The effects of diallyldiethylstibestrol, diallylhexestrol and diethylstilbestrol on fattening steers and heifers

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Abstract:
The purpose of the experiment was to evaluate 3, 3' diallyldiethylstil-bes.trol (DAS) and 3, 3' diallylhexestrol (DAH) in a barley fattening ration-with steers and heifers. Fifty yearling Hereford heifers and 50 yearling Hereford steers were used to evaluate each product.

The animals were allotted to five pens of 10 animals each. One pen served as a control pen and another received 10 mg. diethylstilbestrol (DES) per animal per day. DAS or DAH was fed at the 15, 20, or 25 mg. level per animal per day to the remaining three pens. Five pens of steers and five pens of heifers were used to test DAS, and equal numbers were used to test DAH. In the series of steer pens used to test DAS, one-half of the steers in each pen had previously received 10 mg. of DAS per day in a wintering feed. The experiment was started April 24 and 25. The heifers were fed for 135 days; the steers were fed for 169 days.

The steers and heifers fed 20 or 25 mg. of DAS per day made greater gains than the controls. The heifers fed these levels also gained faster than those fed 10 mg. of DES per day. Steers fed DBS gained at a greater rate than steers fed DAS. In both instances, the animals fed 15 mg. of DAS per day gained less than their controls. The average daily gains of the steers that were previously fed DAS were more than the gains made by steers not previously fed DAS with the exception of the steers that were fed 25 mg. of DAS per day in this trial.

The heifers that were fed 20 or 25 mg. of DAH per day were the only DAH-fed animals to gain at a greater rate than their controls. Those receiving 20 mg. of DAH per day gained significantly faster ($P<.05$) than the control heifers. In both the heifer and steer series that tested DAH, the animals that received DES gained at a lower rate than the control animals. The heifers that received 15 mg. of DAH and the steers that were fed 15 or 25 mg. of DAH per day gained at a lower rate than the controls, while the steers that received 20 mg. of DAH per day equaled the control steers in rate of gain.

The average carcass grades of the heifers were higher in all of the treated lots than in the controls. The DES-fed steers graded slightly lower than the control steers in one trial and higher in the other trial.

The steers which received 20 mg. of DAS or 25 mg. of DAH graded higher than the control steers.

The average weights of livers from all the treated heifers were less than the liver weights of the control heifers. In the heifer series that tested DAS, the pituitary gland weights increased with the increase in rate of gain. The DES treated heifers had longer teat lengths than the control and DAS or DAH treated heifers. In the steers, the thyroid weights were reduced with treatment. Other physiological measurements showed no consistent influence due to treatment.

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ABSTRACT

The purpose of the experiment was to evaluate 3, 3' diallyldiethylstilbestrol (DAS) and 3, 3' diallylhexestrol (DAH) in a barley fattening ration with steers and heifers. Fifty yearling Hereford heifers and 50 yearling Hereford steers were used to evaluate each product.

The animals were allotted to five pens of 10 animals each. One pen served as a control pen and another received 10 mg. diethylstilbestrol (DES) per animal per day. DAS or DAH was fed at the 15, 20, or 25 mg. level per animal per day to the remaining three pens. Five pens of steers and five pens of heifers were used to test DAS, and equal numbers were used to test DAH. In the series of steer pens used to test DAS, one-half of the steers in each pen had previously received 10 mg. of DAS per day in a wintering feed. The experiment was started April 24 and 25. The heifers were fed for 135 days; the steers were fed for 169 days.

The steers and heifers fed 20 or 25 mg. of DAS per day made greater gains than the controls. The heifers fed these levels also gained faster than those fed 10 mg. of DES per day. Steers fed DES gained at a greater rate than steers fed DAS. In both instances, the animals fed 15 mg. of DAS per day gained less than their controls. The average daily gains of the steers that were previously fed DAS were more than the gains made by steers not previously fed DAS with the exception of the steers that were fed 25 mg. of DAS per day in this trial.

The heifers that were fed 20 or 25 mg. of DAH per day were the only DAH-fed animals to gain at a greater rate than their controls. Those receiving 20 mg. of DAH per day gained significantly faster ($P < .05$) than the control heifers. In both the heifer and steer series that tested DAH, the animals that received DES gained at a lower rate than the control animals. The heifers that received 15 mg. of DAH and the steers that were fed 15 or 25 mg. of DAH per day gained at a lower rate than the controls, while the steers that received 20 mg. of DAH per day equaled the control steers in rate of gain.

The average carcass grades of the heifers were higher in all of the treated lots than in the controls. The DES-fed steers graded slightly lower than the control steers in one trial and higher in the other trial. The steers which received 20 mg. of DAS or 25 mg. of DAH graded higher than the control steers.

The average weights of livers from all the treated heifers were less than the liver weights of the control heifers. In the heifer series that tested DAS, the pituitary gland weights increased with the increase in rate of gain. The DES treated heifers had longer teat lengths than the control and DAS or DAH treated heifers. In the steers, the thyroid weights were reduced with treatment. Other physiological measurements showed no consistent influence due to treatment.

INTRODUCTION

In recent years, cattle feeding has been a marginal business. Many times there has been a negative margin in the cattle prices between the feeder cattle and fat cattle; only the more efficient cattle feeding operations have been able to show a profit.

There are several reasons why some of these feeding operations are efficient and economical. Mechanization has helped lower cost by reducing the labor force necessary to feed large numbers of cattle and by making it possible to prepare a variety of palatable feeds. Some cattle feeding operations have been profitable because of proper timing of purchase and sales.

Of importance in recent years has been the development and use of feed additives. There are many types of feed additives on the market. Some of these feed additives have given as much as a 25 percent increase in gain whereas others have given inconsistent or negative results. These additives may be classified as antibiotics, chemobiotics, tranquilizers, goitrogens, and hormones. Within the hormone classification, diethylstilbestrol has been the most widely used growth stimulator. Diethylstilbestrol or stilbestrol, as it is commonly known, is a synthetic female hormone which possesses high estrogenic potency. Stilbestrol has been beneficial in terms of increased gain and improved feed efficiency, but because of its estrogenic activity, constant efforts are being made to improve established products, and new derivities of stilbestrol have been produced. Two of these products that are in the testing stage at the present time are 3, 3' diallyldiethylstilbestrol and 3, 3' diallylhexestrol.

The manufacturer of these products claims that they possess 1/20 to 1/100 of the estrogenic activity of stilbestrol and when fed to cattle, will result in an increased rate of gain and improved feed efficiency. Diallyldiethylstilbestrol (DAS) and diallylhexestrol (DAH) need to be tested to determine if they are beneficial, to determine their mode of action within the animal body, and to determine if there is any residual estrogenic activity in the carcasses of the treated animals.

The purpose of this paper is to present the results of a test designed to determine the effect of DAS and DAH, when fed at three levels to fattening steers and heifers, upon feedlot performance and upon weights of some glands.

LITERATURE REVIEW

Experiments with Diethylstilbestrol

The importance of the endocrine system in the regulation of growth has long been known. Only in recent years have hormones and chemicals which influence hormone secretion been available in quantity for large animal investigation.

Diethylstilbestrol, commonly known as stilbestrol, is a synthetic compound with activity similar to the female hormone estradiol. Stilbestrol has been manufactured for several years and has been used in treating disorders of the reproductive tract.

The first experimental usage of stilbestrol as a compound to increase rate of gain and improve feed efficiency was with chickens.

The implantation of a stilbestrol pellet under the skin of young male chickens has given improved carcass quality and increased fat deposition. Andrews and Bohren (1947) found that stilbestrol increased the efficiency of conversion of feed energy to edible carcass calories as much as 75 percent in chickens.

In the first reported experiment that tested stilbestrol as a growth stimulator for beef cattle, Dinusson et al. (1950) conducted two trials in which stilbestrol was implanted in the neck region of Hereford heifers. In each of the trials, initial weights were approximately 500 pounds. Dosage levels of stilbestrol were 42 mg. and 48 mg. for trials one and two, respectively. The implantation of stilbestrol pellets resulted in increased rate of gain. The stilbestrol treated heifers were easier to keep on feed and had the largest daily feed consumption. These heifers required 4.8 percent and 10.4 percent less feed per pound of gain than the controls, for trials one and two respectively. Carcass grades were not influenced by stilbestrol treatment.

Clegg and Cole (1954) reported a slight daily gain increase of 0.08 pounds per day in heifers implanted with 60 mg. of stilbestrol and fed for 135 days. An increase in daily gain of 0.35 pounds per day was noted after 78 days of treatment. Steers implanted at the same level gained 0.5 pounds per day faster than the controls. A marked benefit in feed utilization was observed in all treated lots.

In three experiments with a total of 120 beef steers, Andrews et al. (1954) reported that rate of gain was significantly increased by the subcutaneous administration of 60, 108, or 120 mg. of stilbestrol. Feed efficiency was consistently improved by all levels of treatment, however, the effect was not significant at the 60 mg. level of stilbestrol treatment. There was no effect on dressing percentage, but there was a reduction in carcass grades of some of the treated steers. An undesirable side effect noted in the treated lots was an elevation of the tailhead with a resulting unevenness of topline.

Burroughs et al. (1954) stated that the advantages of diethylstilbestrol implantation in cattle have been known for some time, but this method has not been widely practiced by cattle feeders. The reasons for this are that a potential human health hazard is involved if substantial pellet residue remains in the tissues of treated cattle; implantation during the fattening period appears to adversely influence carcass quality; implanted animals may exhibit undue restlessness or abnormal sexual activity; and some animals may exhibit toxicity symptoms from pellets. Burroughs initiated a series of trials to determine if oral feeding of stilbestrol would produce increases in gain without undesirable side effects. In three preliminary experiments, trace amounts of stilbestrol were placed in the feed of fattening steers. The levels used were 2.5 mg., 5 mg. and 10 mg. per day and the experimental periods were 36 to 84 days. The placing of trace amounts of stilbestrol in the feed of fattening steers increased live weight gains as much as 35 percent over control animals and reduced feed cost per unit of gain as much as 20 percent. No reduction in the fatness of the cattle or quality of the meat produced was noted in the treated animals. Other advantages of oral administration of stilbestrol were a lack of undesirable side effects that are common in stilbestrol implanted cattle; the ease with which the material could be supplied; the ease with which the additive could be removed from the ration; and the ease with which a constant daily intake can be supplied.

Burroughs et al. (1955) summarized a series of five experiments in which stilbestrol was administered orally. The experiments included several different types of cattle rations, ranging from a high corn fattening ration to a high roughage wintering ration, with a variety of different aged animals of varying feeding histories, as well as animals of different sex. Live weight gains were increased in every feeding trial where stilbestrol was fed. The average increase of weight gain was 20 percent. The highest gain was with the fattening ration and the lowest was with the wintering ration. An Average of 11 percent less feed was required per unit of gain in the five experiments. In some trials, the carcass grades were not influenced, whereas they were one-third lower in the treated groups of some of the experiments. Feed consumption was increased five percent when stilbestrol was included in the ration. Undesirable side effects of mammary development or uneven topline were not found in the stilbestrol fed cattle.

Ten steers were fed 10 mg. of stilbestrol per day in a fattening ration for 123 days and compared with 10 control animals by Perry et al. (1955). A highly significant increase in rate of gain was made by the treated steers with the greatest increase being at the end of 28 days. The increased gain required 9 to 12 percent less feed per unit of gain. Corn intake was increased one pound per day with treatment. An increase in teat length, some elevation of the tailhead, and relaxation of the lumbar vertebrae was noted in the treated steers.

Using approximately 450-pound Shorthorn steer calves in lots of 8 or 9 head each, and feeding 0 or 10 mg. of stilbestrol per day, Andrews et al. (1956) showed a highly significant ($P < .01$) increase in daily gain by the treated steers over the controls. There was a 30 percent increase in rate of gain for those steers which were full fed for 179 days. There was also an increased transit shrink by the treated steers, which was highly significant. There were no appreciable differences in cooler shrinks or dressing percentages.

