

CLXXXV. THE ACTION OF THYROXINE ON THE MILK AND MILK-FAT PRODUCTION OF COWS.

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A PREVIOUS study of the effects of thyroidectomy and thyroid feeding on the lactation of cows has shown that the thyroid gland has a marked influence on the production of milk and milk-fat by the cow [Graham, 1934]. Rises in milk and milk-fat production were shown when desiccated thyroid glands were added to the diet either of thyroidectomised animals or normal animals which were past the peak of the lactation cycle. Milk-fat production appeared to be more closely related to the action of thyroid than was milk secretion. The experiments suggested some relationship between milk-fat formation and metabolic rate.

In investigating this action more fully, it was thought advisable to pin it down, if possible, to thyroxine. If thyroxine were actually shown to reproduce the results found after feeding the dried glands, there are several possible mechanisms by which its activity in this direction could be exercised. If it is an effect directly due to changes in metabolic rate, it ought to be possible to bring about a similar effect with nitrophenols.

EXPERIMENTAL.

Five cows past the peak of the lactation cycle were treated as shown in Table I after a control period of 3 weeks. It will be noted that three animals

Table I. *Showing the daily amounts of various substances fed to cows during the 6 weeks experimental period.*

Cow No.	Week of experiment					
	4	5	6	7	8	9
1	Thyroxine 20 mg.	Thyroxine 5 mg.	Thyroxine 5 mg.	Thyroxine 10 mg.	Thyroxine 10 mg.	Thyroxine 20 mg.
2	2:4-Dinitro-phenol 1 mg./kg.	2:4-Dinitro-phenol 2 mg./kg.	2:4-Dinitro-phenol 1 mg./kg.	*Dried thyroid glands ½ lb.	*Dried thyroid glands ½ lb.	*Dried thyroid glands ½ lb.
3	*Dried thyroid glands ½ lb.	Dried thyroid glands ½ lb.	Dried thyroid glands ½ lb.	Dinitro-phenol 1 mg./kg.	Dinitro-phenol 1 mg./kg.	Dinitro-phenol 1 mg./kg.
4	†Prolactin 10 ml.	Prolactin 10 ml.	Prolactin 10 ml.	Prolactin 3 days 20 ml.	—	Thyroxine 20 mg.
5	†Prolactin 10 ml.	Prolactin 10 ml.	Prolactin 10 ml.	—	Thyroxine 10 mg.	Thyroxine 20 mg.

* ½ lb. represents the original wet weight of the amount of dried material fed.

† 10 ml. prolactin were equivalent to 100 mg. of the active precipitate of the method of preparation (activity tested on guinea-pig).

received injections of thyroxine at some time during the experimental period. Two cows were also given small amounts of 2:4-dinitrophenol in their diets. The milk secretion of the same two animals was shown to be sensitive to the feeding of dried thyroid glands. Daily injections of 100 mg. of the active precipitate of prolactin, prepared by two methods from pituitary glands, were made in two animals. The mammary reaction of these two animals was subsequently shown to be sensitive to thyroxine.

RESULTS AND DISCUSSION.

Fig. 1 shows the effect of injections of thyroxine on the milk and milk-fat production of cow 1. The effect of essentially similar treatment on other animals is demonstrated with cow 4 (9th week, Fig. 4) and cow 5 (8th and 9th weeks, Fig. 5). The results appear to confirm the view that the presence or absence

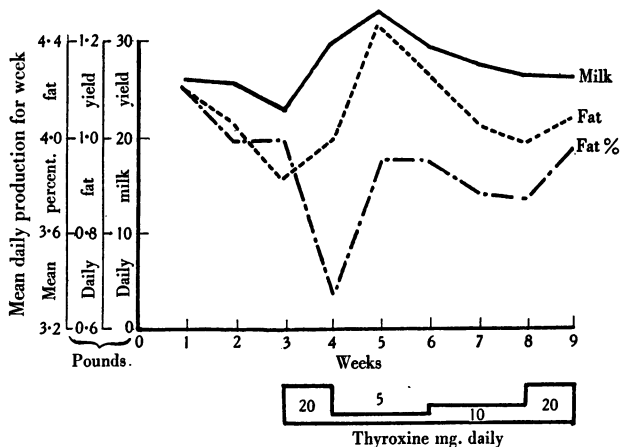


Fig. 1. Showing the effect of injections of thyroxine on the milk yield, milk-fat yield and percentage of milk-fat of cow 1.

