

Alteration of Activity of Thyroid Gland of Beef Cattle with Testosterone.*† (20584)

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The ability of male hormones to cause weight increases in animals of several species has been reviewed by Kochakian(1). Recently the ability of testosterone to increase the average daily gain in beef cattle has been clearly demonstrated(2,3). The activity of the thyroid gland may be very important in the elucidation of the action of testosterone in stimulating growth processes.

Materials and methods. Twelve heifers and 12 steers were divided into 2 groups at random so that 6 heifers and 6 steers were in each group. One group served as controls and received no treatment while the second group was designated as the testosterone group and each calf received weekly intramuscular injections of 1 mg of testosterone per kg of body weight. The average daily gain and feed required per unit gain for individual calves were obtained for the period from 500 to 800 lb live weight and are given in Table I for the treatment and sex groups. When each calf reached 800 lb live weight it was slaughtered and the weight of the thyroid gland taken. A representative sample of the gland was fixed in Bouin's fixative and later sectioned, stained and examined for changes in histological structure. The remainder of the thyroid gland was placed in storage at -10°C . When all the animals had been slaughtered, the thyroid glands of 2 heifers and 2 steers in

each treatment group were individually macerated in distilled water with a Waring blender for 5 minutes and then strained through a double layer of cheese cloth. The filtrate was diluted with distilled water until one gram of original thyroid tissue was contained in 7.5 ml. The diluted filtrate was injected into mice 10 weeks of age, which had been on a ration containing 0.1% of thiouracil for 4 weeks. One subcutaneous injection of 0.2 ml of the thyroid gland suspension was given each mouse and the mice were killed 36 hours later. Thyroid tissue from each calf was injected into 3 male and 4 female mice. The mice were asphyxiated in one-half pint jars sealed with mason lids and maintained at room temperature (24°C). The time interval required for death by asphyxiation in the sealed jars was recorded for each mouse.

Experimental. Testosterone treatment produced a significant increase in the size of the thyroid glands of both heifer and steer calves, (Table I). Histological examination of the thyroid glands revealed that, while the thyroid glands of the control calves were characterized by large colloid areas with epithelium of a low or cuboidal form, the thyroid glands of testosterone-treated calves were characterized by very small colloid areas with tall epithelial cells surrounding them. In control calves a very large amount of the total volume was

TABLE I. Effect of Testosterone on Feed-Lot Performance and Thyroid Activity of Beef Heifers and Steers.

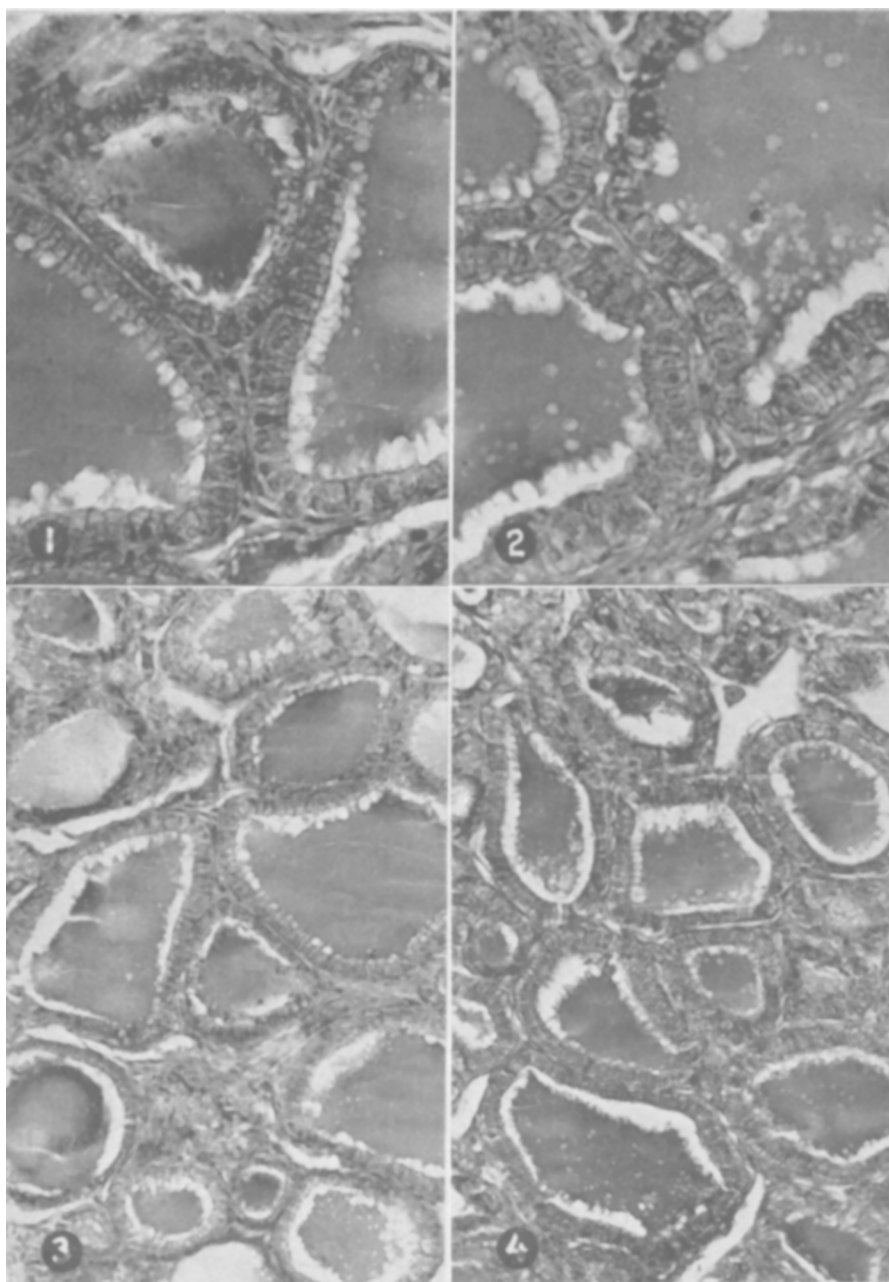
Treatment group	Total digestible nutrients consumed (lb)		Avg daily gain (lb)	Wt of thyroid gland (g)	Survival time of assay mice (min.)
	Per day	Per lb gain			
Control heifers	10.39	4.98	2.09	16.3	43.2
Testosterone-treated heifers	9.89	3.79*	2.61*	19.4*	48.1*
Control steers	10.48	3.98	2.65	17.2	45.6
Testosterone-treated steers	10.05	3.69*	2.74*	19.6*	48.4*