Heaney (1956) studied the effects of adding stilbestrol, aureomycin, and aureomycin plus stilbestrol to a ration containing barley as the principal component. Forty yearling Hereford steers were divided into four lots of 10 head each. Stilbestrol was added to furnish 10 mg. per steer per day and the aureomycin was added at a rate to furnish 75 mg. per steer per day. Initial weights of the steers were about 550 pounds. The control steers gained 2.49 pounds per day and the steers receiving stilbestrol gained 2.71 pounds per day. The addition of stilbestrol and aureomycin to the ration resulted in a rate of gain of 2.31 pounds per day. Feed consumption was higher, feed required per unit of gain and feed cost was lower for the stilbestrol treated steers. Little difference was noted between the controls and stilbestrol treated steers in hot to cold carcass shrink and dressing percent.

Beeson _et al_. (1956) reported that nine yearling Hereford steers fed 10 mg. of stilbestrol per day gained 12 percent more rapidly than the same number of controls. Feed efficiency was improved by 18 percent for the first 98 days in the hormone treated lot, but was reduced 5 percent for the final 81 days. Transit shrink was slightly less for those receiving the stilbestrol and their dressing percentage was 1.3 percent less than the controls.

Clegg and Carrol (1956) conducted three trials evaluating subcutaneous implantation of 60 mg. of stilbestrol. In each of the first two trials, 16 two-year-old Hereford steers were divided into two lots of 8 head each with lot 1 being the controls and lot 2 receiving the implants. The length of trials one and two were 97 days and 185, respectively. Hereford-Angus crossbred heifers were used in trial 3 and fed for 217 days. In trial one, the average daily gain of 3.39 pounds per day for the treated steers was significantly greater ($P < .01$) than the 2.48 pounds per day gained by the controls. The trend was the same in trial 2, but not statistically significant. There was a slight reduction in carcass grades of the treated steers. This reduction in grades was more apparent in the heifers which also had a reduced dressing percent due to treatment.

Clegg and Carrol (1957) compared 10 mg. of stilbestrol per day in the feed against a single 15 mg. subcutaneous implant and controls with no stilbestrol treatment on 550-pound Hereford steers. They reported no significant difference in rate of gain between the treatments, but a significant difference between the treated lots and the controls. The treated lots gained at a 15 percent higher rate than the controls. The maximum gain over the controls occurred at 60 to 80 days. The feeding period was 207 days. At 150 days, the two treated lots had gained the same, but the implanted steers fell behind the orally-treated steers in rate of gain after that time, indicating a loss of effectiveness of the implants. Feed consumption for both treated lots was slightly more than the controls. Live slaughter grades were comparable in all lots as were the dressing percentage and percent cooler shrink. Carcass grades were lower in the treated lots, being the lowest in the lot which was fed stilbestrol. Both treatments gave comparable increases in teat development and size of the seminal vesicles and prostate glands.

Smyrl _et al._ (1957) fed four lots of 10 yearling Hereford steers each, to study the effects of 0, 15, 30, or 45 mg. implants of stilbestrol when the steers were fed a fattening ration and grazed on irrigated pasture. The three lots that were implanted with stilbestrol gained at a greater rate than the controls. The lot that received the 30 mg. implants gained at the greatest rate and required the least amoung of concentrate per unit of gain. The steers were sold on a carcass grade and yield basis; and the steers that received the 15 mg. of stilbestrol returned the most financially by grading higher when slaughtered.

In a summary of four experiments, Kastelic et al. (1956) stated that the feeding of stilbestrol to beef cattle failed to show any consistent effect upon carcass grades or the composition of the rib cut, but in all cases the treated animals gained at a greater rate than the control.

Perry et al. (1958) compared oral treatment to implants as methods of administering stilbestrol to steers. Treatment of steers with 36 mg. implants resulted in a slightly higher gain than those treated with 10 mg. per day orally. In both methods, there was a 9 to 10 percent increase in consumption of ground ear corn, but 7.4 to 8.5 percent less feed was required per unit of gain for the treated steers. Slight mammary development and side effects were the same, regardless of treatment. The steers that were fed stilbestrol consumed 2330 mg. during the 233-day test or 64 times the amount of stilbestrol that was implanted.

Embry and Radabaugh (1958) studied the effects of stilbestrol when fed at 10 mg. per day or implanted at the 36 mg. level. Long yearling Angus steers weighing an average of 735 pounds were used in this experiment. The steers in both treated lots gained at the same rate, which was 0.46 pounds per day greater than the control. The treated steers required less feed per unit of gain. The control steers shrank slightly less than the treated steers during transit. The treated steers had a slightly higher dressing percentage. Carcass grades were higher in the control lot.

Thomas (1958) studied the effects of stilbestrol, oral or implanted, and Synovex with and without Dynafac upon weight gains of yearling Hereford-

Angus crossbred steers and heifers. The heifers were fed for 84 days and the steers 112 days. The steers averaged 600 pounds at the start of the trial. The control steers gained 2.33 pounds per day. The steers on other treatments gained 5 to 22 percent more than the controls. The average daily gain of 2.85 pounds per day, made by the steers that were fed Dynafac and implanted with 36 mg. of stilbestrol, was 10 percent greater than the rate of gain made by the steers that were implanted with stilbestrol but not fed Dynafac.

The heifers averaged 585 pounds at the start of the trial. The heifers fed Dynafac and implanted with 18 mg. of stilbestrol gained 201 pounds and the controls gained 146 pounds.

Steers and heifers fed stilbestrol gained slightly more than those implanted with stilbestrol; however, those fed Dynafac and implanted with stilbestrol gained more than those fed Dynafac and stilbestrol in combination.

Four lots of 10 steers each were fed on irrigated pasture by Thomas et al. (1958). Treatments were a control, 36 mg. stilbestrol implanted, 10 mg. stilbestrol per day in the feed, and 2 gm. of Dynafac per day. The yearling Hereford steers that received the 10 mg. of stilbestrol per day made the greatest gains followed by those that were implanted with stilbestrol. Carcass grades were slightly lower in the treated lots.

O'Mary et al. (1959) reported that 10 mg. of stilbestrol per day in the feed failed to give a significant increase in rate of gain. Carcass grades and yields were not significantly affected when steers were fed stilbestrol and a high molasses concentrate ration. In the same trial, steers which were implanted with 24 mg. of stilbestrol made gains which tended toward statistical significance. Some of the steers had previously been implanted while on pasture and did not gain as fast as those not previously treated. It was also stated that there was no apparent advantage from feeding stilbestrol to implanted steers. Side effects of increased teat length and some raised tailheads were noted in both methods of treatment.

Two trials, using 40 steers each, were conducted by Ogilvie et al. (1959) to study the effects of stilbestrol on feedlot performance and certain carcass characteristics. Four steers made up an initial slaughter group. The remainder were assigned to three lots of 12 head each to receive 0, 10, or 30 mg. of stilbestrol per day in the feed. Four steers from each treatment were slaughtered after 56, 112, or 168 days of treatment. Rate of gain and feed efficiency were not significantly influenced by the 10 mg. level of stilbestrol. The steers in lot 3, receiving 30 mg. of stilbestrol per day, made significantly faster gains than the controls for the 0-56 ($P < .01$) and 0-112 ($P < .05$) days. The gains were 3.48 pounds per day versus 3.16 and 3.00 versus 2.66 for the treated control steers respectively.

Jordan (1959) reported that steers implanted with 36 mg. of stilbestrol ate about one pound more of pellets each day and had a 0.23 pound higher daily gain than their controls. The treated lot, with eight steers per lot, was also more efficient in feed conversion. Carcass grades were higher in the control pen of steers, whereas the treated steers shrank more enroute to market and in the cooler after slaughter.

Chappel (1959) summarized 23 experiments conducted at agricultural experiment stations. Results showed that feeding stilbestrol increased rate of gain about 15 percent and improved feed efficiency about 11 percent. The summary was for all classes of cattle fed many kinds of rations.

Studies of Residual Estrogenic Activity in Carcasses of Stilbestrol Treated Cattle.

Because of the importance of beef in the diet, it is important to know whether estrogenic residues appear in the edible tissues of animals receiving stilbestrol.

Umberger *et al.* (1959) using an improved method tried to detect estrogenic residues in the edible tissue of steers fed up to 60 mg. of stilbestrol per day. The method used was capable of detecting 2 parts per billion in stilbestrol equivalents in every case, and often as low as 0.5 parts per billion. In his study, 22 yearling steers were used. Ten served as controls and ten were fed 10 mg. of stilbestrol per day. One-half of each lot was slaughtered at the end of 90 days of treatment with the remainder being fed for 180 days. One steer was fed 30 mg. of stilbestrol per day and another 60 mg. per day for 150 days, to determine if stilbestrol would be safe is misused. There was not a statistically significant difference in mouse uterine response between the mice fed tissue from the control steers or the mice fed tissue from the stilbestrol-fed steers. It was stated that the failure to detect any residue in the steers fed 30 or 60 mg. of stilbestrol per day provides a margin of safety if misused. The manufacturers of stilbestrol recommend feeding 10 mg. per day to cattle.

O'Mary *et al.* (1959) treated steers with a 24 mg. implant or 10 mg. of stilbestrol orally and failed to detect any estrogenic residue in the livers of the treated steers by using the method of uterine weight response of 21-day-old intact female mice.

Preston et al. (1956) used a modification of the mouse uterine-weight technique as well as a method consisting of feeding the tissues in question to immature, intact female white mice and weighing the uteri. They did not detect stilbestrol residues in any of the beef tissue using either method of assay. The tissues assayed were lean meat, fat, liver, heart, kidney, and offal tissues. The cattle tissues examined were from a series of four experiments. Experiments 1 and 2 involved feeding steers for 112 days with stilbestrol levels of 2.75 to 11 mg. per day. Stilbestrol was removed from the cattle in experiment 1 five days previous to slaughter whereas stilbestrol was fed to experiment 2 animals to the time of loading for slaughter. Six or 12 mg. of stilbestrol was fed per day to the heifers in experiment 3 until two days prior to slaughter. The fourth experiment consisted of steers fed 9 mg. per day of stilbestrol until the time of slaughter.

Composite samples from each of three lots of 10 steers were bioassayed for residual estrogens by Turner (1956). Two of the three groups were fed 10 mg of stilbestrol per day for 148 days. The stilbestrol was removed from the feed approximately 44 hours before slaughter. The method of assay was to feed the tissue in question to ovariectomized female mice and weigh the uteri upon sacrifice. The different tissues assayed represented edible red meat, glands, organs, depot fat, and digestive tract. Results showed that the edible red meat, rib eye, neck trimmings, and tongue did not contain detectable amounts of the hormone. The same results were obtained when the liver, heart, spleen, and brain were assayed, but the kidneys showed evidence of four parts per billion, and the lungs contained ten parts per billion of stilbestrol equivalents.

Perry et al. (1955) fed 10 mg. of stilbestrol to 10 steers for 123 days and did not detect any significant differences in estrogenic activity in the tissues of the treated steers when compared to the control animals. This was true when the hormone was discontinued one week before slaughter or fed until one day prior to slaughter.

Burroughs et al. (1955) failed to detect any stilbestrol residue in the edible and inedible tissues of cattle. The stilbestrol was removed from the ration of the treated cattle a short time before slaughter.

Stob et al. (1954) assayed tissues from steers implanted with 60 mg. of stilbestrol and showed no significant effect upon the uterine weight of mice. Tissues from steers implanted with 120 mg. of stilbestrol gave a significant ($P<.05$) difference in mouse uterine weight indicating estrogenic residue.

Stob et al. (1956) reported a statistically significant increase in uterine weights of mice fed tissues from steer and heifer calves which received 10 mg. stilbestrol per day orally until shipment for slaughter. The tissues assayed were muscle, kidney fat, kidney, intestine, and liver.

Stilbestrol has been shown to cause cancer in mice, and its use has been discontinued in chickens because of the large amounts of residual estrogenic substances found following stilbestrol implantation. The Federal Drug Administration prohibits the use of feed additives that have caused cancer in man or animals if there is any residue of the additive in the edible portion of the carcass of treated animals.

