EFFECTS OF FINAPLIX® IN COMBINATION WITH RALGRO® AND SYNOVEX® ON PERFORMANCE AND CARCASS CHARACTERISTICS OF STEERS AND HEIFERS

by

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CHAPTER I

GENERAL INTRODUCTION

Kansas is among the Nation's leaders in feedlot cattle. Kansas ranked third with 4,155,000 head of fed cattle marketed from over 1900 feedlots in 1988. The number of cattle on feed has increased substantially over the last decade. In 1974, there were 1,160,000 head on feed compared to 1,535,000 head as of February, 1989 (USDA, 1989). Cattle feeding today is viewed as a business opportunity that is heavily dictated by consumer demands. Marketing research indicates a consumer preference toward leaner beef. If demand increases for leaner finished cattle, feedlots will feed younger cattle and should be able to market cattle at an earlier stage of growth with less fat deposit. However, there is a marketing dilemma due to traditional carcass price discounts of $.22 to .33/kg for the leaner Select as compared to Choice quality cattle (Eng, 1986). Nonetheless, if a leaner beef product will improve consumer beef demand, the beef industry should prosper from a production cost and efficiency standpoint.

For more than 30 years, one of the greatest opportunities to capitalize on improved efficiency resulting from leaner beef production has been recognizing the important role of growth promoting hormones. Estrogens are the major hormonal compounds used as growth promotants in the production of beef in the U.S. (Preston, 1975). In early studies, Dinusson et al. (1948) reported that implanting heifers with Diethylstilbestrol (DES), a compound with estrogenic activity, resulted in increases of 12 to 16% in daily gains. Burroughs et al. (1954) first discussed the oral effectiveness of DES in stimulating gains of growing-finishing cattle. As of November, 1979, the use of DES by cattle producers was officially banned for reasons unrelated to its use as a growth promotant in cattle (Preston, 1987). In more recent years, numerous research studies have indicated that growth promotants (estrogens) increase rate of gain and feed efficiency of steers and heifers (Preston, 1975). In addition to the conventional implants that contain estrogen or estrogen-like compounds, an androgenic compound called trenbolone acetate (TBA) has been approved recently by the FDA. It is a synthetic testosterone analogue that is approximately 10-50 times more anabolically active than testosterone itself (Neumann, 1976). This product, when combined with estrogenic compounds in bulls, steers, and heifers has resulted in improved average daily gain and feed efficiency (Grandadam et al., 1975; Galbraith, 1982; Fabry et al., 1983; Brethour, 1986). Heitzman (1976) suggested that androgens and estrogens are both necessary to realize maximum growth potential. Therefore, the objectives of these studies were to determine the effects of trenbolone acetate in combination with estrogenic implants on performance and carcass characteristics of steers and heifers.

CHAPTER II

GENERAL REVIEW OF LITERATURE

Endocrine Relationships to Growth

Gonadal Hormones. Extensive research has been conducted to delineate the endocrine relationships necessary for optimum growth in domestic livestock. There are many growth promoting compounds of both endogenous and exogenous origin that affect growth and development of beef cattle. These growth promoting compounds can be manipulated to enhance either the rate, extent, or efficiency of animal growth, which is critical to the future of the livestock industry. Gonadal hormones can be divided into androgenic and estrogenic steroid hormone classification.

Androgens. In the male, androgens in the form of testosterone are produced by the Leydig cells of the testes, with a limited amount produced by the adrenal cortex. Androgens are involved in the stimulation of spermatogenesis, development and secretion of accessory sex organs, maintenance of secondary sex characteristics, production of anabolic effects and induction of aggressive behavior (Reeves, 1987).

Intact bulls have a higher rate of gain than steers due to the presence of higher concentrations of endogenous male hormones (Galbraith et al., 1978; Fisher et al., 1986b). It is thought that endogenous testosterone acts directly on skeletal muscle by increasing the rate of protein synthesis and deposition (Trenkle, 1987). Schanbacher et al. (1980) concluded that testosterone is associated with a positive nitrogen balance, increased carcass protein, and decreased fat production. While castration has been practiced to provide a higher quality carcass for marketing, it has caused a reduction in live weight gain and lean tissue within the carcass. Compared to bulls, steers generally result in higher quality grade, finish, and tenderness characteristics in meat carcasses. Castration also minimizes management problems usually associated with intact males (Unruh, 1986). Interest in androgen treatment of heifers and the recent availability of trenbolone acetate, a synthetic testosterone implant, has resulted in reports of significant improvements in growth rate and feed efficiency of the heifers with TBA (Heitzman et al., 1974; Galbraith, 1980; Stanton et al., 1988).

