulls at 9, 12 and 15 months of age. The sampling period occurred over 1 year. The bulls were maintained under similar daily conditions since they were brought to the performance test station when they were 8 days old. From 9 to 15 months, the feeding regimen did not change at all and allowed a daily gain in weight of about 0.9 kg. The bulls weighed 450 kg at 1 year of age. From 9 months of age, ejaculates were collected once weekly (two consecutive ejaculates) using an artificial vagina. Sperm output was monitored from 9 to 15 months of age, and the findings were used to select those bulls whose semen would be inseminated for progeny tests. The data for the semen characteristics in the present study were provided by the means of the four ejaculates (1) of the two first collections (9 ± 0.5 months old), (2) of collections of 2 consecutive weeks at 12 months (± 0.5), and (3) of the two last collections (15 ± 0.5 months old) of the control period. At 9 months, 33% of the bulls had no libido, and at 12 and 15 months, respectively, 4% and 2% of the bulls had either no libido or azoospermia when tested. The mean total number of spermatozoa per ejaculate and the percentage of motile spermatozoa are reported in Table 1. An improvement in both characteristics was observed with age. This corresponds with data which have been previously reported (Thibier & Colchen-Bourlaud, 1972).

Plasma testosterone was determined by radioimmunoassay. The procedure used was very similar to that for progesterone and 17α -hydroxyprogesterone (Thibier, Castanier, Tea & Scholler, 1973). The antiserum was raised in rabbits immunized against testosterone-3-(O-carboxy)methyl oxime-BSA. The specificity and accuracy were satisfactory (Leymarie & Scholler, 1974).

The results, as mean $\pm$ S.D. (coefficient of variation) in ng/ml, for the plasma testosterone concentrations of the fifty-one bulls at these three periods were: 9 months, 5.31 ± 3.99 (0.75); 12 months, 4.43 ± 3.01 (0.68); 15 months, 4.34 ± 2.26 (0.52). These levels appear slightly higher than those observed by Rawlings *et al.* (1972) and the levels at 9 months seem to be higher than those at 12 and 15 months. Analysis of variance (Snedecor & Cochran, 1957), however, showed that there were no significant differences between age periods or between bulls (Table 2).

The large range of testosterone concentrations at each period and in each bull is responsible of these non-significant differences. This means that even when bulls are maintained in standardized management conditions, such as those

Table 1. Semen characteristics of bulls around puberty

Age group (months)	No. of bulls	Total no. of spermatozoa ($\times 10^9$)	% Motile spermatozoa
9	34	1.13 ± 0.69	48.0 ± 13.1
12	49	2.75 ± 1.31	60.3 ± 16.8
15	50	3.29 ± 1.31	63.5 ± 15.7

Two consecutive ejaculates were collected once a week. The results are the means $\pm$ S.D. of the four ejaculates collected over a 2-week period.

Table 2. Analysis of variance of plasma testosterone concentrations in bulls around puberty

Source of variation	d.f.	Sum of squares	Mean square	F
Total	153	1.539		
Between age periods	2	29	14.50	1.62 N.S.
Between bulls	50	606	12.12	1.35 N.S.
Residual	101	904	8.95	

N.S. = Not significant ($P > 0.05$).

described above, pronounced fluctuations in blood testosterone levels occur, like those reported for adult bulls (Katongole, Naftolin & Short, 1971), pre-pubertal bulls (Rawlings *et al.*, 1972) and man (Leymarie, Roger & Scholler, 1973). It cannot, therefore, be assumed that there is a significant increase or drop in mean testosterone concentrations around puberty in bulls. At this time, plasma testosterone concentrations were not significantly correlated with age, with the total number of spermatozoa, or with the percentage of motile spermatozoa. Hence, though both sperm production (Attal & Courot, 1963) and sperm output in young bulls, as reported here, increase over the 6-month period, the plasma testosterone concentration appears to be settled by 9 months of age and is independent of the characteristics of the ejaculate noted above.

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