Physiological Effects of Feeding Diethylstilbestrol

In an effort to help clarify the mode of action of stilbestrol in ruminants, Shroder and Hansard (1958) studied its effect upon some of the endocrine glands. The glands were selected from 10 crossbred wether lambs, five of which served as controls and five of which received stilbestrol orally at the rate of 4 mg. per day. Pituitary weights, when used as a fraction of body weights, were significantly higher in the treated lambs. This increase in size was not due to moisture content, but to hypertrophy or hyperplasia which was stated to be an indication of increased activity on the part of that gland. The adrenal weights, when converted to grams per hundredweight, were not significantly affected. Adrenal chloesterol, a measure of adrenal cortical activity, was significantly less for the control lambs. It was stated that the adrenals of the stilbestrol-fed lambs must have been stimulated to an above normal rate of secretion. The above normal levels of adrenal activity were not consistent with the increased retention of nitrogen, a measure of protein anabolism. Assay for growth hormone content of the pituitaries showed significantly more of the hormone from the pituitaries of treated animals. The assay also indicated increased production of the hormone per gram of tissue. Stilbestrol feeding had little effect on ACTH secretion or storage in the pituitary gland.

Gonadotrophin production levels, determined by rat uterine assay, were significantly reduced in the stilbestrol-fed lambs, but the level of circulating estrogens increased due to treatment. Differences were not noted in production of the thyrotropic hormone.

Struempler and Burroughs (1959) studied accelerated growth hormone production in ruminants (steers) when fed 0, 5, or 10 mg. stilbestrol per day. As the level of stilbestrol was increased, the weight of the anterior pituitary gland was increased. The growth hormone index increased substantially, but not at the same rate as the weight of the pituitary. There was a positive relationship between the amount of stilbestrol fed and the amount of growth hormone produced. Animals fed stilbestrol showed an increase in the size of the anterior pituitary, total amount of growth hormone in the anterior pituitary and the amount of growth hormone per unit of cattle weight. The results support the theory that the growth-stimulating influence of stilbestrol in immature ruminants is primarily mediated through growth hormone stimulation within the animal body.

A slight increase in adrenal weights in all lambs and a significant increase in pituitary weights of wether lambs was shown by Davey et al. (1959) when stilbestrol was fed. Thyroid weights were less in the stilbestrol fed lambs, but the thyroid follicular epithelial cell heights were greater than those of the control lambs.

Slightly heavier pituitary glands and significantly heavier adrenal glands were obtained by Cahill et al. (1956) from steers implanted with 84 mg. of stilbestrol. The weights of the thyroid glands were not influenced by treatment. Measurement of the lumbo-sacral angle gave evidence that treatment made this angle much more acute. Percentage of fat appeared to be less in the treated steers.

In a series of 12 trials with 318 treated and 318 control lambs, Clegg et al. (1955) stated that age, sex, or dietary regime did not affect the response to stilbestrol treatment. Most of the treated lambs received 12 or 15 mg. of stilbestrol subcutaneously. One group was implanted with 36 mg. Significantly larger adrenal and pituitary glands were obtained in the treated groups. Enlarged cowpers glands, seminal vesicles, and prostate glands were found in treated wethers. The treated wethers showed noticeable mammary gland development.

Whitehair _et al._ (1953) reported that implanting lambs with 24 mg. of stilbestrol had no apparent effect on the digestibility of major nutrients other than a slight increase in digestibility of crude fiber. There was a marked increase in retention of calcium, phosphorus, and nitrogen, as well as a considerably faster rate of gain in the treated lambs. Other effects of stilbestrol treatment were an increase in size of mammary glands and teats and a noted nervousness of the treated lambs after the third day of treatment.

Clegg and Cole (1954) reported that steers receiving 60 or 120 mg. stilbestrol implants had pituitary glands significantly larger than controls. The adrenal glands were hypertrophied and slightly larger thyroid glands were noted in the treated steers. Heifers treated with 60 mg. implants had significantly larger adrenal and pituitary glands and smaller thyroid glands. Growth hormone content in the pituitaries of the treated heifers was approximately twice that of the controls, but the content of that hormone in the pituitaries of the steers was not greatly changed. It was stated that the content may not be indicative of secretory activity.

<u>Experiments with Diallyldiethylstilbestrol and Diallylhexestrol</u>

Embry _et al._ (1960) fed several feed additives to yearling steers in combination with different proportions of concentrate to roughage. They studied the effect of the additives on rate of gain, feed efficiency, and length of feeding period and market weight necessary to produce slaughter cattle, grading choice. Stilbestrol, fed at 10 mg. per day, was the only additive used that gave greater gain than the control group when fed with all levels of roughage. The roughage levels were 50, 35, and 20 percent of the ration. In all cases with rations containing 20 percent roughage, the lots fed Dynafac and diallyldiethylstilbestrol (DAS) alone or in combination gained more than the control lot. When Dynafac alone, DAS alone, Dynafac with DAS, or Dynafac with stilbestrol were present, greater gains were obtained with the 20 percent roughage rations than with higher levels of roughage.

The effect of adding 16 mg. of DAS to the supplemental pellets of steer calves being wintered in a feedlot was reported by Thomas (1959). The calves were full fed alfalfa hay with two pounds of grain or pellets throughout the winter. A daily gain of 1.28 pounds was reported for those receiving DAS, whereas the control steers, which received 10 mg. of stilbestrol per day, gained 1.38 pounds per day.

Thomas _et al_. (1959) reported an additional gain in steers when 16 mg. of DAS was added to the supplemental pellet which was being fed to steers wintered on native range. When 25 mg. of DAS per day was fed to steers grazing crested wheatgrass pasture, gains were lower. In the feedlot, the combination of 25 mg. DAS and 2 gm. of Dynafac per day for yearling Hereford steers resulted in gains almost equal to those made by steers being fed 10 mg. stilbestrol per day. The steers that were fed 25 mg. of DAS per day gained slightly more than the control steers.

The control steers had the largest rib eye area when based on a body weight ratio. The following results are based on body weight ratios: the livers of the steers receiving 25 mg. of DAS per day, alone or in combination with Dynafac, were smaller than the controls, whereas the livers from the steers receiving 35 mg. of DAS or 10 mg. of stilbestrol were larger than the livers from the control steers. In all cases, the thyroid weights from the treated steers were larger than those from the control steers. The single or combined adrenal weights were higher in the control steers and lightest in the steers receiving 10 mg. of stilbestrol per day. Pituitary weights were inconsistent, but generally smaller in the treated steers. Those from the steers fed stilbestrol were considerably smaller than the controls.

Liver weights, when converted to a body-weight ratio, were smaller than controls in the lots receiving the 25 mg. of DAS alone or with 2 gm. of Dynafac and larger in the lots receiving 35 mg. DAS or 10 mg. stilbestrol.

There was little variation in carcass grades, but they were highest in the lot receiving DAS and Dynafac.

Dyer and Ralston (1959) randomly allotted 45 yearling Hereford steers to three groups and fed 0, 25, or 50 mg. per steer per day of a diphenyl hexane derivative, 3, 3' diallylhexestrol (DAH). Daily gains were higher by 0.35 and 0.25 pounds in the lots fed 25 and 50 mg. of DAH, respectively. The 0.35 pound increase in daily gain was significant ($P < .05$). The increased gains were accompanied by improved carcass grades, marbling score, and percent body fat. No significant differences were found in percent shrink, rumen microbial activity and liver or serum transaminase levels. Bioassay for residual estrogenic activity of tissues from the steers fed 0, 25, and 50 mg. of DAH produced rat uterine weights of 1.11, 0.81, and 1.03 mg. per gram of body weight. Rat uterine weights of 1.06 and 3.47 mg. per gram of body weight were observed when rats were fed a control diet or the control diet plus five parts per billion of stilbestrol.

Results of a cooperative experiment reported by Dyer (1959a) showed that steers fed 25 mg. of DAH per day gained 2.7 pounds per day and those which were fed 24 mg. of stilbestrol per day gained 2.89 pounds per day. When a combination of the two additives was fed, gains were 2.94 pounds per day, however, feed efficiency was not improved accordingly.

Gains for steers receiving 25 mg. of DAH per day were lower than gains of the control steers reported Dyer (1959b). Gains were higher for steers receiving 2 gm. of Dynafac. Animals fed a combination of the additives had higher gains than the other steers in the experiment. There were six to nine steers in each lot. Slight differences existed between treatments as far as dressing percentages and cooler shrinks were concerned. Larger pituitary glands, smaller thyroid glands, smaller livers and smaller left adrenal glands were found in the steers receiving DAH. Dynafac fed steers did not have appreciably different gland weights. When Dynafac and DAH were fed to the steers, the pituitary and thyroid glands were larger.

Summary of Diethylstilbestrol and Two of Its Derivatives as Growth Stimulants

A summary of the literature shows that an increased rate of gain and improved feed efficiency can usually be expected when growing or fattening cattle are treated orally or subcutaneously with stilbestrol. The improvement of rate of gain and feed efficiency are generally more pronounced when the animals are being fed a concentrate ration for the purpose of fattening or very rapid growth. Most carcass studies have shown that there was a reduction of carcass grades when stilbestrol was fed. A few authors reported no effect, to a very slight reduction of carcass grades, but it must be remembered that some prejudice may exist in the minds of those who were instrumental in the development of stilbestrol for oral treatment.

Side effects of reduced loins and raised tailheads, enlargement of the reproductive tract, and increased mammary development have been reported by several authors when stilbestrol was fed.

Most investigators have failed to detect any estrogenic residue of stilbestrol in the carcasses of treated animals when the stilbestrol was removed from the ration 48 hours before slaughter.

The pituitary and adrenal glands collected from treated cattle have usually been heavier or showed greater cell activity than glands collected from the control animals. Differences in weights of the thyroid glands have been inconsistent.

The reduced carcass grades and possible estrogenic residue in animals treated with stilbestrol have probably been instrumental in prompting research to develop growth stimulants which are estrogenically less active.

The limited amount of research with DAS and DAH indicates that improved gains and feed efficiency may be expected when fed with high concentrate rations. The reports to date have shown variability in levels fed and results obtained. Slight improvement of carcass quality has been reported to be associated with the improvement in rate of gain.

METHODS AND PROCEDURE

Pre-experimental Treatment

One hundred yearling Hereford heifers and steers were used as experimental animals. The heifers were bred and raised by the Climbing Arrow Ranch, Three Forks, Montana. The calves were weaned during the latter part of October and early part of November, 1958, and then shipped to the Climbing Arrow feedlot. During the adjustment period of two or three weeks chopped alfalfa hay and water were provided. Calves of similar size were then sorted visually into pens of approximately the same sized animals. One pound of barley per animal was added to the daily ration of alfalfa hay December 1. A winter experiment was initiated in December to evaluate Tran-Q, Dynafac, and dicalcium phosphate in various combinations. The feed additives were added to a grain pellet which was fed at the rate of one pound per animal per day. The barley portion of the ration was gradually increased to three pounds per day. On March 27, the heifers were weighed off the winter experiment. They made an average daily gain of 1 to 1.2 pounds per day throughout the winter. After final weights were taken, the heifers were divided according to size, into sale lots of 50 head each.

The steers used in this experiment were purchased as weaned calves by the Climbing Arrow Ranch in the fall of 1958 and wintered in their feedlot. The steers were given the same treatment and handling care as the heifers and were started on feed at approximately the same time. The pellet which the steers received contained varying levels and combinations of fat and Dynafac and 10 mg. of stilbestrol per animal per day. The steers in one pen received 16 mg. DAS per day in place of stilbestrol. The steers gained approximately 1.25 pounds per day throughout the winter.

After final weights were taken, the steers were divided into sale lots of 50 head each. One sale lot contained 25 steers that received 16 mg. of DAS per day during the winter. This pen of 50 steers and an additional pen of 50 steers was purchased at the Climbing Arrow feeder sale for $34.50 per hundredweight.

Two pens of 50 heifers each were purchased for $32.50 and $32.75 per hundredweight. The animals were kept at the same feedlot for the fattening period and fed in the same manner as before the sale.

