THE EFFECT OF PROGESTERONE-ESTROGEN IMPLANTS AND DIETHYLSTILBESTROL FEEDING ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF STEERS

By

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ABSTRACT

Livestock feeders and producers have long sought a tool which would reduce costs of production, increase gains, and improve the economic value of the animal product. The administration of estrogens alone to steers has increased the rate of gain but has also resulted in a lowered carcass grade. This study was designed to test the effectiveness of a combination progesterone and estrogen implant as a gain stimulator.

The effects of subcutaneous implantation of 1.5 g. progesterone - 50 mg. estradiol combination pellets was compared with the feeding of 10 mg. diethylstilbestrol and no hormone treatment on 800 pound steers on a fattening ration. Implanted cattle gained an average of 3.03 pounds per day as compared to 2.64 pounds per day for the diethylstilbestrol fed lot and 2.30 pounds per day for the control cattle. Implantation resulted in less feed per 100 pounds of gain than oral diethylstilbestrol treatment and oral diethylstilbestrol treated cattle required less feed per 100 pounds gain than controls. Neither hormone treatment had any effect on shrink in transit, dressing percentage, visceral weight, or hide weight. There were no significant differences in carcass grade but implantation resulted in an increase in muscle mass and a reduction in separable carcass fat. Neither moisture content of fat or lean nor ether extract of *Longissimus dorsi* was affected by treatment. There were no differences in cooking shrink

or tenderness of steaks from the treatments. Both hormone treatments resulted in an enlargement of the prostatic portion of the urogenital tract indicating a systemic effect by oral diethylstilbestrol administration. There was no evidence of desquamation or keratinization of epithelium and no evidence of carcinogenesis in any of the tissue examined from the prostatic region.

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INTRODUCTION

Producers and feeders of livestock have long sought tools which would enable them to reduce their costs of production, increase the rapidity of the cattle gains and produce a livestock product for which processors would pay the highest price.

The processor or packer must realize a high carcass yield and a product which is closely related to the appearance of the live animal in order to pay the highest possible price. The consumer must find the edible portion satisfactory not only in appearance but in tenderness, juiciness and flavor. The meat must be free from any toxic or harmful substances.

Meites *et al.* (1952) implanted progesterone-estrogen pellets in heifers for the purpose of effecting lactation. These workers noticed that there was a marked increase in weight in cattle so treated. Other workers, Clegg and Cole (1954) and Andrews *et al.* (1954), reported that the administration of estrogens alone resulted in an increase in rate of gain but at the same time lowered the carcass grade.

Burroughs *et al.* (1954) reported that the feeding of diethylstilbestrol to steers resulted in an increase in rate of gain. This substance has since been incorporated with supplements for use in commercial cattle feeding operations. However, there have been claims made by various segments of industry that carcasses from diethylstilbestrol fed cattle were lacking in quality and that there was excessive carcass shrink. There have also been reports of an increase in moisture of the lean and a decrease in the intramuscular fat, or marbling.

Henneman _et al._ (1953) and Jordan _et al._ (1955) reported that when progesterone was combined with estrogen and implanted into lambs there were increased gains without lowering carcass quality.

This experiment was designed to investigate the overall effectiveness of the combination progesterone and estrogen implant on both feedlot and carcass characteristics of steers and to compare the effects of this combination implant with the oral administration of diethylstilbestrol.

REVIEW

In a study of bred and non-pregnant heifers, Snapp and Bull (1944) reported that bred yearling heifers produced materially better finished carcasses than open heifers although there was no significant difference in rate of gain. These carcasses contained 20% more fat than open heifers but there was no significant difference in carcass grade, which indicated perhaps, that the affect of pregnancy did not appreciably effect indications of quality in the muscling itself and may have resulted in undesirable side effects on the conformation. Meites, _et al_. (1952) administered progesterone-estradiol pellets to heifers for the purpose of effecting lactation, but also noticed a marked increase in weight in these treated cattle.

MODE OF ACTION

The physiological action of exogenous estrogenic substances in the animal is not clear. Clegg and Cole (1954) concluded from blood eosinophil studies that diethylstilbestrol causes an increased release of ACTH from the ruminant pituitary which, in turn, brings about adrenal cortical stimulation.

Contrasting evidence is seen in observations on anterior pituitary growth hormone content of heifers and steers, as reported by Clegg and Cole (1954). The amount of growth hormone in the glands of diethylstilbestrol implanted heifers was approximately twice that of untreated control heifers where but little difference was noted in rate of gain. The steers, on the other hand, showed little difference in anterior pituitary growth hormone content while having a markedly increased rate of gain. These workers noted, however, that in all cases the pituitary glands of the treated steers were significantly larger than the controls and that gland size, or hormone content, was not necessarily indicative of secretion rate. Ellison and Birch (1936) noted that atrophy of the adrenals and thyroid occurring as a result of long time castration can be repaired by the injection of estrogens. Since the atrophy of these glands resulting from hypophysectomy cannot be similarly repaired, these workers assumed that the effect of estrins on the adrenals in the castrate is due to a release of the stored hypophyseal secretion. Thus, estrogen stimulates the pituitary in some manner.

It appears evident that the adrenal plays some role (at least is affected) in the endocrine effect of exogenous estrogenic substance in livestock. According to Dorfman (1955), progesterone is important as an intermediate in corticoid biosynthesis. Corticosterone and desoxycorticosterone are derived by biosynthetic hydroxylating reactions from progesterone. Ellison and Birch (1936) noted that in rats receiving large estrogenic dosages there was a widening of the adrenal cortex $1\frac{1}{2}$ to 2 times the width of the cortex in glands of castrate animals, and in many instances it was wider than the cortex in noncastrate controls. The fascicularis and reticularis were markedly increased in width and contained hypertrophied cellular elements. There were relatively numerous mitoses in hormone treated animals.

Support for the theory of Clegg might be substantiated by the observation of Ellison and Birch (1936) that there were no adrenal effects noted in estrogenic hormone treated animals which had been hypophysectomized prior to treatment. Further endorsement of adrenal effect was shown by Cahill et al. (1954) who reported that the gross weight of the adrenals increased in steers implanted with 105 mg. diethylstilbestrol. They also noted an increased pituitary weight in both steers and bulls.

Similar responses have been noted in sheep by Clegg et al. (1955) who observed significantly larger adrenal and pituitary weights in lambs implanted with diethylstilbestrol. The enlargement of the cowpers, seminal vesicles and prostate glands in estrogen treated wethers as observed by Clegg et al. (1955) is suggestive of androgenic activity.

The presence of both androgenic and estrogenic substances in normal males has been demonstrated by Emmens and Parkes (1947) who stated that there is an excretion of estrogen in normal males although in less degree than in females. They noted that estrogen is also produced by the adrenal in the form of estrone. In many respects, the biological actions of progesterone resemble those of androgens according to Burrows (1949). He stated that androgens caused progestational changes in the uterus, prolongation of gestation and a prevention of abortion after spaying. Similarly, progesterone caused a notable increase in weights of the prostate and seminal vesicles and in the height of the epithelial cells.

The estrogens and androgens share with many other steroids the property of reducing the excretion of sodium and of causing water retention, according to Gaunt *et al*. (1949). They concluded that probably all steroid hormones affect salt and water metabolism in some way. Winter (1952) stated that a relationship exists between adrenal cortical hormones and water balance in the body. Gaunt *et al*. (1949) stated that the hormones of the adrenal cortex may cause either a water retention or an acceleration of water excretion. These workers also noted that after chronic administration, progesterone enhanced water exchange in both normal and hypophysectomized rats. Estrogens have been shown to be specific in modifying the water content of the uterus, but not that of the liver nor skeletal muscle of the rat, according to Weisberg (1953).

The route of administration of steroid substances to an animal to obtain a desired response is of importance. Emmens (1950) stated that natural estrogens are readily absorbed in the intestine, but when ingested they exert relatively little estrogenic activity, owing to oxidation and conjugation in the liver. He stated that the liver can reversibly oxidize estradiol to estrone and to other products and it secretes estrone into the bile. When suspended and injected, estrogens are rapidly absorbed and the administration of excessively large doses effects little prolongation of this transient action, according to Emmens (1950).

As will be noted later, the implantation of pellets composed of estrogenic substances has resulted in prolonged levels of estrogenic activity in both sheep and cattle. Emmens (1950) stated that certain synthetic estrogenic-like substances, namely: diethylstilbestrol, hexestrol and dienestrol do exert an effect when administered orally. He postulated that these synthetic estrogens are not themselves estrogenic but exert their effects after metabolic transformation in the body.

EFFECT OF HORMONE TREATMENT ON FEEDLOT PERFORMANCE

Many reports have substantiated the capacity of exogenous estrogen treatment to stimulate rate of gain in slaughter cattle.

In experiments with implantation of diethylstilbestrol in steers, Clegg and Cole (1954) (60 and 120 milligrams), O'Mary _et al._ (1956) (36 milligrams), Clegg and Carroll (1956) (60 milligrams), Cahill _et al._ (1954) 105 milligrams implanted twice) have shown significant increases in rate of gain over control steers. It is also interesting to note the range in dosage used by these workers which produced gain stimulus. The implantation of 80 milligram pellets of dienestrol improved gains in steers according to Andrews _et al._ (1954).

The effect of diethylstilbestrol implants (60 milligrams) in heifers was reported by Clegg _et al._ (1954) to cause relatively less response in rate of gain than was shown in steers. It required a second 60 milligram implant 66 days after the original implant to cause a significant increase in rate of gain. They concluded that heifers require more than 60 milligrams of estrogen implant to produce a distinct response. However, Clegg and Carroll (1956) reported a significant increase in the rate of gain of yearling crossbred heifers which had been implanted with 60 milligrams of diethylstilbestrol. They also noted that spaying of heifers had little effect on their response to diethylstilbestrol implantation when compared with intact implanted heifers. Dinusson et al. (1950) concluded that the rate of gain was proportional to the amount of estrogen present when they compared 500 pound heifers which were spayed, intact, and implanted with 42 milligrams diethylstilbestrol. It is of interest to note that the spayed heifers gained significantly less than the intact control heifers.

The effect of estrogens alone in stimulating rate of gain is clear but their use has resulted in lowered carcass quality in cattle and lambs. However, recent work with lambs, Henneman et al. (1953), Jordan et al. (1955), have shown that when estrogens are combined with progesterone, a greater stimulation of gain was noted than with estrogens alone. Pincus and Zahl (1937) noted that when progesterone was combined with estrogen there was an increase in recoverable urinary estrogen as compared to estrogen administration alone and they theorized that progesterone gives estrogen partial protection against destruction. Combination implants in lambs showed marked stimulation in gain over non-treated animals according to Andrews et al. (1956). In contrast with these results, Jordan (1953) reported that lambs implanted with diethylstilbestrol alone gained more than those treated with a combination of progesterone-diethylstilbestrol when on a fattening ration. The application of this combination treatment to cattle was perhaps first suggested by the observation of Meites et al. (1952) that heifers implanted with progesterone-estrogen to induce lactation, also showed marked increases in weight and finish. It has been reported by Luther *et al.* (1954) that the combinations of 1500 milligrams progesterone and 50 milligrams estradiol; 300 milligrams testosterone and 50 milligrams estradiol; 1500 milligrams progesterone and 50 milligrams diethylstilbestrol; implanted subcutaneously in 800 pound Hereford steers resulted in a 42-48% increase in rate of gain over controls. A combination implantation of 60 milligrams diethylstilbestrol and 200 milligrams progesterone resulted in a significant increase in gain over control steers according to Andrews *et al.* (1954). These workers also illustrated the importance of the route of administration as shown when 120 milligrams dienestrol and 300 milligrams progesterone administered intramuscularly as a semi-solid injectable base produced no overall stimulus in gain. However, there was a stimulation during the first two months which indicated a lack of prolonged effect by this treatment.

That the oral administration of synthetic estrogens will stimulate rate of gain was shown by the reports of Andrews *et al.* (1955), with 10 milligrams diethylstilbestrol per day to 450 pound calves and Burroughs *et al.* (1955), with 5-10 milligrams diethylstilbestrol per day to yearling steers and heifers. Burroughs *et al.* (1955) reported that heifers did not show as great a degree of response as steers when the same dosage of diethylstilbestrol was fed. These workers claimed that the response to oral diethylstilbestrol is equally as effective the last half of the feeding period as it was the first half (from five experiments ranging from 112 to 168 days in length). This was not shown to be the case, however, in experiments with oral diethylstilbestrol by Perry et al. (1955) who noted the greatest response the first 28 days and Beeson et al. (1956) who noted that increase in growth rate was greatest on 750 pound cattle during the first 98 days of the 179 day test. Dienestrol and hexestrol, when fed at the same rate as diethylstilbestrol (10 milligrams per day), did not produce as rapid gains as diethylstilbestrol but produced as efficient a gain response, according to Andrews et al. (1955). The oral administration of diethylstilbestrol to lambs has shown somewhat less striking effects as reported by Jordan et al. (1955). The substance was fed at the rate of 0.1 milligrams, 0.5 milligrams and 1.5 milligrams per head per day and showed no significant stimulus. When Henneman (1955) fed diethylstilbestrol to lambs at the rate of 3 milligrams per head per day, he observed that there was a significant increase in gain.

It is often assumed that cattle making more rapid gains are more efficient in the utilization of feed. Greater feed efficiency has usually accompanied hormone administration according to Andrews et al. (1955) and Burroughs et al. (1955) with oral synthetic hormone administration; Luther et al. (1954) with combination estrogen progesterone implants; and Dinusson et al. (1950) with 42 milligrams diethylstilbestrol implants. But as reported by these workers, hormone treatment also resulted in increased appetite and feed consumption, which led to the speculation as to whether these treatments were solely a principle of increased feed intake. Dinusson et al. (1950) converted feed consumption to a TDN basis and then corrected to a constant level by means of covariance analysis. They reported that, although differences in gains of treated and control groups were significant at the 1% level, when TDN was corrected to a constant level the differences in gain were not significant. Thus, the increased gains were due mainly to greater feed consumption. However, Beeson _et al._ (1956) observed that feed consumption was "virtually the same for all lots, therefore, indicating an obvious increase in efficiency" in the lot receiving 10 milligrams diethylstilbestrol per day, in the lot receiving 5 milligrams diethylstilbestrol plus 50 milligrams testosterone, and in the lot receiving 175 milligrams testosterone per day. Whitehair _et al._ (1953) reported that the implantation of 24 milligrams of diethylstilbestrol into lambs had no apparent effect on the digestibility of major nutrients of the ration other than a slight increase in the digestibility of the crude fiber. Perry _et al._ (1955) found that faster gains were made with diethylstilbestrol feeding without an increase in feed consumption. These results indicated an increased efficiency in utilization of feed consumed. However, Richardson et al. (1955) noted that there was a significant lowering of digestibility when 10 milligrams of diethylstilbestrol was fed daily to 450 pound steer calves, although there were increased gains.

The stability of synthetic estrogen in the rumen was studied by Cheng and Burroughs (1954), who reported that when diethylstilbestrol was incubated aerobically with rumen fluid for 24 hours at 40°C, a considerable loss was observed. They concluded that since the rumen is primarily anaerobin, no appreciable amount of diethylstilbestrol is lost in the forestomach when fed to cattle or sheep.

The adaptation of hormone treatment to broad types of feeding programs is of considerable economic and practical significance. Klosterman _et al._ (1955) reported that with diethylstilbestrol treatment, reduction in the amount of protein fed resulted in a lower rate of gain. Burroughs et al. (1955) reported that steers receiving oral diethylstilbestrol (5 milligrams per day) on a high roughage ration plus 2.5 pounds corn and 1 pound supplement responded almost as well as cattle on a high grain fattening ration. Similarity of response on pasture without supplemental feeding was obtained by O'Mary and Cullison (1956), who reported that 24 milligrams diethylstilbestrol implants in 600-650 pound steers resulted in a significant increase in gains. Conversely, Clegg and Cole (1954) found that steers and heifers implanted with 60 and 120 milligrams diethylstilbestrol and grazed on irrigated pasture without supplementary feeding did not make a significant increase in gain over controls. However, when they supplemented 2 year old steers on pasture with 5 pounds of rolled barley per head per day, noticeably better gains were made over non-implanted controls. They concluded that sufficiently high energy nourishment must be supplied if growth response is to be recognized.

While some major differences in response have occurred between the species, it is of interest to note that Wilkinson _et al._ (1954) reported that hormone treatment appeared to be as effective for lambs on pasture as it was for those on a high concentrate ration. This was also observed in lambs by Clegg et al. (1955). Light et al. (1956) investigated the use of urea as a source of nitrogen for lambs and found that the feeding of diethylstilbestrol produced significantly greater gains when urea provided up to 41% of the protein equivalent of the ration. They found no interaction between the type of protein and diethylstilbestrol. Luther et al. (1954) reported that improvement of rate of gain of lambs implanted with 250 milligrams progesterone and 10 milligrams estradiol was independent of ration, sex, implant time, weight of animal and initial live grade. Richardson et al. (1955) studied the effects of feeding diethylstilbestrol to 450 pound steer calves during a wintering period and noted no significant differences in gain and that many diethylstilbestrol treated animals developed high tail heads and weak backs. However, when Andrews et al. (1955) fed 10 milligrams diethylstilbestrol per day to heifer and steer calves on a fattening ration, they produced .47 pound more gain per animal per day. With heavier cattle, Burroughs et al. (1955) reported increases in gain from 1000 pound cattle which were fed diethylstilbestrol.

The administration of so-called female hormonal substances to steers has resulted in the development of some undesirable side effects, as reported by O'Mary et al. (1956), who noted that there was a significant depression of the topline, as estimated by scoring in steers implanted with 36 milligrams of diethylstilbestrol. Bell et al. (1954) noted an increase in teat length in diethylstilbestrol fed steers which was 2 to 4 times that of the control steers. Oral diethylstilbestrol treatment of cattle produced no undesirable side effects, such as, mammary development, high tail heads, or relaxation of the muscles in the sacral lumbar region according to Burroughs et al. (1955). These results were not substantiated by Richardson et al. (1955) who noted that many 450 pound steer calves fed 10 milligrams diethylstilbestrol per day developed high tail heads and weak backs. Andrews et al. (1955) reported that steer and heifer calves receiving oral diethylstilbestrol, dienestrol, and hexestrol exhibited mammary development, and enlargement of the vulva was observed in the heifers.

In lambs, certain undesirable conditions have followed administration of estrogenic substances. The most common effects were prolapse of the rectum, Jordan et al. (1955), and stimulation of mammary development, Andrews et al. (1956). Bell, et al. (1955) investigated the effects of Synovex pellets (progesterone-estradiol implants) and diethylstilbestrol pellet implantation on lambs. They noted that all lambs receiving hormones and particularly the lambs receiving the progesterone-estradiol implant carried their tails higher and showed swelling in the rectal region.

There is little agreement in the results of hormone treatment on shrink in transit. Beeson et al. (1956) noted that diethylstilbestrol fed steers had slightly less transit shrink than controls. However, Andrews et al. (1956) reported that in lambs shipped the same distance as reported by Beeson et al. (1956), the diethylstilbestrol fed and dienestrol fed lambs had a higher transit shrink than controls.

SLAUGHTER PERFORMANCE

Clegg and Cole (1954) reported no differences in dressing percentage as a result of implantation of diethylstilbestrol at both 50 and 120 milligram levels in cattle. They also reported no differences in dressing percentages of lambs receiving either 12 or 24 milligram pellets of diethylstilbestrol. O'Mary et al. (1956) also reported no effect on dressing percentage with 36 milligram diethylstilbestrol implants. However, a decrease in dressing percentage was noted by Clegg and Carroll (1956) of heifers treated with 60 milligram pellets of diethylstilbestrol. A decrease in hot dressing percentage was noted in lambs which were implanted with 12 milligrams diethylstilbestrol and in lambs which were fed diethylstilbestrol by Jordan et al. (1955). The lot of lambs treated with Synovex pellets (250 milligrams progesterone - 10 milligrams estradiol) did not show any difference in dressing percentage from the nontreated control lambs according to Jordan et al. (1955). But the same dosage of progesterone-estradiol lowered dressing percentage 2% in lambs as reported by Luther et al. (1954). Bell et al. (1955) reported that hormone treated lambs implanted with either diethylstilbestrol or diethylstilbestrol-progesterone yielded between 3.5 and 4.0% less than control lambs.