of thyroxine itself is the essential condition responsible for the effects of thyroid feeding and thyroidectomy on milk secretion. A marked rise in milk fat production is shown in each instance after the administration of thyroxine. The effect on total milk secretion is again variable. The milk secretion of cow 1 rose from 22.9 lbs. to 32.9 lbs. for the daily average of the week when 20 mg. of thyroxine were injected daily. This represents a rise of over 40 % while the total secretion of cow 5 was hardly affected by thyroxine injections. Cow 4 showed a significant rise in milk secretion during the last week of the experiment when it was receiving thyroxine. Reduction of the quantity of injections in cow 1 was followed by decreases in both total milk and milk-fat production; only milk fat production however rose when the maximum dose was again given.

The results of feeding 2:4-dinitrophenol are shown in Figs. 2 and 3. When this substance was fed at the rate of 1 mg. per kg. of body weight (approximately 500 mg.) daily, neither milk secretion nor fat production was altered, nor was this amount in the diet able to maintain the secretion of cow 3 already stimulated by thyroid feeding. When 2 mg. per kg. were fed to cow 2 during the 5th week of the experiment fat production rose 0.03 lb. daily giving a rise of 0.18 in the butter fat percentage. This rise is of the order of 4 % and may

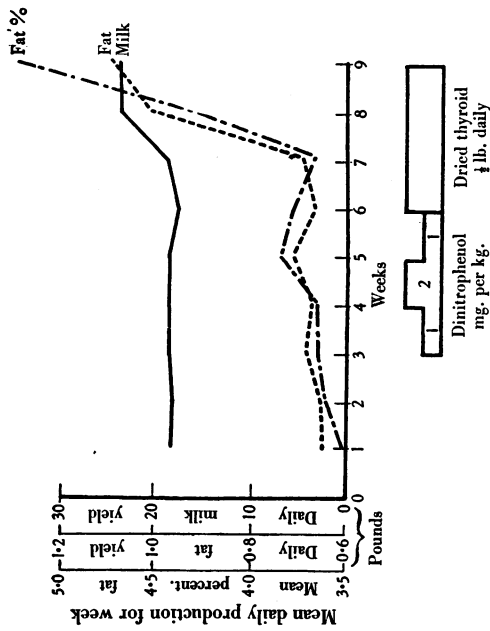


Fig. 2.

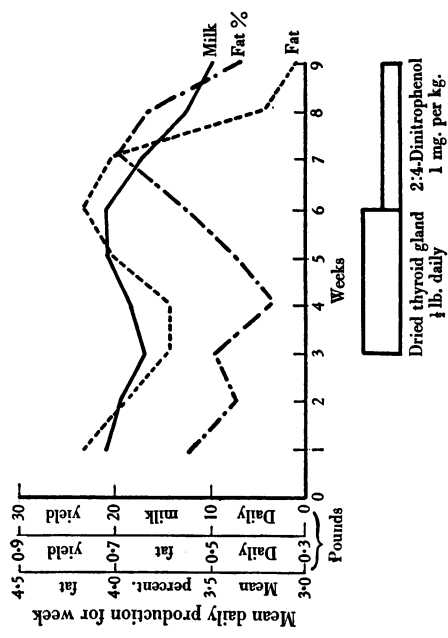


Fig. 3.