Allotting Procedure

The cattle were individually weighed and eartagged on April 16. These unshrunk weights were used to allot the cattle to experimental treatments. Each of the sale pens of 50 cattle was assigned to one of the tests to be conducted. The sale pen that had 25 steers, which previously received DAS, was used to test that product in a fattening ration.

Each test was designed to have five treatments with ten cattle in each. The 50 cattle used for each trial were stratified according to weight and randomized into ten subclasses. The average weight of the cattle in each subclass was approximately the same. The ten subclasses were randomly divided, two per treatment, and designated A and B, to the five treatments. The subclasses in each treatment were maintained in the same pen and received equal treatment.

The 25 steers that had previously received DAS and the remaining 25 steers in that pen of 50 were each stratified and randomly allotted to five subclasses of five steers. The five subclasses of steers that had previously received DAS were randomly allotted into the five treatments of that trial for the A subclass and the same procedure was followed with the five remaining subclasses for the B subclass.

In each trial there was a control lot, a lot that received 10 mg. of stilbestrol per day and three lots that were fed 15 mg., 20 mg., and 25 mg. of DAS or DAH per day. The design of the trial is shown in Table I.

After completing the allotment procedure on paper, the sale pens of cattle were run through a cutting chute and separated into experimental lots by reading the eartags of each animal. They were then placed in the pens in which they would remain throughout most of the experimental period. The order of pen assignment was to give lot 1 the first pen in a feed alley and progress in order through a series of treatments. This method of assignment was done to simplify the order of feeding as much as possible. The pens were uniform in size for each treatment.

Weighing Procedure

Feed and water were removed from the ten pens of heifers at 5:00 P.M., April 23, 1959. At 8:00 A.M., April 24, weighing was started. The pens of heifers were weighed in order starting with lot 11 and progressing through lot 20. Individual weights were taken, and total was checked against a group weight. The weighing time was approximately two hours.

The steers were weighed the following day using the same procedure, the initial date being April 25, with the feed and water being removed the afternoon of April 24.

Periodic weights were taken of each group throughout the experiment at 28-day intervals. These weights were taken without any shrink, but, whenever

TABLE I. DESIGN OF THE EXPERIMENT.

		Steers -- Diallyldiethylstilbestrol (DAS)			
Lot No.	1	2	3	4	5
Treatment	Control	10 mg. DES	15 mg. DAS	20 mg. DAS	25 mg. DAS
Subclass A	5	5	4 1/	5	5
Subclass B	5	5	5	5	5
		Heifers -- Diallyldiethylstilbestrol (DAS)			
Lot No.	11	12	13	14	15
Treatment	Control	10 mg. DES	15 mg. DAS	20 mg. DAS	25 mg. DAS
Subclass A	5	5	5	5	5
Subclass B	5	5	5	5	5
		Steers -- Diallylhexestrol (DAH)			
Lot No.	6	7	8	9	10
Treatment	Control	10 mg. DES	15 mg. DAH	20 mg. DAH	25 mg. DAH
Subclass A	5	5	5	5	5
Subclass B	5	5	5	4 1/	4 1/
		Heifers -- Diallylhexestrol (DAH)			
Lot No.	16	17	18	19	20
Treatment	Control	10 mg. DES	15 mg. DAH	20 mg. DAH	25 mg. DAH
Subclass A	5	5	5	5	5
Subclass B	5	5	5	4 1/	5

1/ One animal died.

possible, they were taken in the morning before the animals were fed. The weights of May 22 were taken in the afternoon after the animals were fed, and the weights of June 19 were taken while they were being fed. Lot 1 was always weighed first and lot 20 last.

At the completion of each trial, the feed and water was removed from the pens as near 5:00 P.M. as possible. Starting at 8:00 A.M. the next morning, the cattle were individually weighed, and again the total was checked by a group weight. As the cattle were weighed, eartags were checked and if any were missing, another tag was assigned and the number recorded. Also, cattle on each treatment were dye branded to facilitate sorting for weighing at the slaughter house.

Method of Feeding and Feeds Used in the Experiment

The cattle were started on feed immediately after initial weights were obtained. The concentrate was fed separately from the hay. The concentrate was started at the rate of three pounds per day per animal. The cattle were group-fed, the concentrate being spread over an area in the feed bunker sufficiently large to allow all ten animals access to the grain at the same time. The grain had previously been mixed and had been weighed into sacks for feeding of each pen.

Feeding of the supplement which contained the additives was started Monday, April 27, for all 20 pens. The protein supplement and additives had previously been prepared by a commercial feed company according to specifications provided by the Animal Industry Department. The supplement was sacked into 50-pound labeled paper bags. Feeding was accomplished by weighing one pound of supplement per animal for each pen into a 10-quart bucket labeled with the pen number and supplement number. The contents of the bucket were spread evenly over the concentrate.

The hay was fed after the grain. The cattle were started on chopped alfalfa from a feed wagon that had an auger type discharge. It was impossible to obtain the exact amount of hay fed each pen at the beginning of the experiment, but the wagon was weighed when full and then after feeding each series of pens. The auger was engaged for approximately the same distance at each pen, and the tractor pulling the wagon was operated at the same speed and in the same gear at all times. The average weight of the hay discharged was recorded for the feed records. The chopped alfalfa hay was fed through July 6. All the pens were changed to grass hay on July 7. This hay was not chopped. Feeding was accomplished by breaking the bales in a hopper mounted on a portable platform scale. The scale was mounted on a wagon for transportation purposes. The amount of hay to feed was determined by visual observation of the hay remaining from the previous day. The hopper full of hay was weighed, the predetermined amount forked into the feed bunker, and the amount recorded. This facilitated greater accuracy of feed consumption records.

The barley used in this experiment was purchased as whole barley and was dry-rolled in a 12-inch, double roller, grain roller. The roller was adjusted to yield uniformly-rolled grain with a minimum of kernels not being cracked. The other constituents of the concentrate mixture needed no preparation and were purchased in weighed sacks.

The concentrate was mixed in a one-ton capacity batch-type mixer. The barley was weighed as it was added to the mixer and the proper number of sacks of beet pulp, wheat-mixed feed, and dehydrated alfalfa pellets were added. The concentrate consisted of 80 percent barley, 10 percent beet pulp, 5 percent wheat-mixed feed and 5 percent dehydrated alfalfa pellets. After thorough mixing, the concentrate was discharged and weighed into burlap sacks.

The feeds used in these trials were chemically analyzed, and the proximate composition is shown in Table II. The protein supplement samples that were analyzed were representative samples accumulated over the feeding period. The concentrates and roughages were not purchased in sufficient quantity to last the entire feeding period. Samples were taken from each lot of feed for analysis.

The inclusive dates that the feeds were fed are also given in the Table.

Treatment of the Animals

Throughout the trial, the animals were observed at least twice a day. The first of these observations was in the morning prior to or at the time of feeding. General condition of the animals was noted as was the amount of feed that had been cleaned up. If the grain had been cleaned up, the amount of feed was raised 10 pounds per pen on alternate days until most of the feed was eaten each day. If the cattle refused to clean up the grain, the amount fed was reduced by 10 pounds per day until they were leaving only a small amount. If any of the animals appeared to be severly sick or bloated in the morning, they were treated immediately. Later in each day, cattle were checked again. Each animal was closely observed for any abnormal conditions. If an animal was bloated, it was removed from the pen and the gas

TABLE II. QUANTITATIVE ANALYSES OF THE FEEDS USED IN THE TRIALS.

Feed	Moisture	Protein	Ether Extract	Crude Fiber	Ash	Phosphorus	Calcium
Protein supple., control	6.2	33.7	1.8	10.6	11.8	2.10	1.38
Protein supple., 10 mg. DES	6.6	33.5	1.4	10.4	11.5	1.95	1.24
Protein supple., 15 mg. DAS	7.0	31.6	1.4	10.7	11.7	2.00	1.26
Protein supple., 20 mg. DAS	7.0	32.6	1.5	10.2	12.0	1.85	1.30
Protein supple., 25 mg. DAS	7.1	33.3	1.3	9.6	12.2	1.97	1.18
Protein supple., 15 mg. DAH	6.8	34.5	1.7	9.6	13.1	2.32	1.42
Protein supple., 20 mg. DAH	6.3	33.8	1.4	10.7	11.4	2.05	1.20
Protein supple., 25 mg. DAH	6.7	34.2	1.3	10.3	12.6	2.22	1.24
Barley 1/	7.8	11.1	2.4	9.2	4.1	----	----
Barley 2/	7.5	10.6	3.4	12.0	4.4	----	----
Barley 3/	8.4	10.5	2.8	11.2	4.4	----	----
Barley, new crop 4/	7.7	10.8	2.9	10.5	4.9	----	----
Dehydrated alfalfa pellets 5/	5.4	13.6	2.2	27.2	18.0	----	----
Dehydrated alfalfa pellets 6/	5.0	14.1	2.0	28.5	17.5	----	----
Beet pulp, molasses 7/	6.3	9.3	0.3	17.6	5.8	----	----
Beet pulp, plain 8/	7.8	8.5	0.2	23.4	2.9	----	----
Chopped alfalfa 9/	6.5	8.7	0.8	21.5	6.4	----	----
Chopped alfalfa 10/	6.4	13.6	1.0	34.1	7.8	----	----
Old grass hay 11/	5.7	7.7	1.1	33.1	5.1	----	----
New grass hay 12/	5.3	9.1	2.2	27.9	10.6	----	----
New grass hay 12/	5.8	10.6	1.5	29.4	9.9	----	----

1/ Fed April 24 to June 12
2/ Fed June 13 to July 31
3/ Fed August 1 to September 7
4/ Fed September 8 to October 11
5/ Fed April 24 to July 25
6/ Fed July 26 to October 11
7/ Fed April 24 to August 25
8/ Fed August 25 to October 11
9/ Fed April 24 to June 10
10/ Fed June 11 to July 6
11/ Fed July 7 to July 24
12/ Fed July 25 to October 11

pressure relieved with a stomach tube then given 1 quart of mineral oil with a stomach pump. Treatment for footrot was 10 cc of Combiotic given intramuscularly and three trisulfa pills administered with a balling gun.

The feed was cleaned from the feed bunkers and weighed back whenever there was an accumulation of feed or when the feed was wet.

The pens were not cleaned at the start of the experiment. A crawler tractor had scraped the manure to the center of each pen forming a large pile. The heifers were fed in the same pens throughout the trial with no further cleaning. As sufficient pens were cleaned and available, the steers were moved to the clean pens. The steers of each trial were moved at the same time to insure uniform conditions for each treatment.

During the week preceding the completion of each trial, live animal photographs were taken. Side-view and rear-view photographs were taken of each animal. This was accomplished by placing each animal in a chute which had a wire grid on one side. The time required for taking the pictures was two days each for the steers and heifers. Each pen was held off feed for one hour while the pictures were taken.

The heifers were weighed off experiment September 6, 1959, starting at 7:30 A.M., feed and water being removed at 5:00 P.M., September 5. As the heifers were weighed, they were dye-marked according to treatment. The heifers were sold to Armour and Company, Denver, Colorado on a grade and yield basis. They were loaded on three semi-trucks and left Three Forks at 12:00 noon. Arrival time in Denver was approximately 8:00 A.M., September 7. Upon arrival, they were sorted to lots by the dye-brand and weighed for determination of transit shrink and dressing percent.

Collection of Carcass Data

One-half of the heifers were slaughtered on September 8 and the remainder on September 9. As the heifers were slaughtered, the carcasses, pituitaries, ovaries and uteri were tagged for later identification. Liver weights were noted at this time. The teat lengths were measured on the kill floor.

Immediately following each day's kill, the ovaries, uteri, and pituitaries were trimmed of excess connective tissue and weighed. The pituitary glands were then quick frozen for possible further study.

The hot to cold carcass shrinks were determined from the carcass weights taken immediately after slaughter and the weights taken approximately 24 hours later. Carcass grades were determined by a U. S. D. A. grader 48 hours after slaughter. The grades were subdivided into one-third grades after one-half of each carcass was ribbed down.

