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Endocrine Glands of Rabbits Fed Cod Liver Oil or Irradiated Cholesterol.

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Studies on the indirect effects of ultra violet light on growth, and its therapeutic action in rickets and tetany in children have received new impetus recently from the independent observations of Hess and Weinstock[1], and of Steenbock and his collaborators[2] that diets which are deficient in certain respects may be made complete by irradiation with light of short wave lengths, or by the addition of certain irradiated substances, such as cholesterol.

The light of the quartz mercury vapor lamp has been found to have definite secondary effects upon some of the endocrine tissues, also, producing a notable hypertrophy of the hypophysis and the (external) parathyroid glands of normal rabbits[3]. The question arises whether the affected glands mediate some of the metabolic effects ascribed to the radiations, and whether irradiated food materials, which appear to have effects similar to those of ultra violet light on growth and in disturbances of calcium and phosphorus metabolism, also act by a specific stimulation of certain endocrine glands.

In these experiments we fed Norwegian cod liver oil, or irradiated cholesterol, to adult male rabbits for periods of several weeks, and at autopsy compared the weights of certain of their endocrine organs with those of normal rabbits, and of rabbits irradiated with a quartz mercury vapor lamp over similar periods of time.

Experiments I and II. Cod liver oil.

In addition to their regular diet, two groups of 6 and of 10 normal adult male rabbits (one group studied in April, the other in December) received 2 to 4 cc. of cod liver oil daily for periods of 3 to 4 weeks. Two groups of 17 and 14 normal rabbits, from the stock of Drs. Brown, Pearce, and Van Allen, examined coincidently with the experimental animals, served as controls. Serum calcium and inorganic phosphorus determinations were made before and at intervals during the experiments, and at au-

topsy, after exsanguination under ether anesthesia, the weights of the endocrine tissues were determined in proportion to net body weight.

TABLE 1.
Cod liver oil administration.
Average weights of endocrine glands (mgm. per kg. net body weight).

Exp. No.	Group	No.	External parathyroids	Pineal	Hypophysis	Thyroid	Thymus	Adrenals	Testicles
1	Fed cod liver oil	6	5.98	9.0	14.0	103.8	1514.	161.5	2314.
April	Controls	17	6.03	9.5	15.8	158.9	1502.	177.5	2490.
	Irradiated	9	7.21	8.7	19.6	229.3	1082.	200.7	2639.
2	Fed cod liver oil	10	5.87	9.7	16.6	97.1	1252.	245.6	3042.
Dec.	Controls	14	5.94	8.3	14.6	108.0	1341.	207.4	2690.
Oct.	Irradiated	6	8.7	10.8	15.5	102.0	1137.	224.7	2643.

The essentially similar results of these two experiments are shown in Table 1, in which the gland weights of two groups of irradiated rabbits are included for comparison. The feeding of cod liver oil did not change the proportionate weights of any of the endocrine organs beyond the limits of normal individual variation. The weight of the thyroid gland especially varies widely in different rabbits and at different seasons, and the differences between the two experiments in the averages for thymus, adrenals, and testicles are also an illustration of seasonal variation so extensively studied by Drs. Brown, Pearce, and Van Allen[4].

Slight variations in the serum calcium and inorganic phosphorus levels of the experimental rabbits all came within normal limits also.

Experiment III. Cholesterol.

Following the method of Hess and Weinstock, a 1 per cent suspension of Kahlbaum's cholesterin in distilled water was prepared fresh each day and exposed to the unfiltered radiations of a quartz mercury vapor lamp (67 v. 5.5 amp.) for 30 minutes at a distance of 30 cm. The irradiated cholesterin suspension was then fed by stomach tube, 6 days a week, in doses of 10 cc.

(0.1 gm.) to 6 normal, adult, male rabbits. Control groups of 6 rabbits each were fed similar doses of non-irradiated cholesterin, or given only the regular diet of hay, oats, and cabbage. Serum calcium and inorganic phosphorus determinations were made at intervals, and after 4 weeks the animals were anesthetized, exsanguinated, and the weights of certain endocrine glands recorded at autopsy.

TABLE II.
Cholesterol administration.
Average weights of endocrine glands (mgm. per kg. net body weight).

Group	No.	External parathyroids	Pineal	Hypophysis	Thyroid	Thymus	Adrenals	Testicles	Spleen
Fed irradiated cholesterol (May)	5*	7.97	10.4	15.5	99.9	769.6	233.6	2290.	643.4
Fed non-irradiated cholesterol	5*	6.4	8.8	15.54	141.9	1190.	255.8	2258.	538.9
Controls	6	8.66	8.63	15.53	107.	1222.	256.6	2312.	516.6
Irradiated rabbits (June)	6	9.67	9.2	17.95	103.9	971.3	—	2258.	—

*Excluding two rabbits which died during the experiment.

On the basis of this single experiment, attention is directed only to the figures for external parathyroids and hypophysis, in which the hypertrophic effects of ultra violet irradiation have been repeatedly observed. The external parathyroid glands of the rabbits fed irradiated cholesterol were considerably larger than those of the non-irradiated cholesterol group, but a similar (seasonal) parathyroid enlargement had occurred in the normal controls also. The question is: why did the rabbits fed non-irradiated cholesterol not show the usual seasonal parathyroid hypertrophy?

As in the experiments with cod liver oil, no significant progressive variations from normal levels were found in the calcium and inorganic phosphorus levels of the blood of these experimental animals.

Under these experimental conditions, the feeding of cod liver oil or irradiated cholesterol to normal rabbits did not produce

changes in the relative weights of endocrine organs, notably the external parathyroids and the hypophysis, which are characteristic effects of irradiation with ultra violet light.

[1] Hess, A. F., and Weinstock, M., PROC. SOC. EXP. BIOL. AND MED., 1924, xxii, 5, 6, 76, 103, 227, 319.

[2] Steenbock, H., and Black, A., *J. Biol. Chem.*, 1924, lxi, 405, and following volumes.

[3] Grant, J. H. B., and Gates, F. L., *J. Gen. Physiol.*, 1924, lxi, 635.

[4] Brown, W. H., Pearce, L., and Van Allen, C. M., *J. Exp. Med.*, November, 1926 (in press).