THE VALUE OF STILBESTROL FOR STEER AND HEIFER CALVES ON HIGH ROUGHAGE RATIONS

by

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INTRODUCTION

In Kansas large quantities of roughage are produced. One of the problems of this area has been to increase efficiency in the utilization of these important feeds.

In recent years, the use of diethylstilbestrol (a synthetic hormone), which when taken into the body produced an estrogenic like effect, has received wide attention, especially in fattening rations. From the first stilbestrol has caused considerable controversy among livestock producers as to its value in the fattening cattle ration, but extensive research has established its value with certain limitations. At the present time no recommendations have been made for stilbestrol usage with high roughage rations due to insufficient data available under controlled experimental conditions.

The sex of the animal is one of the major factors to consider in the use of stilbestrol. Spaying (removal of the ovaries) eliminates a major source of the estrogens in the female.

The effect of stilbestrol on steers, heifers and spayed heifers fed high roughage rations is of special interest to producers of roughage.

Two methods of administering stilbestrol have been used, subcutaneous implantation and oral administration. The growth stimulus appears to be somewhat similar for the two methods of administration for steers on fattening rations, but for high roughage rations the levels and methods of administration have not been compared.

In recognizing the need for more information on these problems confronting beef producers these tests were planned with the following objectives: 1. The effect of feeding and subcutaneous implantation of stilbestrol on steer calves fed a high roughage ration. 2. The effect of spaying on heifers and feeding stilbestrol to nonspayed and spayed heifers on high roughage rations.

REVIEW OF LITERATURE

Only recently have sex hormones been administered to livestock to increase rate of gain and feed efficiency. Sex hormones may be classified as either androgens, male sex hormones, or estrogens, female sex hormones. The primary function of the sex hormones is concerned with the development of secondary sex characteristics, with conditioning of sex accessory organs, and with mating reactions. Both androgen and estrogen are known to affect skeletal growth, depending on amounts present (Rice and Andrews, 1951). The belief is that estrogen stimulates osteogensis and inhibits growth of cartilage and hence longitudinal osseosus growth. There is also the possibility that the pituitary may be altered in its function (Bell, et al. 1954, Clegg and Cole, 1954).

Diethylstilbestrol, hexestrol, and dienestrol are synthetic estrogenic hormones that have been used. Diethylstilbestrol has been used more extensively and with better results than the other hormones.

In 1938 Dodds, et al. synthesized 4:4 dihydroxy-alpha-beta diethylstilbene and a series of other synthetic estrogenic compounds from dihydroxystilbene. This synthetic estrogen later named diethylstilbestrol, is used interchangeably with the term stilbestrol in modern usage (U.S. Pharmanaeopeia 1950).

Stilbestrol is a low cost synthetic preparation which is not chemically related to the natural estrogen, but has estrogenic activity similar to and greater than that of estrone. Shorr, et al. (1939) and Turner (1948) both stated that stilbestrol unlike natural hormones was relatively less readily destroyed by digestive processes-approximately 50 percent as compared with 95 percent for estrone. Stilbestrol can either be fed or it can be implanted subcutaneously in a pellet form.

The Estrogenic Content of Feedstuffs

Bennetts, et al. (1946) described widespread breeding disorders in ewes which were grazing on subterranean clover in Australia. Sheep breeders were besieged with female infertility dystocia or uterine inertia and prolapse or inverted uterus. Lambing in some flocks was reduced to only 8 percent of the mated ewes. Apparently the breeding difficulties were due to excessive oestrogen in subterranean clover.

Pope (1954) stated that work by Curnow and Biggers demonstrated that genistein exhibited estrogenic properties, and it was thought that genistein was the major substance causing the breeding difficulties in Australia.

Cheng, et al. (1952) reported unexpectedly good gains in a lamb fattening experiment in which clover hay, apparently containing estrogenic activity was fed. The lambs implanted with stilbestrol failed to make better gains than the control lot. Cheng _et al._, (1953a) investigated the estrogenic potency of the clover hay fed to these lambs. They estimated that the clover hay furnished only about one-fifthieth of the amount of activity needed to be effective in fattening lambs, assuming that 15 mg of stilbestrol was the dosage. The estrogenic potency of alfalfa increased with consecutive seasonal cuttings.

Approximately 50 species of plants have been shown to possess estrogenic activity according to Pieterse and Andrews (1956a). These workers found that alfalfa cut in various stages of growth contained 0.5 micrograms to 4.3 micrograms of estrogen per pound.

Cheng, _et al_. (1953b) isolated genistin and related isoflavone and tested their estrogenic activity. It was found that formononetin, genistein, biochanin A, and diadzein exerted considerable estrogenic activity as shown by increased mouse uterine weights when fed to immature female mice. However, it was found that these compounds were not as potent as stilbestrol on a weight basis.

Pieterse and Andrews (1956b) found that the estrogenic potency of alfalfa silage increased from the freshly cut stages. A mixture of alfalfa, ladino clover, and brome silage increased in estrogenic activity during fermentation. It appeared that there was considerable variation in estrogenic activity between and within plant species and that differences in season stage of growth and other environmental factors may affect hormonal activity.

The Effect of Stilbestrol Administration to Poultry

Stilbestrol implants were first used in chickens. Studies with broilers by Lorenz (1945), Thayer, et al. (1945) and Andrews and Bohren (1947) indicated an increased growth rate and fat deposition as result of administering stilbestrol. Sykes, et al. (1953) concluded that estrogen treatment can be recommended for improving finish and quality in all classes of meat chickens except mature hens. A slight increase was noted in rate of gain and feed consumption. Feed efficiency was reduced usually by estrogen treatment. It should be pointed out that carcass quality was largely improved by the extra subcutaneous depot fat which improved juiceness, tenderness and palatability of the meat.

The Effect of Orally Administered Stilbestrol on Beef Cattle and Sheep

Diethylstilbestrol incorporated in the ration of fattening steers has resulted in increased rates of gain and efficiency of feed utilization. Feeding stilbestrol was first conceived by Iowa workers in 1951, Burroughs, et al. (1954b). These workers reported that the daily oral intake of 2.5 to 10 mg of stilbestrol by fattening steers increased body weight as much body weight gains as 35 percent over controls. More recent observations by these same workers (1954a) involving different types of rations, ages of cattle, and both sexes, showed an average growth stimulation of 20 percent as a result of feeding stilbestrol to animals. Heifers responded slightly less than steers and 600 pound cattle responded as well as animals double this weight. The greatest stimulation occurred on high grain rations. Similar reports of increased weight gain were reported by Connell (1955) and Duitsman and Kessler (1956).

Beeson, et al. (1956), fattening yearling steers, fed stilbestrol for 179 days and observed a 12 percent increase in gain which was acquired during the first 98 days of the trial. Perry, et al. (1955) also reported that the greatest growth stimulation occurred in the early part of the feeding trial.

Klosterman, et al. (1955b) reported a similar rate of gain in implanted (60 mg) and orally fed (10 mg) per head daily. These workers also noted that the level of protein fed had a significant influence on gain obtained from stilbestrol treatment. Stilbestrol treated animals showed an increase in gain over controls.

