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Initiation and Maintenance of Lactation in Dairy Heifers by Hormone Administration.*

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Reece and Turner¹ reported that the injection of an estrogenic hormone into ovariectomized rats not only increased the lactogen content of the anterior lobe of the pituitary gland but that it also initiated lactation. Soon there appeared reports showing that the administration of estrogenic substances would initiate and maintain lactation in rats,² goats,³⁻⁸ and cows.^{3,9-12}

In the experiments with dairy cattle the quantity of hormone used, the mode of administration, and the duration of treatment have varied greatly. The quantity of milk secreted has varied from negligible amounts^{3,10} to a peak daily production of 16 pounds.¹¹ Because of the possibilities of inducing and maintaining lactation in sterile heifers it was thought desirable to make additional observations on the effectiveness of hormones in

inducing and maintaining lactation in dairy cattle. Two such attempts have been made.

A 30-month-old Holstein-Friesian heifer, H22, that had failed to conceive following 4 matings, was in estrum Jan. 5 and received her first injection Jan. 13. Five mg of diethylstilbestrol dipropionate[†] and 5 mg of testosterone propionate[‡] were injected subcutaneously twice weekly for 6 weeks. Then the testosterone propionate injections were discontinued and the diethylstilbestrol dipropionate was injected subcutaneously twice weekly in increasing doses for 5 weeks (7 mg twice weekly for 2 weeks, 10 mg twice weekly for 2 weeks, and in the 11th week 15 mg on the first injection and 20 mg on the second injection). During the injection period there was a gradual increase in udder and teat size but at no time was the udder filled with secretion.

Milking was begun the day after the last injection. The milk obtained on the first day was similar to colostrum in appearance and it was low in milk fat and high in solids-not-fat. The milk was normal in appearance on the 3rd day of milking. The heifer, however, had to be restrained during the milking period and since it was thought that such conditions were not conducive to milk production a bull calf was placed with her during the month of April. The heifer accepted the calf almost immediately and her maternal behavior was well developed by the end of the month. For the first 6 days the calf had to be fed milk in addition to that which he secured from H22. Until April 15 the calf removed all of the milk secreted by the heifer. After that date $\frac{1}{2}$ to 3

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² Reece, R. P., *J. Dairy Science*, 1941, **24**, 497.

³ Folley, S. J., Scott Watson, H. M., and Bottomley, A. C., *J. Physiol.*, 1940, **98**, 15P.

⁴ Lewis, A. A., and Turner, C. W., *Proc. Am. Soc. Anim. Prod.*, 1940, 63.

⁵ Folley, S. J., Scott Watson, H. M., and Bottomley, A. C., *J. Dairy Research*, 1941, **12**, 241.

⁶ Lewis, A. A., and Turner, C. W., *J. Dairy Science*, 1941, **24**, 845.

⁷ Folley, S. J., and Young, F. G., *Nature*, 1941, **148**, 563.

⁸ Lewis, A. A., and Turner, C. W., *J. Dairy Science*, 1942, **25**, 895.

⁹ Walker, S. M., and Stanley, A. J., *Anat. Rec.*, 1940, **78** (suppl.), 142.

¹⁰ Folley, S. J., Scott Watson, H. M., and Bottomley, A. C., *J. Physiol.*, 1941, **100**, 7P.

¹¹ Walker, S. M., and Stanley, A. J., *Proc. Soc. Exp. Biol. and Med.*, 1941, **48**, 50.

¹² Lewis, A. A., *Jersey Bul.*, 1942, **61**, 459.

[†] The diethylstilbestrol dipropionate (Stilbestryl Dipropionate) was kindly supplied by Dr. C. H. Mellish of the Lakeside Laboratories, Inc., Milwaukee, Wis.

[‡] The testosterone propionate (Perandren) was kindly supplied by Mr. F. E. Houghton of Ciba Pharmaceutical Products, Inc., Summit, N.J.

lb of milk was milked out daily.

On May 2d H22 was placed with the milking herd and, as judged by subsequent daily milk weights, she was in full milk flow. The monthly milk production in pounds on twice-a-day milking to date is: 720.8; 682.7; 665.3; 609.8; 645.0; 583.1; and 610.4, a total of 4517.1 lb. The peak daily milk production was 27.5 lb and the average fat test for the incomplete lactation is 3.82%.

H22 was in estrum Jan. 21 and Feb. 9. During the latter half of the injection period the animal was in intense estrum. Estrous signs subsided 10 days after the last injection and what appeared to be a normal estrous period occurred on April 15. The heifer was in estrum and mated on May 19, June 6, and July 1. An examination on Aug. 26 and on Nov. 10 showed H22 to be pregnant.

A 33-month-old Jersey heifer, 381X, that had failed to conceive following 9 matings was in estrum July 8, at which time she was injected subcutaneously with 10 mg of diethylstilbestrol dipropionate. Five mg of the hormone were injected subcutaneously on July 11 and thereafter twice weekly for 5 weeks. The dose was increased during the next 8 weeks, to 7 mg, 10 mg, 15 mg, and 20 mg, each amount being injected twice weekly for 2 weeks.

At first there was a slight increase in udder and teat size and then the udder appeared to become slightly filled with secretion. The secretion, however, was not removed and secretory activity seemed to subside. By the end of the injection period the udder had increased considerably in size but it was not distended with secretion.

On October 12, three days after the last injection, milking was begun and 1.4 lb of secretion were obtained. The secretion, however, did not have the appearance of normal milk. During the following 2 days 381X was milked twice daily but since the amount of secretion remained small the heifer was milked only once daily for the following 12 days. In this 12-day period the amount of daily secretion gradually increased from 0.4 lb to 1.2 lb.

A week-old calf was allowed to nurse 381X twice daily for the next 9 days; however, the heifer had to be tied in the box stall as she at no time showed any signs of maternal instinct. Although the calf nursed vigorously, additional quantities of milk were removed from the udder on the last 2 days. Consequently the calf was not permitted to nurse any longer and 381X was placed with the milking herd and milked twice daily.

On Nov. 5, heifer 381X produced 3.8 lb of normal-appearing milk and then gradually increased in milk production. In Nov., 381X produced 412.9 lb of milk with an average fat test of 4.42% and in December she produced 852.8 lb of milk with an average fat test of 5.09%. She attained a peak daily production of 33.7 lb on Jan. 14.

Rectal palpation of the ovaries of 381X was made on the day of the first injection, at which time the heifer was in estrum. The mature follicle was found to be present in the right ovary. The heifer remained in estrum for 2 additional days, after which no estrous signs were noted until July 25. The ovaries were palpated again on Aug. 3 and no evidence was found of a persistent corpus luteum. As the dose of diethylstilbestrol dipropionate was increased the animal's behavior became more bull-like rather than similar to that of a cow in intense estrum. On Oct. 13, four days after the last injection, 381X was in estrum and mated. It is doubtful, however, if this was a normal estrous period, since we have evidence that the heifer was still under the influence of diethylstilbestrol dipropionate. An examination on Dec. 28 showed that the heifer was not pregnant and that the right ovary contained a cyst, which was expressed at that time.

Conclusion. The subcutaneous injection of diethylstilbestrol dipropionate either alone or in conjunction with testosterone propionate will stimulate udder and teat growth and initiate and maintain lactation in nulliparous dairy heifers. A nursing calf may aid in bringing about full lactation in heifers prepared for lactation by hormone administration.