

A NOTE ON THE EFFECTS OF DIFFERENT DOSES OF THYROID ON THE FOWL

By F. B. HUTT.

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(With Two Text-figures.)

REPORTS of the effects of thyroid feeding on fowls published to date by various investigators show some lack of uniformity. Giacomini (1924) and B. Zavadovsky (1925) have noted depigmentation of plumage when fresh thyroid gland was given orally in doses which, though not stated exactly, were relatively large. The latter writer also obtained the same result with dried preparations.

On the other hand, Cole and Reid (1924) found that desiccated thyroid when given to Brown Leghorns at the rate of 84 milligrams per pound of live weight caused a greater production of melanin. A similar result was mentioned by Crew (1925). More recently, Torrey and Horning (1925 *a*) found that feeding thyroid resulted in the production of darker feathers in cockerels and capons but not in hens. The latter workers concluded that the ovary secretes a substance which nullifies the action of the thyroid in normal hens. This view hardly seems consistent with the findings of Giacomini and Zavadovsky, each of whom observed depigmentation in both cocks and hens following administration of thyroid.

Hen feathering in male fowls fed upon desiccated thyroid has been reported by Torrey and Horning (1922 and 1925) and Cole and Reid (1924). A trial by Crew and Huxley (1923) with cockerels on a very low thyroid intake failed to confirm these results, but in later work with adult birds Crew's findings agreed with those of the other observers. Neither Giacomini nor Zavadovsky makes any mention of hen feathering in their papers. It might seem at first glance that these differing results were due to the fact that the latter two investigators used fresh thyroid gland while the other workers used a desiccated product. Zavadovsky used dried glands and Poehl's thyroïdin, but so far as can be determined from his paper these substances were fed only to hens and all the cocks used received fresh thyroid. Cole and Hutt (1928), however, obtained hen feathering in males with both fresh gland and Armour's desiccated thyroid.

It seemed possible that the discrepancies in the findings reported above were due to the fact that the thyroid substance was given in different dosages by the several investigators. Cameron and Carmichael (1920) have shown that different rates of thyroid feeding produce decidedly different results in rats, and that comparable data are most readily obtainable by feeding dosages of known amounts of iodine in thyroid combination. Accordingly an experiment was planned to determine the effects of various dosages on feather colour, feather structure, and body weight.

EXPERIMENT.

Ten Black Minorca pullets nine months old and seven cockerels of the same breed and about the same age were given daily doses of desiccated thyroid (Parke, Davis and Co.—0.3 per cent. iodine) in addition to a well balanced ration. A control of each sex (No. 11) received a capsule of beef-scrap daily.

Females 1 to 10 received daily doses of from 4 mg. thyroid iodine per 1000 gm. of body weight to 4 mg. per 10,000 gm. of body weight. The males were numbered 1, 2, 3, 5, 7, 10 and each received a daily dose identical with that given the female of the same number. Thus in each lot No. 5's dose was 4 mg. thyroid iodine per 5000 gm. of body weight, No. 7 received 4 mg. thyroid iodine per 7000 gm. of body weight, and so on.

The two largest doses were administered by mixing the powder with moist mash, shaping the whole to cylindrical pellets and thrusting these down the gullet of the fowl. The smaller doses were given in gelatine capsules. All birds were weighed every three days. Doses for each bird were made up afresh subsequent to each weighing and changed as required to keep the amount given in a constant proportion to the body weight. Since one result of heavy thyroid feeding is a decrease in weight, it is obvious that if the same amount were given throughout the experiment the actual dosage would increase as the body weight decreased.

Feeding was begun on February 4th, 1926, and continued for 31 days.

RESULTS.

Effects of large doses.

The two largest doses, viz. 4 mg. thyroid iodine to 1000 and 2000 gm. body weight, proved lethal to both cockerels and pullets. They caused rapid decline in weight as shown in Figs. 1 and 2. The birds showed evidence of intense thirst and diarrhoea followed by loss of appetite, dullness and lack of co-ordination. The excreta consisted mostly of white urates and mucus. On autopsy the ureters of all four birds were found to be congested with urates through their entire length. Male No. 1 had enormously hypertrophied testes weighing 20.6 and 19.95 gm., whereas 9 or 10 gm. would have been normal for a cockerel of his weight.

Table I.

Effects of large doses of thyroid.