Animals weighing 600 pounds or over respond equally as well as heavier animals receiving stilbestrol. There is little experimental data available as to the value of stilbestrol when included in the ration of fattening and growing calves. Andrews, et al. (1956) reported a 30 percent increase when stilbestrol was included in the fattening ration of calves weighing less than 500 pounds for 179 days. Several experiments have been conducted at Kansas State College which have given inconsistent results with calves fed wintering type rations. Richardson, et al. (1955), using light weight cattle of both sexes, gave oral administration of 10 mg stilbestrol per head daily for a 140 day wintering period. No significant differences in weight gains were obtained. In a more recent experiment these workers (1956c) reported that a low level

(5 mg per head daily)of stilbestrol may be more desirable than a higher level (10 mg per head daily) when fed to steer calves.

Richardson, et al.(1956a) conducted tests to determine the effectiveness of stilbestrol on steers on a wintering, grazing and fattening program.Hereford steer calves weighing 455 pounds were used in this test. The steers fed stilbestrol showed a slight gain over controls during the wintering phase. In the grazing phase stilbestrol feeding did not increase rate of gain. Steers which were fed stilbestrol during the wintering phase, but not on grass showed a decrease in rate of gain compared to controls during the grazing phase. Steers that did not receive stilbestrol on grass, but did in the fattening phase, gained at a faster rate than the steers which had been fed stilbestrol through all phases. It was observed from this one experiment that there was no advantage to long time continued feeding of stilbestrol.

It appears that still more research is needed to determine the value of stilbestrol when administered orally to fattening lambs. A number of experimental trials have been conducted recently to establish the optimum level. Hale, et al. (1955) obtained an increase in gain of 22 percent over controls when 2 mg of stilbestrol was fed daily. However, when the level was increased to 3.6 mg per head daily no increase in gain was obtained. Jordan, et al. (1955) found that feeding low levels (less than 2 mg per lamb per day) did not produce consistent increases in weight gains. Bell and Erhart (1955) obtained an increase in rate of gain when 2 mg of stilbestrol was fed per lamb daily.

Burroughs, et al. (1955) in a series of experiments reported an average reduction of feed required per 100 pounds of gain of 11 percent and an increased feed consumption of 5 percent as a result of stilbestrol feeding at various levels. The decrease in feed required per unit of gain was highest for those animals receiving the fattening rations. Beeson, et al. (1956) reported fattening steers fed stilbestrol were 18 percent more efficient the first 98 days and 5 percent less efficient the last 81 days as compared to controls. Feed consumption remained the same for both groups. Duitsman and Kessler (1956) stated that cattle receiving stilbestrol ate more feed but required less feed per 100 pound of gain. Calves fed a wintering ration, according to Richardson, et al. (1955, 1956a) showed no marked difference in feed efficiency or feed consumption. In another test (1956c) feed efficiency was higher for stilbestrol fed calves.

Kastelic, et al. (1956) made carcass evaluations on 63 carcasses of stilbestrol fed animals and 29 control animals. The differences in the carcasses were small and of little practical importance. There were no difference in the carcass grades of stilbestrol fed calves according to Andrews, et al. (1956). Burroughs, et al. (1954a) reported that carcass grades were lowered an average of one-third of a grade as a result of stilbestrol feeding. Perry, et al. (1955) and Beeson, et al. (1956) reported that carcass grades of stilbestrol fed steers were slightly inferior to control steers. Richardson, et al. (1956a) found stilbestrol cattle to grade slightly lower primarily due to less marbling in the meat, dressing percentage was also lowered.

Kastelic, et al. (1956) and Andrews, et al. (1956) reported that carcasses from stilbestrol animals yielded about the same as control animals. Whereas, Beeson, et al. (1956) found controls dressed significantly higher than treated steers.

Beeson, et al. (1956) reported that shrink to market was slightly less for stilbestrol fed steers than for controls. By contrast, Andrews, et al. (1956) reported a significant increase in transit shrink of stilbestrol fed steers. There were no differences between hot and cold carcass shrinkage. Richardson, et al. (1956a) reported no differences in transit shrinkage. In another experiment these same workers (1956b) found stilbestrol fed cattle to shrink greater in the cooler and in route to market.

In regard to the chemical composition of meat, Andrews, et. al.(1956) found that cuts from the 12th rib of stilbestrol fed animals contained less fat and more water. This is in agreement with Beeson, et al. (1956) concerning fat and water content and in addition they reported a higher protein content of stilbestrol fed cattle.

A 3-year study of carcasses by Bell, et al. (1956b) showed that control lambs usually shrink less than lambs given either 6 mg implants or given 2 mg of stilbestrol in the feed, there being no consistent difference between stilbestrol groups. Lambs receiving stilbestrol orally consistently yielded less but the yield of the implants ranked nearly as high and graded as high as the untreated lambs. Hale, et al. (1955) reported little or no effect on carcass quality from lambs fed 2 mg of stilbestrol daily.

However, at higher levels (3.6 mg per lamb per day) a decrease in carcass quality resulted.

The Effect of Subcutaneous Implantation of Stilbestrol on Beef Cattle and Sheep

Stilbestrol implanted in fattening cattle increases growth rate and feed efficiency. This observation has been reported by a number of investigators. Dinusson, et al. (1950) with heifers and Andrews, et al. (1950, 1954) with steers found that more economical and more rapid gains were made by stilbestrol implanted animals than by controls. Clegg and Cole (1954) in a series of experiments with stilbestrol implants in cattle on varying dietary regimes found that treated steers under dry-lot conditions showed a greater response than heifers. Treated steers made greater gain when supplemental concentrates were fed than when on pasture alone. On pasture, heifers showed no increase in gain over controls. O'Mary and Cullison (1956) reported increased rate of gain in steers on pasture that had received a 24 mg implant of stilbestrol. In another experiment O'Mary, et al. (1956) produced evidence that 36 mg stilbestrol implanted with feed lot steers was sufficient dosage to obtain significant weight gains. However, reimplantation proved to be of no value and a 12 mg implant level appeared to low.

O'Mary, et al. (1953) reported significant increased weight gains on fattening steers using a high roughage ration containing cottonseed hulls and blackstrap molasses. In a test to study the effect of stilbestrol on steer calves fed a wintering ration, Walker, *et al*.(1956) reported an increased rate of gain of 0.23 pounds daily per head over controls. These light weight calves were implanted at a 36 mg level.

Klosterman, *et al*.(1953) reported the effect of stilbestrol implantation upon the growth and fattening of bull calves. Bulls implanted at 25 mg per cwt demonstrated an average daily gain of a third of a pound daily over untreated bulls. The results of this experiment indicated that the effect of the male sex hormone as produced by normal bulls at this hormone level were additive rather than antagonistic. In more recent trials including both steers and bulls, Klosterman, *et al*. (1955) reported a significant increase in rate of gain for both steers and bulls; however, the increase was greater in steers than in bulls as the result of stilbestrol implants.

Increased rate of growth has been consistent with fattening lambs implanted with stilbestrol. Andrews, *et al.* (1949); O'Mary, *et al*. (1952a, 1951); Pope, *et al*. (1950); Means, *et al*. (1953); Clegg, *et al*.(1955); Clegg and Cole (1954); Bell, *et al*. (1954a, 1954b); Wilkinson, *et al*.(1955) and Whiting, *et al*.(1954) have reported increased weight gain from stilbestrol implanted lambs. In most cases 12 milligram stilbestrol pellets have been the usual dosage. This appeared to be the optimum level; however, favorable results have been reported where 24 and 6 mg implants have been used. Jordan (1953a) reported favorable results from a 6 mg stilbestrol level. Bell and Erhart (1956a) observed an increased rate of gain of approximately one-third of a pound daily with lambs implanted with 6 mg of stilbestrol on wheat pasture. According to

Andrews, et al.(1949) and Means, et al.(1953) lambs treated with 24 mg made significant gains over those implanted with 12 mg of stilbestrol. However, Clegg and Cole (1954) reported a depressed growth rate with lambs on pasture as a result of 24 mg stilbestrol implants. Perry, et al. (1951) obtained no significant response between 12 and 24 mg implants administered to suckling lambs. Bell, et al. (1954a) found there was no advantage gained when after 70 days the lambs were implanted with an additional 15 mg stilbestrol pellet.