The cooler shrink (hot to cold carcass) of carcasses from cattle implanted with 60 milligrams diethylstilbestrol was not different from that of control carcasses according to Clegg and Cole (1954). They reported that the implantation of 60 milligrams diethylstilbestrol resulted in a greater percentage of lean, a greater eye muscle (L. dorsi) area, and a smaller proportion of fat. However, there was no difference in the "moisture of the lean". There was also a smaller percentage of ether extract. They observed that fecal nitrogen remained unchanged, whereas urinary nitrogen decreased, thus indicating a true nitrogen storage. Treatment doubled nitrogen storage - probably in the form of protein. Similarly, Whitehair et al. (1953) noted a 38% increase in nitrogen retention in lambs implanted with 24 milligrams diethylstilbestrol. This was accompanied by a marked decrease in urinary nitrogen excretion indicating increased efficiency of utilization of absorbed nitrogen. Heifers implanted with 60 milligrams diethylstilbestrol produced carcasses which had larger eye muscle, containing less ether extract and more moisture, according to Clegg and Carroll (1956).

PHYSIOLOGICAL EFFECTS

Observations on blood composition in estrogen treated animals showed that treated lambs had the ability to maintain plasma protein levels and, with decreased plasma non protein nitrogen, indicated a more efficient utilization of absorbed nitrogen according to Wilkinson et al. (1954). Blood phosphorus did not show as rapid a decline in hormone treated beef heifers as in control, intact, or spayed heifers as reported by Dinusson et al. (1950). These workers stated that with increasing age there is normal decline in blood phosphorus. Dinusson et al. (1950) also noted that blood lipids were highest in the spayed heifers - the slowest gaining group. No significant differences in blood serum Ca were noted by these workers. Whitehair et al. (1953)

noted a marked decrease in the amount of calcium excreted in both the feces and urine of lambs implanted with 24 milligrams diethylstilbestrol. Treated lambs retained nearly 60% more calcium. These workers also noted a 30% increase in phosphorus retention in treated lambs, which was in agreement with the results of Dinusson _et al._ (1950) with beef heifers.

Wilkinson _et al._ (1954) noted a significant increase in total liver dry matter in implanted lambs except when molasses was added to the basal ration. "This was probably due to hypertrophy which resulted from the extra work of detoxification of the implanted diethylstilbestrol". Increased liver weights were noted in both diethylstilbestrol implanted lambs and lambs receiving combination diethylstilbestrol-progesterone implants according to Bell _et al._ (1955). They also noted larger kidneys and hearts in treated lambs, but these workers also reported the administration of estrogens caused hypertrophy of the accessory sex glands. According to Emmens and Parkes (1947), daily injections of one milligram of estrone caused extensive growth of the smooth muscle of the prostate and seminal vesicles and a decrease in glandular tissue. "No growth of the vesicular lumen occurred." According to Burrows (1949) androgens cause enlargement and secretory activity of the prostatic epithelium. In cattle, Clegg and Cole (1954) noted that the implantation of 60 milligrams of diethylstilbestrol for 104 days resulted in an increase in the seminal vesicle weights of treated animals. Histological examination of the treated cattle showed that there were columnar epithelial cells as contrasted to somewhat low cuboidal type epithelial cells in the untreated group. The administration of male sex hormones to the castrate rat increased the height of the epithelial cells according to Turner (1955). Observations by Clegg and Carroll (1956) on secondary sex glands of steers which had been implanted with 60 milligrams diethylstilbestrol showed a stimulation of epithelial cells as well as an increase in fibrous tissue, thus, indicating a presence of both male and female activity resulting from diethylstilbestrol treatment alone. Emmens and Parkes (1947) stated that estrogens (estradiol) promoted the development of smooth muscle in the seminal vesicles of young castrated rats. They also noted that daily injections of 1 milligram or more of estrone caused extensive growth of the smooth muscle of the prostate and a decrease in glandular tissue. No growth of the vesicular lumen occurred.

Ruliffson *et al.* (1954) noted that, with the implantation of lambs, male tissue may be enlarged to such an extent as to cause death due to the prevention of urination. They concluded that this enlargement may be caused by the direct action of diethylstilbestrol but that it is more likely caused by male-like hormones (neutral 17-ketosteroids) probably secreted by the adrenal glands under the influence of ACTH. This conclusion was strengthened by the fact that they observed a marked increase in the 17-ketosteroids in the urine of treated lambs. This accessory sex gland enlargement has been noted by others, namely Wilkinson *et al.* (1954) and Clegg *et al.* (1955). Bell *et al.* (1955) reported that the increase in size of accessory sex organs in wether lambs implanted with progesterone-estrogen combination was generally associated with the size of the dosage.

CARCASS CHARACTERISTICS

Carcass grade was reduced by implantation of 60 or 120 milligrams diethylstilbestrol in steers according to Andrews et al. (1954). It should be noted that these workers removed cattle from test at two different times, marketing the heavier cattle first and that all highest grading cattle were in the group marketed last. Clegg and Carroll (1956) noted somewhat lower carcass grade in steers implanted with 60 milligrams diethylstilbestrol and an even more apparent grade reduction in carcasses from yearling heifers which had been implanted with the same dosage. However, when lower level diethylstilbestrol implants (36 milligrams) were used, O'Mary et al. (1956) obtained no significant differences in carcass grades. Clegg and Cole (1954) noted that a greater percentage of the higher grades was consistently found in the untreated animals in both steers, heifers and ewe lambs when compared with the implanted animals. Treated and control animals were fed the same length of time. One of the advantages claimed by Burroughs et al. (1955) for the use of oral diethylstilbestrol is that it does not lower carcass grade. However, Perry et al. (1955) noted that diethylstilbestrol fed steers produced carcasses that were slightly inferior to those from either dienestrol or hexestrol fed lots and especially from the control lot. Kastelic et al. (1956) studied carcass characteristics from cattle fed varying levels of diethylstilbestrol. They noted that correlations of carcass characteristics of animals within lots with rate of gain were higher than those for carcass characteristics with levels of diethylstilbestrol fed. Regardless of the amount of diethylstilbestrol fed, they reported that there was larger variation in carcass characteristics among animals within lots than there was between lots. They noted that the average daily gain was positively correlated with the fat content of the 9-10-11 rib cut and with carcass grade. There was a significant positive correlation in one trial between rate of gain and carcass grade. Studies by Henneman et al. (1953) with lambs given a combination progesterone-estradiol implant showed that the carcasses produced were not significantly different from controls. A highly significant correlation was obtained by Henneman (1954) between days on feed and carcass grade. This statistic would indicate that the increased growth rate of the hormone treated lambs coupled with a lower carcass grade was due to an increase in scale without an increased rate of feeding. At this point, it may be noteworthy to review the theory set forth by Hammond (1932) that different anatomical regions and tissues grow differently and in a definite order of development in the sheep. The dressed carcass as a whole was found to be later maturing than the visceral organs and parts. The major tissues of the carcass exhibited a marked differential rate of growth with increasing age. The order of decreasing growth (fastest to slowest) followed an outward trend from the central nervous system to bone tendon, muscle, intermuscular fat, and finally, subcutaneous fat. In reference to this theory, Wilkinson et al. (1955) concluded that diethylstilbestrol hastened the development of the earlier maturing tissue and retarded the development of the later maturing tissue. They stated that the retardation of the late maturing tissue may be brought about by the increasing utilization of nutrients by the earlier maturing tissue. The priority of earlier maturing tissue for available nutrients appears to be enhanced by estrogen.

The effect of limited feeding on lambs treated with diethylstilbestrol pellets offers considerable insight into the mechanism of action which takes place when an animal is treated with estrogens. As reported by Wilkinson *et al.* (1955), limited fed treated lambs did not show the increase in carcass development which was shown by the full fed treated lambs. The visceral development was greater in the limited fed treated lambs which lent support to the concept or theory of priority of nutrients for earlier maturing tissue. Limited fed treated lambs showed greater eye muscle cross sections after 49 days on feed but not after 84 days on feed. Full fed treated lambs did not show this decreased development effect. Thus, these workers concluded that in limited fed lambs, the stimulus for muscular growth brought about by the hormone was apparently limited by the nutritional adequacy of the ration. The stimulus was great enough in the early stages of the experiment to produce muscular development at the expense of the adipose tissues, particularly sub cutaneous fat. It was noted that limited fed treated lambs showed less subcutaneous fat at both 49 and 84 day intervals whereas full fed treated lambs showed less subcutaneous fat at only the 49 day period. Thus, the possibility existed that the subcutaneous fat deposition was not delayed as long in the full fed lambs when sufficient nutrients were available for the demanded muscular development.

Jordan *et al.* (1955) found that there was very little difference in carcass grade between Synovex treated lambs and controls even though the Synovex lambs gained significantly faster. However, those lambs which received diethylstilbestrol implants produced lower grading carcasses. Clegg and Cole (1954) observed the following reasons for lower grades in the treated carcasses:

(1) The muscle fibers were larger and had a more coarse appearance. The color of the meat was a darker red than the characteristic pink appearing meat of the controls.

(2) The extent of fat infiltration between the muscle fibers, known as marbling, was distinctly less.

(3) The amount of both internal and external fat deposition was considerably reduced.

(4) The shoulders and rounds were heavier but the loins were lighter than the controls.

(5) The conformation was atypical. Carcasses appeared similar to that of stags, being softer in the flank, and lacked outside covering and showed less fat.

Henneman et al. (1953) reported that lambs treated with a combination progesterone-estradiol implant had a two percent higher moisture content in the external fat than non treated lambs. Bell et al. (1955) reported quite different results on carcass grade with the progesterone-estradiol implant as compared with oral diethylstilbestrol treated lambs and with lambs implanted with diethylstilbestrol. They noted in one test that all hormone treated lambs produced carcasses grading nearly a full grade less than untreated lamb carcasses. In another test, lambs receiving a progesterone-estradiol implant and lambs receiving diethylstilbestrol orally produced lower grading carcasses than untreated lambs and lambs receiving 15 milligram diethylstilbestrol implants.

Bell *et al.* (1955) investigated the tenderness, juiciness, palatability and cooking loss of legs from implanted and control lamb carcasses. They found no consistent differences between lots in these factors.

CARCASS HORMONE RESIDUAL CONTENT

Turner (1956) utilized the ovarectomized mouse uterine weight response technique to detect any estrogenic activity in various tissues of animals fed diethylstilbestrol. No detectable residual estrogen was found in edible red meat, rib-eye, neck trimmings, tongue, liver, heart, spleen and brain. However, the kidneys showed evidence of 4 parts per billion of residual estrogen, and lungs indicated 10-12 parts per billion. Turner also reported that dairy cattle fed 10 milligrams diethylstilbestrol showed as much estrogenic activity in the dried feces as was present in the feed. Preston *et al.* (1956) used the uterine weight response of intact immature mice to estimate residual estrogenic activity in carcasses from cattle fed diethylstilbestrol. They concluded that no detectable estrogenic residues were found in lean, fat, liver, heart, kidney or pooled offal organs. Twombly (1951) found that C^{14} labelled diethylstilbestrol was not found to be significantly concentrated after 10 and 21 hours in the mammary gland, mammary cancer, the uterus, adrenals, or pituitary of the dog, rabbit or mouse. Livers were found to contain 1% to 5% of the radioactivity and the kidney contained 1.7% of the administered radioisotope.

Residual estrogens were found by Stob *et al.* (1954) in the meat of carcasses of steers, lambs, and chickens which had been implanted with synthetic estrogens. They noted estrogenic activity in muscle and liver of steers but only in muscle of lambs. They presented a series of conclusions which are included in the following paragraph.

First, there was no demonstrable effect of site of hormone implantation on the amount of hormone retained in the edible tissue. Secondly, species differences in amount of hormone present were probably a function of time lapse after treatment of animals. Poultry tissue residues were markedly reduced with time, whereas in lamb tissue the loss was slight. Third, the greater the amount of hormone used, the greater the residual retained. Fourth, the type of hormone used had no effect on the residual amount in muscle tissue. Fifth, heat *per se* (150°C for two hours), had no effect on the hormone.

PROCEDURE -

The development of the project encompassed three separate feeding trials.

TRIAL I

Sixteen Hereford steers averaging about 600 pounds were selected from a previous alfalfa brome vs. grass hay experiment and divided as equally as possible into two lots according to previous gain, weight, grade (finish) and type. Each lot contained equal numbers of animals from each previous treatment group. One lot remained as a control and on May 22, 1952, each steer in the second lot was implanted subcutaneously in the neck with 10 pellets containing 1000 milligrams progesterone and 100 milligrams of diethylstilbestrol. Implantation was accomplished in a squeeze chute by making an incision in the hide posterior to the ear with a scalpel, and inserting under the hide a small trocar-type instrument which contained one dosage. The incision was sutured. Each pellet dosage was weighed prior to its implantation in order to obtain an estimation of absorption.

Four steers from each lot were placed on alfalfa brome pasture and the remaining 8 steers (4 from each lot) were put on bluegrass pasture. On August 13th, all pellet residues from the original implantation were removed and then these previously treated cattle were reimplanted with a similar pellet dosage. A supplemental feeding of 12 pounds of corn and 1.5 pounds of soybean oil meal was started in both lots and continued through December 11, 1952. It was necessary to drive all cattle from pasture lots to the experimental barn for weighing (approximately 1 mile). Cattle were weighed individually off test at 3:00 P.M. December 11, 1952, and then trucked to a local slaughter plant and slaughtered on December 12, 1952. Individual weights were taken at 6:00 A.M. prior to slaughter. Live shrink was based on the difference between these two weights.

Attempts were made to recover pellet residues from all cattle at the time of slaughter. The recovered pellets were washed, dried and weighed.

The weight of the full and empty digestive tract of each animal was obtained. The greater and lesser omentum were first removed and weighed. The rumen, reticulum and abomasum were weighed full, emptied and reweighed. The omasum was not emptied. The entire intestinal tract was weighed intact with the mesentary attached. Carcass weights were taken immediately after dressing before shrouding and again 48 hours later. Dressing percentage was based on Michigan State University weights off test December 11 and chilled carcass weights. Carcass grades to the nearest one-third were based on the ribbed carcasses with the characteristics of the rib-eye being taken into consideration in designation of grade. All carcasses were graded by a Federal grader.

Reports of elevation of the tail head in hormone treated cattle prompted the measurement of the conjugate diameter of the pelvic inlet. One measurement was made at the dorsal surface of the anterior portion of the acetabular branch of the pubis on a line perpendicular to the ventral surface of the sacrum. A second measurement was made at the dorsal surface of the posterior segment of the pubic symphysis on a line perpendicular to the ventral surface of the sacrum. Both sides of each carcass were measured.

A wholesale 7-rib cut was removed from each carcass at the packing plant according to the method of Hankins and Howe (1946). These were returned to the Meats Laboratory where the 9-11 rib cut was removed according to the procedure of Hankins and Howe (1946) and frozen for later division into separable fat, separable bone and separable lean. The 9-10-11 rib cut has been shown to be a reliable estimate of entire carcass fat, lean and bone by Hankins and Howe (1946). The following regression equations established by these workers were applied to convert the 9-10-11 rib components to a carcass basis:

$$\text{Lean} \quad Y = 16.08 + .80\ x$$

$$\text{Fat} \quad Y = 3.54 + .80\ x$$

$$\text{Bone} \quad Y = 5.52 + .57\ x$$

All chemical analyses of percent moisture, percent ether extract, iodine number and protein were conducted according to the modifications by Benne (1955) of Association of Official Agricultural Chemists' methods.

External fat was removed from the rib section, then tightly packed in bottles and stored at $0^{o}F$ for moisture determination. Another external fat sample from each animal was ground twice through a 3/32" plate and then heated in a water bath to render fat from the non-fat material. This rendered fat was poured into bottles, sealed and held at $0^{o}F$ prior to the determination of the iodine number. Composite samples of lean from all the carcasses in each treatment group were prepared by combining the Longissimus dorsi and separable lean from the rib sections from all carcasses in each group and then grinding this lean three times through a 3/32" plate. Two samples were obtained from this material, sealed in glass jars and stored at 0°F prior to laboratory analysis. Determinations for moisture, ether extract and protein were made on these composite samples.

TRIAL II

On February 6, 1953, a group of 16 Shorthorn steers from a previous silage feeding experiment were paired as to previous rate of gain, weight, grade (finish), and general type, and placed in two lots. Each lot contained two animals from each of four previous treatment groups. The cattle were weighed individually on February 10 for the initial test weights. All cattle in one lot were implanted subcutaneously in the neck with pellets containing a total of 3 grams progesterone and 100 milligrams diethylstilbestrol on February 13, 1953. There was no subsequent implantation during the 76 day treatment period. Implantation was performed as described in Trial I. Pellets in four of the eight implanted steers also contained 30 milligrams of compound F (17-hydroxy-corticosterone) in order to study the effectiveness of this substance in minimizing the development of connective tissue around the pellets. Weights of each pellet dosage recovered were obtained for absorption information. The dry-lot feeding program included soybean oil meal at a constant rate, ground shelled corn, corn silage and trace mineral salt, The corn ration was started at the rate of four pounds per day and was gradually increased until the cattle were thought to be at their maximum daily corn consumption. All cattle were initially fed corn silage at the rate of 37 pounds per day and then the silage fed was gradually reduced as the amount of corn in the ration was increased. In the event either lot left large quantities of feed in the bunk by the subsequent feeding time, this feed was removed, weighed and entered into the overall feed consumption records. On April 3, the supplement was reduced to 2.4 pounds per day in the control lot and to 2.7 pounds per day in the implanted lot. At this time, the control steers were averaging 26.2 pounds of silage per day and 13.2 pounds of corn, whereas the implanted steers were averaging 26.2 pounds of silage per day and 15.0 pounds of corn per day. Both lots remained on these respective rations for the remainder of the feeding trial. Individual weights were taken on April 26, 27 and 28 and the average of these three day weights used as a final weight in calculating feedlot performance.

During the experiment, one of the steers in the implanted lot developed a swollen area in the neck around the site of implantation and the steer eventually became lame and unthrifty which necessitated its removal from the experiment. Feed consumption data were then adjusted for the entire period to account for the estimated feed consumption of this animal during the period it was on test.

All cattle were weighed early on the morning of April 29 and then trucked to a local packer for slaughter on this date. Weights were taken just prior to slaughter.

Pellets were removed from the neck region of implanted cattle following removal of the head and opening of the hide over the neck. Pellets were then returned to Michigan State University where they were washed, dried and weighed.

Slaughter data were obtained exactly as described in Trial I. Hot carcass weights were taken on the slaughter floor and cold carcass weights were taken approximately 60 hours later. Dressing percentage was calculated by using live cattle weights immediately prior to slaughter (slaughter weights) and chilled carcass weights. Carcasses were graded ribbed by a Federal grader, with rib eye (*Longissimus dorsi*) characteristics considered in the designation of grade. The rib samples were taken and prepared for physical and chemical analysis as described in Trial I with the following modification. Composite samples of lean were prepared from all choice carcasses and all prime carcasses within each treatment group and analyzed separately according to this classification.

TRIAL III

In this trial, yearling Hereford steers from a previous feeding trial were divided on December 3, 1954, into 3 lots of 14 steers each on the basis of previous gain, weight, type and grade. For a period of 140 days, starting on December 3, 1954, all lots were fed 1.5 pounds of protein supplement and 20 pounds of corn silage per steer per day. Ground shelled corn was fed according to appetite. The protein supplement was made up of the following: soybean oil meal, .50 pound; urea, .087 pound; limestone, .20 pound; trace mineral salt, .05 pound; and ground shelled corn, .663 pound. One lot received no hormone treatment and served as a control lot. A second lot received 10 milligrams diethylstilbestrol in the supplement.

The drug-containing supplement was prepared by dissolving diethylstilbestrol crystals in ether and mixing this substance in corn oil at the rate of 760 milligrams of diethylstilbestrol per 100 milliliters corn oil. The ether was removed by the moderate application of heat. This corn oil solution was mixed into the supplement by progressive dilution in which the oil was added to 2 pounds of supplement by means of a small rotary mixer, and then mixed with 8 pounds of supplement to form a total of 10 pounds of pre-mix. The pre-mix was incorporated into 90 pounds of supplement in a cone type feed mixer which produced 100 pounds of supplement that contained 670 milligrams of diethylstilbestrol. When fed at the rate of 1.5 pounds per day, a total of 10 milligrams of diethylstilbestrol was supplied per steer. The supplement, corn and silage were thoroughly mixed when put into the feed bunks.

All cattle in the third lot were confined in a squeeze chute and implanted subcutaneously medial to the maxilla. Implanting was accomplished as described in Trial I. Each steer received 10 pellets which contained a total of 1.5 grams progesterone, 50 milligrams estradiol, 75 milligrams carbowax and 5 milligrams of magnesium stearate.

In order to compensate for the stress incurred during the implantation process, all animals in the other two lots were subjected to the same procedure excepting actual implantation.

The treatment was started on January 31, 1955. However, a short circuit in one of the electric water heaters caused two lots of steers to refuse feed on the regular treatment weigh day of January 28. Therefore, weights of the previous regular weigh day, January 14, were used in calculation of feedlot performance. All weighing was done at approximately the same time of the day.