Bird	Original weight (gm.)	Dose of thyroid iodine	Death	Loss in weight (gm.)	Desiccated thyroid consumed (gm.)	Thyroid iodine consumed (gm.)
Male 1	2691	4 mg. 1000 gm.	9th day	182	24.927	.075
„ 2	2598	4 mg. 2000 gm.	14th „	682	14.904	.045
Female 1	2541	4 mg. 1000 gm.	22nd „	781	27.703	.083
„ 2	2364	4 mg. 2000 gm.	22nd „	647	19.731	.056

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The two females went into precipitate moult. No. 1 started ten days after moulting began, No. 2 on the thirteenth day. None of the birds were given any thyroid when they had lost their appetites, but feeding was resumed on alternate days when the appetites were regained.

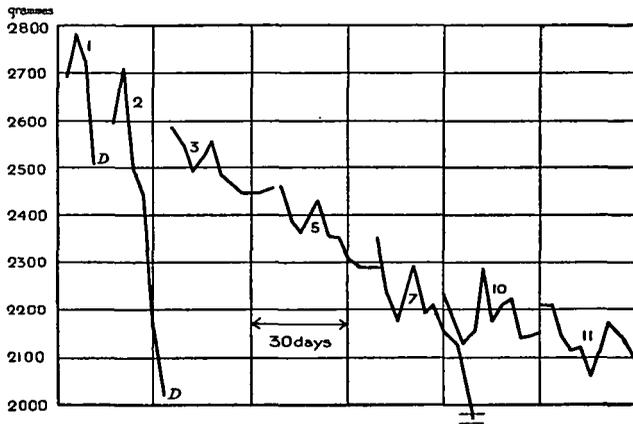


Fig. 1. Changes in body weight of Males.

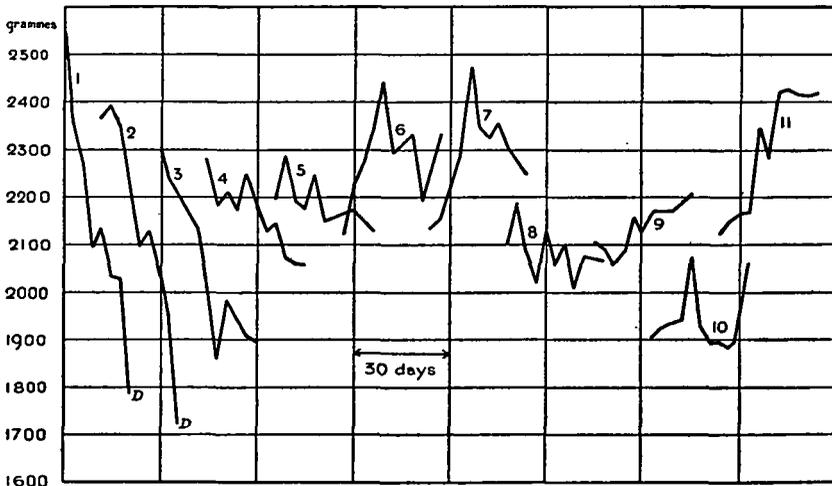


Fig. 2. Changes in body weight of Females.

In the case of both sexes No. 1 received daily 4 mg. thyroid iodine per 1000 gm. of body weight; No. 2, 4 mg. per 2000 gm.; No. 3, 4 mg. per 3000 gm. and so on. No. 11 was given beef-scrap. 4 mg. per 1000 and 2000 gm. proved to be lethal (D). 4 mg. per 3000 to 5000 gm. caused loss in weight in both sexes. 4 mg. per 7000 gm. affected the male only. Smaller doses did not affect the weight of either sex.

Table I summarises the effects of the two largest doses. There was not much difference between the sexes in their ability to withstand heavy doses. The females probably lived longer because thyroid feeding was stopped for several days when they lost their appetites. All four birds succumbed to doses which other workers have shown are not lethal for rats.

Effect on body weight.

The changes in body weight are shown graphically in Figs. 1 and 2. There is considerable normal variation in the weights of fowls even when taken at the same hour each day, hence the data do not present smooth curves. It is evident that the female on a dose of 4 mg. thyroid iodine per 3000 gm. lost weight rapidly. No. 4 had a marked decline, No. 5 a slight one and the remainder on the smaller doses were not significantly affected. Of the cockerels Nos. 3, 5 and 7 lost weight steadily, while No. 10 receiving only 4 mg. thyroid iodine per 10,000 gm. of body weight was entirely unaffected. The number of birds used was small, but the results give some indication that the females were better able to withstand the thyroid treatment than were the males.