Growth and weight responses from stilbestrol treatment have not been consistent in young lambs. Jordan and Dinusson (1950) obtained no increase in growth of 25 pound suckling implanted lambs. Perry, et al. (1951) reported a significant increase in rate of gain of 46 pound suckling implanted lambs. Most of this increased growth rate was made during the first 28 days of the experiment. Jordan (1953b) obtained no increase in rate of gain on suckling lambs two and one half and three months old and only a slight increase on suckling lambs three and one half months old with implants. On the basis of these experiments it appeared that age and weight may be factors responsible for inconsistent results, indicating the older and heavier lambs give a greater response to stilbestrol treatment. However, Clegg, et al. (1955) reported a significant increase in rate of gain with lambs implanted with stilbestrol at various levels regardless of age, sex, or dietary regime.

Dinusson, *et al.* (1950) reported on feed consumption and efficiency of stilbestrol treated heifers. They found heifers receiving the stilbestrol treatment were easier to keep on feed and required less feed per unit of gain than controls in two experiments. Andrews, *et al.* (1950) reported increased feed consumption and feed efficiency on stilbestrol implanted steers. In a later experiment, Andrews, *et al.* (1954) reported that feed efficiency was consistently increased when stilbestrol treated steers were implanted at 60, 108 or 120 milligrams per steer. The feed efficiency improved with increasing implant levels. Klosterman, *et al.* (1955a) found feed consumption to be noticeably greater when stilbestrol was implanted, as did Clegg and Cole (1954) and Andrews, *et al.* (1954). Walker, *et al.* (1956) studying the effects of stilbestrol implants on light weight calves on a high roughage ration, reported increased weight gain and no feed efficiency increase as a result of treatment.

Andrews, *et al.* (1949) limited the amount of feed fed to stilbestrol treated lambs to the same amount fed the control group. The treated lambs required 31 percent less corn per pound of gain. In studying the effects of stilbestrol on suckling and fattening lambs, Jordan (1953b) found there was little difference in the daily feed consumption of the treated or control lambs but that the stilbestrol-treated lambs were easier to keep on full feed than the controls. Data in the literature pertaining to feed consumption and efficiency tends to show an increase from stilbestrol treatment.

Dinusson, et al.(1950) working with heifers and O'Mary, et al. (1956) working with steers reported no significant difference in carcass grade or dressing percentage from low level implantation. Clegg, et al. (1951) and Clegg and Cole (1954) reported lower carcass grades for stilbestrol treated cattle. The latter authors stated that the lowering of carcass grade was due to: red and coarse meat, less internal and external fat deposition, less marbling, heavier shoulders and rounds but lighter loins than the controls. Clegg and Carroll (1956) and Andrews et al. (1954) found that stilbestrol did not affect dressing percentage, but there was a reduction in carcass grade. Klosterman (1955a) found that implantation of stilbestrol significantly increased the carcass grade of bulls, but lowered the grade of the steer carcasses by one-fourth of a grade.

In lambs there was almost complete agreement among investigators that stilbestrol implants caused some reduction in carcass grade and a slight lowering of dressing percentage. The main factors responsible for lowered carcass quality, grade and dressing percent appeared to be a reduction of internal and external fat, according to: O'Mary, et al.(1952b); Clegg and Cole, (1954); Wilkinson, et al. (1955). Bell, et al. (1954a) reported slightly lower values for carcass grades and dressing percentage of lambs treated with stilbestrol. The carcasses had a watery, slimy appearance and yielded one to five percent lower than the controls. Jordan (1953b) and Pope, et al. (1950) reported similar results. However, Jordan (1950) noted no effect on carcass grades of lambs four months of age or younger. Galloway, et al. (1952) found that a combination of stilbestrol-progesterone implants resulted in more finish, higher dressing percentage and higher carcass grades than the controls.

Little information concerning shrinkage is available in literature pertaining to lamb implants. Jordan and Bell (1952) and Jordan (1953b) found that treated lambs tended to shrink more following slaughter and the largest amount of shrink occurred during the first 24 hours. Other investigators, Clegg and Cole (1954) and Wilkinson, et al. (1955) found no difference in the percentage of shrink between hot and cold carcass weights of the treated and control lambs.

Side Effects

It seemed that the detrimental side-effects often encountered from stilbestrol implantation were lessened or eliminated when compared with oral administration. Beeson, et al. (1956); Andrews et al. (1956) and Erwin, et al.(1956) with steers and Burroughs, et al. (1955) with steers and heifers have all reported no undesirable effects when animals were fed 5 to 20 mg per animal daily. However, Perry, et al. (1955) reported slight, but recognizable, pelvic and mammary development when 10 mg of stilbestrol was fed per head daily. Richardson, et al.(1955) reported high tailheads and depressed loins in steers and heifers. The heifers showed an enlargement of the vulva and developed more of a cowy appearance; however, these side effects become less noticeable as the animals matured.

Dinusson, *et al.*(1950) reported that stilbestrol implants at a 42 mg level in heifers caused pronounced mammary and teat development, elevated tail heads, and appeared to be in constant heat throughout the feeding period. Andrews, *et al.* (1954), Clegg and Cole (1954) likewise observed elevated tailheads, excessive riding and marked mammary growth as result of stilbestrol implants. Clegg, *et al.* (1951) reported the mammary development of heifers was great enough to be objectionable, and reported that in one group of 80 treated heifers four developed prolapse of the vagina. Fattening steers implanted at a low level (36 mg) according to O'Mary, *et al.* (1956) showed a depression of the loin at 85 and 65 days for the two experiments respectively. These workers, as did Clegg and Carroll (1956) reported an increase of seminal vesicular weight of treated steers over controls.

Hale, *et al.* (1955) feeding wether lambs on a ration including 2 mg of stilbestrol per lamb per day reported no undesirable side effects. However, when the level was increased to 3.6 mg daily the lambs exhibited some of the characteristic side effects commonly displayed in implanted animals.

Numerous investigators have reported undesirable side effects as a result of administering stilbestrol to sheep subcutaneously. Increase in size of mammary glands and secretion of milk by both ewe and wether lambs have been reported by Jordan (1953b) and Clegg and Cole (1955). Perry, *et al.* (1951) and Jordan (1953b) observed marked development of the external genitalia, as if the ewe lambs were in estrus. Jordan (1953b) reported that the fertility of treated ewe and ram lambs was not permanently impaired. O'Mary *et al*. (1952a) found that stilbestrol increased seminal vesicles and ampullae size in wethers and decreased ovarian follicle diameter in ewes. Several instances have been reported in which death losses occurred. Bell, *et al*. (1954a) reported that 12 of 517 lambs were lost from prolapse of the rectum and from excessive swelling and inflammation in the rectal or perineal region. Measurements revealed an increase in the size of accessory sex organs. This caused swelling, preventing urination and the straining caused a prolapse of the rectum. Jordan (1953b) observed a severe outbreak of prolapse of the rectum and uterus resulting in urinary blockage in lambs treated with 12 mg of stilbestrol. Ruliffson, *et al*. (1954) stated that secondary male tissues (cowper's gland, prostate, and seminal vesicles) may be enlarged to such an extent as to cause death due to prevention of urination. Further, that this is probably caused by the action of male-like hormones (neutral-ketosteroids) produced by the adrenal gland under the influence of ACTH. Stilbestrol probably caused the pituitary gland to produce increased amounts of ACTH. They found a marked increase of 17 ketosteroids in the urine of treated lambs.

