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Responses in Molt and Lay of Fowl to Progestins and Gonadotrophins.* (22588)

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The effects of progesterone in initiating proliferation of the resting feather papilla with consequent molt of the old plumage is well established(1), but there is as yet no clear picture of the point of attack of the steroid in this process. Local stimulation is entirely conceivable in view of the importance of the mesodermal component in feather regeneration. The experimental demonstration, however, has not proven entirely satisfactory(2), although the technics employed may later be found to have been inadequate. Alternatively, progesterone could be thought to act through its effects in the pituitary, the interruption of lay which follows its administration being especially suggestive in this regard. These alternatives were further investigated. Laying hens were treated with compounds other than progesterone having expected progestational activity in one series of experiments. Complementary experiments on possible interference of gonadotrophins or prolactin with the known response to progesterone were carried out simultaneously.

Methods. The hens used belonged to a strain of New Hampshires maintained at the University of Maryland Poultry Farm. They were in their first year of lay and had completed the normal autumnal molt when brought into the laboratory. Each bird was placed in a single cage and individual egg records were kept for over a month prior to treatment. Distribution of the birds to the experimental groups was made on the basis of these records. Individual egg records were continued during the period of treatment and for about 6 weeks thereafter. For tabular representation, weekly production per group was used. Date of molt was arbitrarily set as the day when all birds in the group had commenced a regular daily shedding of body plumage. Duration of molt was counted to the day when the entire group had ceased daily feather loss. No attempt was made to record feather number per hen but notations were made of noticeable differences in individual intensities of shedding. One control group served for all the concurrent experimental series. Testosterone propionate (TP), 50 mg/ml and desoxycorticosterone acetate (DCA), 10 mg/ml were dissolved in 8 parts sesame oil and 2 parts benzyl alcohol. Cortisone acetate (CA) was suspended in the same vehicle, 10 mg/ml. Progesterone (Pg.) was administered as a preparation having slow absorption from local depots.† Pregnant mares' serum (PMS) was Cutter's "Serum Gonadin." Follicle stimulating hormone (FSH), luteinizing hormone (LH) and prolactin (LTH) were Armour's‡ preparations.

Results. Series I. TP and DCA were injected as multiples of the Pg. dosage, corresponding roughly to the respective ratios given by Hooker and Forbes(3) for systemic administration in the mouse. Cortisone acetate was injected as the weight equivalent of the DCA dosage. Details of administration

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† Repositol Progesterone, Pitman-Moore Co.

‡ The FSH, LH and LTH preparations were most kindly furnished by Dr. I. M. Bunding, Armour and Co., Chicago, Ill.

TABLE I. Effect of Compounds with Progestational Activity and of Cortisone Acetate upon Lay and Molt in Hens. Progesterone was given as a single intramuscular injection Jan. 9. TP, DCA and cortisone acetate (CA) were injected subcutaneously daily at the indicated levels Jan. 9-14, and 16-21. Controls were untreated. Onset of molt is counted in days from day 1 of treatment; duration, days.

Treatment, mg	No. of eggs laid by groups of 5 birds each								Molt	
	12/27	1/3	1/10	1/17	1/24	1/31	2/7	2/14	Onset	Duration
Controls	24	25	20	18*	20	22	20	21	—	0
Pg. 20	24	22	2	11†	9	8	12	14	16	10
TP 50	23	22	3	2	0	0	0	0	26	35
DCA 10	24	26	3	0	0	1	8	21	12	19
CA 10	23	23	21	24	24	23	19	20	—	0

* One bird became diseased and ceased lay. † One bird died.

and effects in reproduction and molt are listed in Table I. DCA and TP both suppressed lay and there was a subsequent molt. However, DCA acted more rapidly with respect to both processes and for shorter periods. CA was wholly inactive; the records of this group show that daily handling of the hens was not a factor in the results obtained with other agents.

Series II. Gonadotrophins were given in 10-fold difference, singly and in combination with a constant Pg. dose. Details of administration and effects on egg production and molt are listed in Table II. PMS, 20 r.u., was ineffective on rate of lay; with the addition of Pg., lay ceased at once. A gradual diminution of egg number, more marked with FSH, followed the injection of FSH, 1.0 mg or of LH, 0.5 mg; the addition of Pg. brought a prompt interruption. When the gonadotrophins were administered at the higher levels, the presence of Pg. brought only a slight augmentation in the early period of response. Molt occurred wherever lay ceased.

The FSH treated hens were conspicuous for the appearance of soft-shelled eggs at 1.0 mg and of 2 soft shell eggs upon the same day at both dosages of FSH plus Pg. These observations of premature and multiple ovulations are interesting although admittedly incomplete in absence of autopsies which were incompatible with records of molt.