The cattle were weighed off test on three consecutive days - the average of the three weights was used as the off test weight. All steers were taken off feed April 23 and trucked to Detroit early the following morning. Individual weights were recorded after arrival in Detroit. The cattle were graded by two graders in the Detroit stockyards and the average of the two scores were used as live slaughter grade. All cattle were killed on April 25 at which time carcass data were collected in the same manner as reported in Trial I. There was a chilling period (hot to cold carcass) of approximately 40 hours. Dressing percentage was based on live weights at Detroit and chilled carcass weights. Carcasses were graded ribbed by a Federal grader and rib-eye characteristics considered in designation of grade. Measurements of the conjugate diameter of the pelvic inlet were also made as described in Trial I. Wholesale rib cuts were removed according to the method of Hankins and Howe (1956) and returned to Michigan State University. A tracing of the 12th rib surface cut at right angles to the plane of the halved vertebrae was obtained from each carcass. The area of Longissimus dorsi was determined by means of a compensating polar planimeter. Fat thickness was measured according to the procedure of

Naumann (1951). The 9-11 rib section was removed according to procedure of Hankins and Howe (1946) and separated immediately into fat, lean and bone.

All chemical determinations were performed according to a modification of the Association of Official Agricultural Chemists' methods as outlined by Benne (1956). Samples of internal fat (kidney knob) and external fat (wholesale rib cut) were obtained from each carcass, ground, and analyzed for moisture. Samples of the Longissimus dorsi were ground three times and then the percent moisture and the percent ether extract were determined. The combined separable fat and separable lean excluding the Longissimus dorsi were ground together three times and then samples obtained for measurement of the percent ether extract and the percent moisture present. After preparation, all samples were tightly packed in jars and frozen.

By applying the percentages of moisture and fat as determined by chemical analysis of the separable rib constituents, it was possible to calculate the theoretical amount of water and ether extract in the 9-10-11 rib cut. No correction could be made for either moisture or fat content of the bone.

Longissimus dorsi steaks from 12th rib area cut 1" thick from each carcass were weighed before and after cooking to an internal temperature of 63°C in deep fat maintained at 147°C.

For an estimate of relative tenderness, 1/2 inch cores were obtained from the cooked steaks parallel to the muscle fibers for use with the Warner-Bratzler shear. Eight readings were taken from each steak, two from each of four cores.

Portions of the urogenital tract including the bladder, ureter, urethral muscle, body of prostate, seminal vesical and bulbourethral gland were removed at the time of slaughter. Thyroid and adrenal glands from 4 steers in each lot were also obtained. Tissues for microscopic examination were removed from animals as soon after killing as possible and placed in 10 percent neutral formal-saline solution. After proper fixation, the tissues were processed, embedded in paraffin, sectioned and stained with hematoxylin and eosin.

Calculation of analysis of variance, correlation coefficient and covariance analysis were performed exactly as described in Snedecor (1946).

TRIAL I - RESULTS

Pasture performance data are presented in Table 1. For the overall feeding period, the implanted cattle in both pastures showed somewhat higher gains (2.14 pounds/steer/day) than the control steers (1.94 pounds/steer/day). There was an increase in gain in both pasture lots in both control and implanted cattle during the last 121 days during which period corn and supplement were supplied. This relatively small overall effect of hormone treatment on pasture cattle is in agreement with the results of Clegg and Cole (1954). However, the greatest spread in gains appeared during the initial implant period, although both hormone treated and control steers had relatively higher rates of gain when corn and supplement were fed. The implanted steers had noticeably higher tail heads, lower backs, and showed an increase in teat length. There was considerable evidence of restlessness and riding in the implanted cattle.

Table 1

Pasture Performance of Steers - Trial I

	Control		Implant	
	Alfalfa Brome	Bluegrass	Alfalfa Brome	Bluegrass
	lb.	lb.	lb.	lb.
Initial average weight	615	595	612	603
Average weight after first 81 days	759	720	774	746
Average weight after 202 days	1020	974	1068	1013
Average daily gain/steer (81 days)	1.45	1.50	1.99	1.88
First Implant (81 days) Average both pastures	1.48		1.94	

Table 1

Pasture Performance of Steers - Trial I (continued)

	Control		Implant	
	Alfalfa Brome	Bluegrass	Alfalfa Brome	Bluegrass
	lb.	lb.	lb.	lb.
Average daily gain (121 days)	2.37	2.10	2.43	2.32
Second implant (121 days) Average both pastures	2.24		2.38	
Average daily gain - entire period 202 days	2.00	1.88	2.25	2.03
Average daily gain - entire period - both pasture lots	1.94		2.14	

An average of 64.7 percent of the original pellet implant was apparently absorbed as estimated by the amount of pellet residue remaining in the treated cattle after the first 81 days on test. (Table 2) However, during the second implant period of 121 days with supplemental feeding, there was an average pellet absorption of 46.23 percent. Thus, assuming all previous pellet residue was recovered, there appeared to have been a reduction in the rate of absorption during the second implantation period. It appeared that gain stimulation was greatest during the period of greatest absorption, although a slightly different feeding program was introduced during the second implant period. Dinusson et al. (1950) theorized that, in heifers, the rate of gain is proportional to the amount of estrogen present.

Although control cattle appeared to have had a somewhat higher live shrink, there was considerable variation in percent live shrink within lots. There was little difference between lots in the percent fill (paunch contents) expressed as percent slaughter weight.

Table 2

Pellet Implant Absorption - Trial I

	First Implant 81 days			Second Implant 121 days			
Cattle No.	Amount Recovered	Amount Absorbed	Percent Absorption	Amount Recovered	Amount Absorbed	Percent Absorption	Total Absorption
	g.	g.	%	g.	g.	%	g.
701	.4782	.6218	56.5	.6262	.4738	43.1	.9956
709	.4398	.6602	60.0	.6437	.4563	41.5	1.0165
704	.3020	.7980	72.5	.6390	.4610	41.9	1.1590
707	None Recovered			.5548	.5452	49.6	
705	.2562	.8438	76.7	.5965	.5035	45.8	1.2473
708	.4483	.6517	59.2	.5495	.5505	50.0	1.1022
703	None Recovered			.6798	.4202	38.2	
702	.4060	.6940	63.1	.4425	.6575	59.8	1.2510
			64.7 $\bar{x}$			46.2 $\bar{x}$	

The control steers had slightly higher percentages of caul fat (greater omentum) as shown in Table 3 when expressed as percent of slaughter weight. In view of the higher grades of the control carcasses, this slight increase in percent caul fat was further evidence of an increased fat deposition. Cattle from both lots had similar dressing percentages with considerable variation within each lot.

Table 3

Slaughter Data - Trial I

	Control	Implant
	%	%
Average Live Shrink	2.98	2.59
Average Fill (stomach)[1]	6.67	6.78
Average Caul Fat[1]	1.27	.93
Average Dressing Percent (cold)	59.2	58.7
Average Chilling Shrink	3.2	2.9

1 Expressed as percent slaughter weight.

There was no significant effect on chilling shrink due to treatment. Livers from the implanted cattle were significantly heavier than those from the controls (Table 4). The relative increase in liver mass in this trial is in agreement with the findings of Wilkinson _et_ _al_. (1954) and Bell _et_ _al_. (1955) with implanted lambs. Wilkinson _et_ _al_. (1954) concluded that this was due to hypertrophy which resulted from the extra work of detoxification by the liver of implanted diethylstilbestrol. There were little differences between treatments in spleen, heart or hide expressed as percent of slaughter weight minus stomach fill as shown in Table 4.

Table 4

Slaughter Offal Data - Trial I

	Control	Implant
	%[1]	%[1]
Liver	1.26	1.38*
Spleen	.21	.21

Table 4

Slaughter Offal Data - Trial I (continued)

	Control	Implant
Heart (cap on)	.50	.52
Hide	9.05	8.69

[1] Expressed as percent slaughter weight minus fill.
* Significant $P < .05$

According to Table 5, the implanted lot produced two choice and six good grade carcasses, whereas the control lot yielded six choice and two good grade carcasses. This indicated a lowered carcass grade as a result of the 900 milligrams progesterone - 100 milligrams diethylstilbestrol pellet dosage in this trial. This lowering of carcass grade was similar to the observations of Andrews et al. (1954) and Clegg and Carroll (1956) with the implantation of diethylstilbestrol in steers.

Table 5

Carcass Grade - Trial I

Control		Implant	
Carcass No.	U S D A Grade	Carcass No.	U S D A Grade
694	Choice	701	Good
697	Choice -	709	Choice -
696	Choice	704	Good
698	Good	707	Choice -

Table 5

Carcass Grade - Trial I (continued)

Control		Implant	
Carcass No.	U S D A Grade	Carcass No.	U S D A Grade
695	Good	705	Good +
699	Choice -	708	Good -
692	Choice -	703	Good
693	Choice -	702	Good +

As shown in Table 6, carcasses from the implanted lot showed a significantly greater conjugate diameter of the pelvic inlet than the controls, which was supported by the evidences of tail head elevation in the live animals.

Studies of separable carcass lean as estimated by 9-10-11 rib cut showed that carcasses from implanted cattle had significantly higher proportions of carcass lean than carcasses from control cattle (Table 6). This increase in muscle mass was also noted by Clegg et al. (1954) with 60 mg. diethylstilbestrol implantation. There was a lower proportion of separable fat in the carcasses from the implanted cattle although the differences were not significant. Very little difference was found in percent carcass bone from either group. Analysis of composite lean samples showed no significant difference between lots in percent moisture or percent protein (Table 6). However, percent ether extract in the lean samples from the control carcasses was higher than in lean samples from the implanted group. As ether extract is an estimate of marbling, the higher grading carcasses from the control lot would be expected to show a greater ether extract content in the lean. The higher percent of ether extract in the Longissimus dorsi of the control cattle supported evidence of more marbling in this muscle and is directly proportional to carcass grade. In view of the significant increase in separable lean, it would appear that implantation stimulated the development of slightly more muscle mass but that this muscle did not have the intramuscular fat development of the non-hormone treated animals, a factor which resulted in a lowered carcass grade.

There were no significant differences found between the carcass groups in percent moisture in raw fat or iodine number of raw fat. (Table 6).

Table 6

Physical and Chemical Carcass Characteristics - Trial I

	Control	Implant
Anterior pelvic measurement (mm)	137.5	162.7
Posterior pelvic measurement (mm)	137.9	180.9*
Average separable carcass lean (%)[1]	56.84	58.42*
Average separable carcass fat (%)[1]	29.66	27.80
Average separable carcass bone (%)[1]	14.21	14.57
Moisture - lean meat (%)	72.1	72.7
Ether extract - lean meat (%)	4.2	2.8
Protein - lean meat (%)	23.3	23.7

Table 6

Physical and Chemical Carcass Characteristics - Trial I (continued)

	Control	Implant
Moisture - raw tallow (%)	6.6	5.7
Iodine number - rendered tallow (gms)[2]	48.9	50.8

* Significant $P < .05$

[1] As estimated from 9-10-11 rib cut (Hankins - 1946)

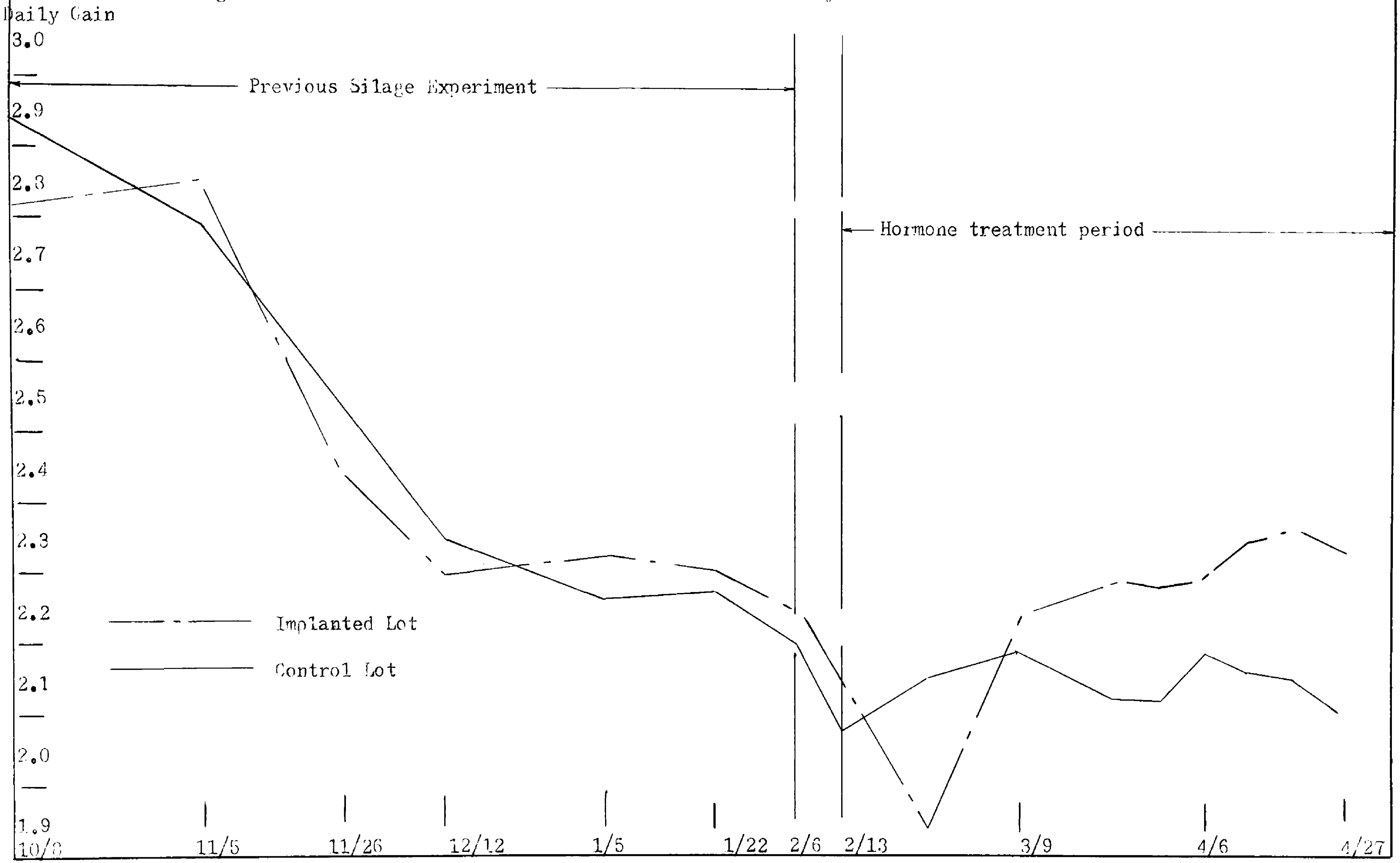
[2] Grams of iodine absorbed by 100 grams fat.

TRIAL II - RESULTS

Implantation of 3 grams progesterone and 100 milligrams diethylstilbestrol resulted in average daily gains of 2.61 pounds as compared to an average daily gain of 2.16 pounds for the non-treated steers as shown in Table 7. Although this was an increase in average rate of gain of .53 pounds per day, there was considerable variation in rate of gain within each lot and this difference in gain was not statistically significant. As can be seen in Appendix Table XI, there was considerable variation in the weights of these cattle at the beginning of the trial. A graphic illustration of response to hormone treatment is shown in Figure 1. There appeared to be a gradual decline in rate of gain during the pre-treatment period even though there was no effect of high temperatures during the cool fall and winter months. There was a lowering in rate of gain in the treated lot after implantation which was then followed by a sharp rise in gain. It seemed quite possible that this was due to disturbances from the actual mechanics of implantation and also to an adjustment or alteration in the systemic functions of the steers. There was a definite change in the behavior of the implanted steers following implantation which was characterized by riding and general restlessness. This atypical activity disappeared approximately one week after treatment.

Appetite stimulation was noted in the steers of the hormone treated lots. As all cattle were fed according to appetite, the implanted cattle showed an increased feed consumption. As shown in Table 7, the implanted cattle consumed 1163.5 pounds of silage, 578.2 pounds of corn and 138.4

Figure 1. Trial II Rate of Gain Entire Period - 229 Days



pounds of supplement per 100 pounds of gain as compared with 1246.9 pounds of silage, 548.9 pounds of corn and 204 pounds of supplement required per hundred pounds of gain for the control lot. Thus, the implanted lot required a total of 1880.1 pounds of feed and the control cattle a total of 1926.4 pounds of feed to gain 100 pounds.

Table 7 - Trial II

Feedlot Performance

	Control	Implant	
	lb.	lb.	
Initial average weight	1071	1078	
Final average weight	1232	1282	
Average total gain per steer	161	204	
Average daily gain per steer	2.16	2.64	
Average silage consumed per 100 lb. gain	1246.9	1163.5	41.6
Average corn consumed per 100 lb. gain	548.9	578.2	49.6
Average supplement consumed per 100 lb. gain	130.6	138.4	
Total feed consumed per 100 lb. gain	1926.4	1880.1	

During the test period of 76 days, the implanted steers absorbed an average of 33.3% of the pellet, as estimated by weight differences, assuming that all residual pellet material was recovered. Pellet absorption data are shown in Table 8. It was apparent that the inclusion of compound F (17-hydroxy corticosterone) in the pellet increased absorption as there was an average absorption of 38.4% of the pellets containing compound F as compared to an average absorption of 28.2% of the pellets not containing compound F. This 33% absorption would indicate that hormonal effects by implantation could be extended over longer periods of feeding, although no information was provided in this trial as to the qualitative nature of the residual material.

Table 8 - Trial II

Pellet Absorption

Cattle No.	Initial pellet weights	Weight recovered pellets	Absorption	Absorption
	g.	g.	g.	%
Compound F				
532	3.1000	1.9760	1.124	36.3
533	3.1003	2.2253	.875	28.2
537	3.1000	1.5310	1.569	50.6
No compound F				
531	3.0996	2.2976	.802	25.9
534	3.1002	2.3482	.752	24.3
535	3.1003	1.9453	1.155	37.3
536	3.1009	2.3209	.780	25.2

It can be seen in Table 9 that, during the 18 hour live shrink period, the implanted cattle averaged 3.8% shrink as compared to 2.7% shrink for the control lot. Thus, it appeared that the greater feed consumption of the implanted cattle had filled the stomach and intestines to a greater degree and proportionately more was lost during the immediate pre-slaughter period. This hypothesis was substantiated to some degree by the greater proportion of fill and slightly higher full stomach and intestine weights as shown in Table 9. The implanted cattle dressed one percent lower, 62.4% as compared to 63.4% for the control cattle but this was accounted for by heavier hides, more fill, and a slightly higher percentage of caul fat as shown in Table 9. The control carcass had an average chilling shrink of 2.8% which is slightly higher than the 2.3% shrink of the implanted carcasses.

Table 9 - Trial II

Slaughter Performance and Offal Yields

	Control	Implant
	%	%
Live shrink (18 hr.)	2.7	3.8
Dressing % (cold)	63.4	62.4
Chilling shrink	2.8	2.3
Fill[1]	4.7	5.1
Full stomach and intestine[1]	14.4	14.6
Liver[1]	1.2	1.1
Heart[1]	.36	.36
Caul fat[1]	2.0	2.2
Hide[1]	5.9	6.3

[1] Expressed as percent slaughter weight.

In contrast to the results of Trial I, the carcass grades were practically equal for the two lots as shown in Table 10. This was in disagreement with the reduction in carcass grade from the implantation of 60 or 120 milligrams of diethylstilbestrol in steers as reported by

Andrews *et al.* (1954), and with the implantation of 60 milligrams of diethylstilbestrol in steers as reported by Clegg and Carroll (1956). However, the results of carcass grade in this trial were in agreement with the results of Henneman *et al.* (1953) with a combination progesterone-estradiol implant in lambs and Jordan *et al.* (1955). It was of interest to note that when O'Mary *et al.* (1956) used a lower level of (36 milligrams) diethylstilbestrol implants, no differences in carcass grade were obtained.

Table 10 - Trial II

Carcass Grade

Control		Implant	
Cattle No.	Grade	Cattle No.	Grade
601	Prime	531	Prime -
602	Choice +	532	Choice +
603	Choice +	533	Prime -
604	Choice +	534	Choice +
605	Prime -	535	Choice +
606	Prime -	536	Choice +
607	Choice +	537	Prime
608	Prime -		

The similarity in carcass grade between lots in this trial was reflected in the similar proportions between lots in separable carcass lean, fat and bone as shown in Table 11. There was little differeuce in area of *Longissimus dorsi* and in fat thickness at the 12th rib.