Klosterman, *et al*. (1955a) found that stilbestrol caused some retardation in sexual development in weanling bull calves. There was also some depression of testes growth and a stimulation of teat development in the treated bulls. Elevated tail heads in both bulls and steers were evident.

Digestion Trials and Nitrogen Retention

Whitehair, et al. (1953) conducted a digestion trial to determine the effect of stilbestrol on digestibility of ration nutrients. The only effect noted was a slight increase in digestibility of crude fiber by the treated lambs. Brooks, et al. (1954) studied the effect of stilbestrol on cellulose and protein digestion in lambs. These workers found the coefficient of digestibility of cellulose and protein to be increased 16 and 18 percent respectively in animals that received 10 or 20 mg of stilbestrol daily. In vitro, Brooks, et al. (1953) reported a 9 percent increase in cellulose digestion as a result of adding 10 to 20 mg of stilbestrol to the basal ration. Jordan (1953b), Bell, et al. (1955) and Erwin, et al. (1956) concluded that treatment with stilbestrol had no effect on digestibility of any of the feed nutrients. Richardson, et al. (1955) reported a consistent decrease in digestibility when stilbestrol was fed to steer calves.

Nitrogen balance studies have shown a marked increase in nitrogen retention when ruminants were fed or implanted with stilbestrol. Clegg and Cole (1954) reported that stilbestrol implants (60 mg per steer) resulted in nitrogen storage double that of the controls. These workers found the increase in nitrogen retention to be associated with a decrease in urinary nitrogen, whereas, this treatment has no influence on fecal nitrogen. This indicated true nitrogen storage. Jordan (1953b) also observed a greater nitrogen retention resulting from a smaller volume of urine excreted by treated lambs as there was no difference in nitrogen concentration between treated and untreated lambs. Other investigators reporting increased nitrogen retention by stilbestrol treated lambs include Whitehair, et al. (1953) and Bell, et al. (1955). In addition both groups of workers reported marked calcium and phosphorus retention as a result of stilbestrol treatment.

Mode of Action of the Growth Stimulating Effect of Stilbestrol

The implantation of stilbestrol in cattle and sheep caused an increase in rate of gain and feed efficiency in nearly all tests. In a search for the mode of action Clegg and Cole (1954) made detailed studies of the effect of stilbestrol implants on some of the endocrine glands of steers and heifers treated at 60 and 120 mg levels. These workers found hypertrophied pituitarys, adrenal and thyroid glands. There appeared to be a greater number of acidiphils in the hypophysis of both treated heifers and steers than in the controls. Histologically, the adrenal glands of the treated animals were not grossly different from the controls. The adrenal hypertrophy was due largely to cortical enlargement. These workers also reported a marked response following treatment with either 12 or 24 mg of stilbestrol in sheep. They postulated that since a depression of blood eosinophils was associated with an increase in adrenal corticle activity, stimulated by an increased secretion of ACTH, it would seem that stilbestrol caused an increased release of this hormone from the ruminant pituitary, thus bringing about adrenal cortical stimulation. This adrenal material being the substance responsible for the growth effect.

Clegg (1952) found that where cattle were treated with stilbestrol, the eye muscle increased in size and less fat deposition occurred, also, treated steers retained twice as much nitrogen as the controls.

O'Mary, et al. (1952a) reported a greater water content in treated lambs and suggested that this might account for some of the increased gain. Whiting, et al. (1954) concluded that the increased body weight resulting from stilbestrol administration was due to the higher moisture content of the tissues and to the greater proportion of offal.

Cahill, et al.(1956) noticed an increase in size of pituitary glands in stilbestrol treated steers and bulls. Bell, et al. (1956b) working with lambs found hypertrophy of pituitary, adrenal and thyroid glands.

Estrogenic Activity of Animal Tissue After Treatment of the Animal with Stilbestrol

For some time the question of whether or not stilbestrol was collecting in the tissue of treated animals was unanswered. Beeson, et al. (1955); Perry, et al. (1955) and Preston, et al. (1956) have been unable to detect estrogenic activity in the meat of treated animals. Whereas, Stob, et al. (1954) were able to measure slight estrogen retention in sample tissue from beef steers, lambs and chickens. These workers say that in all probability the amount of hormone present in beef muscle and liver does not exceed 0.01 microgram per gram in case of sheep and chicken muscle. Turner (1956) reported no detectable residual estrogen in the liver, heart, spleen and brain but found measurable amounts in the kidneys and lungs of steers receiving 10 mg of stilbestrol fed orally per day for 148 days.

The Effect of Spaying on Heifers

It is a well known fact that castration of male animals intended for meat purposes, increases their value in this country. One of the difficulties in feeding heifers is the disturbance caused by their coming in heat. In order to avoid these disturbances, spaying is sometimes resorted to by feeders. The value of spaying heifers has been a controversial subject for some time.

Spaying of heifers lowers the rate of gain and reduces feed efficiency according to Gramlich (1925, 1927), Gramlich and Thalman (1930) and Dinusson, et al. (1950). Hart, et al. (1940) found spaying increased gain in one trial and lowered it in another. Clegg and Carroll (1956) found spaying to have no effect on growth rate, dressing percent or carcass grade.

EXPERIMENT I

THE EFFECT OF STILBESTROL ON STEER CALVES FED A HIGH ROUGHAGE RATION

Experimental Animals, Materials and Methods

Twelve head of good quality Hereford steer calves from the Williams Ranches near Lovington, New Mexico were used in this test. The calves were divided into three groups of four animals each.

One group received no stilbestrol, a second group was implanted with 36 mg of stilbestrol and a third group received 5 mg of stilbestrol per head daily orally.

Each afternoon all steers were brought in, stanchioned and individually fed their respective ration. They remained stanchioned overnight and were turned out together in the morning in an adjoining lot. The calves did not have access to the feeding stalls during the day. A basal ration of four pounds of ground milo grain and one pound of soybean oil meal was fed per head daily with all the atlas sorghum silage they would consume. Any feed not consumed by a steer on a given day was not weighed back because the concentrate and roughage were mixed together. Any time feed was left in the bunk that steer's ration was decreased the following feeding. There was no attempt to equalize the silage intake, instead, an effort was made to feed the steers all they would consume. The calves were weighed individually bi-monthly.

Results and Discussion

A summary of the results is found in Table 1. The average total gain did not differ markedly between groups. The implanted steers gained 0.19 pounds more per head daily than those fed stilbestrol. This is in agreement with Perry, et al. (1955). These workers reported a 7 percent greater growth stimulation from implanted fattening steers when compared with those fed orally. Klosterman, et al. (1955) with fattening steers and Walker (1956) with steers fed a wintering type ration reported no significant differences in gains between the steers which were implanted and those which were fed stilbestrol.