Estrogens. Estradiol is produced from aromatization of androgens and is secreted from the ovaries of heifers and testes of bulls. Of all the steroids, estrogens have the widest range of physiologic functions. Estrogens are involved in reproductive activities and development of female secondary characteristics. Nonreproductive effects of estrogens include stimulation of calcium uptake and ossification of bones (Reeves, 1987). In ruminant animals, estrogens are the major hormonal compounds used as growth promotants in the United States. These compounds cause a release of growth hormone releasing factors from the hypothalamus, which causes an increase in growth hormone (GH) secretion, resulting in increased growth and nitrogen retention (Preston, 1975). Trenkle (1983) reported that following exogenous estrogenic treatment, there was an increase in plasma GH concentration and greater nitrogen retention and protein deposition.

VanderWal (1975a) conducted a study with Friesian bull calves and reported on the effectiveness of anabolic agents in improving nitrogen retention and growth. In normal veal calves, the percentage of digested feed protein converted to body protein gradually decreased from 70% to less than 40% during the growing period. By implantation with the most effective anabolic agent tested (20 mg estradiol and 140 mg TBA), the digested protein to body protein conversion over the trial period of 38 days increased from 39% in the control to 58% in the implanted group. It was concluded that the major reason for the extra weight gain obtained by administration of anabolic agents was due to enhanced protein accretion resulting from improved protein conversion efficiency. Estrogenic implants have been shown to reduce testicle size and masculinity scores in bulls and at the same time improve live weight gain (Brethour and Schanbacher, 1983, Schanbacher, 1984).

Presently, the exact mode of action of anabolic agents in relation to growth is unclear, however there is supporting evidence that hormonal interactions are responsible for the growth and behavioral differences among bulls, steers, and heifers (Unruh, 1984). Hopefully, the results of these trials and future research studies will assist in understanding the hormonal relationships of growth in cattle production.

Anabolic Agents in Feedlot Cattle

Commercial Implants for Cattle. Thirty years of research and industry experience has recognized that implanting with growth promoting hormones has returned more dollars per dollar invested than any other management tool in the livestock industry. Practically all cattle are given hormone implants upon arrival at commercial feedlot facilities. The implantation of anabolic compounds is thought by researchers to increase nitrogen retention, causing increased muscle growth and decreased fat deposition. This allows the conversion of nutrients to muscle with lower levels of energy and thus more efficient weight gain (Collins et al., 1989). In animal production, anabolic agents are generally described in relation to their classification (estrogenic, androgenic or progestogenic) or by whether they are biologically endogenous or exogenous (Patterson and Salter, 1985). The implants may contain estradiol, alone or in combination with progesterone or testosterone, or they may contain zeranol, a synthetic drug with estrogenic activity. Currently in the United States, there are several growth promoting compounds used in cattle as shown in Table 1.

The following section of this review will focus on the commercial implants that were used in this research which evaluated their effects on performance and carcass characteristics of steers and heifers.

Trenbolone Acetate (Finaplix®). Trenbolone acetate is a growth promoting implant (trade name Finaplix), a synthetic analogue of the male steroid testosterone. Finaplix has FDA approval for both steers and heifers in feedlot growing-finishing programs. Androgenic agents appear to increase protein accretion in muscle by causing an anabolic effect upon protein metabolism to increase muscle growth (Buttery et al., 1978). Brethour (1985) reported that implanting with 200 mg TBA alone improved steer gains 9% over nonimplanted steers, but this was only about half the response obtained with single implant treatments of the estrogenic implants, Ralgro and Synovex-S. Trenkle (1987) indicated that TBA seems to increase protein deposition by decreasing the rate of protein degradation. Heitzman and Chan (1974) and Crouse et al. (1987) found that heifers implanted with TBA alone increased growth and nitrogen retention. However, TBA seems to require the presence of an estrogen in order to promote a maximum growth response (Heitzman, 1976). Gainsworthy et al. (1986) indicated that TBA implantation of cull dairy cows resulted in significantly higher ($P<.01$) live weight gains and tended