Results of an investigation of the qualitative nature of the carcass components as illustrated in Table 11 showed that there was little effect on moisture of the carcass fat. In neither trial II nor trial I was there any statistically significant difference between treated and control groups in the degree of saturation of carcass fat as estimated by iodine absorption number. When lean samples were grouped by carcass grade, it was noted that in either group, the lean from choice carcasses had more moisture and less ether extract than the lean from prime carcasses. This was to be expected in view of the higher requirement for marbling in prime than in the choice carcasses. Marbling (as estimated by ether extract) and moisture would be expected to have an inverse relationship in the same sample of lean. There was an inverse relationship shown between ether extract in the Longissimus dorsi and percent moisture in the Longissimus dorsi in all three trials.

There was little difference in percent protein between groups, although choice lean samples from implanted carcasses had slightly more protein than choice lean samples from control carcasses. The choice lean samples from the implanted lot also had a slightly lower percent ether extract.

Table 11 - Trial II

Physical and Chemical Carcass Composition

	Control	Implant
Average separable carcass lean[1] (%)	51.10	50.28
Average separable carcass fat[1] (%)	38.43	38.29
Average separable carcass bone[1] (%)	12.38	12.84
Moisture raw tallow (%)	5.7*	5.4
Iodine number raw tallow[2] (g.)	52.23	52.42
Longissimus dorsi area (sq.in.)	12.30	11.97
Fat thickness[3] (mm.)	20.6	21.6

Composite Lean Meat Samples

	Control		Implant	
	Choice Carcasses	Prime Carcasses	Choice Carcasses	Prime Carcasses
	%	%	%	%
Moisture	68.4	65.5	68.4	65.9
Ether extract	9.5	12.6	9.1	12.2
Protein	21.4	21.1	22.5	21.0

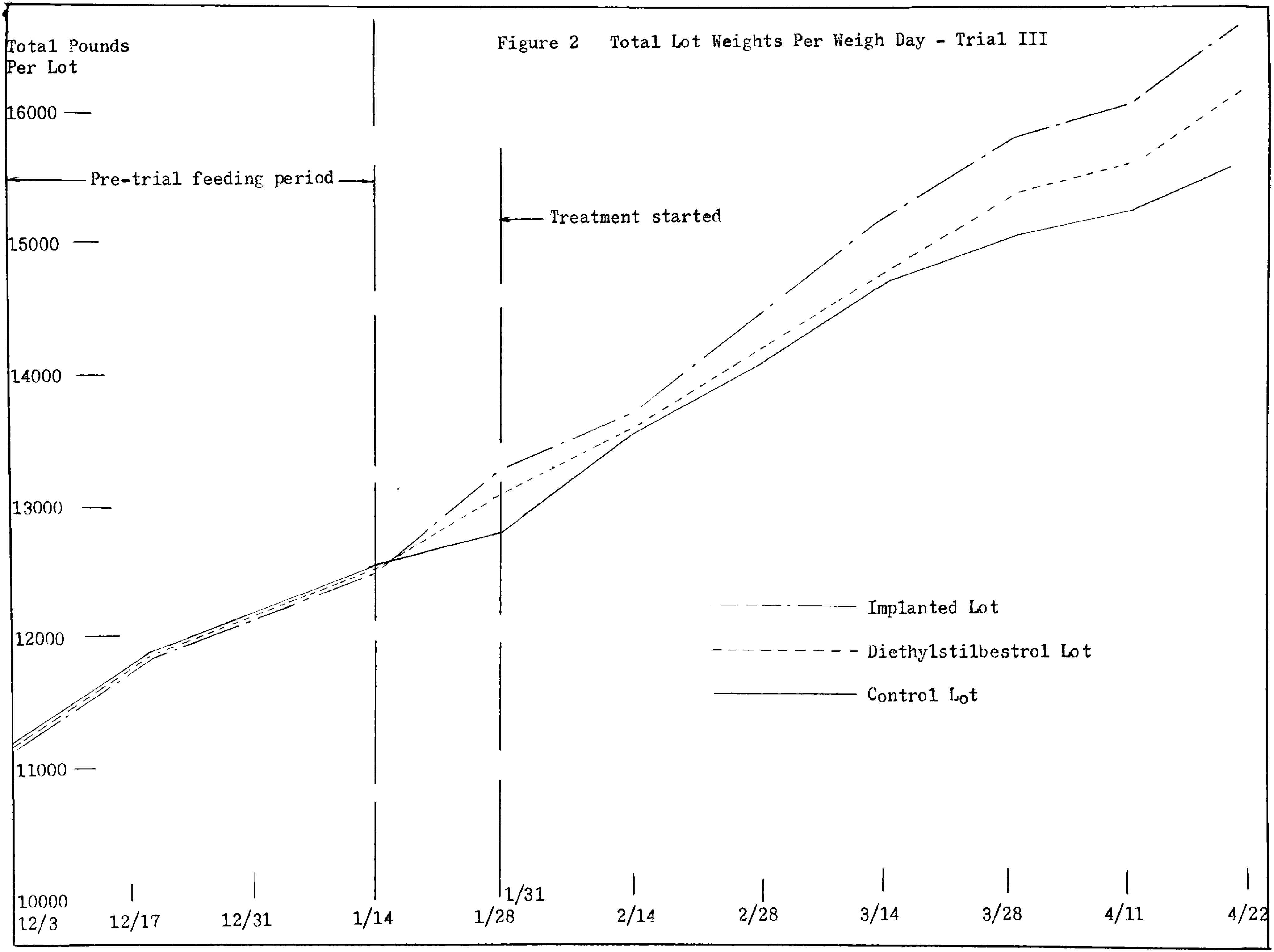
1 Estimated from 9-10-11 rib cut (Hankins 1946).
2 Gram of iodine absorbed by 100 grams of fat.
3 Measured at 12th rib cut.
* Average with sample #601 removed - See Appendix Table.

TRIAL III - RESULTS

The implanted steers made an average daily gain of 3.03 pounds compared to 2.64 and 2.30 pounds for diethylstilbestrol fed and control steers, respectively, as shown in table 12. Pretrial average daily gains of 2.1, 2.2, and 2.1 pounds for control, diethylstilbestrol fed and implanted lots respectively, indicated relative uniformity of the three lots and supported the stimulating effect of both treatments on rate of gain. The gains of both the implanted and diethylstilbestrol fed steers were significantly greater than the controls at the 1% level. In addition, the rate of gain of implanted cattle was significantly greater at the 1% level than of diethylstilbestrol fed cattle. Implantation with 1.5 grams of progesterone and 50 milligrams of estradiol (30:1 ratio) resulted in a 31.7% increase in rate of gain over controls and a 14.8% increase in rate of gain over the diethylstilbestrol fed cattle. The diethylstilbestrol fed cattle showed a 14.1% increase in rate of gain over controls. Graphic illustration of stimulus in rate of gain is shown in Figure 2. This increased rate of gain of diethylstilbestrol fed cattle when compared to steers receiving no hormone treatment was in agreement with the results of Burroughs et al. (1955), Perry et al. (1955) and Beeson et al. (1956).

The relatively greater response to combination implantation in rate of gain of cattle as compared to treatments with estrogen alone was similar to the results of Henneman et al. (1953) and Jordan et al. (1955) with lambs. In Trial I, with the 900 milligrams progesterone - 100 milligrams diethylstilbestrol dosage on pasture and on pasture

Figure 2 Total Lot Weights Per Weigh Day - Trial III



supplemented with corn and a protein supplement, there was a relatively small increase in rate of gain. A considerably higher average rate of gain in Trial II resulted from the implantation of 3 grams of progesterone with the same estrogen diethylstilbestrol) dosage of 100 milligrams. However, in Trial II there was considerable variation in the initial weight and type of cattle in each lot and the variation in feedlot gain was quite large in each lot (see Appendix Table II). In the three trials, the greatest stimulus in gain resulted from the implantation of 1.5 grams of progesterone and 50 milligrams of estradiol in the Trial III cattle on a fattening ration. Hormone treatment produced a stimulation in appetite in both lots but at different stages in the feeding program and to different degrees. Implanted cattle showed a marked increase in appetite one week after implantation which was maintained for the duration of the feeding period. There was no appreciable increase in appetite in the diethylstilbestrol fed lot until approximately 30 days after treatment. Stimulation in gain was first noted in the implanted lot 30 days after treatment and in the diethylstilbestrol fed lot 60 days after treatment. The reason for the delay in response of the diethylstilbestrol fed lot to treatment is not clear and was in disagreement with the results of Perry et al. (1955), who noted that the greatest response to oral diethylstilbestrol treatment occurred during the first 28 days of treatment.

There was some evidence of restlessness in the implanted cattle during the week following implantation but after this time there was no further evidence of erratic behavior. There was no unusual behavior in any of the steers of the oral diethylstilbestrol lot.

As a consequence of increased appetite in this test, feed consumption increased in both hormone treated lots. Inasmuch as ground shelled corn was fed according to appetite, actual corn consumption may be used as a measure of appetite. At the end of the treatment period, the implanted steers were eating an average of 17.0 pounds of corn per day as compared to 15.5 and 14.0 pounds respectively for the diethylstilbestrol fed and control lots. Corn consumption for the entire treatment period averaged 16.0 pounds per day for implanted cattle and 15.3 pounds for diethylstilbestrol fed and 14.5 pounds for control cattle. Apparently, this increased feed consumption in the hormone treated lots was more than offset by the increase in rate of gain which resulted in an increased feed efficiency. As shown in Table 12, the implanted lot required 658 pounds of silage, 529 pounds of corn and 50 pounds of supplement per 100 pounds of gain compared to 754 pounds of silage, 579 pounds of corn, 57 pounds of supplement per 100 pounds of gain and 865 pounds of silage, 643 pounds of corn and 65 pounds of supplement per 100 pounds of gain for the diethylstilbestrol fed and control lots, respectively. This increased feed efficiency was in agreement with the reports of Andrews _et al_. (1955), Burroughs _et al_. (1955), Luther _et al_. (1954) and Dinusson et al. (1950).

The observations of Beeson _et al_. (1956) and Perry _et al_. (1955) that oral diethylstilbestrol administration did not cause increased feed consumption do not support a hypothesis of estrogen stimulation from increased feed intake but suggested an increase in utilization of feed consumed. However, when Dinusson corrected feed consumption by covariance analysis to a constant level in individually fed cattle, the differences in gain were no longer significant. Thus, increased gain in that trial was a function of increased feed consumption. The little effect in rumen digestion in lambs following estrogen implantation as reported by Whitehair et al. (1953) would lend support to the results of Dinusson et al. (1950).

As shown in Table 12, the implanted cattle were graded higher on a live basis than either the diethylstilbestrol fed or control cattle. Cattle from the control lot received the lowest live grade.

Table 12 - Trial III

Feed Lot Performance of Experimental Steers

		Control	Diethylstilbestrol fed	Implanted	LSD[a] (1%)
Initial average weight (12/4/54) (beginning of trial)	(lb.)	808	805	808	
Initial average treatment weight (1/14/55)	(lb.)	903	899	896	
Final average weight	(lb.)	1122	1156	1192	
Average pre-treatment daily gain/ steer	(lb.)	2.1	2.2	2.1	
Average daily treatment gain/ steer	(lb.)	2.30	2.64	3.03	.31
Feed consumed/100 lb. gain:					
Silage	(lb.)	865	754	658	
Corn	(lb.)	643	579	529	
Supplement	(lb.)	65	57	50	
Live slaughter grade score[b]		5.9	5.5	5.2	

[a] LSD = Least significant difference.
[b] Based on numerical range of 1 (Prime-high) to 9 (Good-low)

Because of considerable damage to the pellets during their removal from the steers at the time of slaughter, it was not possible to determine pellet absorption in this trial. A study of the dressing percentage of the three lots (Table 13) showed that there were no significant differences in dressing percentage due to hormone treatment. The slightly higher dressing percentage of the implanted lot was different from the results of Trial II. Clegg and Cole (1954) and O'Mary *et al.* (1956) reported that there was no effect on dressing percentage due to estrogen implantation in cattle. There were other reports, however, Clegg and Carroll (1956) with cattle and Jordan *et al.* (1955) with lambs in which estrogen treatment lowered dressing percentage. Dressing percentage is subject to the effects of many variables. Neither treatment had any effect on the relative size of the visceral organs, namely, heart, liver, or spleen as shown in Table 13. Although results with lambs have shown heavier pelts, Bell *et al.* (1955), Wilkinson *et al.* (1955), there were no significant differences in hide weights in this trial.

There was no effect of hormone treatment on chilling shrink in any of the trials. Similar observations of no hormone treatment effect on chilling shrink have been reported by Clegg and Cole (1954) with cattle. These results are of particular interest in view of the reports by commercial packers that carcasses from hormone treated cattle (fed diethylstilbestrol) shrunk more during the initial chilling period (hot to cold carcass) than cattle which had supposedly received no hormone treatment.

Table 13 - Trial III

Slaughter Data

	Control	Diethylstilbestrol Fed	Diethylstilbestrol Implanted
	%	%	%
Cold dressing percent	61.9	62.0	62.6
Cooler shrink	1.51	1.41	1.27
Stomach fill (% live slaughter weight)	3.4	3.2	3.4
Heart (% hot carcass weight)	.65	.67	.70
Liver (% hot carcass weight)	16.0	16.5	16.3
Spleen (% hot carcass weight)	.26	.26	.26
Hide (% slaughter weight)	8.0	8.2	7.9

CARCASS CHARACTERISTICS

Differences in carcass grades between lots as shown in Table 14 were not significant. There was considerable variation in carcass grades within each lot as shown in Table 14. This was in agreement with the work of Kastelic et al. (1956) who reported that there was considerable variation within treatment groups of cattle which had received diethylstilbestrol orally and that no consistent affect on carcass grade could be noted which was due to hormone treatment. One of the advantages claimed by Burroughs et al. (1954) with the use of oral diethylstilbestrol was that it did not lower carcass grade. However, Perry et al. (1955) stated that oral diethylstilbestrol treatment resulted in inferior carcasses. It is of particular significance that in Trials II and III, with the higher ratio of progesterone to estrogen and with steers on a higher energy ration, there was no evidence of the marked reduction in the carcass grade of hormone treated cattle shown in Trial I.

Carcasses from the implanted cattle and from the diethylstilbestrol fed cattle had a significantly greater spread between the posterior end of the aitch bone and sacral vertebrae as shown in Table 14. Relatively greater effect was shown on posterior measurements than on the anterior pelvic diameter. This was suggestive of elevation of the tail head in both the treated lots. Upon visual observations, cattle buyers reported that the characteristic was not particularly noticeable. Subcutaneous fat accumulation may have minimized the appearance of tail head elevation.

Table 14 - Trial III

Carcass Grade and Pelvic Measurements

	Control	Diethylstilbestrol fed	Implanted
Choice +	1	3	0
Choice	1	3	3
Choice -	7	5	3
Good +	3	3	7
Good	2	0	1
Good -	0	0	0
Average coded value[1]	6.3	5.6	6.4
Anterior pelvic diameter (mm.)	151.4	155.5	162.4
Posterior pelvic diameter (mm.)	154.7	180.1	200.6

1 Based on numerical range of 1 (Prime +) to 9 (Good -)

A study of the physical carcass composition as estimated by the 9-10-11 rib cut showed that implantation significantly increased the muscle mass or separable carcass lean. After adjusting by covariance analysis for differences in carcass weights on a within lot basis, the differences in grams of separable lean were not significant. The relationship between percent lean and carcass weight appeared to be different between lots from what it was within lots. As carcass weight increased in each treatment group, there was a lower percent carcass lean. However, implantation resulted in a higher overall proportion of separable lean in which the preceding relationship existed. Correlation coefficients within lots between carcass grade and gain as shown in Table 15, were low but all indicated a negative trend. Kastelic *et al.* (1956) reported that a significant positive correlation within treatment lots between gain and carcass grade was obtained in one experiment. The control and diethylstilbestrol fed groups of Trial III had r values of -.28 and -.32 between gain and separable carcass fat, whereas the implanted group showed a positive r value of +.15 as shown in Table 15. Correlation coefficients of +.20, -.18 and +.28 were obtained between gain and fat thickness at the 12th rib for control, diethylstilbestrol fed and implanted groups respectively. There appeared to be little relationship in this trial between gain and ether extract in the *Longissimus dorsi*. Values of r were +.06, -.14, and +.07 respectively for control, diethylstilbestrol fed and implanted groups. As bone remained relatively constant, the significantly lower percentage of separable fat obtained was to be expected.

Table 15 - Trial III

Correlations Between Gain and Various Carcass Components

	Control	Diethylstilbestrol fed	Implant
	r	r	r
Gain (lb.) vs. percent carcass fat	-.28	-.32	+.15
Gain (lb.) vs. percent carcass lean	+.37	+.28	-.16
Gain (lb.) vs. carcass grade	-.05	-.16	-.02
Gain (lb.) vs. ether extract (*L. dorsi*)	+.06	-.14	+.07
Gain (lb.) vs. fat thickness	+.20	-.18	+.28

Although there were no significant differences in *Longissimus dorsi* area, there was considerable variation within lots and the implanted group carcasses had an average area of 10.52 square inches compared to 9.90 square inches for the carcasses from the oral diethylstilbestrol lot and 9.79 for the carcasses from the control lot as shown in Table 16. This increased muscle mass was suggestive of a protein anabolic effect on the animal which has been reported by Clegg *et al.* (1954) with the implantation of 60 milligrams of diethylstilbestrol in cattle.

Although differences in fat thickness at the 12th rib were not significant, the tendency toward less external fat thickness in implanted carcasses was in agreement with the smaller proportion of separable fat in the 9-10-11 rib section as determined by physical separation. This was in agreement with the results of Clegg *et al.* (1954) who reported that the amount of both internal and external fat deposition was considerably reduced in steers implanted with 60 milligrams of diethylstilbestrol.

Table 16 - Trial III

Physical Carcass Composition

	Control	Diethylstilbestrol fed	Implant	LSD 5%
Carcass lean[1] (%)	53.3	53.4	56.4	2.26
Carcass fat[1] (%)	34.7	34.2	31.3	2.77
Carcass bone[1] (%)	13.2	13.5	13.4	
<u>Longissimus</u> <u>dorsi</u> area (sq.in.)	9.79	9.90	10.52	
Fat thickness-12th rib (in.)	.92	.96	.77	

[1] As estimated from 9-11 rib cut (Hankins 1946)

By applying the percentages of moisture and fat as determined in chemical analysis of the separable rib constituents, it was possible to calculate the theoretical amount of water and ether extract in the 9-10-11 rib cut. However, no corrections were made for either moisture or fat content of the bone. Moisture content of the entire 9-10-11 rib was highest in the implanted carcasses and lowest in the control carcasses. Conversely, ether extract was highest in control carcasses and lowest in the implanted carcasses. This was particularly interesting inasmuch as carcasses from the diethylstilbestrol fed lot had the highest ether extract content in the <u>Longissimus</u> <u>dorsi</u>.

The external fat of carcasses from the diethylstilbestrol fed lot had a higher average moisture content as shown in Table 17, but when analysis of variance was applied, these differences were not significant. There was little difference between lots in moisture in the internal fat.

Neither hormone treatment resulted in any significant effect on the moisture content or percent ether extract in the Longissimus dorsi. The slight differences in average values showed the expected inverse relationship between ether extract and moisture. Likewise there were no significant differences in the percent moisture or ether extract in the combined fat and lean (excluding the Longissimus dorsi). Again, the implanted group carcasses having the slightly higher percent moisture in the combined fat and lean had a somewhat lower percentage ether extract. Although the diethylstilbestrol fed group showed the highest proportion of ether extract and lowest amount of moisture in Longissimus dorsi, it was interesting to note that the control group had the highest proportion of ether extract and lowest moisture content in the combined fat and lean. Although the progesterone, estrogen and adrenal cortical hormones have the property of affecting body water metabolism according to Gaunt et al. (1949), the administration of progesterone and estrogen apparently had no effect on carcass moisture in these trials. Weisberg (1953) stated that while estrogens may affect the water content of the uterus of the rat, they do not affect that of the liver nor of the skeletal muscle.

Table 17 - Trial III

Chemical Carcass Composition

	Control	Diethylstilbestrol fed	Implant
External fat H_2O (%)	7.94	9.15	7.89
Internal fat H_2O (%)	3.50	3.62	3.70
Longissimus dorsi H_2O (%)	71.65	71.05	71.78
Longissimus dorsi Ether Extract (%)	5.68	6.65	5.11

Table 17 (continued) Trial III

Chemical Carcass Composition

	Control	Diethylstilbestrol fed	Implant
Combined fat and lean (excl. L. dorsi) H_2O (%)	34.37	35.63	37.00
Combined fat and lean (excl. L. dorsi) ether extract (%)	54.93	53.31	51.35
Entire 9-10-11 rib cut H_2O (%)	41.5	42.1	44.1
Entire 9-10-11 rib cut ether extract (%)	45.5	44.8	41.9

As shown in Table 18, hormone treatment did not increase the cooking shrink of *Longissimus dorsi* steaks. Hormone treatment did not affect the relative tenderness of steaks cooked by the deep fat method. This was in agreement with the report of Bell *et al.* (1955) on the tenderness and cooking shrink of lamb legs from hormone treated and control lambs.