Table 1. The effect of stilbestrol, orally fed and subcutaneously implanted in steer calves fed a high roughage ration. December 15, 1955, to April 7, 1956 -- 114 days

Treatment	Control	Implants[1]	Oral [2]
Lot number	1	2	3
Number of steers per lot	4	4	4
Initial wt. per steer, lbs.	337	335	335
Final wt. per steer, lbs.	524	538	516
Gain per steer, lbs.	187	203	180
Daily gain per steer, lbs.	1.63	1.76	1.57
Daily ration per steer, lbs.:			
Ground milo grain	4.0	3.96	4.0
Soybean oil meal	1.0	0.99	1.0
Sorghum silage	18.88	21.80	18.52
Lbs. of feed required per 100 lbs. of gain:			
Ground milo grain	248.12	225.25	256.66
Soybean oil meal	62.03	59.77	64.16
Sorghum Silage	1161.49	1241.33	1183.33

1 Thirty-six milligrams (3-12 mg pellets) were implanted at the base of the ear at the beginning of the experiment.

2 Five milligrams of stilbestrol in one pound of soybean meal was fed daily to each steer.

It was interesting to note that the implanted steers did not show any increase over controls until after the second weigh period (28 days). The increased weight gain occurred during the next 72 days. At the termination of the experiment (last 13 days) the implants gained only .36 pound in comparison to .92 pounds per calf daily for the controls. All lots showed a considerable decrease in daily weight gains for this period. This was during the spring and the winter hair coat and manure tags were being shed. However, all calves were on an equal basis. Throughout the feeding period it was observed that the oral fed calves fluctuated considerably in average daily weight gains as determined from one weigh period to another. Stilbestrol by oral administration did not increase weight gains in this test. However, Richardson et al.(1955) with steers and heifers and in (1956) with steers, and Walker (1956) with steers reported some but not significant weight gain increases by oral administration of stilbestrol included in a high roughage ration.

At the end of the treatment period, the implanted steers were eating an average of 23.8 pounds of silage per day as compared to 19.9 pounds and 18.7 pounds for the stilbestrol fed and control lot, respectively. Silage consumption for the entire treatment period averaged 21.8 pounds per day for implanted steer calves, 18.5 for stilbestrol fed, and 18.8 for control. Hence, the implanted steers consumed 2.9 pounds more silage per head daily and required 79.9 pounds more silage for 100 pounds gain than the controls. The silage consumption for implanted steers was 15 percent greater than the controls. Numerous investigators have reported increased appetite, Clegg, et al.(1954); Andrews, et al. (1954) and Klosterman, et al. (1955) as a result of stilbestrol implants.

Feed efficiency was not improved to any extent as result of stilbestrol administration. The orals required more soybean meal, milo grain and silage per 100 pounds of gain than did the controls; however, they required less silage per 100 pounds of gain than did the implants. Implants showed improved concentrate efficiency but more silage was required to produce 100 pounds of gain. Stilbestrol has not improved feed efficiency markedly on similar type rations and weight of cattle according to Richardson, et al. (1955, 1956a) under oral administration and Walker, et al. (1956) using implants.

No undesirable side effects were observed with oral administration of stilbestrol. This is in agreement with Burroughs, et al. (1955). By contrast, Richardson, et al. (1955) observed undesirable side effects with steer and heifer calves fed 10 mg. of stilbestrol daily on a high roughage ration. The only undesirable side effect noted was a slight increase in teat length of the stilbestrol implanted steers. Walker (1956) in a series of experiments reported undesirable side effects in calves fed a high roughage ration implanted at the 36 mg level. O'Mary, et al. (1956) observed a slight depression of the loin of implanted steers 65 days after implantation.

The stilbestrol administered steers were easier to keep on feed and displayed more aggressiveness at feeding time. However, in the presence of personnel they were more nervous and harder to handle. They were quicker to kick and harder to get into stanchions.

EXPERIMENT II

THE EFFECT OF SPAYING AND FEEDING STILBESTROL TO HEIFER CALVES FED A HIGH ROUGHAGE RATION

Experimental Animals, Materials and Methods

Forty head of good quality Hereford heifers, averaging 365 pounds at the start of the experiment were used. They were purchased from the Williams Ranches near Lovington, New Mexico. They were divided into four lots of 10 heifers each on the basis of weight and quality. The treatments were: Lot 7, spayed; lot 8, spayed plus 5 mg of stilbestrol per head daily the first 56 days, and 10 mg per head daily the remainder of the test; lot 9, nonspayed control heifers; lot 10, nonspayed plus 5 mg of stilbestrol per head daily during the first 56 days of the test and 10 mg per head daily during the remainder of the test. The heifers were placed on test November 16, 1955 for 143 days until April 6, 1956. The two lots of spayed heifers were spayed November 17, 1955. All four lots were fed a basal ration of: 3.8 pound of ground milo grain and 1 pound of soybean oil meal per head daily, Atlas sorghum silage ad libitum, and free access to bone meal and salt. Due to a shortage of sorghum silage about 6 pounds of alfalfa hay was fed per head daily during the last 17 days of the test. The heifers were weighed at 28 day intervals.

Results and Discussion

The results of the 143 day feeding period are shown in Table 2. The nonspayed heifers made an average daily weight gain increase of .29 pounds per heifer per day over the spayed heifers. A comparison of weight gain between spayed and nonspayed heifers by periods is found in Table 3. The average daily gain for the two lots was almost identical for the first one-half of the feeding period. However, the first 14 days weight gains were in favor of the nonspayed heifers which was probably influenced by the spay-

Table 2. The effect of spaying and feeding of stilbestrol on the performance of heifer calves on wintering rations. November 16, 1955, to April 7, 1956 --143 days.

Treatment	Spayed	Spayed[1] plus stilbestrol	Non-spayed	Nonspayed[1] plus stilbestrol
Lot number	7	8	9	10
Number of heifers per lot	10	10	10	10
Initial wt. per heifer, lbs.	366	365	364	365
Final wt. per heifer, lbs.	574	597	613	613
Gain per heifer, lbs.	208	232	249	248
Daily gain per heifer, lbs.	1.45	1.62	1.74	1.73
Daily ration per heifer, lbs:				
Ground milo grain	3.81	3.81	3.81	3.81
Soybean oil meal	1.02	1.02	1.02	1.02
Sorghum silage	25.54	25.29	24.86	25.10
Alfalfa hay[2]	.82	.81	1.82	.81
Mineral (bonemeal and salt)	.07	.06	.05	.07
Lbs. feed required per 100 lbs. gain:				
Ground milo grain	262	235	219	220
Soybean oil meal	70	63	59	59
Sorghum silage	1756	1559	1428	1448
Alfalfa hay	56	51	47	47
Mineral (bonemeal and salt)	5	5	3	4
Feed cost per 100 lbs. gain	15.48	13.55	12.44	12.85

1 Five mg of stilbestrol was fed the first 56 days of the test and 10 mg thereafter.

2 Alfalfa hay was fed only the last 17 days of the test at the rate of about 6 pounds per head daily.

Table 3. Daily gain per heifer by periods, chronologically, for spayed and nonspayed heifers.

Lot number	Spayed lbs. per day 7	Nonspayed lbs. per day 9
1 (14 days)	1.21	1.43
2 (28 days)	1.64	1.64
3 (28 days)	1.89	1.86
4 (29 days)	1.51	2.27
5 (28 days)	.86	.96
6 (16 days)	1.56	2.37
143-day average	1.45	1.74

ing operation. The next 56 days weight gains were approximately the same for both lots which showed that spaying operation itself had no serious influence on weight gain. The nonspayed heifers made their greatest increase in gain over the spayed heifers during the last one-half of the feeding period.

The spayed heifers were the least efficient of all lots in converting feed to weight gains. This is in agreement with Gramlich (1925, 1927); Gramlich and Thalman (1930); Hart, et al. (1940) and Dinusson, et al. (1950).