Effect on feather structure.

One week after feeding started a patch of feathers was plucked from the neck and left wing-bow of every bird.

In male fowls, feathers in these areas have a marginal zone at the distal end in which the barbs lack barbules and hooks. Such feathers appear pointed in contrast with feathers from the same regions in females. This difference constitutes a secondary sex character in the domestic fowl.

New feathers grown on these spots by the surviving thyroid-fed males were "henney" in all birds, both males and females.

Effect on colour of plumage.

New feathers growing on the plucked areas of the left wing-bow showed white and greyish borders at the tips in amounts varying according to the doses given to different birds. Thus, of the females Nos. 3, 4 and 5 had white tips up to a quarter of an inch wide while the remainder, on the smaller doses, had smaller amounts, and Nos. 9 and 10 showed only a small number of greyish spots. White or grey ticking was less evident on the new neck feathers than on the wing-bow.

The cockerels showed similar results. Nos. 3 and 5 had new wing-bow feathers white tipped, No. 7 had only a few spots of white and No. 10's new feathers were entirely black.

One generally recognised effect of thyroid feeding on fowls is a more or less precipitate moult. In this experiment the surviving birds on the heavier doses, viz. females Nos. 3 and 4 and male No. 5, underwent partial moults. New primary feathers on these birds had patches of white ranging from small white tips in male No. 5 to nearly solid white feathers in female No. 3. Female No. 7 also shed two primaries on each wing, but the new feathers growing in were entirely black.

It is of interest to note that among the wing-bow feathers plucked from two of the males were quite a number which were partly red in colour. This is not an uncommon defect in Black Minorcas. The new feathers replacing them, however, were solid black, except for white tips on No. 3.

The degree of depigmentation was difficult to measure exactly, but it was quite evident that the birds receiving daily doses of 4 mg. thyroid iodine to 3000, 4

and 5000 gm. of body weight showed the most depigmentation. Those receiving smaller doses had very little white in new feathers, while those on doses of 4 mg. to 9000 and 10,000 gm. of body weight produced solid black feathers, only a few of which had (in the females only) small greyish tips.

Since this experiment was done Brambell (1926) has observed corresponding degrees of depigmentation on similar doses. The fact that some of his birds showed less of the effect than others was probably due to differential body weight or differential consumption of the mash containing thyroid, which was fed to the entire flock and not administered individually.

New feathers on the thyroid-fed birds were dull in appearance and somewhat rough, due probably to the partial atrophy of the uropygial gland first noted by Giacomini as a consequence of thyroid feeding. The quilling of the rectrices and remiges observed by Torrey and Horning (1925 *a*) was present to a slight extent in new remiges replacing those shed by the birds on the heavier doses.

SUMMARY.

Daily doses of 4 mg. thyroid iodine per 1000 and 2000 gm. of body weight proved lethal to male and female fowls.

Daily doses of 4 mg. thyroid iodine per 3000 to 5000 gm. body weight caused loss in weight in males and females. The same amount of thyroid iodine to 7000 gm. of body weight caused loss of weight in a cockerel but not in a hen. Smaller doses had no effect on the weight in either sex.

All doses, even 4 mg. thyroid iodine to 10,000 gm. body weight, caused hen feathering in the males.

Depigmentation was quite marked in the case of the heavier doses, but less evident in that of the smaller. In general, depigmentation was most evident in the birds which declined in weight. The minimum daily dose necessary to produce marked depigmentation was 4 mg. thyroid iodine to 5000 gm. of body weight. This explains why several investigators have not obtained the depigmentation described by Giacomini and Zavadovsky.

On doses of 0.8 mg. thyroid iodine per bird or less, Cole and Reid, and Crew observed production of darker feathers. On much larger doses Giacomini, Zavadovsky and the writer observed depigmentation.

It would seem that the smaller doses of thyroid cause increased production of melanin, presumably by the general increase in metabolic processes, but that at a certain stage (which this experiment indicates to be around 4 mg. thyroid iodine per 5000 gm. of body weight) the production of pigment is arrested.

The use of a definite dosage of thyroid iodine based on body weight has led to consistent results and to an explanation of some of the discrepancies which have previously appeared in the literature.

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