Table 18 Trial III

Shear Values and Cooking Shrink

	Control	Diethylstilbestrol fed	Implant
Cooking shrink (%)	19.3	19.3	18.9
Warner-Bratzler shear readings, (lb.)	6.7	6.7	5.9

Physiological effects

The adrenal glands of all groups appeared normal upon gross examination. Microscopic examination also revealed no abnormal characteristics in the adrenal glands from either treated or control animals. However, an increase in adrenal weight has been reported by Cahill _et al._ (1954) with the implantation of 105 milligrams of diethylstilbestrol in steers, and by Clegg _et al._ (1955) with the implantation of diethylstilbestrol in lambs. The reason for the disagreement between the results of this trial and those of Cahill and Clegg on adrenal effects may have been due to differences in hormone treatment. There were no clear cut differences in the thyroid tissue from any of the cattle.

Upon gross examination, the prostatic portion of the urogenital tract appeared normal in the cattle of the control lot. There was an increase in the diameter of the prostatic portion from steers of the oral diethylstilbestrol group and a further increase in the diameter in this region in steers of the implanted lot. Illustration of this effect on seminal vesicle and bulbo urethral glands is shown in figures 3 and 4 and this enlargement of accessory sex glands was similar to that reported by Bell _et al._ (1955), Clegg _et al._ (1954), Wilkinson _et al._ (1954) and Clegg _et al._ (1955). An enlargement of secondary sex glands in lambs as reported by Ruliffson _et al._ (1954) occasionally resulted in death due to the inhibition of normal urination resulting from closure of the urethral lumen. None of the cattle of either treatment groups in this project gave appearance of experiencing difficulty in urination. In neither group was there any evidence of restriction on the size of the urethral lumen.

Microscopic examination revealed that in both the diethylstilbestrol fed lot and implanted lot there was some hyperplasia of the urethral

Figure 3. Seminal vesicle glands from a control steer (left), a diethylstilbestrol fed steer (center) and an implanted steer (right).

Figure 4. Bulbo-urethral glands from a control steer (left, a diethylstilbestrol fed steer (center) and an implanted steer (right).

mucosa of the prostatic area. The epithelial layers adjacent to the lumen were flattened and there was no evidence of desquamation or keratinization in either group. The prostatic glands from both oral diethylstilbestrol and implanted groups were hyperplastic and the lumina of some showed evidence of secretory activity. Burrows (1949) stated that androgens cause enlargement and secretory activity of the prostatic epithelium. An appearance of secretory activity of the columnar epethelial cells was observed by Cole et al. (1954) in the seminal vesicles of cattle implanted with 60 milligrams of diethylstilbestrol for 104 days. There was considerable enlargement of the urethral muscle in glands from both treated groups as shown in Figures 6 and 7 when compared to control lot as shown in Figure 5. The pars disseminata was enlarged in the glands from both diethylstilbestrol fed and implanted cattle. As shown in figure 7, the pars disseminata portion of the implanted glands showed increased glandular development. Emmens and Parkes (1947) reported that the injection of estrone in control rats caused extensive growth of the smooth muscle of the prostate and a decrease in glandular tissue. This enlargement of the urethral muscle and increased glandular development is suggestive of the presence of both estrogenic and androgenic activity in both hormone treated groups. This is similar to the effects of diethylstilbestrol implants in cattle as reported by Clegg and Carroll (1956). There was no evidence of desquamation or keratinization of the epithelium of the prostate glands from any of the cattle. The lumina of the bulbo-urethral glands of both hormone treated groups showed some evidence of secretory activity. There was no evidence of

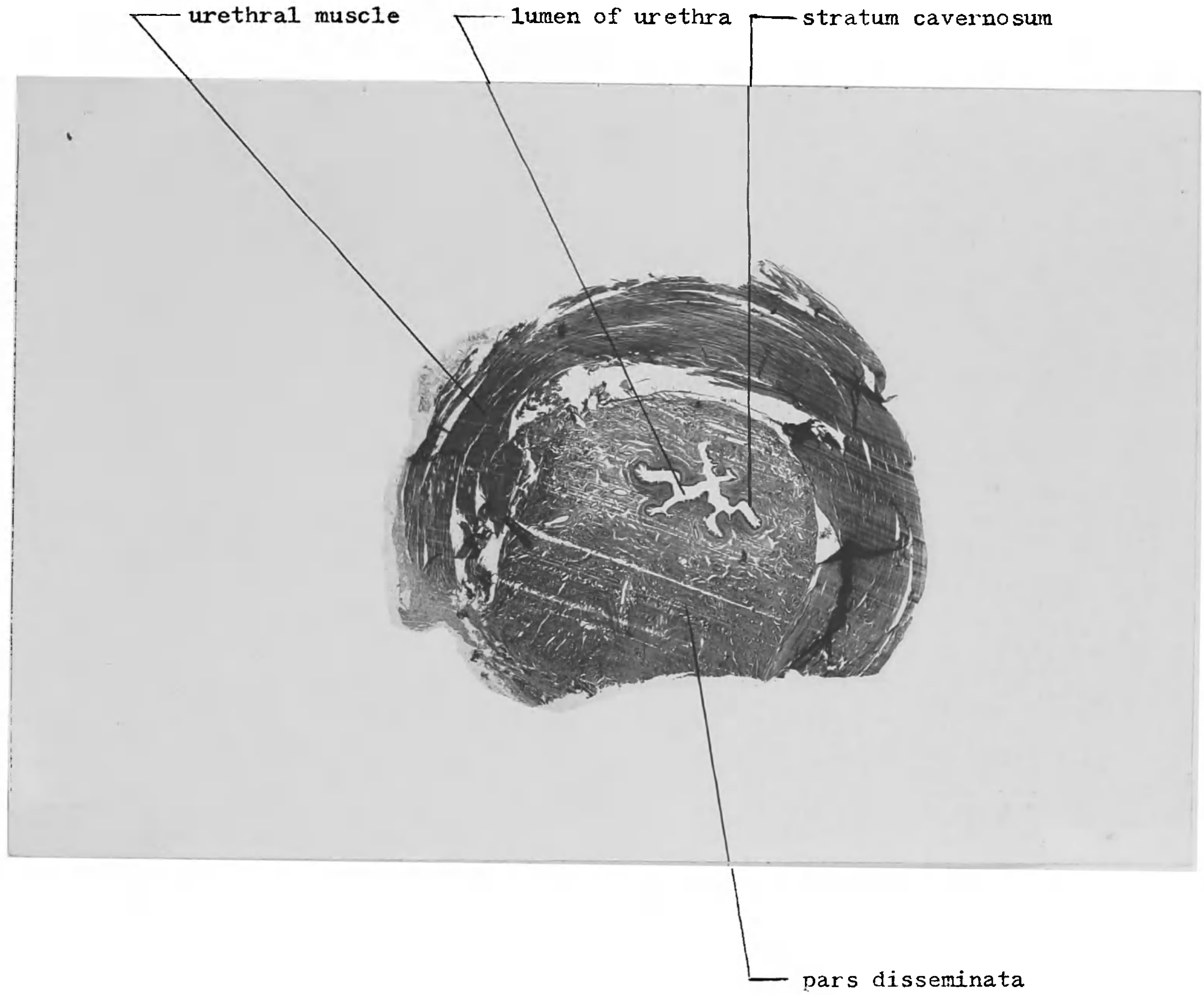


Figure 5. Cross section of the prostatic region of the urethra of a control steer (X 5.3)

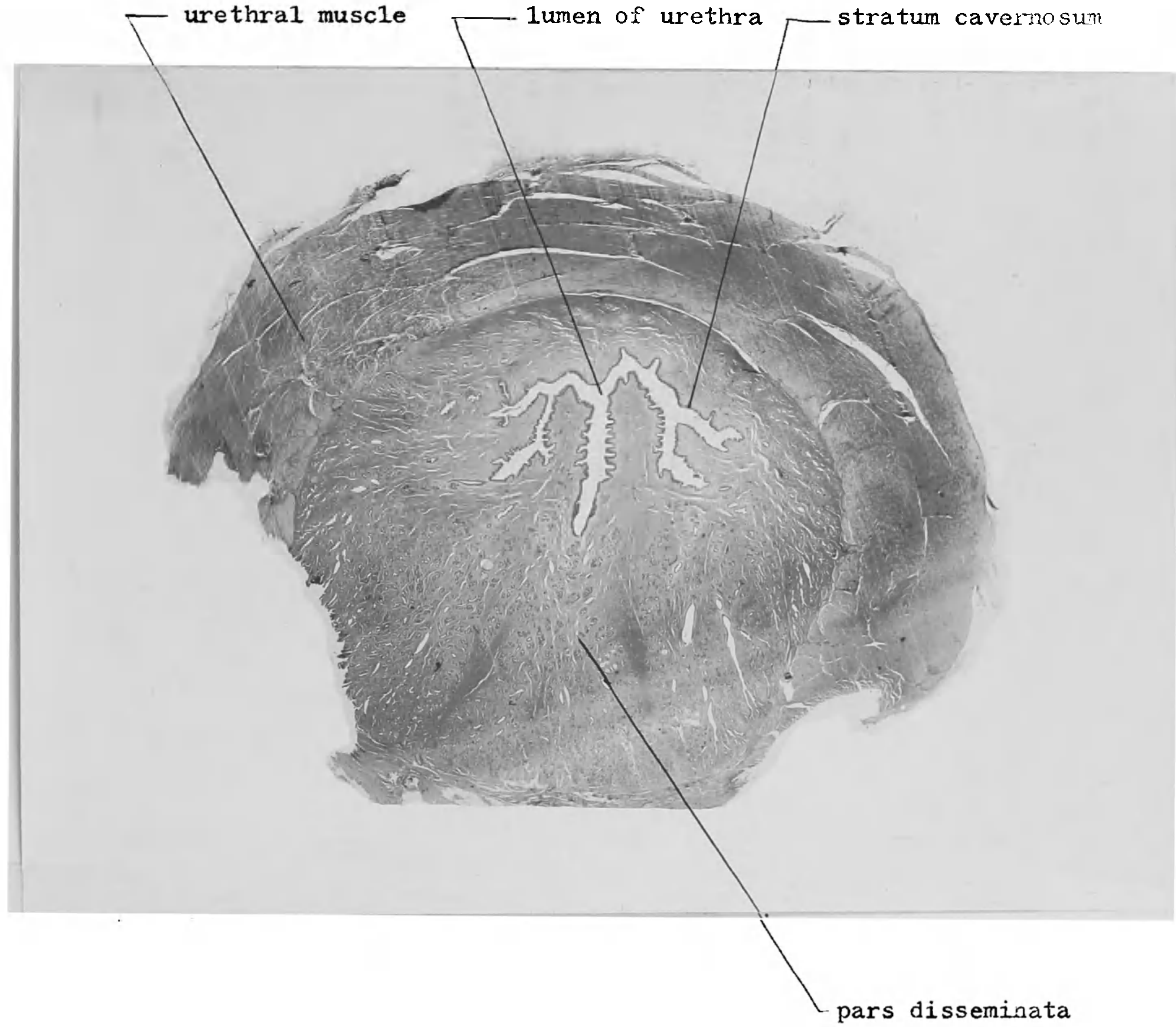


Figure 6. Cross section of the prostatic region of the urethra of a diethylstilbestrol fed steer (X 5.3)

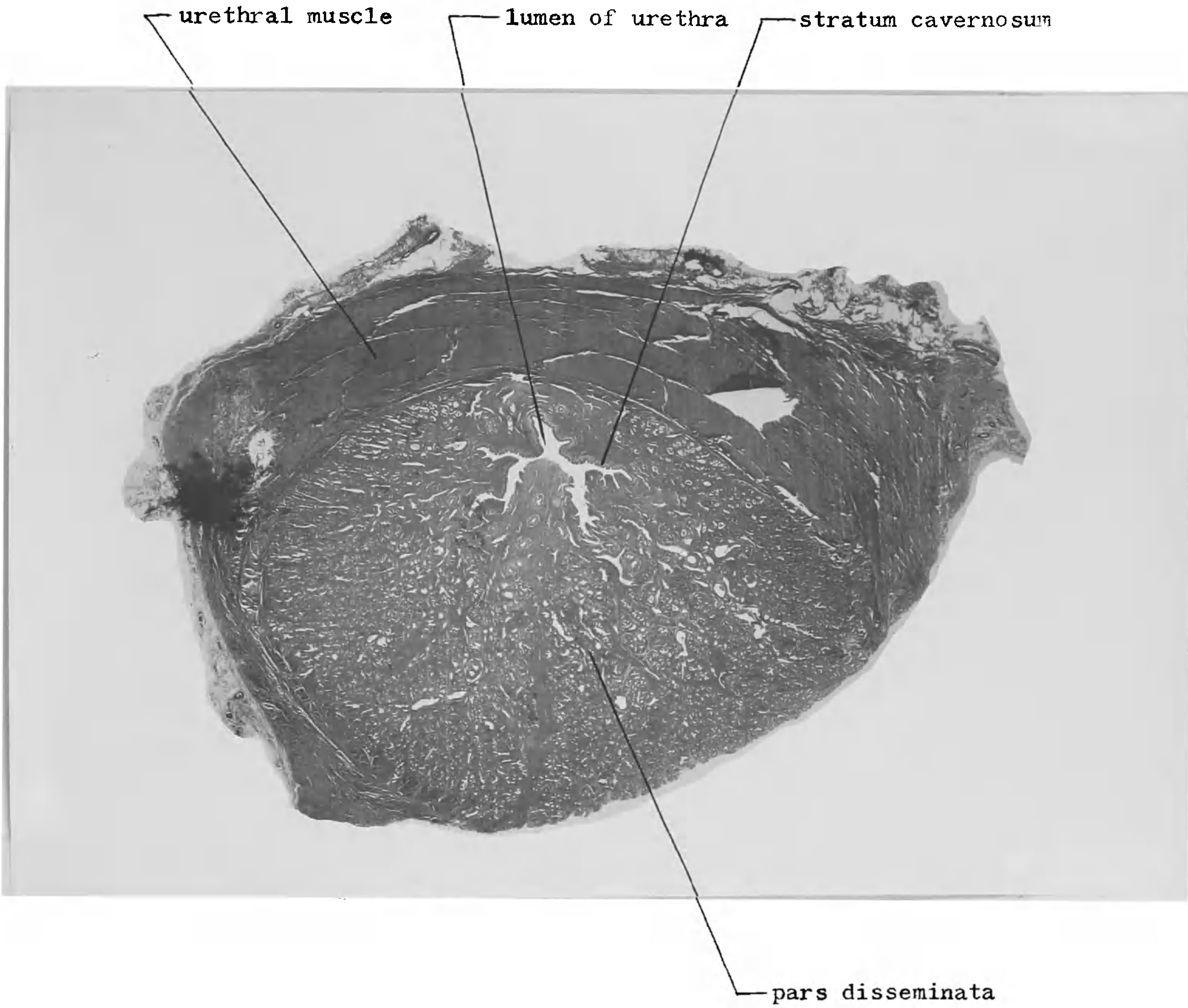


Figure 7. Cross section of the prostatic region of the urethra of an implanted steer (X 5.3)

desquamation or keratinization of the epithelium of the bulbo-urethral glands of either hormone treated group. None of the tissues examined from control, hormone fed, or implanted groups had any evidence of carcinogenesis.

SUMMARY AND CONCLUSIONS

It is clear that the implantation of progesterone and estrogen has stimulated the rate of gain in steers. Steers on pasture implanted with 900 milligrams progesterone and 100 milligrams diethylstilbestrol showed slightly greater gains than non-treated control steers, however, the stimulus was not of the magnitude noted in the subsequent trials with steers on a fattening ration and implanted with a higher ratio of progesterone to estrogen. This relatively poorer response to hormone treatment by cattle on pasture confirmed the previous reports of Clegg and Cole (1954) and Burroughs et al. (1955). The heavier steers in trials II and III showed considerable response to hormone treatment, thus indicating the practicability of implantation in heavier feedlot cattle. The combination of progesterone and estrogen resulted in a significantly greater rate of gain than was obtained with oral diethylstilbestrol treatment.

Hormone treatment resulted in appetite stimulation as measured by feed consumption. The pattern of increased feed consumption in the three lots of Trial III paralleled somewhat the relative rates of gain. This was suggestive that, at least in part, the effect of hormone treatment on rate of gain resulted from an increase in total feed consumption. The increased feed consumption and increased feed efficiency observed in this experiment was similar to the reports of Andrews et al. (1955), Burroughs et al. (1955), Luther et al. (1954) and Dinusson et al. (1950) on the use of estrogen and combination progesterone and estrogen implants and oral diethylstilbestrol in cattle.

It was evident in Trials II and III that the implanted cattle did not suffer the pronounced ill effects of behavior and the atypical appearance shown in the steers in Trial I. This may have been due in part to the higher ratio of progesterone to estrogen in the implant dosage. Reduction in the total hormone pellet dosage in the implanted cattle in Trial III as compared to the pellet dosage of the Trial II steers did not result in any diminished stimulus in rate of gain in the Trial III cattle. Although, no information was provided in this experiment as to the maximum effective duration of such treatment, there was no suggestion of a decreased treatment effect in the Trial III steers treated for 98 days.

There was no information obtained in this trial as to the mode of action of progesterone in the combination treatment nor on the relative degree of absorption of progesterone and estrogen in the pellets.

Implantation in Trial I produced a lowered carcass grade. In subsequent trials with a different implant dosage and with cattle on a fattening ration, there was no treatment effect on carcass grade. That estrogenic treatment may lower carcass grade in cattle has been shown by Clegg and Carroll (1956), Andrews _et al_. (1954) and Clegg _et al_. (1954). Hormone dosage itself may play an important role in carcass grade as shown by Henneman _et al_. (1953) and Jordan _et al_. (1955) who reported that a combination progesterone-estradiol implant did not lower carcass grade in lambs, whereas lambs receiving diethylstilbestrol implants produced lower grading carcasses. There was considerable variation within lots in carcass grade in Trials II and III which was similar to the reports of Kastelic et al. (1956) with oral diethylstilbestrol treatment.

There were no effects of treatment on chilling shrink in any of the trials. This was in agreement with the results of Clegg _et al._ (1954). There were no significant differences in dressing percentages between groups in any of the trials. Lean samples from the implanted group in Trial I had a lower percent ether extract which paralleled the lack of marbling in the lower grading carcasses. There were no significant differences in ether extract of lean between groups in Trials II and III. This suggested similarities in the degree of marbling in the control and treated group carcasses in these trials. One of the causes of the reduction of carcass grade as reported by Clegg _et al._ (1954) was the lesser amount of intra-muscular fat in the lean.

Implantation in Trial II did not result in any significant differences in separable carcass lean, fat or bone, nor in _Longissimus dorsi_ area nor in fat thickness. However, in Trials I and III, implantation resulted in a significant increase in muscle mass but in Trial III when the effect of carcass weight within lots on this separable lean was removed, the differences in lean were not significant. There was relatively little relationship in Trial III between rate of gain and carcass fat, carcass lean, carcass grade, ether extract in the _Longissimus dorsi_ and fat thickness of carcasses.

In Trial III, the prostatic portion of the urogenital tract was definitely enlarged in steers of the stilbestrol fed lot and enlarged still further in steers of the implanted lot. Neither implantation nor diethylstilbestrol feeding appeared to result in any restriction in the size of the lumen of the urethra.

The enlargement of the accessory sex glands in the steroid hormone treated steers indicated that it could possibly serve as an indication of this type of hormone administration. It indicated further that oral diethylstilbestrol was absorbed from the digestive tract and produced a systemic effect.