Stilbestrol fed to the spayed group of heifers (lot 8) increased the daily gain .17 of a pound per heifer as compared to the spayed heifers in lot 7. The weight gain from stilbestrol treatment seemed to be well distributed over the entire feeding period. This response occurred without any increase in feed consumption.

It appears from this experiment that stilbestrol added to the ration of heifers which have been deprived of their primary estrogen source will produce a growth stimulatory response. However, compared to the nonspayed group (lot 9) the spayed plus stilbestrol (lot 8) produced .12 of a pound less gain, with a slight decrease in feed efficiency.

Clegg and Carroll (1956) found that spaying had no effect on growth response and that stilbestrol increased the rate of gain significantly in both spayed and intact fattening heifers when implanted with 60 mg stilbestrol.

A comparison between nonspayed (lot 9) and nonspayed plus stilbestrol (lot 10) revealed very little difference in weight gain, silage consumption, and feed efficiency.

There were a few heifers in lot 10 that exhibited slight mammary stimulation and one heifer had a slightly protruding vagina, but she recovered with no treatment.

SUMMARY AND OBSERVATIONS

In Experiment I, 12 head of good quality Hereford steer calves were used to determine the effect of administering to steer calves stilbestrol on high roughage wintering type rations. Four calves served as controls, four were implanted with 36 mg of stilbestrol at the base of the ear and four others received 5 mg per steer per day in their daily ration.

The results of this test where the animals were individually fed for 114 days, showed that the steers receiving stilbestrol by either method of administration did not differ markedly in growth rate, feed efficiency or feed consumption in comparison with control animals. Best results were obtained from the implanted steers which showed a slight increase of .13 pound per steer daily in rate of gain compared with the controls. Stilbestrol fed steers were easier to keep on feed, but were more nervous. Side effects of any practical significance were not noted.

Forty head of good to choice Hereford heifers were used in Experiment II to ascertain the effect of feeding stilbestrol and spaying on heifers fed a high roughage ration. The heifers, averaging 365 pounds, were divided into 4 lots of 10 each as follows: Lot 7, spayed; lot 8, spayed plus 5 mg of stilbestrol per head daily during the first 56 days of the test and 10 mg per head daily during the remainder of the test; lot 9, nonspayed controls; and lot 10, nonspayed plus 5 mg of stilbestrol per head daily during the first 56 days and 10 mg thereafter.

The results of this test demonstrated that spaying depressed growth rate. The rate of gain was .19 of a pound per heifer per day in favor of nonspaying. It was concluded that the spaying operation itself did not seriously retard the heifers as shown by their weight gain at 28 day intervals since the nonspayed heifers made their greatest increase in gain over the spayed heifers during the latter part of the feeding trial. The spayed heifers which did not receive stilbestrol required more feed per 100 pounds of gain than any other group.

The spayed heifers fed stilbestrol in lot 8 showed an increase of .17 of a pound gain per head daily over the spayed heifers in lot 7 not fed stilbestrol. However, the rate of gain of spayed heifers fed stilbestrol was still .12 of a pound per head less daily than the control heifers in lot 9. Feed required per 100 pound of gain was greater for spayed stilbestrol-fed heifers in comparison with controls. The control lot and nonspayed stilbestrol fed heifers showed no difference in rate of gain, feed efficiency or feed consumption.

Some mammary stimulation was noted and one of the nonspayed stilbestrol-fed heifers had a slightly protruding vagina but recovered with no treatment.

From these limited experiments it appeared that no advantage accrued from implantation or oral administration of stilbestrol when fed to steer calves or intact heifers. Gain is increased by feeding stilbestrol to spayed heifers.

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LITERATURE CITED

Andrews, F.N. and B.B. Bohren.
Influence of thiouracil and stilbestrol on growth, fattening and feed efficiency in broilers. Poul. Sci. 26:1947.

Andrews, F.N., W.M. Beeson and C. Harper.
The effect of stilbestrol and testosterone on the growth and fattening of lambs. J. Animal Sci. 8:578. 1949.

Andrews, F.N., W.M. Beeson and F.D. Johnson.
Effect of hormones on the growth and fattening of yearling steers. J. Animal Sci. 9:677. 1950.

Andrews, F.N., W.M. Beeson and F.D. Johnson.
The effect of stilbestrol, dienestrol, testosterone and progesterone on the growth and fattening of beef steers. J. Animal Sci. 13:99. 1954.

Andrews, F.N., Martin Stob, T.W. Perry and W.M. Beeson.
The oral administration of diethylstilbestrol, dienestrol, and hexestrol for fattening calves. J. Animal Sci. 15:685. 1956.

Beeson, W.M., F.N. Andrews, T.W. Perry and Martin Stob.
The effect of orally administered stilbestrol and testosterone on growth and carcass composition of swine. J. Animal Sci. 14:475. 1955.

Beeson, W.M., F.N. Andrews, Martin Stob and T.W. Perry.
The effects of oral estrogens and androgens singly and in combination on yearling steers.J.Animal Sci. 15:679. 1956.

Bell, T. Donald, Walter H. Smith and A.B. Erhart.
The effect of stilbestrol upon lamb performance in the feedlot. J. Animal Sci. 13:425-432. 1954.

Bell, T. Donald and A.B. Erhart.
Feedlot and pasture fattening tests with feeder lambs. Livestock Feeders Day, Kansas Agr. Exp. Sta. Circular 335:58. 1955.

Bell, M.C., R.M. Taylor, R.L. Murphee and C.S. Hobbs.
The effect of feeding urea and stilbestrol on ration digestibility and on calcium, phosphorus and nitrogen retention in lambs. J. Animal Sci. 14:1193-1194. 1955.

Bell, T. Donald and A.B. Erhart.
Lamb-Feeding experiments, Feedlot and pasture fattening tests with feeder lambs. Livestock Feeders Day, Kansas Agr. Exp. Sta. Circular 335:63. 1956a.

Bell, T. Donald, Walter H. Smith, A.B. Erhart, and D.L. Mackintosh. Lamb-Feeding experiments, Supplemental report concerning the use of hormones. Livestock Feeders Day, Kansas Agr. Exp. Sta. Circular 335:65. 1956b.

Bennetts, H.W., E.J. Underwood and F.L. Shier. A specific breeding problem of sheep on subterranean clover pasture in western Australia. Australian Vet J. 22:2. 1946.

Brooks, C.C., G.B. Garner, M.E. Muhrer and W.H. Pflander. The effect of fat and diethylstilbestrol on cellulose digestion by sheep rumen microorganisms. J. Animal Sci. 12:909. 1953.

Brooks, C.C., G.B. Garner, M.E. Muhrer, and W.H. Pflander. Effects of some steroid compounds on ovine rumen functions. Science 120:55. 1954.

Burroughs, Wise, E.W. Cheng, C.C. Culbertson, W.H. Hale and J. Kastelic. Oral administration of diethylstilbestrol for growth and fattening in beef cattle. J. Animal Sci. 13:978. 1954a.

Burroughs, W., C.C. Culbertson, Joseph Kastelic, Edmund Cheng, and W.H. Hale. The effects of trace amounts of diethylstilbestrol in rations of fattening steers. Science 120:66-67. 1954b.

Burroughs, Wise, H.H. Hale, Edmund Cheng, W.H. Hale and Paul Homeyer. The influence of oral administration of diethylstilbestrol to beef cattle. J. Animal Sci. 14:1015-1024. 1955.