TABLE 1. TRADE NAME, MANUFACTURER, CHEMICAL COMPOUND AND U.S. FOOD AND DRUG ADMINISTRATION (FDA) APPROVAL STATUS FOR ANABOLIC GROWTH STIMULANTS IN THE UNITED STATES[a]

Trade Name	Produced By	Chemical Component (Dosage)	Date Approved	FDA Approval Status: Calves	Steers	Heifers
Compudose	Elanco	Estradiol-17β (24 mg)	01/12/82	Yes	Yes	Yes
Finaplix-S	Hoechst-Roussel	Trenbolone acetate (140 mg)	06/17/87		Yes	
Finaplix-H	Hoechst-Roussel	Trenbolone acetate (200 mg)	06/17/87			Yes
MGA[b]	Upjohn	Melengestrol acetate (.25 - .50 mg per day orally)	06/03/77			Yes
Ralgro[b]	International Minerals & Chemical	Zeranol (36 mg)	11/05/69	Yes	Yes	Yes
Synovex-C	Syntex	Progesterone (100 mg) & estradiol benzoate (10 mg)	11/05/69	Yes		
Synovex-H	Syntex	Testosterone propionate (200 mg) & estradiol benzoate (20 mg)	07/16/58			Yes
Synovex-S	Syntex	Progesterone (200 mg) & estradiol benzoate (20 mg)	02/20/56		Yes	
Steer-oid	Anchor Labs	Identical to Synovex-S	11/12/82		Yes	
Heifer-oid	Anchor Labs	Identical to Synovex-H	07/24/84			Yes

[a]Adapted from Taylor (1984), McEvoy et al. (1987) and Collins et al. (1989).
[b]For MGA, a 48-hour withdrawal period is required and for Ralgro, a 65-day withdrawal period is required.

to increase (P=.06) feed intake compared with control cows over a 100-day feeding period. In general, when TBA was used with an estrogenic implant, an additional 5 to 7% growth response was obtained (Galbraith and Geraghty, 1982; Heitzman, 1983; Brethour, 1985; Lobley et al., 1985; Steen, 1985; Trenkle, 1987).

Progesterone and Estradiol Benzoate (Synovex-S®). Progesterone is often referred to as the hormone of gestation. It prepares the reproductive organs of the female for pregnancy. The actions of progesterone outside of its reproductive functions are largely unknown. Exogenous progestins are known to be anabolic in beef cattle but the exact mechanism of this action is largely unknown. The main sources of progesterone are the ovary and the placenta, although it is also found in the adrenals and the testes where some secretion takes place. Metabolism of gestagens vary among species but in ruminants most progesterone is converted to androgens (Velle, 1975).

Estradiol has been shown to increase plasma levels of growth hormone which in turn increases muscle and bone synthesis (Trenkle and Burroughs, 1978; Grigsby, 1981). Trenkle and Burroughs (1978) and Gopinath and Kitts (1981) indicated that estradiol increased plasma levels of insulin which increases glucose and amino acid uptake by the cells thereby stimulating protein synthesis. Estradiol has also been reported to increase plasma levels of thyroxine which results in increased metabolic and growth rates (Kahl et al., 1978; Rumsey et al., 1980).

Testosterone Propionate and Estradiol Benzoate (Synovex-H®). Synovex-H is a growth stimulating implant for growing and finishing heifers. Mode of action of the compounds in this implant has been discussed in the previous two sections. In addition, testosterone is believed to have a direct effect on the muscle cell thus exerting an anti-catabolic effect on muscle by slowing muscle breakdown (Vernon and Buttery, 1976). Lobley et al. (1985) indicated that the anabolic effect of trenbolone-estrogen implant combinations is primarily to decrease muscle protein degradation rather than increase protein synthesis.