APPENDIX - Table I   Trial I

Steer Weights - Both Pasture Lots

	Control				Implant		
Steer No.	Initial wt. 5/21/52	Reimplant wt. 8/13/52	Final wt. 12/11/52	Steer No.	Initial wt. 5/21/52	Reimplant wt. 8/13/52	Final wt. 12/11/52
	lb.	lb.	lb.		lb.	lb.	lb.
			Alfalfa Brome				
699	570	658	923	701	565	737	1064
694	575	716	1022	705	570	781	1072
696	675	767	1049	709	695	861	1167
695	640	790	1086	708	618	715	967
			Bluegrass				
698	560	687	973	704	575	715	969
692	655	769	998	702	553	750	1074
693	575	701	978	707	618	722	952
697	590	724	948	703	665	795	1057

APPENDIX - Table II Trial I

Live Shrink

Control Cattle No.	MSU wt.	Slaughter wt.	Shrink	Shrink	Implant Cattle No.	MSU wt.	Slaughter wt.	Shrink	Shrink
	lb.	lb.	lb.	%		lb.	lb.	lb.	%
697	948	925	23	2.4	701	1004	1020	44	4.1
674	1022	990	32	3.1	709	1167	1135	32	2.7
696	1049	1020	29	2.8	704	969	950	19	2.0
698	973	945	28	2.9	707	952	915	37	3.9
695	1086	1040	46	4.2	705	1072	1050	22	2.0
699	923	850	73	7.9	708	967	955	12	1.2
692	998	1010	+12	+1.2	703	1057	1038	22	2.1
693	978	960	18	1.8	702	1074	1045	29	2.7

APPENDIX - Table III Trial I

Stomach Fill

Control			Implant		
Cattle No.	Fill lb.	Fill %[1]	Cattle No.	Fill lb.	Fill %[1]
694	64	6.5	701	78	7.6
697	70	7.6	709	71	6.3
696	67	6.6	704	78	8.2
698	63	6.7	707	47	5.1
695	76	7.3	705	74	7.0
699	38	4.5	708	58	6.1
692	63	6.2	703	78	7.5
693	77	8.0	702	70	6.7

[1] Expressed as percent of slaughter weight.

APPENDIX - Table IV   Trial I

Caul Fat (Greater Omentum)

Control			Implant		
Cattle No.	Caul fat	Caul fat	Cattle No.	Caul fat	Caul fat
	lb.	%[1]		lb.	%[1]
694	12	1.21	701	9	.88
697	10	1.08	709	13	1.14
696	14	1.37	704	9	.95
698	11	1.16	707	9	.98
695	14	1.35	705	11	1.05
699	11	1.29	708	9	.94
692	13	1.29	703	8	.77
693	14	1.45	702	9	.86

[1] Expressed as percent slaughter weight.

APPENDIX - Table V Trial I

Dressing Percent (Cold)

Control		Implant	
Cattle No.	Dressing percent	Cattle No.	Dressing percent
	%		%
694	58.6	701	59.8
697	57.9	709	58.8
696	61.4	704	57.7
698	59.0	707	57.3
695	59.4	705	59.1
699	57.6	708	59.9
692	61.6	703	58.3
693	56.9	702	58.8

APPENDIX - Table VI Trial I

Spleen, Heart and Hide Data

	Control							Implant					
Cattle No.	Spleen lb.	Spleen %[1]	Heart lb.	Heart %[1]	Hide lb.	Hide %[1]	Cattle No.	Spleen lb.	Spleen %[1]	Heart lb.	Heart %[1]	Hide lb.	Hide %[1]
694	1.7	.184	4.2	.453	92.0	9.93	701	1.6	.170	5.1	.541	78.0	8.28
697	2.3	.269	4.9	.573	84.0	9.82	709	2.7	.254	5.4	.507	90.0	8.46
696	1.7	.178	4.3	.451	77.0	8.08	704	2.1	.241	4.7	.539	76.0	8.71
698	1.7	.193	4.0	.454	80.0	9.07	707	1.8	.207	4.8	.553	83.0	9.56
695	2.0	.207	4.7	.487	72.0	7.47	705	1.6	.164	4.8	.492	92.0	9.43
699	1.7	.209	4.2	.517	77.0	9.48	708	2.2	.245	4.4	.491	72.0	8.03
692	2.3	.243	5.2	.549	82.0	8.66	703	2.0	.209	5.3	.554	80.0	8.36
693	2.0	.226	4.3	.487	87.0	9.85	702	2.1	.215	5.0	.513	85.0	8.72

[1] Expressed as slaughter weight minus stomach fill.

APPENDIX - Table VII   Trial I

Liver Data

Control			Implant		
Cattle No.	Liver	Liver	Cattle No.	Liver	Liver
	lb.	%[1]		lb.	%[1]
694	11.4	1.23	701	13.7	1.45
697	9.4	1.10	709	15.0	1.41
696	12.8	1.34	704	12.1	1.39
698	11.5	1.30	707	11.1	1.28
695	12.7	1.32	705	12.8	1.31
699	9.9	1.22	708	11.7	1.30
692	11.2	1.18	703	13.6	1.42
693	12.2	1.38	702	14.3	1.47

[1] Expressed as percent slaughter weight minus fill.

APPENDIX - Table VIII   Trial I

Chilling Shrink

	Control				Implant		
Cattle No.	Hot Carcass	Cold Carcass	Chilling Shrink	Cattle No.	Hot Carcass	Cold Carcass	Chilling Shrink
	lb.	lb.	%		lb.	lb.	%
694	619	599	3.1	701	656	636	3.0
697	568	549	3.3	709	709	686	3.2
696	668	644	3.6	704	572	560	2.1
698	592	575	2.9	707	561	546	2.7
695	666	645	3.2	705	652	634	2.8
699	548	532	2.9	708	600	580	3.3
692	635	615	3.1	703	635	615	3.0
693	577	557	3.5	702	653	632	3.2

APPENDIX - Table IX Trial I

Measurements - Conjugate Pelvic Diameter

Control Carcass No.	Control Anterior Spread	Control Posterior Spread	Implant Carcass No.	Implant Anterior Spread	Implant Posterior Spread
	mm.	mm.		mm.	mm.
694	140	135	701	160	172
697	137	142	709	180	190
696	145	135	704	165	200
698	140	150	707	145	170
695	145	140	705	160	160
699	128	132	708	160	170
692	135	134	703	170	180
693	130	135	702	162	205*

* Sacrum fractured resulting in atypical position.

APPENDIX - Table X Trial I

Physical Carcass Composition

Cattle No.	Lean 9-11 rib cut	Lean 9-11 rib cut	Fat 9-11 rib cut	Fat 9-11 rib cut	Bone 9-11 rib cut	L.N.*	Total bone 9-11 rib	Total bone 9-11 rib	Wt. of rib before sep.	Sum of components	Sep. carc. lean per Y	Sep. carc. fat per Y	Sep. carc. bone per Y
	g.	%	g.	%	g.	g.	g.	%	g.	%	%	%	%
Control													
692	1992	48.96	1349	33.16	669	20	689	16.94	4068	99.06	55.25	30.07	15.18
693	2191	51.44	1440	33.81	560	18	578	13.57	4259	98.82	57.23	30.59	13.25
694	2207	49.02	1584	35.18	630	16	648	14.39	4502	98.59	55.30	31.68	13.72
695	2437	50.99	1537	32.16	719	31	750	15.69	4779	98.84	56.87	29.27	14.46
696	2788	50.95	1947	35.58	658	28	686	12.54	5472	99.07	56.84	32.00	12.67
697	2248	54.01	1135	27.27	688	31	719	17.27	4162	98.55	59.29	25.36	12.36
698	2301	52.08	1371	31.03	680	22	702	15.89	4418	99.00	57.74	28.36	14.58
699	1963	50.12	1294	33.04	595	20	615	15.70	3916	98.86	56.18	29.97	14.47
Implant													
701	2483	53.09	1386	29.62	740	22	762	16.29	4678	99.00	58.55	27.24	14.80
702	2651	53.71	1413	28.63	777	21	808	16.37	4935	98.71	59.05	26.44	14.85
703	2523	52.90	1439	30.17	724	34	758	15.89	4769	98.96	58.40	27.68	14.58
704	2249	54.81	1158	28.22	630	25	655	15.96	4103	98.99	59.93	26.12	14.62
705	2393	52.29	1500	32.77	647	20	667	14.58	4576	99.64	57.91	29.76	13.83
707	2265	53.15	1252	29.38	687	20	707	16.59	4261	99.12	58.60	27.04	14.98
708	2386	51.88	1427	31.02	730	28	758	16.48	4599	99.38	57.58	28.36	14.91
709	2941	51.56	1870	32.78	820	30	850	14.90	5703	99.24	57.33	29.76	14.01

* Ligamentum nucei

APPENDIX - Table XI Trial II

Steer Weights

Steer No.	Pre-treatment wt. 9/10	Av. wt. 3/2-3-4	Initial test wt. 2/10	2/23	3/9	3/23	3/30	4/6	4/13	4/20	4/26	4/27	4/28	Av. wt. 4/26-27-28 Final Test wt.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Control														
607	770	1094	1089	1137	1160	1172	1195	1231	1225	1237	1259	1252	1273	1261
604	740	984	975	1019	1047	1037	1053	1064	1085	1094	1091	1100	1108	1100
605	740	1106	1070	1140	1190	1232	1228	1255	1271	1282	1293	1291	1292	1292
606	710	1059	1071	1107	1162	1195	1210	1257	1256	1288	1300	1278	1300	1293
603	770	1134	1126	1152	1202	1230	1218	1252	1255	1284	1259	1273	1269	1267
602	755	1033	1029	1060	1083	1117	1126	1147	1145	1133	1154	1135	1143	1144
608	720	1099	1107	1128	1150	1159	1171	1183	1206	1217	1207	1209	1227	1214
601	785	1059	1074	1102	1149	1166	1204	1236	1260	1269	1291	1283	1284	1286
Implant														
537	735	1066	1059	1085	1124	1171	1190	1220	1222	1256	1271	1265	1268	1268
533	800	1053	1048	1093	1119	1164	1169	1208	1222	1250	1251	1253	1249	1251
531	815	1136	1146	1173	1210	1229	1255	1284	1299	1319	1341	1333	1342	1339
535	680	1103	1103	1163	1232	1289	1304	1336	1359	1378	1371	1381	1394	1382
536	665	965	976	998	1015	1033	1058	1086	1112	1122	1128	1126	1128	1127
532	705	1027	1047	1061	1104	1167	1159	1195	1208	1213	1229	1225	1241	1232
534	825	1171	1168	1209	1241	1281	1296	1328	1340	1360	1373	1368	1388	1376

APPENDIX - Table XII Trial II

Slaughter and Carcass Yields

Steer No.	Wt. MSU 4/28	Slaughter wt.	Live 18 hr. shrink	Live 18 hr. shrink[2]	Hot carcass wt.	Cold carcass wt.	Percent cooler shrink[3] 48 hr.	Dressing	Carcass grade
	lb.	lb.	lb.	%	lb.	lb.	%	%[1]	
Control									
601	1284	1250	34	2.6	830	804	3.1	64.4	Prime
602	1143	1120	23	2.0	742	728	1.9	65.0	Choice+
603	1269	1250	19	1.5	811	783	3.5	62.6	Choice+
604	1108	1075	33	3.0	693	675	2.6	62.8	Choice+
605	1292	1260	32	2.5	824	800	2.9	63.5	Prime-
606	1300	1255	45	3.5	805	786	2.4	62.6	Prime-
607	1273	1220	53	4.2	803	778	3.1	63.8	Choice+
608	1227	1200	27	2.2	775	756	2.5	63.0	Prime-
Implant									
531	1342	1280	62	4.6	830	809	2.5	63.2	Prime-
532	1241	1195	46	3.7	775	758	2.2	63.4	Prime+
533	1249	1205	44	3.5	764	748	2.1	62.1	Prime-
534	1388	1345	43	3.1	845	826	2.2	61.4	Choice+
535	1384	1325	69	4.9	827	808	2.3	61.0	Choice+
536	1128	1100	28	2.5	717	700	2.4	63.6	Choice+
537	1268	1215	53	4.2	777	759	2.3	62.5	Prime

[1] Expressed as percent slaughter weight.
[2] Expressed as percent MSU weight 4/29 1:00 P.M.
[3] Expressed as percent hot carcass weight.

APPENDIX - Table XIII Trial II

Slaughter Performance

Steer No.	Stomach full	Stomach empty	Fill	Percent[1] fill	Intestine	Full stomach & intestine	Percent[1] full stomach & intestine
	lb.	lb.	lb.	%	lb.	lb.	%
Control							
601	103	51.5	51.5	4.12	60	163.0	13.0
602	92	43.5	48.5	4.33	60	152.0	13.6
603	119.5	62	57.5	4.60	69	188.5	15.1
604	107	53.5	53.5	4.98	59	166.0	15.4
605	129	57	72	5.71	66	195.0	15.5
606	121	57.5	63.5	5.06	68	189.0	15.1
607	96	47	49	4.02	61	157.0	12.9
608	109	54.5	54.5	4.54	66.5	175.5	14.6
Implant							
531	108	55.5	52.5	4.10	68.5	176.5	13.8
532	99	56.5	42.5	3.56	69.5	168.5	14.1
533	130	55	75	6.22	69	199.0	16.5
534	119	53	66	4.91	71	190.0	14.1
535	154.5	66.5	88	6.64	59.5	214.0	16.2
536	85.5	44	41.5	3.77	52	137.5	12.5
537	124	44.5	79.5	6.54	62.5	186.5	15.3

[1] Expressed as percent slaughter weight.

APPENDIX - Table XIV Trial II

Slaughter Offal Data

Steer No.	Liver lb.	Liver %[1]	Hide lb.	Hide %[1]	Caul Fat lb.	Caul Fat %[1]	Heart lb.	Heart %[1]
Control								
601	16.0	1.3	88.0	7.0	21.0	1.7	4.4	.35
602	11.3	1.0	60.0	5.4	19.0	1.7	4.6	.41
603	13.5	1.1	72.0	5.8	25.5	2.0	4.5	.36
604	13.2	1.2	63.0	5.9	21.5	2.0	4.0	.37
605	15.6	1.2	70.0	5.6	18.0	1.4	4.0	.32
606	15.5	1.2	72.0	5.7	31.0	2.5	4.4	.35
607	12.9	1.1	83.0	6.8	27.5	2.3	4.5	.36
608	14.7	1.2	63.0	5.3	26.0	2.2	4.5	.38
Implant								
531	15.3	1.2	74.0	5.8	25	1.9	4.3	.34
532	14.0	1.2	73.0	6.1	16.5	1.5	4.5	.38
533	13.3	1.1	74.0	6.1	20.5	1.7	4.5	.37
534	14.7	1.1	85.0	6.3	44.0	3.3	5.2	.38
535	16.2	1.2	87.0	6.6	20.0	1.2	5.1	.38
536	10.4	.9	73.0	6.0	32.0	2.9	3.6	.33
537	15.5	1.3	80.0	6.6	36.0	3.0	4.4	.36

[1] Expressed as percent slaughter weight.

APPENDIX - Table XV Trial II

Physical Separation 9-10-11 Rib Cut and Estimated Carcass Composition

Cattle No.	Sep. lean	Sep. lean	Sep. fat	Sep. fat	Sep. bone	L.N[1]	Total bone	Bone	Wt. of rib before separation	Total	Sep. carc. lean Per Y	Sep. carc. fat Per Y	Carc. bone Per Y
	g.	%	g.	%	g.	g.	g.	%	g.	%	%	%	%
Control													
601	3058	44.00	3221	46.35	638	18	656	9.44	6949	99.79	51.28	40.62	10.90
602	2334	38.01	3054	49.73	705	21	726	11.82	6140	99.56	46.49	43.32	12.26
603	2950	46.92	2572	40.90	702	28	730	11.61	6287	99.43	53.62	36.26	12.14
604	2553	46.66	2106	38.49	770	27	797	14.57	5471	99.72	53.41	34.33	13.82
605	2746	41.37	2915	43.92	834	19	853	12.85	6637	98.14	49.18	38.68	12.84
606	2807	44.42	2687	42.52	761	33	794	12.56	6319	99.50	51.62	37.56	12.68
607	2825	42.53	2985	44.94	791	23	814	12.26	6642	99.79	50.10	39.49	12.52
608	2868	46.29	2605	42.05	675	18	693	11.19	6195	99.53	53.11	37.18	11.90
Implant													
531	2452	40.40	2875	47.37	696	30	726	11.96	6068	99.73	48.40	41.44	12.34
532	2741	47.82	2347	40.95	652	17	669	11.67	5731	100.4	54.34	36.30	12.17
533	2338	37.52	3128	50.20	704	23	727	11.67	6230	99.39	46.10	43.70	12.17
534	2876	47.86	2187	36.40	882	35	917	15.26	6008	99.52	54.37	32.66	14.22
535	2890	47.18	2375	38.77	795	29	824	13.45	6125	99.40	53.82	34.56	13.19
536	2406	38.71	3044	48.97	710	26	736	11.84	6215	99.52	47.05	42.72	12.27
537	2450	39.77	2827	45.89	844	20	864	14.03	6160	99.69	47.90	36.71	13.52

[1] Ligamentum muchae

APPENDIX - Table XVI Trial II

Chemical and Physical Carcass Composition

Control			Implant		
Cattle No.	Moisture in raw tallow [1]	Iodine number of rendered tallow [2]	Cattle No.	Moisture in raw tallow [1]	Iodine number of rendered tallow [2]
	%	g.		%	g.
601	10.3*	51.8	531	6.3	52.5
602	4.8	52.6	532	5.6	55.2
603	6.6	54.9	533	4.3	49.1
604	4.6	54.0	534	5.4	53.3
605	6.9	52.1	535	4.5	52.2
606	7.4	54.3	536	6.8	53.0
607	4.3	48.8	537	4.9	51.7
608	5.3	49.4			

1 Averages of results from 2 or more determinations.
2 Grams of iodine absorbed by 100 grams of fat.
* Sample jar broken upon removal from frozen storage.

APPENDIX - Table XVII Trial II

Longissimus dorsi Area and External Fat Thickness

Cattle No.	Control L. dorsi	Fat thickness	Cattle No.	Implant L. dorsi	Fat thickness
	sq. in.	mm.		sq. in.	mm.
601	13.33	25	531	13.14	16
602	11.77	26	532	13.60	23
603	11.57	22	533	10.02	25
604	12.43	17	534	12.99	15
605	11.85	23	535	12.24	22
606	11.39	20	536	10.12	30
607	14.08	16	537	11.72	20
608	11.98	16			

APPENDIX - Table XVIII   Trial III

Steer Weights - Control Steers

Cattle No.	12/3 1954	12/17	12/31	1/14 1955	1/28	2/14	2/28	3/14	3/28	4/11	4/21	4/22	4/23
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
4	696	750	781	762	797	835	862	915	932	953	980	982	986
8	684	728	750	763	796	840	860	916	936	945	944	988	974
17	746	790	838	848	860	898	950	990	1034	1038	1064	1084	1066
22	850	897	930	963	980	1037	1076	1124	1134	1158	1153	1188	1178
23	800	847	866	893	920	996	1030	1080	1090	1120	1129	1155	1146
24	740	781	803	830	850	906	948	980	1022	1033	1035	1064	1044
30	960	972	1016	1052	1068	1138	1178	1238	1242	1264	1275	1310	1300
31	788	840	881	902	950	1022	1062	1104	1132	1142	1126	1184	1168
32	832	880	904	928	955	1010	1070	1098	1135	1148	1162	1186	1194
33	830	898	931	961	975	1057	1090	1136	1184	1188	1205	1226	1212
36	932	934	958	978	1002	1082	1110	1138	1178	1162	1174	1194	1188
37	780	828	855	878	910	958	994	1015	1052	1062	1076	1094	1096
39	868	886	888	900	930	958	982	1030	1056	1057	1080	1100	1084
42	802	860	886	897	929	987	1013	1050	1062	1096	1105	1116	1106

APPENDIX - Table XIX Trial III

Steer Weights - Diethylstilbestrol Fed Lot

Cattle No.	12/3 1954	12/17	12/31	1/14 1955	1/28	2/14	2/28	3/14	3/28	4/11	4/21	4/22	4/23
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
1	680	740	768	770	825	855	890	942	954	988	1035	1050	1030
2	830	395	890	920	980	1026	1076	1102	1138	1142	1172	1170	1186
3	772	816	863	892	938	976	1033	1088	1134	1156	1185	1192	1180
7	838	887	911	945	998	1040	1084	1154	1200	1222	1246	1250	1240
10	795	811	845	885	933	960	1000	1062	1090	1122	1166	1172	1144
11	880	913	950	955	998	1014	1033	1065	1126	1118	1152	1160	1160
14	788	840	880	910	968	990	1014	1058	1060	1120	1174	1176	1176
20	814	857	888	908	951	988	1024	1070	1122	1146	1178	1176	1160
25	695	746	785	820	878	912	940	983	1008	1025	1052	1066	1064
28	920	968	988	1007	1065	1108	1154	1198	1240	1266	1288	1290	1284
29	952	968	986	1020	1060	1108	1140	1165	1222	1236	1278	1268	1254
38	770	774	807	810	862	888	924	967	1000	1020	1040	1046	1036
40	800	842	842	884	925	954	998	1020	1068	1062	1106	1114	1108
41	738	795	834	860	905	945	1010	1042	1096	1110	1140	1138	1120