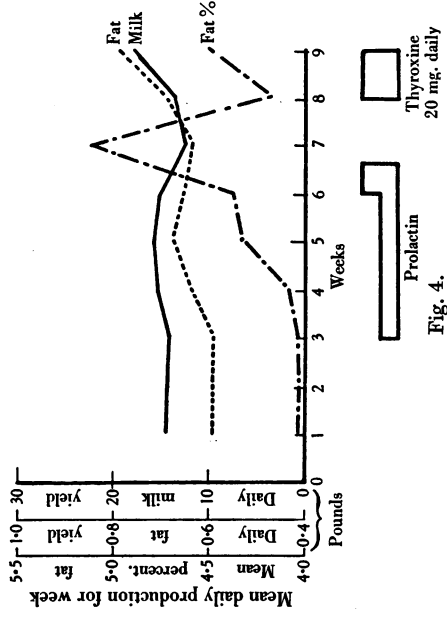


Fig. 4.

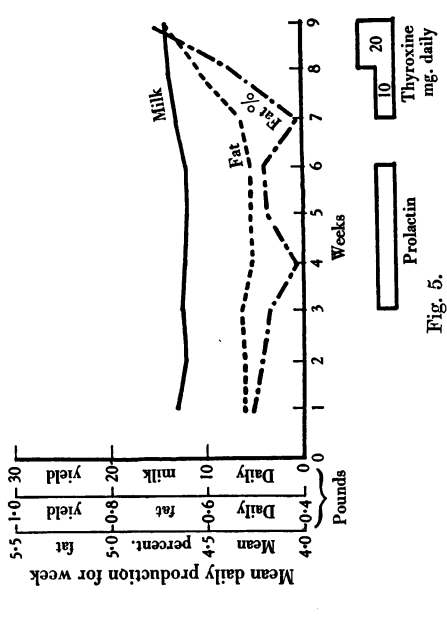


Fig. 5.

Figs. 2 and 3. Showing the effect of feeding 2:4-dinitrophenol or desiccated thyroid glands on the milk yield, milk-fat yield and milk-fat percentage of cows 2 and 3.

Figs. 4 and 5. Showing the effect of injections of prolactin or thyroxine on the milk yield, milk-fat yield and milk-fat percentage of cows 4 and 5.

or may not be significant. The weight of milk secreted remained constant. Dinitrophenol had been purposely used with great caution since nothing is known of its effects when fed to this species. No pyrexia was observed, however, with the amounts used.

The two preparations of prolactin were injected daily into cows 4 and 5 (Figs. 4 and 5). Cow 4 received a preparation made by the method of Lyons and Catchpole [1933] while cow 5 was given one prepared by the method of Riddle *et al.* [1933]. The injections into cow 4 were followed by a slight rise in secretion which later fell. Fat production rose appreciably and fell more slowly than milk secretion as shown by the rising fat content of the milk from the 5th week. Doubling the amount of injections for 3 days during the 6th week augmented rather than checked the fall in secretion. Cow 5 showed no change in the secretion of either milk or milk-fat after receiving daily injections of prolactin for a period of 3 weeks.

While the results given by cow 4 resemble those after the administration of thyroxine to some extent, the preparation injected was grossly contaminated with protein. The facts that the animal had developed a body temperature above the normal by the 7th week and that doubling the amount of the injections was followed by a fall in secretion make it appear that the results obtained might be due to the effect of injecting a foreign protein rather than to the uncomplicated effect of prolactin. The preparation injected into the other animal was apparently more free from protein and caused no changes in secretion.

In conclusion one may point out that each animal at one time or another during the course of the experiment came under the influence of added thyroxine either as thyroid glands in the diet or as the pure hormone. The rise in milk-fat production was always marked. The rise in milk secretion, however, showed large variations giving more evidence that the cause of the increase in total milk secretion may not be identical with the cause of the rise in milk-fat. It may or may not be a significant observation that cows with a fine texture of skin show a much smaller milk secretion-response to thyroxine than do those with coarse hides.

SUMMARY.

Thyroxine is the principle in the thyroid gland which causes a marked increase in the production of milk fat. Thyroxine also causes a less regular increase in milk secretion when given to cows during the period of declining lactation.

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