

INDUCTION OF LACTATION WITH HORMONES

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The development of complete mammary gland growth and induction of lactation by means of injected hormones on a practical basis would be of economic value to dairymen because sterile heifers and cows could be brought into production. Estimated figures suggest that one-half of the approximate 30% yearly cow turnover have the genetic merit to be considered as candidates for induced lactation. Thus, we have somewhere around 25-30,000 cow/year leaving Florida herds who could qualify for induced lactation. These represent a sizeable dollar value when salvage values and replacement costs are considered.

Mammary gland development in pre-pubertal heifers proceeds at a rate comparable to general body growth until puberty is reached. After puberty mammary gland growth is under hormonal control. Hormones are further involved in milk production since they are responsible for initiation and the maintenance of lactation once it has been established.

Much of the research on hormonal requirements of mammary growth has dealt with the role of estrogen and progesterone. Estrogen and progesterone secreted from the ovary during recurring estrus cycles, after puberty has been reached, stimulates mammary tissue growth. However, in attempting to induce lactation we must consider hormones other than those from the ovary. But we begin here because it is primarily estrogens and progesterone (progestins) which become available during pregnancy from both ovarian and placental origin that complete the complex of hormones necessary to stimulate complete mammary gland growth and subsequently initiate lactation at parturition.

Methods to induce lactation in cattle are not new inventions of the current crop of dairy scientists. Rather, they have long been of interest because this represented one way, a research tool, to gain an understanding of the factors bringing about normal growth of the mammary gland and resultant initiation of lactation.

The development and subsequent availability of a synthetic estrogen (diethylstilbesterol) during the 1930's opened up new means to study mammary growth and lactation. An early study at the Florida Experiment Station was published by Marshall, Becker and co-workers in 1948. They found, using 14 open heifers and 5 dry open cows, that injected animals often responded slowly to stilbesterol treatment. Udder tissue developed rapidly in heifers, udders filled and teats distended and milking was begun 14 to 17 days after beginning the injections. Cows responded more slowly and even adversely in a few instances. They concluded that the low level of production resulting from stilbesterol injections was insufficient to justify its use in commercial dairy herds.

Since the 1930's Dr. C. W. Turner and his colleagues at the University of Missouri have studied mammary gland growth and the means to induce lactation. I will present just a summary and conclusions of their findings from over the years. They induced lactation in a manner intended to mimic pregnancy, and thus took 180 days to do it by injecting estrogens or estrogens and progesterone in constant or changing quantities. For the most part, they used low doses of estrogen and progesterone (100 mg, 100 mg P). Milk secretion was stimulated after the long growth phase by the injection of 3 mg estrogen/day for an additional 14 days or more if necessary. On the basis of comparisons between treated and untreated animals they concluded that milk yield was 80-90% of that which would have been expected had cows calved normally. The mean daily yield, however, was only 22.7 pounds. Normal lactating and induced animals were fairly low producers and estimates of total expected production from induced animals seem optimistic.

Japanese workers induced lactation in unbred 16 month old Holstein heifers by treatment with stilbesterol during the course of a 10 year study. Their objective was to determine performance of the female at an early age...even before she became a dam. To do this they induced lactation in 30 Holstein heifers and compared induced lactation yield to subsequent normal lactation yield. Of the 30 original cows only 22 completed both lactations and the yields they obtained are shown in the following table.

	AGE	DURATION	DAYS TO PEAK	MILK YIELD	PEAK PROD.	AVE. DAILY PROD.	100 DAY MILK YIELD
INDUCED	16.6	241	116	2360	12.9	9.06	1031
NORMAL	31.7	295	29	8757	46.9	29.4	3883

$\frac{\text{Yield Induced}}{\text{Yield Normal}} \times 100$	=	26.9	27.5	30.8 = % Normal
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SUMMARIZING EARLY WORK

Although stilbesterol, estrogen or estrogen and progesterone combined injected into non-lactating cows or heifers brought about growth of the gland it most often resulted in unacceptably low milk production. Yields were generally only 50-80% of contemporaries undergoing normal lactation with peak production, duration and persistence less than normal and complete failure often observed. Generally, mammary tissue growth was not extensive nor entirely normal in appearance when observed histologically. Such treatment has question-

able effects on reproduction. Usually this treatment has been attempted with poor breeding cows so subsequent reproductive performance could not be evaluated critically, although both positive and negative reports on subsequent reproductive performance have been observed.

Interest in a practical yet effective means to induce lactation has been rekindled by the recent reports of Dr. K. L. Smith and co-workers at the Ohio State University Research Center at Wooster. They designed experiments to investigate effects of estrogen and progesterone on colostrum formation and also obtained results which suggested that the same hormone treatment they used would be effective in initiating lactation.

Dr. Smith has been somewhat successful with 7 day injection schedules with milk production initiated within another 14 days. Their treatment required a total elapsed time of only 21 days after treatment was initiated. Their hormone injection schedule was calculated to provide blood hormone levels comparable to levels found during the latter stage of pregnancy and thus may be mimicing conditions found then and at the time of parturition. Dr. Smith has brought cows into lactation in this manner and has described induced lactations which appear normal with yields up to 7,000-11,000 lbs./milk. Some of these cows were producing as high as 60 lbs/day with about 60% producing 30 lbs. or more. Of course not all treated cows came into lactation so we are only talking about those that did. An early evaluation suggests that cows brought into production will produce at a minimum of 80-85% of their previous production and that some will even produce as well or better than previous lactations.

Although this technique looks quite promising, many questions remain unanswered and I would like to emphasize that we are not yet to a point where this can be recommended to our commercial dairymen. Foremost among the reasons for this is that the injection of the exogenous hormones (estrogen and progesterone) in this quantity and for this purpose has not been approved by the Food and Drug Administration and should not be used because in their view, it renders milk and animals contaminated. But there are many other even more sound reasons. Success and failure occurs for unknown reasons, which pinpoints how little we understand about what we are really doing when we administer massive doses of these hormones. Subsequent breeding performance cannot be predicted and lactation persistency and yield are variable. Extensive estral behavior by the cows during treatment necessitates their isolation from other herd animals. Finally, inducing lactation will not improve production of cows whose genetic capability is low and it can only be used with non-lactating cattle free of mastitis.

Although recent research has done much to renew our interest in an effective and practical means to induce lactation it has also provided more questions than answers. It is expected that more extensive research efforts in this area will do much to provide the answers and perhaps result in a means for commercial dairymen to successfully induce lactation in selected cattle.