APPENDIX - Table XX Trial III

Steer Weights - Implanted Lot

Cattle No.	12/3 1954	12/17	12/31	1/14 1955	1/28	2/14	2/28	3/14	3/28	4/11	4/21	4/24	4/23
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
5	902	955	980	1000	1060	1064	1126	1152	1178	1198	1228	1228	1226
6	854	900	906	940	1012	1040	1092	1147	1174	1188	1228	1234	1244
9	828	858	897	914	950	992	1048	1117	1148	1182	1236	1230	1210
12	770	831	880	932	984	1052	1122	1193	1258	1278	1318	1322	1304
13	874	920	950	952	1016	1034	1084	1126	1172	1185	1228	1228	1196
15	862	900	926	933	998	1024	1098	1132	1166	1194	1232	1234	1224
16	795	820	829	865	925	956	1008	1058	1110	1112	1129	1136	1114
18	720	793	776	805	870	902	942	995	1020	1054	1114	1126	1108
19	810	869	903	910	986	1022	1058	1102	1136	1160	1188	1196	1188
21	947	970	993	1008	1078	1100	1160	1190	1248	1270	1312	1310	1304
26	774	830	850	861	924	980	1018	1074	1114	1126	1164	1182	1166
27	662	690	740	770	832	880	922	995	1036	1074	1112	1108	1096
34	835	859	889	915	977	1020	1078	1145	1198	1188	1235	1248	1226
35	678	690	702	738	775	820	857	898	952	960	994	994	984

APPENDIX - Table XXI Trial III

Live Slaughter Steer Grade Scores

Control				Diethylstilbestrol Fed				Implant			
Cattle No.	Grader A	Grader B	Average	Cattle No.	Grader A	Grader B	Average	Cattle No.	Grader A	Grader B	Average
4	8	8	8.0	1	8	8	8.0	5	5	6	5.5
8	7	8	7.5	2	6	7	6.5	6	5	5	5.0
17	5	6	5.5	3	6	5	5.5	9	5	5	5.0
22	4	5	4.5	7	5	5	5.0	12	5	5	5.0
23	5	6	5.5	10	6	6	6.0	13	4	5	4.5
24	6	6	6.0	11	3	4	3.5	15	5	5	5.0
30	5	5	5.0	14	7	6	6.5	16	7	6	6.5
31	7	7	7.0	20	4	4	4.0	18	4	6	5.0
32	7	6	6.5	25	5	6	5.5	19	5	6	5.5
33	7	7	7.0	28	5	5	5.0	21	4	5	4.5
36	5	5	5.0	29	5	7	6.0	26	4	5	4.5
37	6	5	5.5	38	4	5	4.5	27	4	5	4.5
39	4	4	4.0	40	4	5	4.5	34	6	6	6.0
42	5	6	5.5	41	6	6	6.0	35	6	7	6.5

Based on following numerical equivalents:

Prime + 1	Choice + 4	Good + 7
Prime 2	Choice 5	Good 8
Prime - 3	Choice - 6	Good - 9

APPENDIX - Table XXII Trial III

Dressing Percentage and Chilling Shrink

	Control							Diethylstilbestrol Fed					
Cattle No.	Live wt. Detroit	Hot Carcass wt.	Cold Carcass wt.	Shrink	Shrink	Dressing % (cold)	Cattle No.	Live wt. Detroit	Hot Carcass wt.	Cold Carcass wt.	Shrink	Shrink	Dressing % (cold)
	lb.	lb.	lb.	lb.	%	%		lb.	lb.	lb.	lb.	%	%
4	950	590	580	10	1.7	61.1	1	975	612	602	10	1.6	60.5
8	940	580	570	10	1.7	60.6	2	1165	720	709	11	1.5	60.9
17	1030	628	621	7	1.1	60.3	3	1150	740	731	9	1.2	63.6
22	1115	718	709	9	1.3	63.6	7	1220	753	745	8	1.1	61.1
23	1115	702	692	10	1.4	62.1	10	1100	704	696	8	1.1	63.3
24	1020	644	632	12	1.9	62.0	11	1125	696	686	10	1.4	61.0
30	1275	816	803	13	1.6	63.0	14	1140	722	710	12	1.7	62.3
31	1125	691	681	10	1.4	60.5	20	1135	726	715	11	1.5	63.0
32	1155	743	730	13	1.7	63.2	25	1035	642	632	10	1.6	61.1
33	1190	744	731	13	1.7	61.4	28	1260	810	800	10	1.2	63.5
36	1155	729	720	9	1.2	62.3	29	1225	780	771	9	1.2	62.9
37	1065	662	652	10	1.5	61.2	38	1020	638	627	11	1.7	61.5
39	1055	676	666	10	1.5	63.1	40	1080	674	663	11	1.6	61.4
42	1085	683	673	10	1.5	62.0	41	1110	697	688	9	1.3	62.0

APPENDIX - Table XXII Trial III

Dressing Percentage and Chilling Shrink (continued)

Cattle No.	Live wt. Detroit	Hot Carcass wt.	Implanted Cold Carcass wt.	Shrink	Shrink	Dressing % (Cold)
	lb.	lb.	lb.	lb.	%	%
5	1200	770	760	10	1.3	63.3
6	1205	762	755	7	.9	62.7
9	1185	756	746	10	1.3	63.0
12	1280	812	804	8	1.0	62.8
13	1175	774	765	9	1.2	65.1
15	1195	758	749	9	1.2	62.7
16	1090	712	700	12	1.7	64.2
18	1080	666	658	8	1.2	60.9
19	1165	744	733	11	1.5	62.9
21	1275	797	785	12	1.5	61.6
26	1140	705	698	7	1.0	61.2
27	1070	663	653	10	1.5	61.0
34	1210	780	769	11	1.4	63.6
35	985	616	609	7	1.1	61.8

APPENDIX - Table XXIII Trial III

Full and Empty Stomach Weights

Control						Diethylstilbestrol Fed					
Cattle No.	Stomach Full	Empty Stomach (-Peck)	Peck (Omasum)	Fill	Fill[1]	Cattle No.	Stomach Full	Empty Stomach (-Peck)	Peck (Omasum)	Fill	Fill[1]
	lb.	lb.	lb.	lb.	%		lb.	lb.	lb.	lb.	%
4	59	17	11	31	3.3	1	73.5	16	14	43.5	4.4
8	66.5	16	18	32.5	3.5	2	70	20	17	33	2.8
17	79.5	14	14	51.5	5.0	3	52	17	19	16	3.1
22	81	17	14	50	4.5	7	75	23	17	35	2.9
23	74	20	15	39	3.5	10	65	17	11	37	3.4
24	51	15.5	12	23.5	2.3	11	71.5	21	13.5	37	3.3
30	72.5	20	10	42.5	3.3	14	67.5	20	14	33.5	2.9
31	89	20	15.5	53.5	4.8	20	63	19.5	15	28.5	2.5
32	65	16	14	35	3.0	25	70	18	13	39	3.8
33	85	21.5	15	48.5	4.1	28	77	23	11	43	3.4
36	70.5	18	19	33.5	2.9	29	62.5	18.5	12.5	31.5	2.6
37	65	18.5	18	28.5	2.7	38	49	16	15	18	1.8
39	52.5	19	13	20.5	1.9	40	70	19	13	38	3.5
42	70	20.5	17.5	32	2.9	41	66	18	20	28	2.5

1 Expressed as percent live weight - Detroit

APPENDIX - Table XXIII Trial III

Full and Empty Stomach Weights (Continued)

Cattle No.	Stomach Full	Implanted Empty Stomach (-Peck)	Peck (Omasum)	Fill	Fill[1]
	lb.	lb.	lb.	lb.	%
5	73	19	11	43	3.6
6	81	18	15	48	2.5
9	77.5	19	16	42.5	3.6
12	89	21.5	15	52.5	4.1
13	57	18	11	28	2.4
15	82.5	19	15	48.5	4.1
16	56	19	13	24	2.2
18	76	19	15.5	41.5	3.8
19	65	16	14	35	3.0
21	77	21.5	16	39.5	3.1
26	78	18	18.5	41.5	3.6
27	88	20	13	55	5.1
34	69	23	15	31	2.6
35	64	15	11	38	3.9

1 Expressed as percent live weight - Detroit

APPENDIX - Table XXIV Trial III

Hide and Liver Data

	Control					Diethylstilbestrol Fed					Implant			
Cattle No.	Hide lb.	Hide %[1]	Liver lb.	Liver %[1]	Cattle No.	Hide lb.	Hide %[1]	Liver lb.	Liver %[1]	Cattle No.	Hide lb.	Hide %[1]	Liver lb.	Liver %[1]
4	76	12.9	9.8	16.6	1	89	14.5	10.8	17.6	5	90	11.7	11.2	14.5
8	70	12.1	9.7	16.7	2	99	13.8	11.2	15.6	6	91	11.9	11.9	15.6
17	96	15.3	10.0	15.9	3	98	13.2	12.1	16.4	9	95	12.6	13.3	17.6
22	94	13.1	9.9	13.8	7	92	12.2	14.3	19.0	12	95	11.7	12.7	15.6
23	96	13.7	11.6	16.5	10	90	12.8	11.4	16.2	13	86	11.1	11.4	14.7
24	75	11.6	9.9	15.4	11	85	12.2	12.1	17.4	15	90	11.9	11.0	14.5
30	96	11.8	12.0	14.7	14	91	12.6	12.7	17.6	16	90	12.6	13.0	18.3
31	87	12.6	11.4	16.5	20	97	13.4	11.2	15.4	18	89	13.4	11.8	17.7
32	91	12.2	11.4	15.3	25	81	12.6	9.4	14.6	19	92	12.4	11.3	15.2
33	91	12.2	11.5	15.5	28	95	11.7	12.2	15.1	21	102	12.8	12.8	16.1
36	96	13.2	11.5	15.8	29	98	12.6	12.0	15.4	26	94	13.3	12.1	17.2
37	78	11.8	13.1	19.8	38	86	13.5	11.0	17.2	27	84	12.7	10.8	16.3
39	91	13.5	10.1	14.9	40	94	13.9	11.5	17.1	34	97	12.4	13.3	17.1
42	90	13.2	11.3	16.5	41	97	13.9	11.2	16.1	35	90	14.6	10.8	17.5

1 Expressed as % hot carcass weight.

APPENDIX - Table XXV Trial III

Spleen and Heart Data

Control					Diethylstilbestrol Fed					Implant				
Cattle No.	Heart lb.	Heart %[1]	Spleen lb.	Spleen %[1]	Cattle No.	Heart lb.	Heart %[1]	Spleen lb.	Spleen %[1]	Cattle No.	Heart lb.	Heart %[1]	Spleen lb.	Spleen %[1]
4	4.1	.69	2.0	.34	1	4.4	.72	1.9	.31	5	4.3	.56	1.6	.21
8	4.0	.69	1.8	.31	2	5.4	.75	2.0	.28	6	6.8	.89	1.8	.24
17	3.9	.62	1.5	.24	3	4.9	.66	2.0	.24	9	5.2	.69	2.0	.26
22	4.8	.67	1.8	.25	7	5.5	.73	1.9	.25	12	5.6	.69	1.8	.22
23	4.2	.60	1.7	.24	10	4.3	.61	2.0	.28	13	5.4	.70	2.1	.27
24	4.4	.68	1.8	.28	11	4.8	.69	2.1	.30	15	5.9	.78	2.0	.26
30	4.6	.56	1.7	.21	14	5.2	.72	1.6	.22	16	4.6	.65	2.0	.28
31	4.7	.68	1.8	.26	20	4.2	.58	1.5	.21	18	4.2	.63	2.0	.30
32	5.0	.67	1.6	.22	25	4.3	.66	2.0	.31	19	5.8	.78	2.1	.28
33	4.4	.59	1.5	.20	27	5.1	.63	1.7	.21	21	5.0	.63	2.1	.26
36	4.6	.63	1.9	.26	29	4.9	.63	2.1	.27	26	4.9	.70	1.5	.21
37	4.8	.73	1.9	.29	38	4.1	.64	1.7	.27	27	4.9	.74	1.9	.29
39	4.5	.67	1.8	.27	40	4.3	.64	1.5	.22	34	5.4	.69	2.3	.29
42	4.5	.66	1.9	.28	41	4.9	.70	2.1	.30	35	4.4	.71	1.9	.31

[1] Expressed as % hot carcass weight.

APPENDIX - Table XXVI Trial III

Carcass Grades

Control			Diethylstilbestrol Fed			Implant		
Cattle No.	Grade	Grade Code[1]	Cattle No.	Grade	Grade Code[1]	Cattle No.	Grade	Grade Code[1]
4	Gd	8	1	Gd +	7	5	Ch	5
8	Gd +	7	2	Ch -	6	6	Ch	5
17	Ch -	6	3	Ch +	4	9	Gd +	7
22	Gd +	7	7	Gd +	7	12	Gd +	7
23	Ch -	6	10	Ch	5	13	Gd +	7
24	Ch -	6	11	Ch -	6	15	Gd +	7
30	Ch -	6	14	Ch -	6	16	Gd +	7
31	Gd	8	20	Ch +	4	18	Ch	5
32	Ch	5	25	Gd +	7	19	Gd +	7
33	Ch -	6	28	Ch +	4	21	Gd +	7
36	Ch -	6	29	Ch	5	26	Ch -	6
37	Ch +	4	38	Ch -	6	27	Ch -	6
39	Gd +	7	40	Ch	5	34	Ch -	6
42	Ch -	6	41	Ch -	6	35	Gd	8

[1] Based on following numerical equivalents:

Prime +	1	Choice +	4	Good +	7
Prime	2	Choice	5	Good	8
Prime -	3	Choice -	6	Good -	9

APPENDIX - Table XXVII Trial III

Pelvic Diameter

	Control							Diethylstilbestrol Fed					
Cattle No.	Rear Right	Rear Left	Average	Front Right	Front Left	Average	Cattle No.	Rear Right	Rear Left	Average	Front Right	Front Left	Average
	mm.	mm.	mm.	mm.	mm.	mm.		mm.	mm.	mm.	mm.	mm.	mm.
4	155	155	155	155	155	155	1	175	175	175	150	145	148
8	133	133	133	150	150	150	2	190	190	190	150	155	153
17	145	153	149	140	140	140	3	185	180	183	155	155	155
22	165	153	159	155	155	155	7	195	190	193	155	153	154
23	150	150	150	145	140	143	10	183	180	182	153	150	152
24	140	150	145	155	155	155	11	180	175	178	165	165	165
30	160	155	158	165	155	160	14	185	190	188	150	150	150
31	180	163	172	153	153	153	20	183	185	184	155	160	158
32	155	160	158	155	155	155	25	193	188	191	160	160	160
33	150	170	160	147	150	149	26	180	173	177	155	160	158
36	160	152	156	150	147	149	29	170	175	173	165	162	164
37	163	160	162	160	160	160	38	185	145	165	135	150	143
39	145	145	145	152	153	153	40	165	160	163	153	153	153
42	170	157	164	145	140	143	41	177	182	180	165	165	165

APPENDIX - Table XXVII Trial III

Pelvic Diameter (continued)

	Implant					
Cattle No.	Rear Right	Rear Left	Average	Front Right	Front Left	Average
	mm.	mm.	mm.	mm.	mm.	mm.
5	190	195	193	175	175	175
6	220	225	223	180	185	183
9	175	190	183	167	170	169
12	210	195	203	155	155	155
13	197	200	199	155	160	158
15	205	205	205	160	160	160
16	195	190	193	165	163	164
18	203	200	202	160	155	158
19	195	192	194	170	170	170
21	200	200	200	160	160	160
26	205	205	205	155	150	153
27	220	210	215	155	147	151
34	190	193	192	155	155	155
35	203	200	202	165	160	163

APPENDIX - Table XXVIII Trial III

Physical Separation, 9-10-11 rib cut and estimated carcass composition

	Control							Diethylstilbestrol Fed					
Cattle No.	Lean 9-11 Rib	Carcass Lean	Fat 9-11 Rib	Carcass Fat	Bone 9-11 Rib	Carcass Bone	Cattle No.	Lean 9-11 Rib	Carcass Lean	Fat 9-11 Rib	Carcass Fat	Bone 9-11 Rib	Carcass Bone
	%	%	%	%	%	%		%	%	%	%	%	%
4	48.9	55.2	36.9	33.1	13.2	13.0	1	57.0	61.7	25.7	24.1	15.8	14.5
8	50.1	56.2	32.1	29.2	16.5	14.9	2	46.1	53.0	40.3	35.8	13.1	13.0
17	47.3	53.9	37.1	33.2	14.3	13.7	3	47.4	54.0	37.7	33.7	13.8	13.4
22	42.9	50.4	42.5	37.5	13.3	13.1	7	52.2	57.8	33.2	30.1	14.1	13.6
23	46.2	53.0	40.6	36.0	12.1	12.4	10	50.9	56.8	33.0	29.9	15.7	14.5
24	50.6	56.6	35.6	32.0	13.2	13.0	11	44.1	51.4	40.5	35.9	14.1	13.6
30	46.6	53.4	39.4	35.1	12.7	12.8	14	46.9	53.6	37.0	33.1	15.3	14.2
31	49.0	55.3	35.8	32.2	14.4	13.7	20	44.1	51.4	43.8	38.6	11.1	11.8
32	47.5	54.1	39.5	35.1	11.8	12.2	25	48.2	54.6	35.7	32.1	14.5	13.8
33	46.6	53.4	37.8	33.8	14.0	13.5	28	40.0	48.1	47.0	41.1	11.6	12.1
36	48.0	54.5	38.4	34.3	13.1	13.0	29	44.8	51.9	40.4	35.9	14.2	13.6
37	45.0	52.1	40.7	36.1	13.5	13.2	38	46.0	52.9	39.8	35.4	13.9	13.1
39	40.8	48.7	45.6	40.0	12.6	12.7	40	44.2	51.4	41.2	36.5	13.1	13.0
42	41.3	49.1	43.8	38.6	14.0	13.5	41	41.7	49.4	42.0	37.1	15.3	14.2

APPENDIX - Table XXVIII Trial III

Physical Separation, 9-10-11 rib cut and estimated carcass composition (continued)

			Implant			
Cattle No.	Lean 9-11 Rib	Carcass Lean	Fat 9-11 Rib	Carcass Fat	Bone 9-11 Rib	Carcass Bone
	%	%	%	%	%	%
5	46.0	52.9	39.4	35.1	13.2	13.0
6	46.7	53.4	40.8	36.2	12.2	12.5
9	50.5	56.5	33.7	30.5	14.3	13.7
12	48.0	54.5	37.1	33.2	13.6	13.3
13	45.4	52.4	41.4	36.7	12.3	12.5
15	50.2	56.2	35.6	32.0	13.1	13.0
16	54.6	59.8	29.5	27.1	15.0	14.1
18	50.7	56.6	34.6	31.2	14.0	13.5
19	52.9	58.4	32.1	29.2	14.4	13.7
21	51.3	57.1	32.4	29.5	15.4	14.3
26	52.1	57.8	35.0	31.5	11.7	12.2
27	50.5	56.5	34.3	31.0	13.5	13.2
34	48.6	55.0	36.1	32.4	14.4	13.7
35	58.7	63.0	24.0	22.7	16.4	14.9

APPENDIX - Table XXIX Trial III

Fat Thickness - Rib-eye Area

Control			Diethylstilbestrol Fed			Implant		
Cattle No.	Fat Thickness	Rib eye area	Cattle No.	Fat Thickness	Rib eye area	Cattle No.	Fat Thickness	Rib eye area
	50th in.	sq. in.		50th in.	sq. in.		50th in.	sq. in.
4	31	8.12	1	49	9.22	5	43	7.24
8	11	11.87	2	56	9.62	6	50	9.93
17	34	8.30	3	41	11.64	9	38	9.95
22	50	9.97	7	34	11.84	12	41	11.65
23	61	10.71	10	36	10.24	13	38	10.70
24	45	9.50	11	46	10.39	15	36	10.25
30	47	9.53	14	23	9.22	16	26	11.31
31	44	9.79	20	79	9.51	18	39	10.66
32	52	10.65	25	40	9.91	19	36	12.19
33	50	9.20	28	54	8.90	21	39	11.49
36	63	10.43	29	48	11.22	26	53	10.63
37	53	10.27	38	48	8.90	27	38	9.73
39	52	7.97	40	57	8.90	34	37	11.76
42	49	10.77	41	56	9.14	35	23	9.84