Cahill, V.R., L.E. Kunkle, Earle W. Klosterman, F.E. Deatherage and Eugene Wierbicki. The effect of diethylstilbestrol implantation on carcass composition and the weight of certain endocrine glands of steers and bulls. J. Animal Sci. 15:701-709. 1956.

Cheng, Edmund W., Charles D. Story, C.C. Culbertson and Wise Burroughs. Detection of estrogenic substances in alfalfa and clover hays fed to fattening lambs. J. Animal Sci. 11:758. 1952.

Cheng, E.W., C.D. Story, C.C. Culbertson and W. Burroughs. Detection of estrogenic substances in alfalfa and clover hay fed to fattening lambs. J. Animal Sci. 12:507-514. 1953a.

Cheng, E.W., L. Yoder, C.D. Story and Wise Burroughs. Estrogenic activity of various synthetic isoflavone derivaties and compounds isolated from differet livestock feeds. J. Animal Sci. 12:944. 1953b.

Clegg, M.T.
The use of diethylstilbestrol to increase nitrogen retention. J. Animal Sci. 11:758-759. 1952.

Clegg, M.T., H.H. Cole and H.R. Guilbert.
Effects of stilbestrol on beef heifers and steers. J. Animal Sci. 10:1074. 1951.

Clegg, M.T. and H.H. Cole.
The action of stilbestrol on the growth response in ruminants. J. Animal Sci. 13:108. 1954.

Clegg, M.T., Reugen Albaugh, Joseph Lucas, and W.C. Weir.
A comparison of the effect of stilbestrol on the growth response of lambs of different age and sex. J. Animal Sci. 14:178-185. 1955.

Clegg, M.T. and F.D. Carroll.
Further studies on the anabolic effect of stilbestrol in cattle as indicated by carcass composition. J. Animal Sci. 15:37-47. 1956.

Connell, W.E.
Hormones and antibiotics for fattening steers. Colorado A and M Agr. Exp. Sta. Gen. series No. 605. 1955.

Dinusson, W.E., F.N. Andrews and W.M. Beeson.
The effects of stilbestrol, testosterone and thyroid alterations on growth and fattening of beef heifers. J. Animal Sci. 9:321. 1950.

Dodds, E.C., L. Goldberg, W. Lawson, and R. Robinson.
Estrogenic activity of certain synthetic compounds. Nature. 141:247-248. 1938.

Duitsman, W.W. and Frank B. Kessler.
Value of stilbestrol and aureomycin when fed individually and in combination in the fattening ration of yearling steers. Beef cattle feeding investigations. Kansas Agr. Exp. Sta. Cir. 334:12. 1956.

Erwin, E.S., I.A. Dyer and M.E. Ensiminger.
Effects of chlortetracyline, inedible animal fat, stilbestrol and high and low quality roughage on performance of yearling steers. II. Digestibility of dry matter, crude fiber, crude protein, and ether extract. J. Animal Sci. 15:717-721. 1956.

Galloway, L.J., Bratzler, L.H. Blakeslee, and J. Meites.
Effects of stilbestrol implants on growth and carcass quality of lambs. J. Animal Sci. 11:792. 1952.

Gramlich, H.J.
Sex as a factor in beef production. Am. Soc. Animal Prod. p. 83. 1925.

Gramlich, H.J.
The effect of spaying in beef production. Am. Soc. Animal Prod. p. 213. 1927.

Gramlich, H.J. and R.R. Thalman.
Sex and age as factors in cattle feeding. Nebr. Exp. Sta. 1930 Bull. 252. 1930.

Hale, W.H., P.G. Homeyer, C.C. Culbertson, and Wise Burroughs.
Response of lambs fed varied levels of diethylstilbestrol. J. Animal Sci. 14:909-918. 1955.

Hart, G. H., H.R. Guilbert and H.H. Cole.
The relative efficiency of spayed open and bred heifers in the feed lot. Calif. Exp. Sta. Bull. 645. 1940.

Jordan, R.M.
The effect of stilbestrol on fattening lambs. J. Animal Sci. 9:383-386. 1950.

Jordan, R.M.
Effect of level of stilbestrol on growth in fattening lambs. J. Animal Sci. 12:680-683. 1953a.

Jordan, R.M.
The effect of stilbestrol on suckling and fattening lambs. J. Animal Sci. 12:670-679. 1953b.

Jordan, R.M. and W.E. Dinusson.
Effect of stilbestrol on the growth rate of suckling lambs. J. Animal Sci. 9:380-382. 1950.

Jordan, R.M. and T. Donald Bell.
Effect of stilbestrol on carcass quality and shrinkage and nitrogen retention by lambs. J. Animal Sci. 11:795. 1952.

Jordan, P.J., R.M. Jordan, and H.G. Groom.
Effect of stilbestrol, progesterone-estradiol implants and oral administration of stilbestrol on fattening lambs. J. Animal Sci. 14:936-940. 1955.

Kastelic, J., Paul Homeyer and E.A. Kline.
The influence of the oral administration of diethylstilbestrol on certain carcass characteristics of beef cattle. J. Animal Sci. 15:689-700. 1956.

Klosterman, E.W., L.E. Kunkle, and A.L. Moxon.
The influences of sex hormones upon rate and efficiency of gain of fattening calves. J. Animal Sci. 12:948-949. 1953.

Klosterman, E.W., V.R. Cahill, L.W. Kunkle, and A.L. Moxon. The subcutaneous implantation of stilbestrol in fattening bulls and steers. J. Animal Sci. 14:1050-1057. 1955.

Klosterman, E.W., V.R. Cahill, Orville G. Bently and A.L. Moxon. The effect of protein level on response from stilbestrol when fed and when implanted in fattening steers. J. Animal Sci. 14:1249. 1955.

Lorenz, F.W.
The influence of diethylstilbestrol on fat deposition and meat quality in chickens. Poul. Sci. 24:128-133. 1945.

Means, T.M., F.N. Andrews and W.M. Beeson.
The effect of hormones on the growth and fattening of lambs. J. Animal Sci. 12:176-181. 1953.

O'Mary, C.C., A.L. Pope, G.D. Wilson, R.W. Bray, and L.E. Casida. The effects of diethylstilbestrol, testosterone and progesterone on growth and fattening and on certain carcass characteristics of western lambs. J. Animal Sci. 10:1079-1080. 1951.

O'Mary, C.C., A.L. Pope, G.D. Wilson, R.W. Bray, and L.E. Casida. The effects of diethylstilbestrol, testosterone and progesterone on growth and fattening and certain carcass characteristics of western lambs. J. Animal Sci. 11:656-673. 1952a.

O'Mary, C.C., W.S. Wilkinson, G.D. Wilson, R.W. Brady, A.L. Pope, and L.E. Casida.
The effect of stilbestrol on certain carcass characteristics and feed utilization of full fed and limited fed western lambs. J. Animal Sci. 11:751. 1952b.

O'Mary, C.C., E.P. Warren, T.J. Davis, and H.H. Pierce.
The effects of stilbestrol on the performance of fattening steers fed blackstrap molasses. J. Animal Sci. 12:952-953. 1953.

O'Mary, C.C.and A.E. Cullison.
Effects of low level implantation of stilbestrol in steers on pasture. J. Animal Sci. 15:48-51. 1956.

O'Mary, C.C., E.P. Warren, T.J. Davis, and H.H. Pierce, Jr
Effects of low level implantations of stilbestrol in steers fattened on dry lot rations. J. Animal Sci. 15-52-58. 1956.