The steers were weighed off experiment October 11, following the same weighing procedure that was used with the heifers. The steers were sold to Armour and Company, Spokane, Washington. Difficulties were encountered in obtaining sufficient trucks to haul all of the steers and to leave at the same time. All of the cattle except lots 1, 2, 4, and five head from lot 6 were loaded and shipped at 12:00 noon, October 11. The remaining steers were held on the loading dock until 5:00 A.M., October 12, at which time they were loaded and shipped. Transportation time to Spokane was approximately 12 hours.

Upon arrival at Spokane, the cattle were given access to feed and water. They were sorted to lots and group weighed 18 hours after arrival.

The steers in lots 4, 5, 8, and 9, and five head each from lots 3 and 10 were slaughtered on October 13. The remainder were slaughtered October 14. The glands collected from the steers were the pituitary, adrenals, and thyroids. The glands were trimmed, weighed, and frozen after each day's kill was completed. Liver weights and condition, cooler shrinks, and carcass grades were obtained in the same manner as they were with the heifers.

RESULTS AND DISCUSSION

Diallyldiethystilbestrol Trial

Feedlot performance of steers and heifers

The feedlot performance results for the steers fed DAS are shown in Table III. All lots showed an improvement of feed efficiency and lower feed cost per unit of gain compared to the controls. The steers that received 15 mg. of DAS per day were the only ones that failed to gain at a greater rate than the controls.

TABLE III. EFFECT OF DIALLYLDIETHYLSTILBESTROL AND DIETHYLSTILBESTROL ON FEEDLOT PERFORMANCE OF STEERS. (APRIL 24 TO OCTOBER 11, 1959 -- 169 DAYS.)

Lot No.	1	2	3	4	5
Treatment	Control	DES 1/	DAS 2/		
		10 mg.	15 mg.	20 mg.	25 mg.
No. Steers	10	10	9	10	10
Average weight (lbs.)					
Initial	718.5	719.0	706.0	738.5	710.5
Final	1126.0	1148.5	1106.0	1158.5	1134.5
Gain	407.5	429.5	400.0	420.0	424.0
Daily gain	2.41	2.54	2.37	2.48	2.51
Average daily ration (lbs.)					
Concentrate, supplement, mineral, and salt	18.64	18.36	18.23	18.59	18.84
Hay	6.52	6.59	6.20	6.53	6.58
Total	25.16	24.95	24.43	25.12	25.42
Feed/cwt. gain (lbs.)					
Concentrate, supplement mineral, and salt	772.96	722.54	770.16	748.21	751.13
Hay	270.55	259.12	261.94	262.88	262.10
Total	1043.51	981.65	1032.10	1011.09	1013.23
Feed cost/cwt. gain ($)	18.91	17.87	18.81	18.31	18.35

1/ Diethylstilbestrol
2/ Diallyldiethylstilbestrol

The rate of gain made by the steers receiving 20 and 25 mg. of DAS per day approached that of the stilbestrol-fed steers. This is in agreement with Embry et al. (1960) and Thomas et al. (1959).

The rate of gain of the steers fed stilbestrol was increased 5 percent, and feed efficiency improved 5 percent when compared with the controls. This is less than the 7.4 to 8.5 percent improvement in feed conversion reported by Perry et al. (1958) and a 15 percent increase in rate of gain of treated steers reported by Clegg and Carrol (1957).

None of the three DAS treatments gained as much as the steers receiving stilbestrol. Statistically, there were no differences between treatments at the 5 percent level. Within treatments, there was a significant ($P<.05$) difference in rate of gain between the steers that had been treated with 10 mg of DAS per day during the previous winter. The rate of gain for the within-treatment groups is shown in Table IV. In lots 1 through 4, the steers that had previously been fed DAS gained at a greater rate than those which were not previously treated. In lot 5, the pretreated steers did not gain as rapidly as the non-pretreated steers. Analysis of variance table for this trial is in the Appendix Table I..

TABLE IV. RATE OF GAIN FOR PRETREATED STEERS.

Lot No.	1	2	3	4	5
Treatment	Control	DES	DAS		
		10 mg.	15 mg.	20 mg.	25 mg.
Pretreated	2.66	2.88	2.46	2.70	2.33
Not pretreated	2.16	2.20	2.30	2.27	2.69

The average daily feed consumption of the stilbestrol fed steers was slightly less than for the controls, (this information does not agree with Clegg and Carrol, 1957). The higher average daily feed consumption and reduced feed conversion of the control lot probably accounts for the higher feed cost per unit of gain of the control lot. The steers that received 25 mg. of DAS per day had the highest concentrate consumption at one time, consuming 28 pounds of concentrate per day. The control steers and those fed 20 mg. of DAS per day followed with a peak consumption of 27 pounds per day. The other steers ate 25 pounds of concentrate per day at their peak.

The weights, gains, average feed consumption, feed efficiency, and cost of feed for the heifers fed DAS are summarized in Table V.

TABLE V. EFFECT OF DIALLYLDIETHYLSTILBESTROL AND DIETHYLSTILBESTROL ON FEEDLOT PERFORMANCE OF HEIFERS. (APRIL 24 TO SEPTEMBER 6, 1959 -- 135 DAYS).

Lot No.	11	12	13	14	15
Treatment	Control	DES 1/		DAS 2/	
		10 mg.	15 mg.	20 mg.	25 mg.
No. heifers	10	10	10	10	10
Average weights, (lbs.)					
Initial	592	575	582	592	575
Final	850	843	830	875	848
Gain	258	268	248	283	273
Daily gain	1.91	1.99	1.84	2.10	2.02
Average daily ration (lbs.)					
Concentrate & supplement	16.00	15.95	15.94	16.02	15.77
Hay	6.26	6.16	6.30	6.46	6.31
Mineral & salt	0.089	0.089	0.089	0.089	0.089
Total	22.349	22.199	22.329	22.569	22.169
Feed/cwt gain (lbs.)					
Concentrate, supplement mineral and salt	845	808	873	767	786
Hay	333	310	343	308	313
Total	1178	1118	1216	1075	1099
Feed cost/cwt. gain ($)	21.57	20.76	22.30	19.63	20.12

1/ Diethylstilbestrol
2/ Diallyldiethylstilbestrol

The greatest increase in rate of gain over the controls was a 10 percent increase made by the heifers receiving 20 mg. of DAS per day. These heifers also converted their feed more efficiently, requiring 103 pounds less feed per hundredweight gain than the controls. The heifers receiving 25 mg. of DAS per day gained at a 6 percent greater rate than the controls with 79 pounds of feed less required per hundredweight gain. The heifers receiving 15 mg. of DAS per day gained 3.6 percent less than the controls and required 38 pounds of feed more per hundred pounds of gain. The heifers receiving stilbestrol gained 4 percent faster than the controls and required 60 pounds less feed per hundredweight gain. The 0.08 pound per day increase in daily gain was the same as that reported by Clegg and Cole (1954), when heifers were implanted with 60 mg. of stilbestrol. Embry et al. (1960) reported additional gains in steers over the controls by feeding 20 mg. DAS per day, but the gains were less than those made by the steers receiving stilbestrol. Statistical analysis of the rate of gains for this trial showed there was a nonsignificant difference in rate of gain. The analysis of variance table is given in the Appendix Table II.

There was an inverse relationship between the rate of gain and the feed cost and feed required per hundredweight gain. There was very little variation in feed consumption per day. The average feed consumption for the five pens was 15.94 pounds of concentrate and 6.30 pounds of roughage per day per heifer. The difference in feed consumption was only 0.4 of a pound per day with the highest gaining lot eating the most and those receiving 25 mg. of DAS consuming the least. The heifers fed 10 mg. of stilbestrol per day ate 0.24 pound of feed per day less than the controls. This is not in agreement with Clegg and Carrol (1957) and Perry et al. (1958).

The lack of variation of feed consumption may be due to failure to feed at maximum intake at all times.

The steers and heifers that were fed 15 mg. of DAS made a lower rate of gain than their respective controls. The greatest increases in rate of gain were made by the heifers fed 20 mg. of DAS per day and the steers fed 25 mg. of DAS per day.

Shrinks, yields, and grades of the diallyldiethylstilbestrol fed cattle

The shrinks, yields, and grades for the steers are shown in Table VI. The final weight to off-truck weight shrinks for the steers were determined from the final weights at Three Forks and group weights taken in Spokane, Washington, approximately 18 hours after arrival. It must be assumed that the animals had equal access to and consumed equal amounts of hay and water. Thirty-five head of the steers remained on the loading dock 17 hours longer before being shipped. The transit shrinks of the steers are rather close and should not be valued very high because of the inconsistent treatment.

The hot to cold carcass shrinks were close and did not appear to be associated with rate of gain or treatment.

The steers receiving 20 mg. of DAS per day had the highest average carcass grade by having seven steers in the high good grade. The steers receiving 15 mg. of DAS per day were the slowest gaining and the lowest grading steers. The stilbestrol-fed steers had a slight reduction of carcass grades when compared to the control steers. Clegg and Carrol (1957) reported a reduction in carcass grade when steers were fed 10 mg. of stilbestrol per day, and Kastilec et al. (1956) reported that feeding of stilbestrol had no consistent effect upon carcass grades. Part of this data is in agreement with Thomas _et al_. (1959) who reported slightly improved carcass grades when DAS was fed to fattening steers.

TABLE VI. EFFECT OF DIALLYLDIETHYLSTILBESTROL AND DIETHYLSTILBESTROL ON CARCASS GRADES, SHRINKS, AND YIELDS OF STEERS (SLAUGHTERED IN SPOKANE, OCTOBER 13-14, 1959).

Lot No.	1	2	3	4	5
Treatment	Control	DES	DAS		
		10 mg.	15 mg.	20 mg.	25 mg.
Shrinks, (%)					
Final weight to off-truck weight	3.15	2.92	2.81	2.37	3.22
Hot to cold carcass weight	1.20	1.19	1.37	1.27	1.26
Dressing Percent					
Final weight to cold carcass weight	59.08	59.10	59.29	28.90	58.92
Off-truck weight to cold carcass weight	61.00	60.89	61.00	60.33	60.88
Carcass Grades					
Choice					
High	1	0	0	0	1
Average	0	0	0	0	0
Low	2	3	1	2	1
Good					
High	4	3	4	7	5
Average	0	3	4	1	1
Low	3	1	0	0	2
Score 1/	2.90	2.80	2.67	3.10	2.90

1/ Score computed upon basis of high choice 6, average choice 5, low choice 4, high good 3, average good 2, and low good 1.

The carcass grades, yields, and shrinks for the heifers fed DAS are shown in Table VII.

In this trial, the heifers fed stilbestrol and diallyldiethylstilbestrol had greater transit shrink than the control heifers. The higher gaining lots which received 20 mg. or 25 mg. of DAS per day had the greatest

TABLE VII. EFFECT OF DIALLYLDIETHYLSTILBESTROL AND DIETHYLSTILBESTROL ON CARCASS GRADES SHRINKS AND YIELDS OF HEIFERS (SLAUGHTERED IN DENVER, COLORADO SEPTEMBER 7, 1959).

Lot No.	11	12	13	14	15
Treatment	Control	DES		DAS	
		10 mg.	15 mg.	20 mg.	25 mg.
Shrink (%)					
Final weight of off-truck weight	5.30	6.88	5.54	8.29	8.26
Hot to cold carcass weight	0.73	0.84	0.81	0.86	0.84
Dressing Percent					
Final weight to cold carcass weight	59.51	59.90	60.77	58.04	60.52
Off-truck weight to cold carcass weight	63.60	64.29	64.38	63.28	65.92
Carcass Grades					
Choice					
Average	0	2	0	0	0
Low	2	3	5	2	3
Good					
High	4	2	3	6	6
Average	4	3	2	2	0
Low	0	0	0	0	1
Score 1/	2.8	3.4	3.3	3.0	3.1

1/ Score computed upon basis of high choice 6, average choice 5, low choice 4, high good 3, average good 2, and low good 1.

transit shrink. In all lots, the hot to cold carcass shrink was less than one percent.