Zeranol (Ralgro®). Zeranol is an estrogen-like compound isolated from a mold, gibberella zea, originally found in corn. It is a resorcylic acid lactone with estrogenic activity (Heitzman, 1978). Zeranol's mode of action is not completely clear, although there is evidence for an elevation of plasma growth hormone and insulin concentrations in treated animals (Buttery et al., 1978). Trenkle and Burroughs (1978) suggested zeranol may increase production of androgens from the adrenal cortex, increase thyroid hormone activity, elevate GH secretion and have a direct effect at the receptor site of target cells. Simms et al. (1988) studied the effect of sequential implanting with Ralgro on steer lifetime performance. Results indicated that implanting suckling calves did not reduce gains during the growing or finishing phases of production. Similarly, finishing gains were not reduced when zeranol was implanted during the growing phase. Overall results verified a positive impact of Ralgro implants on lifetime performance because steers receiving four successive implants were 25 kg heavier ($P<.05$) than control steers at the time of slaughter.

Trenkle (1983) concluded that androgens primarily act on muscle cells to increase protein while the estrogens may stimulate GH secretions from the hypothalamus and anterior pituitary.

Effects of Anabolic Agents on Cattle Growth

Response of Steers to Implantation. Implanting feedlot steers with anabolic compounds is a common management practice for improving animal performance. Not all species, or sex classes within a species, react to exogenous anabolic agents with the same effectiveness (Vander Wal and Bererde, 1983). For example, when feedlot steers are implanted with an estrogenic compound, rate of gain typically is increased 8-15%, while feedlot heifers generally exhibit a 0-10% increase in gain (Roche and Quirke, 1985; Roche, 1986). Under similar conditions of adequate nutrition, bulls gain more quickly and efficiently than steers. This lowered production due to castration has been attributed to reduced levels of endogenous anabolic hormones in the steer (Field, 1971). Therefore, the use of exogenous hormones or hormone-like compounds to improve beef production from steers has considerable interest. Galbraith and Watson (1978) conducted a study with 20 British Friesian steers and found a 25% increase in live weight gain with implantation of hexoestrol (a synthetic estrogen) and a 41% increase in gain with TBA and Hexoestrol compared to a control group during the final 70 days of the experiment. The control steers were 22% and 37% less efficient than steers treated with Hexoestrol alone and TBA plus Hexoestrol, respectively. Consequently, the improvement in the live weight gain due to implant treatment may be directly related to an improved feed efficiency. Their review concluded that these compounds stimulated liveweight gain in ruminant animals and that the increase in growth rates was related mainly to an increased deposition of protein tissue at the expense of fat in the carcass.

Numerous research studies have shown that combining implants containing compounds with androgenic and estrogenic activity are more effective in promoting growth in steers then when these compounds are administrated separately (Galbraith, 1982; Roche and Quirke, 1985; Brethour, 1986; Trenkle, 1987; Istasse, 1988). Roche and Davis (1978) studied the effects of TBA and zeranol, alone and in combination, in steers. Each implant increased final liveweight, daily gain, and carcass weight. When both implants were used in combination, there was an additive effect, indicating that the two compounds act independently. This suggests an independent mode of action or that a sub-maximal dose of one of the compounds was given. Brethour (1985) reported that a combination of 200 mg

TBA plus Synovex-S resulted in 26% faster steer gains than controls. Gains were similar with a Ralgro + 200 mg TBA implant treatment and significantly ($P<.05$) better than when no implants were used. Galbraith and Dempster (1979) reported that TBA + Hexoestrol implanted Friesian steers gained 36% faster than untreated animals in a 90-day trial. Fisher et al. (1986b) indicated the combination of estradiol + TBA implanted in the same ear of steers was the most effective in increasing growth rate, carcass weight, feed efficiency, and reducing fat deposition as indicated by the weight of omental and perirenal fat. Galbraith et al. (1983) reported British Friesian steers implanted with TBA + estradiol-17β gained significantly more live weight than controls with a 12 kg increase in the first 28-day feeding period and a 23.5 kg advantage in gain over controls in a 56-day period.