* Indicates a significant difference from corresponding control (.05 level).

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Thyroid glands from control and testosterone-treated beef cattle.

FIG. 1. Thyroid from control animal. $\times 240$.

FIG. 2. Thyroid from animal receiving injections of testosterone. Note increased height of epithelium of follicle compared with control (Fig. 1). $\times 240$.

FIG. 3. Thyroid from control animal. Note large amount of colloid in follicles. $\times 120$.

FIG. 4. Thyroid from animal receiving testosterone injections. Note reduction in colloid and greater proportion of cellular material. $\times 120$.

occupied by colloid while in the testosterone-treated calves less than one-fourth of the total volume of the gland was occupied by colloid

(plate 1).

Testosterone had a definite effect on the ability of the thyroid gland to alter the time

TABLE II. Effect of Testosterone Treatment upon Ability of Thyroid Gland Tissue from Experimental Calves to Decrease the Time Required for Asphyxiation of Thiouracil-Treated Mice.

Source of thyroid gland tissue	Sex of mice used		
	Male	Female	All mice
	Survival time (min.)		
Heifers			
Control	33.6	50.4	43.2
Testosterone	36.0	57.1	48.1
Steers			
Control	35.3	53.3	45.6
Testosterone	37.0	56.9	48.4

required for hypothyroid mice to die of asphyxiation. As is indicated in Table II, the mice receiving thyroid material from control calves asphyxiated more quickly than those receiving thyroid tissue from testosterone-treated calves. In both cases the time required for asphyxiation was less than that of mice receiving no thyroid tissue.

Discussion. The increased average daily gain and feed efficiency of the calves receiving testosterone treatment as compared with control calves appears to be associated with an increased size of the thyroid gland and increased activity. The appearance of the thyroid gland of testosterone-treated calves is indicative of a highly active state. The stores of thyroxine in the colloid areas have been depleted and the epithelial cells surrounding these colloid areas are tall columnar in appearance indicating a high degree of secretory activity. The inability of thyroid tissue of testosterone-treated calves to decrease the asphyxiation time of the thiouracil-treated mice as much as thyroid tissue from control

calves is indicative of a lower concentration of thyroxine in the gland and as a result a somewhat slighter effect on metabolic activity and asphyxiation time. This is an excellent example of an endocrine gland in which the retained hormone concentration is not directly proportional to the activity of the gland in secreting that hormone.

Summary and conclusions. 1. Testosterone injected intramuscularly at the rate 1 mg/kg of body wt per week in beef heifers and steers from 500 to 800 lb live wt had the following effects: a) Increased average daily gain and decreased feed requirements per unit gain. b) Increased weight of the thyroid glands. c) Increased secretory activity of the thyroid gland. d) Decreased stores of thyroxine in the thyroid gland. 2. Correlations between thyroid gland activity and growth rate are suggested as indicating a possible mode of the action of testosterone in affecting growth of beef cattle. 3. A method is described using the time of asphyxiation of thiouracil-treated mice as a measure of thyroxine content of the thyroid gland.

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