The dressing percentages were computed from the final weight and the off-truck weight and the cold carcass weights. The dressing percentage computed from the final weight is probably the most accurate because of the more nearly equal weighing conditions. The lot fed 10 mg. of stilbestrol per day yielded slightly more than the controls. Andrews et al. (1954) reported no effect on dressing percentage among steers that were implanted with 60, 108, or 120 mg. of stilbestrol and controls. The highest gaining heifers in this trial had the lowest dressing percent, per day. The highest dressing lot was lot 13, which received 15 mg. of DAS per day and made the lowest rate of gain.

The highest grading lot of heifers were fed 10 mg. of stilbestrol per day. This is not in agreement with Clegg and Carrol (1956) and Burroughs *et al*. (1955). The heifers that received 15 mg. of DAS per day had the highest average carcass grades of the DAS fed heifers. The stilbestrol and DAS fed heifers had average carcass grades higher than the controls.

Gland weights of cattle fed diallyldiethylstilbestrol

Table VIII gives the lot averages for the body weight and organ weight ratios of the livers, pituitary glands, individual and combined adrenal glands, and thyroid glands for the steers fed DAS.

TABLE VIII. GLAND WEIGHT: BODY WEIGHT RATIOS1/ FOR STEERS FED DIALLYLDIETHYLSTILBESTROL.

Lot No.	Treatment	No. livers condemned	Liver	Pituitary	Right Adrenal	Left Adrenal	Combined Adrenals	Thyroid	Order of rate of gain
1	Control	5	1.294	0.167	0.944	0.846	1.790	3.334	4
2	10 mg.DES	5	1.271	-----	0.960	0.962	1.922	3.264	1
3	15 mg.DAS	7	1.220	0.175	0.840	0.843	1.683	2.870	5
4	20 mg.DAS	6	1.341	0.161	0.970	0.955	1.925	2.890	3
5	25 mg.DAS	2	1.430	0.171	0.963	0.931	1.894	2.760	2

1/ Computed as grams or pounds per 100 pounds body weight.

Treatment or rate of gain did not appear to have any influence upon the weights of the livers or the number of livers that were condemned. The pituitary glands were not saved in lot 2. The pituitary glands from the steers fed 15 mg. or 25 mg. of DAS per day were heavier than the pituitary glands from the control steers, whereas the same glands from the steers that received 20 mg. of DAS per day were lighter than those from the controls.

The adrenal gland weights, individual or combined, from the steers fed the different levels of DAS were inconsistent and apparently not influenced by rate of gain or treatment. Clegg et al. (1955) and Cahill et al. (1956) reported increased adrenal weights in stilbestrol treated animals and Shroder and Hansard (1959) reported that adrenal cortical activity was increased but the weights of the glands was not significantly influenced.

The average thyroid weights for the steers treated with stilbestrol or DAS were in all cases lighter than the thyroids from the control steers. This is in agreement with Clegg and Cole (1954) and Davey et al. (1959). Reports of increased thyroid weights in stilbestrol or DAS treated steers are those of Cahill et al. (1956) and Thomas et al. (1959).

The weights of the glands and reproductive organs from the heifers fed DAS are shown in Table IX. The heifers that received stilbestrol had longer teats than the controls. Increased teat lengths in stilbestrol were also reported by O'Mary et al. (1959) and Perry et al. (1955). Within the lots being fed DAS, the teat lengths varied and were not associated with rate of gain or treatment. The uterus weights to body weight ratio showed no consistency for treatment or rate of gain.

The pituitary gland weights from the heifers fed stilbestrol were heavier than the pituitaries of the control heifers. The stilbestrol-fed heifers had a higher rate of gain than the control heifers. The increase in pituitary weight, is in agreement with Shroder and Hansard (1958) and Clegg et al. (1955) who reported that pituitary weights were increased in stilbestrol treated animals. Clegg and Cole (1954) reported that growth hormone content of the pituitary glands from heifers implanted with 60 mg.

TABLE IX. BODY MEASUREMENTS AND GLAND WEIGHTS FOR HEIFERS FED DIALLYL-DIETHYLSTILBESTROL.

Lot No.	11	12	13	14	15
Treatment	Control	DES	DAS		
		10 mg.	15 mg.	20 mg.	25 mg.
Teat length (inches)	1.29	1.40	1.112	1.33	1.356
Body weight ratio	.00152	.00166	.00136	.00152	.00159
Uterus weight (oz.)	8.02	7.71	7.97	7.77	7.6
Body weight ratio	.00945	.00915	.0096	.00888	.00897
Combined ovary weights (grams)	11.3562	12.2192	10.4611	10.9320	11.6022
Pituitary weights (grams)	1.4021(4)	1.6222(5)	1.6297(3)	1.9446(7)	1.7936(5)
Liver weights (lbs.)	12.19	11.13	11.52	11.03	11.58
Body weight ratio	.01435	.01320	.00460	.01261	.01366
Condemned Livers	2	2	1	0	1

( ) Indicates number saved.

of stilbestrol was approximately twice the amount found in the pituitaries of control heifers. Within the three lots receiving DAS, there was a relationship between rate of gain and the pituitary weights, with the faster gaining animals having the heavier pituitary glands. Thomas et al. (1959) reported smaller pituitary glands from stilbestrol and DAS treated steers.

The pituitary weights were the only common measurements for the steers and heifers. This gland was consistently heavier in the treated heifers, but the results varied in the treated steers.

Expenses and returns from cattle fed diallyldiethylstilbestrol

The cost and returns for the steers fed DAS are shown in Table X. The steers in lot 2 lost the least, losing $53.98 per steer. This was a result of the steers gaining more and yielding heavier carcasses. This lot was also one of the higher grading lots of steers. The differenced in net returns for the steers in lots 1, 3, 4, and 5 were small, with the differences in total investment being made up with a corresponding difference in gross return due to increased carcass weight or grade. The average live weight selling price of the steers was $25.85 per hundredweight, which resulted in an $8.65 per hundredweight negative margin.

TABLE X. COST AND RETURNS OF THE STEERS FED DAS (APRIL 25 - OCTOBER 11, 1959--169 DAYS).

Lot No.	1	2	3	4	5
Treatment	Control	DES	DAS		
		10 mg.	15 mg.	20 mg.	25 mg.
No. Steers	10	10	9	10	10
Financial return/ steer ($)					
Initial cost ($34.50/cwt.)	244.29	244.46	240.04	251.09	241.57
Feed cost	77.08	76.75	75.20	76.92	77.83
Yardage @ 7¢/day	11.83	11.83	11.83	11.83	11.83
Trucking charge	9.56	10.04	9.68	10.18	9.82
Total investment	342.76	343.08	336.75	350.02	341.05
Gross return	283.31	289.10	277.37	289.39	283.74
Net return/steer	-59.45	-53.98	-59.38	-60.63	-57.31

The financial cost and returns for the heifers fed DAS are shown in Table XI. The higher initial cost and lower selling price, as a result of lower grades accounts for the increased loss in the control lot. The higher initial cost of the heifers in lot 14, which received 20 mg. of DAS per day, combined with the low selling price, as a result of a large number of heifers in the good grade, may be responsible for the increased loss in that lot. This pen of heifers made the highest rate of gain in this trial, but the gain was not indicative of carcass grade or financial return. In the lot fed 25 mg. DAS the returns were the highest, and when combined with the lowest initial cost, showed the smallest deficit.

TABLE XI. COST AND RETURNS OF THE HEIFERS FED DAS (APRIL 24 - SEPTEMBER 6, 1959--135 DAYS).

Lot No.	11	12	13	14	15
Treatment	Control	DES		DAS	
		10 mg.	15 mg.	20 mg.	25 mg.
No. Heifers	10	10	10	10	10
Financial return/ heifer ($)					
Initial cost ($32.50 cwt.)	192.40	186.88	189.15	192.24	186.88
Feed cost	55.54	55.64	55.30	55.65	56.84
Yardage @ 7¢/day	9.45	9.45	9.45	9.45	9.45
Trucking charge	13.12	12.95	12.94	13.24	12.83
Total investment	270.51	264.92	266.44	270.68	266.00
Gross return	216.37	218.15	218.38	217.34	220.19
Net return/heifer	-54.14	-46.77	-48.06	-53.34	-45.81

Results of the Diallylhexestrol Trial

Feedlot performance of the steers and heifers

The feedlot performance of steers fed diallylhexstrol is shown in Table XII. In this trial, none of the treatments exceeded the controls in rate of gain. The steers fed stilbestrol made a lower rate of gain and required more feed per unit of gain than the controls. This is contrary to reports by Perry *et al.* (1958), Clegg and Carrol (1957), and Andrews *et al.* (1956).

The steers fed 20 mg. of DAH per day gained at the same rate as the controls and required slightly less feed. The gains made by the steers receiving 15 or 25 mg. DAH per day were, respectively, 0.24 and 0.18 pounds per day below the controls; these differences were not statistically significant at the 5 percent level. The analysis of variance table is in the Appendix Table III. Comparable results were shown by Dyer (1959b). The range in average feed consumption was less than one pound per day.

TABLE XII. EFFECT OF DIALLYLHEXESTROL AND DIETHYLSTILBESTROL ON FEEDLOT PERFORMANCE OF STEERS.

Lot No.	6	7	8	9	10
Treatment	Control	DES		DAH	
		10 mg.	15 mg.	20 mg.	25 mg.
No. Steers	10	10	10	9	9
Average Wt. (lbs.)					
Initial	702.0	708.5	703.5	704.5	695.5
Final	1132.0	1131.5	1092.5	1134.0	1094.0
Gain	430.0	423.0	389.0	429.5	398.5
Daily gain	2.54	2.50	2.30	2.54	2.36
Average daily rations (lbs.)					
Concentrate, supplement, mineral and salt	18.92	18.91	18.56	18.90	19.03
Hay	6.83	7.01	6.60	6.53	6.03
Total	25.75	25.92	25.16	25.43	25.06
Feed/cwt. gain (lbs.)					
Concentrate, supplement, mineral and salt	743.84	755.51	806.48	743.94	807.39
Hay	268.35	280.09	286.58	257.15	255.93
Total	1012.19	1035.60	1093.06	1001.09	1063.32
Feed cost/cwt. gain ($)	18.25	18.59	19.77	18.16	19.51

Table XIII gives the weights, gains, feed consumption and efficiency, and feed cost per unit of gain for the heifers fed diallylhexestrol.

The rate of gain for the controls in this trial was substantially higher than the previous heifer control lot. The rate of gain made by the heifers receiving stilbestrol was 0.07 pound per day less than the controls. This is not in agreement with reports of Clegg and Cole (1954) and Burroughs et.al. (1959) who reported increased in rate of gain of stilbestrol treated heifers.

TABLE XIII. EFFECT OF DIALLYLHEXESTROL AND DIETHYLSTILBESTROL FEEDLOT PERFORMANCE OF HEIFERS. (APRIL 24 - SEPTEMBER 6, 1959-- 135 DAYS).

Lot No.	16	17	18	19	20
Treatment	Control	DES 1/		DAH 2/	
		10 mg.	15 mg.	20 mg.	25 mg.
No. Heifers	10	10	10	9	10
Average weights (lbs.)					
Initial	554	559	558	552	538
Final	846	843	834	876	834
Gain	292	284	276	324	296
Daily gain	2.17	2.10	2.04	2.40	2.19
Average daily rations (lbs.)					
Concentrate and supplement	16.02	15.92	15.96	16.71	15.99
Hay	6.30	6.24	6.37	6.19	6.21
Mineral and salt	0.089	0.089	0.089	0.089	0.089
Total	22.409	22.249	22.419	22.989	22.289
Feed/cwt. gain (lbs.)					
Concentrate, supplement, mineral and salt	743.0	761.0	780.0	701.0	733.0
Hay	291.0	297.0	312.0	258.0	283.0
Total	1034.0	1058.0	1092.0	959.0	1016.0
Feed cost/cwt. gain ($)	18.94	19.59	19.87	17.69	18.69

1/ Diethylstilbestrol
2/ Diallylhexestrol

The heifers receiving 15 mg. of DAH per day had the lowest average daily gains and highest feed requirement and cost per hundredweight gain in this trial. The heifers that received 25 mg. of DAH per day gained slightly more than the controls, whereas the ones fed 20 mg. of DAH per day gained considerably faster with less feed per unit of gain than the control heifers. The rate of gain made by the heifers receiving 20 mg. DAH was significantly greater ($P < .05$) than the rate of gain made by the control heifers. The analysis of variance table is shown in Appendix Table IV.