Gropp et al. (1974) studied the effects of implantation on veal bull calves. On the average, when implanted with estradiol and TBA, the calves showed an improvement of 14% in gain and 9% in feed efficiency in comparison to the control group. Similar growth benefits have been reported in male veal calves implanted with TBA and estrogenic compounds (Grandadam et al., 1975).
VanderWal et al. (1975b) also indicated similar results on performance of 563 Friesian bull calves. These calves were implanted with various anabolic agents at 11 weeks of age and maximum growth response was obtained with 20 mg estradiol in combination with 140 mg trenbolone (Revalor). Calves gained 10.5, 15.8, 12.6,

10.4, and 9.6 kg per calf by 4 to 5 weeks after various implant treatments, compared with 4.1 kg gain per calf by 2 to 3 weeks after administration of 20 mg estradiol alone.

There have been numerous studies comparing combination implant treatments in ruminant animals. Sulieman et al. (1986) studied the response of early weaned wether lambs (47 days of age) treated with various doses of TBA combined with estradiol 17β. On average, hormonal treatment resulted in significant increases in live weight gain and feed intake. Differences in dose level had little effect on growth and carcass characteristics. Sulieman et al. (1988) reported similar results in live weight gain of 5 month old wether lambs implanted with TBA and estradiol-17β. The daily gain of control and implanted wethers was 273 g and 410 g, respectively ($P<.001$). Singh et al. (1984) observed that implantation of trenbolone acetate and estradiol 17-β as a combined implant (Revalor) increased liveweight gain and nitrogen retention in growing wether lambs.

However, response differences exist in the literature for the various estrogenic compounds used in combination with trenbolone acetate. The effectiveness of these compounds may have been influenced by dosage levels and by variation in age, breed, time of castration and weight at the time of implantation of the research animals (Johnson, 1987). Nonetheless, research studies have indicated that TBA, in conjunction with estrogenic agents, does enhance growth and that reimplanting stimulates an additional growth response (Lobley et al., 1985).

Response of Heifers to Implantation. Traditionally, the beef industry has discriminated against feeder heifers when compared to steers in the market place. Price discrimination has probably been due to growth capabilities and feed conversion being less efficient in heifers. The implantation of anabolic compounds such as Synovex-H, Ralgro, and Compudose in heifers is widely practiced. Interest in androgen implant treatments of heifers and the recent availability of trenbolone acetate (Finaplix) has intensified research studies with this product (Schanbacher, 1984). In heifers, the ovaries are the primary glands which secrete endogenous steroids that influence performance traits in cattle. The gonadal steroid in blood that results in the fastest growth rates in young heifers is estrogen (Heitzman, 1976). Feed efficiency and weight gain is lower in spayed feedlot heifers than in intact heifers (Horstman et al., 1982). In practice, implants of estrogens and androgens, such as trenbolone acetate, are used in heifers and cull cows to improve performance. This usage of exogenous anabolic compounds and their interaction with various endogenous hormones are believed to influence tissue growth and may increase growth rate and efficiency of heifers to be comparable to steers (Crouse et al., 1987).

Little et al. (1979) studied the effect of implanting prepuberal dairy heifers with trenbolone acetate (T) or a combination of trenbolone acetate and estradiol-17β (TE). Twenty-seven British Friesian heifer calves were implanted with T or TE at 16 weeks and at 31 weeks of age. Body weight gains were not significantly different during the first implant treatment period, but gains were increased in the T ($P<.05$) and TE ($P<.01$) groups, compared with controls, following the second implant at 31 weeks of age. After 46 weeks, only the TE treatment group remained significantly higher ($P<.05$) in body weight gain. Daily gains were as follows: T, .80 kg; TE, .87 kg; Control, .72 kg. Following both implant treatments, there was increased nitrogen retention, as indicated by lower concentrations of urea in serum. Galbraith (1980) conducted a study involving eight uniform Hereford X Friesian heifers weighing approximately 365 kg. The heifers implanted with trenbolone acetate showed a significant improvement in growth rate ($P<.05$) and feed conversion ($P<.01$), with a 23% feed/gain response in treated animals. Mean live weight gains were .7 and .8 kg/day for control and treated heifers, respectively. Heitzman et al. (1974) conducted a similar study with twelve Friesian X Ayrshire paired heifers ranging from 16 to 23 months of age. The heifers receiving trenbolone acetate had an improved liveweight gain of 62.2 kg, and this was 25.6 kg (71% benefit) more than the control group during an eight week period. Henricks et al. (1982) reported on the effect of a 300 mg TBA implant in heifers for a long term (LT, 99-day) and short term (ST, 66-day) time period. Following implantation with TBA, heifers in the ST group gained faster ($P<.05$) than heifers in the control or LT groups. Feed efficiency was not different ($P>.10$) among the three groups, but there was a trend toward improved efficiency in the implant treatment groups. Henricks suggested the reduced gain response of the LT group was due to the length of the implant period. During the first 5 weeks of the trial, the LT group gained faster (P<.05) than the other two groups. The daily gains were 1.11, 1.14, and 1.25 kg for the Control, ST, and LT groups respectively. Extending the implant period may have nullified the effect on gain of the LT group.

