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Comparison of Erythrocyte Numbers in Normal and Hormone-Treated Brown Leghorn Fowl.*

L. V. DOMM, ELSIE TABER AND DAVID E. DAVIS.

From the Whitman Laboratory of Experimental Zoology, The University of Chicago.

This investigation includes a comparison of the number of erythrocytes found in the blood of normal brown Leghorn hens, roosters, capons and sinistrally and bilaterally ovariectomized poulards, with the number found following treatment with various sex hormones.

The normal male has a red cell count of 3,600,000 per cubic millimeter (average of 18) which is approximately a million higher than that of the female—2,700,000 (average of 18). The capon (18), sinistrally ovariectomized poulard (19), and bilaterally ovariectomized poulard (12) have counts of 2,510,000, 3,000,000, and 2,520,000 respectively.¹

Since there is a decided sex difference in erythrocyte number, and since the characteristic male number is reduced in the capon whose count is equivalent to that of a bilaterally ovariectomized poulard, there appears to be a sex hormonal control of erythropoiesis, with the male hormone causing an increase in red cells and the female hormone a decrease.

To test this assumption, females, capons, and sinistrally and bilaterally ovariectomized

poulards were given daily subcutaneous injections of testosterone propionate. In every case there was a rise in the erythrocyte number after 15 injections and the counts made after 24 injections were equal to or approaching that of a normal male. (See Table I). Daily injections are being continued on 6 of the 9 females shown in Table I and the high red cell numbers have now been maintained for more than 160 days.

In a similar manner injections of alpha-estradiol benzoate or diethylstilbestrol were given males, capons, and bilaterally ovariectomized poulards. With no exception, the erythrocyte counts were reduced. (See Table I). In both androgen and estrogen injected birds the red cell numbers had returned to approximately the normal levels when counts were made 21 or 45 days after injections were discontinued.

It has been shown that gonadotropic hormones injected into young birds stimulate a precocious production of hormones by the immature gonads. That androgen as well as estrogen is produced by the stimulated ovary is shown by the masculinization of head furnishings and development of oviducts in treated females.² Juhn and Domm³ reported that the erythrocyte level in juvenile birds is the same as that of the mature female. In order to obtain information on the erythrocyte picture in birds treated with gonadotropins we injected a P.M.S. gonadotropic hormone into both males and females, beginning on the fourth day after hatching. In both sexes the erythrocyte levels of treated birds were above those for untreated controls. (See Table I).

Counts made on a series of 36 intersexual

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¹ Taber, E., Davis, David E., and Domm, L. V., *Anat. Rec.*, 1941, **81**, 89.

² Domm, L. V., *Cold Spring Harbor Symposia on Quant. Biol.*, 1937, **5**, 241.

³ Juhn, M., and Domm, L. V., *Am. J. Phys.*, 1930, **94**, 656.

TABLE I.
Effect of Hormones on Erythrocyte Number.

No. of birds	Sex*	Treatment	Red cells in millions per mm ³		
			Normal	11-15 days	24-29 days
9	F	0.50-1.50 mg testost.	2.70 (avg of 18)	3.29	3.17
6	C	1.00-3.75 " "	2.51 " " "	2.84	3.30
3	S.P.	1.25-3.75 " "	3.00 (" " 19)	3.36	3.77
3	B.P.	1.25-3.75 " "	2.52 (" " 12)	2.93	3.34
8	C	0.33-1.50 mg α -estra.	2.51 (" " 18)	2.12	2.36
3	C	1.00-2.00 " stilb.	" " " "	2.08	—
3	B.P.	0.50-1.50 " α -estra.	2.52 (" " 12)	—	1.93
2	M	2.50-5.00 " stilb.	3.60 (" " 18)	—	1.42
6	J.M.	140 I.U. P.M.S.	2.27 (" " 3)	—	2.76
6	J.F.	" " "	2.48 (" " 8)	—	3.01
3	C	0.33 mg α -estra. + 1.00 mg testost.	2.51 (" " 18)	2.99	3.30
3	C	1.00 mg stilb. + 1.00 mg testost.	" " " "	3.01	2.78

*C, capon; F, female; J.F., juvenile female; J.M., juvenile male; M, male; S.P. and B.P., sinistrally and bilaterally ovariectomized poulards.

males,⁴ feminized by estrogen injection during incubation, averaged 2,850,000, essentially that of the normal female. There was no correlation between the number of erythrocytes and the degree of plumage feminization.

In an attempt to reproduce the intersexual condition experimentally, capons were given daily injections of both testosterone propionate and alpha-estradiol benzoate or diethylstilbestrol. As a result of the α -estradiol testosterone combination the average red cell count of 3 capons was raised from 2,640,000 to 3,300,000 after 25 injections, while in 3 testosterone treated controls the average increase was from 2,220,000 to 3,340,000, showing a slightly greater increment than the capons receiving double injections. Three control capons receiving α -estradiol alone showed an average decrease from 2,620,000 to 2,180,000. The results of the stilbestrol testosterone combination were varied, one showed an increase from 2,290,000 to 3,010,000, and 2 decreases from 2,830,000 to 2,540,000, and 3,230,000 to

2,790,000 after 25 injections. The average red cell count for these 3 capons showed a rise from 2,783,000 to 3,010,000 after 15 injections and a drop to 2,780,000 after 25 injections, which is lower at both points than the average obtained from testosterone injected capons. (See Table I).

Conclusions. From these results we conclude that one of the factors responsible for the higher erythrocyte number in male fowl is the presence of androgen while the lower number in the female is caused either by a lack of an adequate amount of androgen or by the presence of estrogen. The mechanism by which the increase is brought about is not known, but the decrease may be due to deposition of endosteal bone which would interfere with erythropoiesis.^{5,6} The results obtained from combined androgen and estrogen injections are not conclusive, although there is some indication that the stimulating effect of androgen on red cell formation is inhibited in some way by estrogen.

⁵ Bloom, M. A., Bloom, W., Domm, L. V., and McLean, F. C., *Anat. Rec.*, 1940, **78**, 143.

⁶ Bloom, W., and Domm, L. V., *Anat. Rec.*, 1941, **81**, 91.

⁴ Domm, L. V., and Davis, David E., *Proc. Soc. Exp. Biol. and Med.*, 1941, **48**, 665.