In lot 19, one heifer died on July 9. The amount of supplemental pellet fed was adjusted accordingly, but the amount of concentrate mixture was not immediately reduced or adjusted. This extra amount of feed that was available for the remaining 9 heifers may have been sufficient to account for the increase in rate of gain and improved feed efficiency of this lot. The average feed consumption for this pen was 0.5 pounds of total feed or 0.7 pounds of concentrate a day greater than the controls.

Feed efficiency and feed cost for the heifers of this trial were associated with rate of gain.

Shrinks, yields and grades of diallylhexestrol fed cattle

The shrink, dressing percent, and carcass grades of the DAH-fed steers are shown in Table XIV. As mentioned previously, the steers were not treated equally during transit. Considering the unequal treatment, the intransit shrinks are close in magnitude.

The hot carcass to cold carcass shrinks ranged from 1.26 to 1.37 percent. The cooler shrinks were rather close and did not correlate with treatment or rate of gain.

The highest grading lot received 10 mg. of stilbestrol per steer per day. This is not in agreement with Clegg and Carrol (1957) who reported a reduction in carcass grades of steers fed 10 mg. of stilbestrol per day. Lot 9 steers, which received 20 mg. of DAH per day, graded slightly lower than the controls, and the steers which received 25 mg. of DAH per day were the highest grading steers of the three lots fed DAH. This data is in partial agreement with that reported by Dyer and Ralston (1959), who reported

TABLE XIV. EFFECT OF DIETHYLSTILBESTROL AND DIALLYLHEXESTROL ON CARCASS GRADES, SHRINKS AND DRESSING PERCENT OF STEERS.

Lot No.	6	7	8	9	10
Treatment	Control	DES	DAH		
		10 mg.	15 mg.	20 mg.	25 mg.
Shrink (%)					
Final weight to off-truck weight	3.14	2.47	2.52	3.38	3.61
Hot to cold carcass weight	1.28	1.37	1.26	1.31	1.29
Dressing Percent					
Final weight to cold carcass weight	58.58	58.64	58.76	58.85	58.87
Off-truck weight to cold carcass weight	60.47	60.13	60.28	60.91	61.10
Carcass Grades					
Choice					
High	0	2	0	0	0
Average	0	2	0	0	0
Low	2	1	2	1	6
Good					
High	5	3	7	4	1
Average	3	1	0	3	2
Low	0	1	1	1	0
Score 1/	2.90	3.80	2.90	2.88	3.44

1/ Score computed upon basis of high choice 6, average choice 5, low choice 4, high good 3, average good 2 and low good 1.

higher carcass grades for DAH fed steers.

The shrinks, dressing percent, and carcass grades of the heifers that were fed to test diallylhexestrol are shown in Table XV.

The heifers that were fed stilbestrol shrank considerably less during transit than the control heifers or the ones fed DAH. The control heifers shrank slightly less than the DAH fed heifers which shrank over eight percent. Beeson et al. (1956) also reported less transit for stilbestrol treated cattle and Andrews et al. (1956) reported a significant increase in transit shrink for stilbestrol treated cattle. Dyer and Ralston (1959) reported no significant differences for transit shrink of DAH fed steers.

TABLE XV. EFFECT OF DIETHYLSTILBESTROL AND DIALLYLHEXESTROL ON CARCASS GRADES, SHRINKS AND YIELDS OF HEIFERS. (SLAUGHTERED IN DENVER, COLORADO, SEPTEMBER 7, 1959).

Lot No.	16	17	18	19	20
Treatment	Control	DES		DAH	
		10 mg.	15 mg.	20 mg.	25 mg.
Shrink (%)					
Final weight to off-truck weight	7.86	3.91	8.03	8.05	8.33
Hot to cold carcass weight	0.74	0.81	0.70	0.89	0.73
Dressing Percent					
Final weight to cold carcass weight	58.67	59.35	59.47	58.49	59.70
Off-truck weight to cold carcass weight	63.69	61.77	64.66	63.53	65.13
Carcass Grades					
Choice					
Average	1	0	0	2	0
Low	1	4	4	2	3
Good					
High	3	4	3	3	4
Average	4	1	2	1	3
Low	1	1	1	1	0
Score 1/	2.70	3.10	3.10	3.33	3.00

1/ Score computed upon basis of high choice 6, average choice 5, low choice 4, high good 3, average good 2 and low good 1.

In all cases, the average cooler or hot to cold carcass shrink was less than one percent, based upon the hot carcass weight and 24-hour cooler weight. In most instances, the treated lots tended to shrink slightly more. Andrews et al. (1956) and Clegg and Carrol (1957) each reported comparable cooler shrinks or no appreciable differences between controls and steers fed 10 mg. of stilbestrol per day.

The heifers fed 20 mg. of DAH per day made the greatest daily gain and had the highest average carcass grade. The heifers fed 10 mg. of stilbestrol or 15 mg. of DAH had the same average carcass grade. This was closely followed by the carcass grades of the heifers fed 25 mg. of DAH. The average carcass grades of the treated heifers in this trial was higher than the average carcass grade of the control heifers.

The feeding of diallylhexestrol did not result in any consistent or large changes in transit shrink, cooler shrink, or dressing percent in heifers or steers. The average carcass grades of DAH treated heifers were consistently above the control-heifer carcass grades, and when DAH was fed to steers, the carcass grades were equal to or above the average grades of the control steers.

Gland weights of cattle fed diallylhexestrol

Table XVI gives lot averages for the gland weight and body weight ratios of the glands collected from the steers that were fed DAH.

TABLE XVI. GLAND WEIGHT, BODY WEIGHT RATIOS[1/] FOR STEERS FED DIALLYLHEXESTROL.

Lot No.	Treatment	No. livers condemned	Liver	Pituitary	Right Adrenal	Left Adrenal	Combined Adrenals	Thyroid	Order of rate of gain
6	Control	5	1.36	0.165	0.921	0.883	1.804	3.73	1
7	10 mg.DES	4	1.41	0.207	0.928	0.924	1.852	3.24	3
8	15 mg.DAH	4	1.40	0.179	0.922	0.936	1.858	3.27	5
9	20 mg.DAH	1	1.35	0.174	0.884	0.866	1.750	2.79	1
10	25 mg.DAH	7	1.41	0.171	0.940	0.980	1.920	3.51	4

1/ Computed as grams or pounds per 100 pounds body weight.

The average weight of the pituitary glands from the steers fed 10 mg. of stilbestrol per day was considerably larger than the weight of pituitary glands from the control steers. This is in agreement with Clegg et al. (1955), Cahill et al. (1956), Davey et al. (1959) and Struempler and Burroughs (1959) but not in agreement with Thomas et al. (1959). The pituitary glands from the steers fed DAH were larger than the same glands from the control steers. Dyer (1959b) reported larger pituitary glands in DAH fed steers.

The left and right adrenal glands from the steers fed 10 mg. of stilbestrol were considerably larger than the ones from the control steers. The adrenal weights, individual or combined, from the steers fed the different levels of DAH were inconsistent and apparently not influenced by rate of gain or treatment. Larger adrenal glands from stilbestrol treated animals have been reported by Clegg _et al_. (1955) and Davey et al. (1959). Dyer (1959b) reported smaller adrenal glands from DAH fed steers.

The thyroid weights for the steers treated with stilbestrol or DAH were, in all cases, lighter than the controls. This is in agreement with Clegg and Cole (1954) and Davey _et al_. (1959). When DAH was fed, Dyer (1959b) reported smaller thyroid glands. Reports that differ are those of Cahill _et al_. (1956) who reported unchanged thyroid weights from steers implanted with 84 mg. of stilbestrol, and Thomas _et al_. (1959) who reported an increase in size of the thyroid gland in steers fed 10 mg. of stilbestrol per day.

The glands collected from the steers fed 20 mg. of DAH per day were, with the exception of the pituitary gland, consistently smaller than the glands from steers on the other treatments.

Table XVII gives the teat length, uterus weights, combined ovary weights, pituitary weights, and liver weights of the heifers fed DAH. Also given are the body weight ratios of the uteri, teat length, and livers. The heifers that received stilbestrol had longer teats than the controls. Within the groups receiving DAH, the teat length varied and was not associ-

TABLE XVII. BODY MEASUREMENTS AND GLAND WEIGHTS FOR HEIFERS FED DIALLYLHEXESTROL.

Lot No.	16	17	18	19	20
Treatment	Control	DES	DAH		
		10 mg.	15 mg.	20 mg.	25 mg.
Teat length (inches)	1.37	1.39	1.30	1.22	1.34
Body weight ratio	.00162	.00165	.00156	.00139	.00161
Uterus weight (oz.)	7.86	8.30	7.96	8.14	7.61
Body weight ratio	.00937	.00985	.00954	.00928	.00912
Combined ovary weight (grams)	14.4651	11.0189	11.6320	12.1310	12.1496
Pituitary weight (grams)	1.3776(6)	1.2953(7)	1.8738(5)	1.8738(5)	1.6296(4)
Liver weight (lbs.)	.014.2	.01357	.01375	.01405	.01391
Comdemned livers	0	0	2	0	0

( ) Indicates number saved.

ated with treatment or rate of gain. Increased teat lengths were also reported by O'Mary et al. (1959), by Perry et al. (1955) in stilbestrol implanted steers, and by Clegg and Carrol (1957) when implanted and oral stilbestrol were compared.

The uterus weights or their body weight ratio showed no consistency between treatment or rate of gain.

The pituitary gland weights of the heifers fed stilbestrol in lot 16 were lighter than the controls. In each of these two lots, the pen of heifers having the higher rate of gain had the heavier pituitaries. Within the lots of heifers receiving DAH, the fastest gaining lot had the largest pituitary glands, but the gains and pituitary weights were reversed in the other two lots. Part of these results are in agreement with Davey et al.

(1959), Shroder and Hansard (1958) and Clegg *et al.* (1955) who reported that pituitary weights were increased in stilbestrol treated animals when the treated animals gained at a greater rate. Clegg and Cole (1954) reported that growth hormone content of the pituitaries from heifers implanted with 60 mg. of stilbestrol was approximately twice the amount found in pituitaries of control heifers. Dyer (1959b) reported larger pituitary glands in steers fed DAH.

Expenses and returns for cattle fed diallylhexestrol

The financial statement for the steers of the DAH trial is shown in Table XVIII. The steers fed 10 mg. of stilbestrol or 25 mg. of DAH per day

TABLE XVIII. COST AND RETURNS OF STEERS FED DAH (APRIL 25 - OCTOBER 11, 1959--169 DAYS)

Lot No.	6	7	8	9	10
Treatment	Control	DES	DAH		
		10 mg.	15 mg.	20 mg.	25 mg.
No. Steers	10	10	10	9	9
Financial return/ steer ($)					
Initial cost ($34.50/cwt.)	238.68	240.89	239.19	239.53	236.47
Feed cost	78.47	78.68	76.90	77.97	77.68
Yardage @ 7¢/day	11.83	11.83	11.83	11.83	11.83
Trucking charge	9.86	9.93	9.59	9.86	9.49
Total investment	338.84	341.33	337.49	339.19	335.47
Gross return	281.18	285.21	272.40	281.81	279.38
Net return/steer	-57.66	-56.12	-65.09	-57.38	-56.09

showed the smallest deficit. The stilbestrol-fed steers were slightly heavier resulting in a higher initial cost, but the differences remained approximately the same throughout the trial. The net returns of the control steers and the steers fed 20 mg. of DAH per day were close and followed the other two lots rather closely. The steers fed 15 mg. of DAH had the lowest feed cost, but this was the lowest gaining lot. The low rate of gain combined with the lower carcass grades of this lot resulted in the greatest financial loss per steer.