APPENDIX - Table XXX Trial III

External and Internal Fat - Moisture

	Control						Diethylstilbestrol Fed						
	Internal Fat			External Fat				Internal Fat			External Fat		
Cattle No.	Sample I	Sample II	Average	Sample I	Sample II	Average	Cattle No.	Sample I	Sample II	Average	Sample I	Sample II	Average
	%	%	%	%	%	%		%	%	%	%	%	%
4	3.03	3.00	3.02	6.77	6.98	6.88	1	5.38	5.37	5.38	10.71	10.66	10.69
8	3.59	3.56	3.58	8.40	8.44	8.42	2	3.00	3.08	3.04	7.24	7.26	7.25
17	3.73	3.77	3.75	6.95	6.87	6.91	3	3.86	3.86	3.86	9.06	8.87	8.97
22	4.00	3.97	3.99	12.20	11.83	12.02	7	3.53	3.53	3.53	8.04	7.85	7.95
23	3.36	3.36	3.36	8.30	8.31	8.31	10	3.33	3.26	3.30	6.78	6.84	6.81
24	3.89	3.86	3.88	7.09	6.93	7.01	11	3.16	3.12	3.14	7.68	7.72	7.70
30	3.71	3.74	3.73	8.54	8.79	8.67	14	4.00	3.99	4.00	7.51	7.59	7.55
31	3.53	3.38	3.46	9.36	9.10	9.23	20	3.63	3.59	3.61	10.12	10.07	10.10
32	3.57	3.66	3.62	7.00	6.99	7.00	25	3.79	3.75	3.77	7.31	7.18	7.25
33	3.20	3.26	3.23	6.84	6.44	6.64	28	3.33	3.35	3.34	9.48	9.43	9.46
36	3.23	3.22	3.23	7.92	7.94	7.93	29	3.24	3.30	3.27	8.36	8.04	8.20
37	3.36	3.36	3.36	8.41	8.32	8.37	38	3.39	3.39	3.39	10.65	10.50	10.58
39	3.16	3.21	3.19	7.29	7.33	7.31	40	3.87	3.87	3.87	10.44	10.52	10.48
42	3.64	3.65	3.65	6.47	6.45	6.46	41	3.13	3.11	3.12	15.12	15.10	15.11

APPENDIX - Table XXX Trial III

External and Internal Fat - Moisture (continued)

	Implant					
	Internal Fat			External Fat		
Cattle No.	Sample I	Sample II	Average	Sample I	Sample II	Average
	%	%	%	%	%	%
5	3.39	3.38	3.39	7.62	7.47	7.55
6	3.40	3.31	3.36	7.80	7.91	7.86
9	3.54	3.52	3.53	8.69	8.72	8.71
12	3.64	3.55	3.60	8.67	8.54	8.61
13	3.23	3.21	3.22	8.22	8.17	8.20
15	3.39	3.28	3.34	7.60	7.65	7.63
16	3.06	3.03	3.05	7.84	7.69	7.77
18	4.01	3.94	3.98	7.07	7.00	7.04
19	3.27	3.30	3.29	7.28	7.26	7.27
21	4.11	4.20	4.16	9.01	8.78	8.90
26	3.12	3.17	3.15	8.60	8.84	8.72
27	4.64	4.62	4.63	8.18	8.11	8.15
34	4.31	4.18	4.25	7.60	7.85	7.73
35	4.84	4.95	4.90	6.39	6.29	6.34

APPENDIX - Table XXXI Trial III

<u>Longissimus</u> <u>dorsi</u> - Moisture, Ether Extract

	Control						Diethylstilbestrol Fed					
Cattle No.	Percent H_2O (1)	Percent H_2O (2)	Average	Percent Ether Extract (1)	Percent Ether Extract (2)	Average	Cattle No.	Percent H_2O (1)	Percent H_2O (2)	Average	Percent Ether Extract (1)	Percent Ether Extract (2)	Average
	%	%	%	%	%	%		%	%	%	%	%	%
4	72.61	72.76	72.69	4.39	4.48	4.41	1	72.18	72.51	72.35	4.70	4.55	4.63
8	72.76	72.62	72.69	4.35	4.66	4.51	2	71.53	71.68	71.61	4.80	4.87	4.84
17	71.63	71.80	71.72	6.17	5.97	6.07	3	71.18	71.19	71.19	6.68	6.74	6.71
22	72.24	72.49	72.37	4.77	4.67	4.72	7	72.43	72.57	72.50	4.49	4.53	4.51
23	71.40	71.75	71.58	5.43	5.28	5.36	10	72.11	72.02	72.07	6.20	6.34	6.27
24	72.45	72.32	72.39	5.12	5.07	5.10	11	68.96	69.14	69.05	8.36	8.21	8.29
30	71.76	71.97	71.87	4.90	4.75	4.83	14	72.04	72.11	72.08	5.23	5.57	5.40
31	72.26	72.45	72.36	4.87	4.71	4.79	20	68.27	68.48	68.38	9.69	9.70	9.70
32	71.00	70.76	70.88	6.88	7.14	7.01	25	71.61	71.84	71.73	5.43	5.42	5.43
33	71.06	71.44	71.25	6.63	6.13	6.38	28	68.37	68.49	68.43	11.61	11.69	11.65
36	70.96	71.05	71.01	6.59	6.47	6.53	29	72.19	72.20	72.20	5.71	5.50	5.61
37	68.54	68.41	68.48	9.49	9.57	9.53	38	71.60	71.25	71.43	6.02	5.99	6.01
39	72.69	72.61	72.65	4.34	4.44	4.39	40	69.61	69.56	69.59	8.37	8.28	8.33
42	71.16	71.23	71.20	5.99	5.90	5.95	41	72.19	71.85	72.02	5.52	5.93	5.73

APPENDIX - Table XXXI (continued) Trial III

<u>Longissimus dorsi</u> - Moisture, Ether Extract

	Implant					
	Percent H_2O			Percent Ether Extract		
Cattle No.	(1)	(2)	Average	(1)	(2)	Average
	%	%	%	%	%	%
5	69.64	69.99	69.82	7.82	7.54	7.68
6	71.13	70.63	70.88	6.05	6.33	6.19
9	72.93	72.80	72.87	3.53	3.48	3.51
12	71.82	71.84	71.83	5.48	5.46	5.47
13	72.17	72.17	72.17	4.93	4.90	4.92
15	72.57	72.68	72.63	3.86	3.78	3.82
16	72.92	73.10	73.01	3.81	3.67	3.74
18	70.67	70.54	70.61	6.83	7.03	6.93
19	71.66	71.63	71.65	4.92	5.02	4.97
21	72.47	72.49	72.48	4.04	3.78	3.91
26	70.93	71.00	70.97	5.66	5.59	5.63
27	70.62	70.48	70.55	6.74	6.46	6.60
34	72.07	72.37	72.22	5.13	4.97	5.05
35	72.99	73.38	73.19	3.23	2.93	3.08

APPENDIX - Table XXXII Trial III

Combined Fat and Lean 9-11 Rib Cut - Moisture and Ether Extract

	Implant						Diethylstilbestrol Fed					
Cattle No.	Percent H_2O (1)	Percent H_2O (2)	Average	Percent Ether Extract (1)	Percent Ether Extract (2)	Average	Cattle No.	Percent H_2O (1)	Percent H_2O (2)	Average	Percent Ether Extract (1)	Percent Ether Extract (2)	Average
	%	%	%	%	%	%		%	%	%	%	%	%
4	35.19	35.41	35.30	53.30	53.19	53.24	1	44.90	44.72	44.81	41.27	41.49	41.38
8	37.25	37.55	37.40	51.06	50.77	50.91	2	31.99	32.34	32.17	57.94	57.35	57.65
17	33.24	34.22	33.73	56.59	55.36	55.97	3	34.83	34.46	34.65	54.35	54.75	54.55
22	34.29	34.07	34.18	55.31	55.67	55.49	7	41.01	40.41	40.71	46.15	46.90	46.53
23	33.13	33.35	33.24	56.52	56.86	56.69	10	39.80	38.80	39.30	48.05	49.35	48.70
24	36.79	37.35	37.07	51.78	51.15	51.47	11	34.74	34.62	34.68	54.23	54.24	54.24
30	36.13	35.70	35.92	52.81	53.21	53.01	14	36.33	35.93	36.13	52.71	53.05	52.88
31	34.43	34.61	34.52	54.70	54.62	54.66	20	30.88	30.26	30.57	59.45	60.28	59.87
32	31.96	32.29	32.13	58.17	57.64	57.91	25	36.74	36.42	36.58	51.59	51.81	51.70
33	38.45	38.07	38.26	49.21	49.80	49.51	28	29.10	28.93	29.02	62.25	62.24	62.25
36	35.10	34.87	34.99	54.13	54.39	54.26	29	33.58	34.18	33.88	55.97	55.09	55.53
37	33.38	33.24	33.31	55.96	56.13	56.05	38	35.78	35.56	35.67	53.00	52.97	52.99
39	31.61	32.25	31.93	58.38	57.75	58.07	40	37.89	38.10	38.00	50.16	50.50	50.33
42	28.75	29.60	29.18	62.31	61.14	61.73	41	32.42	32.36	32.64	57.98	57.58	57.78

APPENDIX - Table XXXII (continued) Trial III

Combined Fat and Lean 9-11 Rib Cut - Moisture and Ether Extract

	Implant					
	Percent H_2O			Percent Ether Extract		
Cattle No.	(1)	(2)	Average	(1)	(2)	Average
	%	%	%	%	%	%
5	34.91	34.75	34.83	53.96	54.20	54.08
6	35.27	35.34	35.31	53.70	53.46	53.58
9	35.69	34.89	35.29	53.18	54.01	53.60
12	40.66	40.81	40.74	46.89	46.59	46.74
13	31.61	32.59	32.10	58.58	57.26	57.92
15	37.14	37.59	37.37	51.28	50.64	50.96
16	40.11	39.74	39.93	47.34	47.44	47.39
18	38.07	37.53	37.80	49.78	50.49	50.14
19	36.92	37.41	37.17	51.56	50.63	51.10
21	34.07	34.47	34.27	55.56	54.85	55.21
26	36.75	37.43	37.09	51.50	50.64	51.07
27	34.31	33.49	33.90	54.82	55.91	55.37
34	35.42	35.39	35.41	53.59	53.47	53.53
35	46.68	46.76	46.72	38.30	38.14	38.22

APPENDIX - Table XXXIII Trial III

Calculated Moisture and Ether Extract in 9-10-11 Rib Cut

Control Steers

Cattle No.	Rib-eye wt.	Rib-eye H_2O	Rib-eye H_2O (A)	Comb. Fat & Lean (excl. rib-eye)	Comb. Fat & Lean (excl. rib-eye) H_2O	Comb. Fat & Lean (excl. rib-eye) H_2O (B)	Total H_2O (A) + (B)	Total wt. 9-10-11 rib (-bone)	H_2O in 9-10-11 rib (-bone)	Rib-eye Ether Ext.	Rib-eye Ether Ext. (C)	Comb. Fat & Lean (excl. rib-eye) Ether Ext.	Comb. Fat & Lean (excl. rib-eye) Ether Ext. (D)	Total Ether Ext. (C) + (D)	Total wt. 9-10-11 rib (-bone)	Ether Ext. in 9-10-11 rib (-bone)
	g.	%	g.	g.	%	g.	g.	g.	%	%	g.	%	g.	g.	g.	%
4	810	72.69	588.8	2907	35.30	1026.2	1615.0	3717	43.4	4.41	35.7	53.24	1547.7	1583.4	3717	42.6
8	910	72.69	661.5	2621	37.40	980.3	1641.8	3531	46.5	4.51	41.0	50.91	1334.4	1375.4	3531	39.0
17	872	71.72	625.4	3073	33.73	1036.5	1661.9	3945	42.1	6.07	52.9	55.97	1720.0	1772.9	3945	44.9
22	847	72.37	613.0	4617	34.18	1578.1	2191.1	5464	40.1	4.72	40.0	55.49	2562.0	2602.0	5464	47.6
23	980	71.58	701.5	4060	33.24	1349.5	2051.0	5040	40.7	5.36	52.5	56.69	2301.6	2354.1	5040	46.7
24	859	72.39	621.8	3666	37.07	1359.0	1980.8	4525	43.8	5.10	43.8	51.47	1886.9	1930.7	4525	42.7
30	881	71.87	633.2	4626	35.92	1661.7	2294.9	5507	41.7	4.83	42.6	53.01	2452.2	2494.8	5507	45.3
31	1057	72.36	764.8	4189	34.52	1446.0	2210.8	5246	42.1	4.79	50.6	54.66	2289.7	2340.3	5246	44.6
32	1055	70.88	747.8	4482	32.13	1440.1	2187.9	5537	39.5	7.01	74.0	57.91	2595.5	2669.5	5537	48.2
33	1085	71.25	773.1	4007	38.26	1533.1	2306.2	5092	45.3	6.38	69.2	49.51	1983.9	2053.1	5092	40.3
36	1035	71.01	735.0	4362	34.99	1526.3	2261.3	5397	41.9	6.53	67.6	54.26	2366.8	2434.4	5397	45.1
37	923	68.48	632.1	4378	33.31	1458.3	2090.4	5301	39.4	9.53	88.0	56.05	2453.9	2541.9	5301	48.0
39	700	72.65	508.6	4414	31.93	1409.4	1918.0	5114	37.5	4.39	30.7	58.07	2563.2	2593.9	5114	50.7
42	907	71.20	645.8	3901	29.18	1138.3	1784.1	4808	37.1	5.95	54.0	61.73	2408.1	2462.1	4808	51.2

APPENDIX - Table XXXIV Trial III

Calculated Moisture and Ether Extract in 9-10-11 Rib Cut

Diethylstilbestrol Fed

Cattle No.	Rib-eye wt.	Rib-eye H_2O	Rib-eye H_2O (A)	Comb. Fat & Lean (excl. rib-eye)	Comb. Fat & Lean (excl. rib-eye) H_2O	Comb. Fat & Lean (excl. rib-eye) H_2O (B)	Total H_2O (A) + (B)	Total wt. 9-10-11 rib (-bone)	H_2O in 9-10-11 rib (-bone)	Rib-eye Ether Ext.	Rib-eye Ether Ext. (C)	Comb. Fat & Lean (excl. rib-eye) Ether Ext.	Comb. Fat & Lean (excl. rib-eye) Ether Ext. (D)	Total Ether Ext. (C) + (D)	Total wt. 9-10-11 rib (-bone)	Ether Ext. in 9-10-11 rib (-bone)
	g.	%	g.	g.	%	g.	g.	g.	%	%	g.	%	g.	g.	g.	%
1	1025	72.35	741.6	3398	44.81	1522.6	2264.2	4423	51.2	4.63	47.5	41.38	1406.1	1453.6	4423	32.9
2	904	71.61	647.4	4382	32.17	1409.7	2057.1	5286	38.9	4.84	43.8	57.65	2526.2	2570.0	5286	48.6
3	960	71.19	683.4	4012	34.65	1390.2	2073.5	4972	41.7	6.71	64.4	54.55	2138.5	2252.9	4972	45.3
7	1052	72.50	762.7	4134	40.71	1683.0	2445.7	5186	47.2	4.51	47.4	46.53	1923.6	1971.0	5186	38.0
10	929	72.07	669.5	3525	39.30	1385.3	2054.8	4454	46.1	6.27	58.2	48.70	1716.7	1774.9	4454	39.8
11	758	69.05	523.4	4027	34.68	1396.6	1920.0	4785	40.1	8.29	62.8	54.24	2184.2	2247.0	4785	47.0
14	937	72.08	675.4	4199	36.13	1517.1	2192.5	5136	42.7	5.40	50.6	52.88	2220.4	2271.0	5136	44.2
20	994	68.38	679.7	4601	30.57	1406.5	2086.2	5595	37.3	9.70	96.4	59.87	2754.6	2851.0	5595	51.0
25	1007	71.31	718.1	3436	36.58	1256.9	1975.0	4443	44.5	5.43	54.7	51.70	1776.4	1831.1	4443	41.2
28	803	68.43	549.5	5283	29.02	1533.1	2082.6	6086	34.2	11.65	93.5	62.25	3288.7	3382.2	6086	55.6
29	857	72.20	618.8	4386	33.88	1486.0	2104.8	5243	40.1	5.61	48.1	55.53	2435.5	2483.6	5243	47.4
38	787	71.43	562.3	3363	35.67	1199.6	1761.8	4150	42.5	6.01	47.3	52.99	1782.1	1829.4	4150	44.1
40	767	69.59	533.8	4140	38.00	1573.2	2107.0	4907	42.9	8.33	63.9	50.33	2083.7	2147.6	4907	43.8
41	916	72.02	659.7	4131	32.64	1348.3	2008.0	5407	39.8	5.73	52.5	57.78	2386.9	2439.4	5047	48.3

APPENDIX - Table XXXV Trial III

Calculated Moisture and Ether Extract in 9-10-11 Rib Cut

Implanted Steers

Cattle No.	Rib-eye wt.	Rib-eye H_2O	Rib-eye H_2O (A)	Comb. Fat & Lean (excl. rib-eye)	Comb. Fat & Lean (excl. rib-eye) H_2O	Comb. Fat & Lean (excl. rib-eye) H_2O (B)	Total H_2O (A) + (B)	Total wt. 9-10-11 rib (-bone)	H_2O in 9-10-11 rib (-bone)	Rib-eye Ether Ext.	Rib-eye Ether Ext. (C)	Comb. Fat & Lean (excl. rib-eye) Ether Ext.	Comb. Fat & Lean (excl. rib-eye) Ether Ext. (D)	Total Ether Ext. (C) + (D)	Total wt. 9-10-11 rib (-bone)	Ether Ext. in 9-10-11 rib (-bone)
	g.	%	g.	g.	%	g.	g.	g.	%	%	g.	%	g.	g.	g.	%
5	890	69.82	621.4	4217	34.83	1468.8	2090.2	5107	40.9	7.68	68.4	54.08	2280.6	2349.0	5107	46.0
6	938	70.88	864.9	4688	35.31	1655.3	2320.2	5626	41.2	6.19	58.1	53.58	2511.8	2569.9	5626	45.7
9	1097	72.87	799.4	3901	35.29	1376.7	2176.1	4998	43.5	3.51	38.5	53.60	2090.9	2129.4	4998	42.6
12	1068	71.83	767.1	4641	40.74	1890.7	2657.8	5709	46.6	5.47	58.4	46.74	2169.2	2227.6	5709	39.0
13	919	72.17	663.2	4177	32.10	1340.8	2004.0	5096	39.3	4.92	45.2	57.92	2419.3	2464.5	5096	48.4
15	1037	72.63	753.2	4296	37.37	1605.4	2358.6	5333	44.2	3.82	39.6	50.96	2189.2	2228.8	5333	41.8
16	1049	73.01	765.9	3134	39.93	1251.4	2017.3	4183	48.2	3.74	39.2	47.39	1485.2	1524.4	4183	36.4
18	950	70.61	670.8	3759	37.80	1421.0	2091.8	4709	44.4	6.93	65.8	50.14	1884.8	1950.6	4709	41.4
19	1250	71.65	895.6	4226	37.17	1570.8	2466.4	5476	45.0	4.97	62.1	51.10	2159.5	2221.6	5476	40.6
21	1059	72.48	767.6	4057	34.27	1390.3	2157.9	5116	42.2	3.91	41.4	55.21	2239.9	2281.3	5116	44.6
26	1053	70.97	747.3	3891	37.09	1443.2	2190.5	4944	44.3	5.63	59.3	51.07	1987.1	2046.4	4944	41.4
27	956	70.55	674.5	3393	33.90	1150.2	1824.7	4349	42.0	6.60	63.1	55.37	1878.7	1941.8	4349	44.6
34	1051	72.22	759.0	4015	35.41	1421.7	2180.7	5066	43.0	5.05	53.1	53.53	2149.2	2202.3	5066	43.5
35	840	73.19	614.8	2853	46.72	1332.9	1947.7	3693	52.7	3.08	25.9	38.22	1090.4	1116.3	3693	30.2

APPENDIX - Table XXXVI Trial III

Warner-Bratzler Shear Readings - Cooking Shrink

Control			Diethylstilbestrol Fed			Implant		
Cattle No.	Average Shear Reading	Cooking Shrink	Cattle No.	Average Shear Reading	Cooking Shrink	Cattle No.	Average Shear Reading	Cooking Shrink
	lb.	%		lb.	%		lb.	%
4	7.4	18.0	1	6.7	22.3	5	8.0	24.3
8	5.6	17.1	2	6.7	22.7	6	5.9	19.8
17	4.4	21.4	3	7.4	18.9	9	7.1	21.6
22	5.9	21.4	7	6.4	18.7	12	4.7	20.8
23	6.6	21.7	10	7.4	19.5	13	6.7	15.4
24	10.4	13.3	11	5.8	22.4	15	6.6	16.7
30	6.7	21.9	14	6.5	22.7	16	5.7	20.5
31	7.4	21.0	20	6.0	14.7	18	5.9	22.9
32	6.8	19.8	25	8.2	19.2	19	7.3	17.0
33	6.8	16.0	28	7.1	15.7	21	9.6*	21.6
36	5.8	23.0	29	6.3	17.2	26	6.5	15.5
37	5.9	18.8	38	6.4	24.1	27	6.8	19.4
39	7.0	14.3	40	7.9	15.5	34	6.4	13.0
42	6.9	22.8	41	5.6	16.8	35	5.0	15.8

* One side of steak dried before cooking.

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