LTH at 0.5 and 5.0 mg differed markedly from the preceding. Lay was practically unaffected with the low dosage; with the higher level, it was somewhat diminished, but only for the period of treatment. The effect of Pg. with LTH became apparent only at that same period where it further depressed egg number. At no time, however, was ovulation entirely interrupted and within about a week all 4 groups of hens returned to normal lay. LTH

TABLE II. Effect of Anterior Pituitary Gonadotrophins and of Pregnant Mares' Serum, Singly and in Combination with Progesterone, upon Lay in Hens. PMS, FSH, LH and LTH were injected subcutaneously daily into 3 birds at indicated levels Jan. 9-14, and 16-21. Figures in parentheses are numbers of eggs laid by 3 birds upon identical treatment but which in addition received a single intramuscular injection of Pg., Jan. 9. Egg number of 3 birds receiving Pg. alone are entered in bottom line. Onset of molt is counted in days from day 1 of treatment; duration, days. Entries in parentheses apply as in records of lay.

Treatment	Egg No.								Molt	
	12/27	1/3	1/10	1/17	1/24	1/31	2/7	2/14	Onset	Duration
PMS 20 r.u.	12(16)	12(14)	15(0)	16(0)	14(0)	12 (0)	10 (0)	13 (0)	—(12)	0(38)
200	17(14)	15(13)	5(0)	2(1)	0(0)	0 (0)	0 (0)	0 (2)	19(12)	28(38)
FSH 1.0 mg	16(13)	15(13)	5(5)	2(2)	1(0)	0 (0)	0 (0)	2 (0)	15(14)	19(23)
10.0	14(15)	14(15)	9(7)	4(4)	0(0)	0 (0)	0 (0)	0 (0)	13(11)	28(25)
LH .5	12(16)	13(14)	15(1)	16(4)	10(0)	8 (0)	8 (0)	9 (0)	—(16)	0(28)
5.0	13(16)	15(14)	5(2)	0(0)	0(0)	0 (0)	0 (0)	0 (0)	16(13)	29(31)
LTH .5	15(11)	14(13)	14(4)	12(1)	15(8)	16(14)	17(13)	17(15)	—(14)	0 (5)
5.0	15(14)	15(14)	11(2)	4(1)	7(4)	13(13)	13(15)	16(14)	6(14)	18 (7)
Pg. 20	14	13	0	3	5	4	7	11	16	10

thus differs sharply from PMS, FSH and LH in offsetting the effect of Pg. rather than augmenting it as did these gonadotrophins. Furthermore, molt appeared at the 5.0 mg level even though lay had not been wholly suppressed.

Discussion. The data presented here show that an interrupted reproductive phase does not necessarily lead to immediate activation of the papilla (TP, Table I) and conversely, that molt may occur with continued lay (LTH, 5 mg; Table II). The present records of molt take the shedding of the standing feather as measure of onset. Actually, the first events in the papilla occur about a week to 10 days sooner since approximately that time is required for the formation of the underlying feather that ultimately expels its predecessor. This activation occurred early in the periods of treatment, remarkably so with LTH, with the one significant exception of TP treated hens. On the supposition that progestins may directly stimulate the papilla, the delayed response of the TP group could suggest a transformation of part of the androgen to another, progestationally effective compound as has been suggested by Hooker and Forbes(3) in the mouse. However, Layne and Common(4) describe a more rapid onset of molt, toward the end of 10 days of treatment with TP, 5.0 mg/day. These tests were run on immature pullets, 59 days of age, perhaps explaining the difference. The absence of any reaction with cortisone acetate is not surprising since Hertz and Tullner(5) have recently pointed out its lack of progestational activity in the rabbit.

Summary. Progesterone, appropriately administered, has the capacity to a) induce proliferation of the feather papilla with consequent molt, and b) interrupt a laying period. Several compounds with known or suspected progestational activity were tested to ascertain their effectiveness in these respects. Desoxycorticosterone acetate interrupted lay; molt was initiated soon thereafter. Testosterone propionate similarly interrupted lay but molt was evident only after considerable delay. Cortisone acetate was ineffective in either process. Other experiments examined the action of several gonadotrophins given in 10-fold difference of dosage, alone and in conjunction with a constant progesterone dosage. Pregnant mares' serum, follicle stimulating hormone, or luteinizing hormone in adequate dosage diminished or interrupted lay for 3 weeks or more beyond the actual time of treatment. Progesterone augmented all such effects. Molt occurred if lay ceased. Prolactin affected lay very slightly and counteracted interference by progesterone. Molt occurred very early with prolactin alone and was brief and light with progesterone given simultaneously. At the higher dosage level, some molt appeared even though lay was not entirely suppressed.

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