The cost and returns for the heifers that were fed DAH are given in Table XIX. Lot 19, which received 20 mg. of DAH per day, made the greatest

TABLE XIX. COST AND RETURNS OF HEIFERS FED DAH (APRIL 24 - SEPTEMBER 6, 1959--135 DAYS).

Lot No.	16 Control	17 DES	18	19 DAH	20
		10 mg.	15 mg.	20 mg.	25 mg.
No. Heifers	10	10	10	9	10
Financial return/heifer ($)					
Initial cost (32.75/cwt.)	181.44	183.07	182.91	180.85	176.36
Feed cost	55.40	55.64	54.84	56.96	55.32
Yardage @ 7¢/day	9.45	9.45	9.45	9.45	9.45
Trucking charge	12.87	13.37	12.66	13.29	12.62
Total investment	259.16	261.29	259.86	260.55	253.75
Gross return	212.71	215.59	213.99	221.05	214.00
Net return/heifer	-46.45	-45.70	-45.87	-39.50	-39.75

net return. This was the fastest gaining lot and had a slightly higher feed cost, but the returns were increased by higher grading carcasses. This lot was closely followed by lot 20, fed 25 mg. of DAH in net returns. The low initial cost in lot 20 probably accounts for the smaller loss than was shown in lots 16, 17, and 18. The control lot and the lots which received 10 mg. of stilbestrol per day or 15 mg. of DAH per day showed small differences in net returns, with the control lot having the smallest net return.

There was a financial loss shown in all lots. Most of this loss can be attributed to the large negative margin between the purchase price and live weight selling price. The selling price, when converted to a live weight basis, was approximately $25.00 to $25.75 per hundredweight. When compared with the purchase price, this gave a $6.75 to $7.75 per hundredweight negative margin on the original weight for the heifers and a $8.75 to $9.50 negative margin for the steers.

Incidence of Disease

Three steers and one heifer died during the experiment because of bloat. The steers died during the night when they were not being attended, and the heifer died while being treated for bloat. Table XX gives the animal number, lot number, symptom, and date of death or treatment of disorder for the cattle in this experiment.

Nine other cases of bloat were severe enough to require treatment. Steer 739 in lot 1 was treated for bloat three times in 18 days. Many other cases of bloat were observed. These animals were watched carefully and if the bloat did not subside in a reasonable length of time, they were treated. Six cases of footrot were treated. There did not appear to be any association between treatment or location of pens and the incidence of footrot. Steer 765 in lot 8 was afflicted with general septicemia in May as diagnosed by a veterinarian. This steer was isolated and was individually fed for 28 days. Steer 718 in lot 2 was severely foundered at the end of the trial.

It was assumed that each steer ate equal amounts of the feed that was offered each day. To calculate feed efficiency, one-tenth of the feed fed up to the date of death was subtracted from the total fed up to that time.

TABLE XX. INCIDENCE OF DISEASE OR DISORDER OF THE CATTLE.

Lot No.	Animal Number	Treated for	Dates
1	708	Footrot	7/1
1	739	Bloat	6/24, 7/4, 7/12
2	718	Footrot	7/15, 8/10, 9/1, 9/8
		Severely foundered at end of trial	
3	911	Died of bloat	8/26
3	49	Bloat	8/1
3	1404	Bloat	8/1
5	918	Bloat	6/22
5	547	Bloat	6/20
6	819	Footrot	7/15
8	1390-727	Footrot	6/27
8	765	General septicemia	June 1/
8	715	Footrot	7/15
9	1419	Died of bloat	10/1
10	777	Footrot	7/15
10	840	Died of bloat	6/21 2/
13	1465	Bloat	6/1
14	1462	Bloat	8/17
19	1491	Died of bloat	7/9

1/ Individually fed for 28 days.
2/ Bloated three times in May and early June, but no records of dates were kept.

The hays used in this experiment were assayed for estrogenic potency. The results are shown in Table XXI. The estrogenic activity is in terms of micrograms of stilbestrol per pound of feed. Uterine response of immature female mice to the feed was used to determine the estrogenic activity of the hay. The grass hay was high in estrogenic activity. This may have been influential in the response of the cattle to the feed additives.

TABLE XXI. ESTROGENIC ACTIVITY OF HAY.

Sample	Date Fed	Potency micrograms of Diethylstilbestrol/lb. of feed
Grass hay	July 25 - Oct. 11	13.62
Alfalfa hay	April 24 - June 10	1.02
Alfalfa hay	June 11 - July 6	6.81
Dehydrated alfalfa pellets	April 25 - July 25	2.27

SUMMARY

One hundred yearling Hereford heifers were fed for 135 days and 100 yearling Hereford steers were fed for 169 days in this experiment. The ration for the steers and heifers consisted of alfalfa hay, (later changed to grass hay), one pound of a 32 percent protein pellet per animal per day, that contained the feed additives, and a concentrate mixture of 80 percent barley, 10 percent dried molasses beet pulp, 5 percent wheat mixed feed and 5 percent dehydrated alfalfa pellets. The cattle were started on feed with three pounds of concentrate per day; this amount was raised one pound per animal on alternate days until the cattle refused to consume all they were offered.

Previous to initiation of the trial, the animals were weighed for allotment to treatment. They were stratified according to weight and randomly allotted to treatment. Part of the steers had previously been treated with diallyldiethylstilbestrol. These steers were allotted separately according to weight and previous treatment to the sub-division of the experiment which was to further test DAS. The animals were allotted into 5 lots with 10 animals in each lot. Within each trial, one lot served as a control and one lot received 10 mg. of stilbestrol per animal per day. The three remaining lots received the three levels of diallyldiethylstilbestrol and diallylhexestrol. DAS and DAH were each tested with steers and heifers.

Studied in this experiment were the effects of DAS and DAH upon the rate of gain, feed efficiency, transit and cooler shrink, dressing percentage, carcass grades, the weights and measurements of some of the re-

productive organs of heifers, the weights of some of the endocrine glands and livers of steers and heifers, and the financial returns.

The steers that received 15 mg. of DAS per day gained at a lower rate than their controls but required less feed per unit of gain, whereas the steers that received 20 or 25 mg. of DAS per day gained at a greater rate than their controls. The stilbestrol-fed steers in this trial made the fastest and most efficient gains. In four of the lots, the steers that had previously been fed DAS gained at a greater rate than those not previously treated, but in the fifth lot, the previously treated steers did not gain as fast as those not previously fed DAS.

The heifers receiving 20 or 25 mg. per day of DAS gained at a greater rate and with less feed per unit of gain than the control heifers or the stilbestrol-fed heifers in that trial. The heifers receiving 15 mg. of DAS per day made the lowest and most inefficient gains of all pens of cattle fed.

The final weight to off-truck weight shrinks for the steers were about the same; because of the inconsistent treatment, these figures should not be valued too highly. The differences in cooler shrinks for the steers were rather small and did not appear to be associated with treatment or rate of gain.

In most cases, the heifers that were fed the derivatives of stilbestrol shrank the most during transit. The transit shrinks for the control and stilbestrol-fed heifers were inconsistent.

The hot to cold carcass shrink for the heifers was, in all lots, less than one percent.

The DAS-fed steers showed no consistent improvement or depression of carcass grade, whereas the average carcass grade for the DAS fed heifers was higher than the average grade of the control heifers.

Diallyldiethylstilbestrol did not influence the weights of liver, pituitary or adrenal glands of the steers or the weight of the reproductive organs or the teat length of the heifers. The treated steers had lighter thyroid glands, whereas the weights of the pituitary glands of the treated heifers increased when the rate of gain increased.

There was a financial loss in all lots of the DAS trials. The cattle fed stilbestrol or 25 mg. of DAS showed the least loss.

The control steers and those which received 20 mg. of DAH per day made the greatest gains and gained most efficiently in that test. These steers were followed closely in rate of gain and feed efficiency by the steers that received stilbestrol. The steers that received 15 or 25 mg. of DAH per day had the lowest gains of that trial.

The heifers that were fed 15 mg. of DAH per day gained at a lower rate than their controls or the stilbestrol-fed heifers of that trial. The lot which received 25 mg. of DAH per animal per day gained slightly faster than their controls, whereas those which were fed 20 mg. of DAH per day gained significantly ($P < .05$) faster than the controls. The significant increase in rate of gain may have been due to an excess amount of feed available after the death of one heifer.

There was a small difference in transit shrink made by the steers in this test; the same can be said about the heifers, with the exception of the lot that was fed stilbestrol. The cooler shrink was quite small and did not vary much with treatment.

The average dressing percent of the steers in the DAH trial varied less than one percent. The highest average carcass grades in this test were for the steers fed stilbestrol and the heifers fed 20 mg. of DAH per day.

The weights of the pituitary glands of the diallylhexestrol-fed steers were heavier than the same glands from the control steers, and the thyroid glands from the treated steers were lighter than the thyroid glands from the control steers. The pituitary glands from the heifers fed 20 mg. of DAH per day were heavier than the pituitary glands from the control heifers.

Measurements taken of the reproductive organs of the heifers were variable and apparently not associated with treatment.

The net returns for the cattle used to test DAH showed that the heifers fed 20 or 25 mg. of DAH per day had the smallest deficit. The steers fed 15 mg. of DAH per day made the largest financial loss. The other cattle showed consistent losses.

The results of this experiment may have been confounded by an unusually high amount of estrogenic substances found in the grass hay that was fed.

From the results of these trials, definite conclusions cannot be made at the present time regarding the use of 3, 3' diallyldiethylstilbestrol and 3, 3' diallylhexestrol; however, the rate of gain was lower in all lots fed the new derivatives at the level of 15 mg. per animal per day. The rate of gain was increased over controls when diallyldiethylstilbestrol was fed at the 20 or 25 mg. level to steers and heifers.

The only substantial increase in rate of gain for the DAH fed cattle was made by the heifers fed 20 mg. of DAH per day.

The heifers fed DAS or DAH had slightly higher carcass grades than the control heifers, but these additives did not appear to influence the carcass grades of the steers.

The lack of a consistent difference in the weights of the glands collected or in the reproductive organs of the heifers probably indicates that DAS and DAH are low in estrogenic potency.

The results of these trials indicate that diallyldiethylstilbestrol may be beneficial in stimulating feedlot gains of steers and heifers, but because of the lack of a consistent response to diallylhexestrol, recommendations for this product cannot be made at the present time.

Before positive recommendations for diallyldiethylstilbestrol or diallylhexestrol can be made, more tests should be conducted to determine whether they are beneficial and to determine the proper level of usage.

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APPENDIX TABLE I. ANALYSIS OF VARIANCE FOR STEERS FED DAS.

Variation	D.F.	S.S.	M.S.	F
Treatment	4	0.1988	0.0497	0.351
Pre-treatment	1	1.0103	1.0103	7.1399*
Pre X treatment	4	1.5975	0.3994	2.82261*
Error	39	5.5186	0.1415	
Total	48	8.3256		

* Significant at the 5 percent level.

APPENDIX TABLE II. ANALYSIS OF VARIANCE FOR HEIFERS FED DAS.

Variation	D.F.	S.S.	M.S.	F
Treatment	4	0.5154	0.1289	1.4196
Between lots within treatment	5	0.3713	0.0743	0.8183
Within treatment	40		0.0908	
Total	49	4.5190		

APPENDIX TABLE III. ANALYSIS OF VARIANCE FOR STEERS FED DAH.

Variation	D.F.	S.S.	M.S.	F
Treatment	4	0.4856	0.1214	1.9612
Between lots within treatment	5	0.2909	0.0582	0.9402
Within treatment	38	2.3515	0.0619	
Total	47	3.1280		

APPENDIX TABLE IV. ANALYSIS OF VARIANCE FOR HEIFERS FED DAH.

Variation	D.F.	S.S.	M.S.	F
Treatment	4	0.6003	0.1501	2.8374*
Between lots within treatment	5	0.2928	0.0586	1.1078
Within treatment	39	2.0631	0.0529	
Total	48			

* Significant at the 5 percent level.