Perry, T.W., F.N. Andrews, and W.M. Beeson.
The effect of stilbestrol on suckling lambs. J. Animal Sci. 10:602-606. 1951.

Perry, J.W., W.M. Beeson, F.N. Andrews, and Martin Stob.
The effect of oral administration of hormones on growth rate and deposition in the carcass of fattening steers. J. Animal Sci. 14:329-335. 1955.

Perry, T.W., W.M. Beeson, M.T. Mohler, Martin Stob and F.N. Andrews.
Oral stilbestrol vs levels of implanted stilbestrol, with and without aureomycin. Purdue Univ. Ag. Exp. Sta. Mimeo A.H.165 (Progress Report) 1956.

Pharmacopeia of the United States.
14th ed. Easton, Pa.-Mack Printing Co., p. 172. 1950.

Pieterse, P.J.S., and F.N. Andrews.
The estrogenic activity of alfalfa and other feedstuffs. J. Animal Sci. 15:25-36. 1956a.

Pieterse, P.J.S., and F.N. Andrews.
The estrogenic activity of alfalfa, grass, and corn silage. J. Dairy Sci. 39:81-89. 1956b.

Pope, A.L., C.C. O'Mary, W.E. Batterman, R.W. Bray, and L.E. Casida.
The effect of certain steroid hormones on the growth, fattening and carcass quality of heavy lambs. J. Animal Sci. 9:680-681. 1950.

Pope, G.S.
The importance of pasture plant estrogen in the reproduction and lactation of grazing animals. Dairy Sci. Abstr. 16:333-335. 1954.

Preston, Rodney, Edmund Cheng, C.D. Story, Paul Homeyer, John Pauls and Wise Burroughs.
The influence of oral administration of diethylstilbestrol upon estrogenic residue in the tissues of beef cattle. J. Animal Sci. 15:3-12. 1956.

Rice, V.A. and F.N. Andrews.
Breeding and improvement of farm animals. McGraw-Hill Book Company, 1951.

Richardson, D., F.H. Baker, D.L. Good and R.F. Cox.
The value of stilbestrol in beef cattle rations wintering phase. 1954-1955 Progress Report, Ks. Agr. Exp. Sta. Circular 320.

Richardson, F.H. Baker, E.F. Smith and R.F. Cox.
The value of stilbestrol in beef cattle rations-wintering, grazing, and fattening phases. 1955-1956a. Progress Report. Ks. Agr. Exp. Sta. Circular 40-45:335.

Richardson, D., E.F. Smith and R.F. Cox.
The value of stilbestrol in beef cattle rations. 1955-1956 Progress Report, Ks. Agr. Exp. Sta. Circular 355:45-46.

Richardson, D., D.L. Mackintosh, J.D. Wheat, C.S. Menzies and R.F. Cox.
The value of stilbestrol in the fattening rations of beef steers. 1955-1956b Progress Report. Ks. Exp. Sta. Circular 335:41.

Ruliffson, W.S., T.D. Bell, J.S. Hughes, and A. Nunn.
Neutral 17-ketosteroids in the urine of normal and diethylstilbestrol treated wether lambs. J. Animal Sci. 13:1030. 1954.

Shorr, E.F., F.H. Robinson and G.N. Popanicalaeu.
A clinical study of the synthetic estrogen stilbestrol. J. Am. Med. Ass'n. 13:2312-2318. 1939.

Stob, M., F.N. Andrews and W.M. Beeson.
Estrogenic activity of the meat of cattle, sheep and poultry following treatment with synthetic estrogens and progesterone. J. Animal Sci. 13:138. 1954.

Sykes, J.F., F.N. Andrews, F.W. Hill, F.W. Lorenz, J.W. Thomas and C.F. Winchester.
Hormonal relationships and applications in the production of meats, milk and eggs. Report of the committee on animal nutrition. National Academy of Sci., National Research Council. 1953.

Thayer, R.H., R.G. Jaup and R. Penquite.
Fattening chickens by feeding estrogens. Poul. Sci. 24:483. 1945.

Turner, C. Donnell.
General Endocrinology. W.B. Saunders Co. Philadelphia, Pa. 1948.

Turner, C.W.
Biological assay of beef steer carcasses for estrogenic activity following the feeding of diethylstilbestrol at a level of 10 mg per day in the ration. J. Animal Sci. 15:13-24. 1956.

Walker, G. L.
A study of the effect of diethylstilbestrol on beef cattle fed high roughage rations. Master's thesis. Kansas State College. 1956.

Walker, G.L., E.F. Smith, R.F. Cox, D. Richardson and B. A. Koch.
The use of stilbestrol implants for steer calves on a wintering ration. 1955-1956 Progress Report, Ks. Exp. Sta. Circular 335:20.

Whitehair, C.K., W.D. Gallup, and M.C. Bell.
Effect of stilbestrol on ration digestibility and on calcium, phosphorus and nitrogen retention in lambs. J. Animal Sci. 12:331-337. 1953.

Whiting, F., R.D. Clark, and C.E. Allen.
Synthetic estrogen in lambs. Canadian J. of Ag. Sci. 34:288. 1954.

Wilkinson, W.S., C.C. O'Mary, G.D. Wilson, R.W. Bray, A.L. Pope and L.E. Casida.
The effect of diethylstilbestrol upon growth, fattening and certain carcass characteristics of full-fed and limited-fed western lambs. J. Animal Sci. 14:866. 1955.

THE VALUE OF STILBESTROL FOR STEER AND HEIFER CALVES ON HIGH ROUGHAGE RATIONS

by

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In recent years, the use of diethylstilbestrol, a synthetic hormone, which when taken into the body produces an estrogenic hormone like effect, has received wide attention especially in fattening rations. Since stilbestrol was effective in stimulating growth in fattening animals, the question was raised as to its possible effect on growing animals fed on a high roughage ration.

One purpose of this study was to determine the effect of stilbestrol implanted and orally administered on the rate of gain, feed consumption and feed efficiency of steer calves fed a high roughage ration. These animals were individually fed and weighed. Twelve animals were used, four animals to a treatment. One group served as the control, another was implanted with 36 mg of stilbestrol at the base of the ear. The third group received 5 mg of stilbestrol in their ration daily. The implanted steers gained .13 of a pound more per head daily than the controls. Feed consumption and efficiency was slightly increased for the implanted steers when compared with controls. There was little difference in gain, feed consumption and feed efficiency between control and orally administered stilbestrol animals.

Another purpose of this study was to determine the effect of feeding stilbestrol to heifer calves on high roughage rations. Spaying was also studied with and without stilbestrol in the ration. Forty head of Hereford heifers were used in this test, they were divided into 4 lots of 10 each. The heifers in lot 7 were spayed, in lot 8 the heifers were spayed, and also received 5 mg of stilbestrol for the first 56 days of the test and 10 mg thereafter. Animals in lot 9 served as the controls, in lot 10 were nonspayed animals which received 5 mg of stilbestrol for the first 56 days and 10 mg for the remaining time on test.

In this study spaying heifers depressed the rate of growth and feed efficiency. The nonspayed heifers made their greatest increase in gain over the spayed heifers during the latter part of the feeding trial. Stilbestrol incorporated into the ration of spayed heifers increased the rate of gain and feed efficiency. However, the spayed heifers fed stilbestrol did not gain as rapidly or efficiently as the nonspayed (control) heifers. Stilbestrol fed to nonspayed heifers produced no additional gain or feed efficiency.

From the limited work in this study with calves on a high roughage ration it was observed that there was little advantage in using stilbestrol implants or orally feeding stilbestrol to calves.