Crouse et al. (1987) studied the response of ovariectomized (OVX) or intact control heifers that were implanted with TBA alone or TBA in combination with estradiol. Although not statistically significant, heifers implanted with TBA, and TBA plus estradiol, suggested improved gain and efficiency. The OVX treatment group tended to have poorer feed efficiency which is consistent with other research studies that have shown spayed heifers in feedlot conditions did not perform comparably to intact heifers (Horstman et al., 1982). Hamernik et al. (1985) reported that gain and feed efficiency of OVX heifers tended to be similar to intact heifers and less than hysterectomized heifers. They concluded that the elevated progesterone concentration from the maintained Corpora Lutea of hysterectomized heifers was related to improved performance. Garnsworthy et al. (1986) indicated that implanting cull dairy cows with TBA resulted in greater (P>.05) liveweight gain–1.35 kg/day compared to 1.12 kg/day for the control group in a 60-day trial. Animals fed for 100 days also resulted in greater daily gains in the TBA group compared to controls (1.31 vs. .92 kg, P<.01).

Exogenous anabolic agents have demonstrated improved animal performance in feedlot heifers. Researchers, due to its importance to the feedlot industry, will continue to assess the potential of currently available and newly developed hormonal implants for use in feedlot heifers as well as steers.

Effect of Implants on Masculinity Traits of Steers and Heifers

Evaluation of masculinity traits as influenced by implants in feedlot steers and heifers has been conducted to a limited extent and with varied results. Brethour (1986) conducted a study that involved implantation of 200 mg TBA in combination with Ralgro or Synovex-S. Implant treatments that included TBA produced obvious masculine traits in steers including curly faces, broad heads, thick necks, prominent crests, and some dark-cutting carcasses. Those traits were more pronounced when steers were implanted with TBA 200 days before slaughter as compared to those implanted within the last 60 days only. Masculine traits were especially evident when TBA + Synovex-S was reimplanted twice following the initial implants. Results of Fisher et al. (1986a) indicated that steers implanted with TBA did not show development or muscle distribution comparable to bulls. Also, the use of TBA in bulls showed no difference in muscle distribution compared to untreated bulls. There was no effect of anabolic agents on the characteristic muscle weight distribution of bulls. Galbraith and Watson (1978) indicated a slight raising of the tailhead, depression of the loin, and teat development and elongation in steers treated with Hexoestrol. Moreover, implantation with TBA tended to cause thickening of the neck and increased shoulder development, although there was no obvious changes in behavior among steers. Little et al. (1979) indicated that implanting prepuberal dairy heifers with TBA or a combination of TBA plus estradiol-17β markedly reduced udder size and suggested that TBA should not be administered to prepuberal heifers which will be retained for breeding and milk production.

Effects of Implants on Carcass and Meat Traits. The use of TBA in combination with estrogenic agents has tended to increase carcass weight in steers (Steen, 1985; Fisher et al., 1986a). Steen (1985) also indicated steers implanted with TBA plus estrogenic compounds had slightly less kidney knob fat than control steers, but observed no differences in ribeye area per unit carcass weight between control and implanted steers. Silcox (1986) conducted a study with bulls and reported that kidney, heart and pelvic fat was estimated to be .8 kg more for bulls implanted with TBA and zeranol than control bulls, although similar ribeye areas were found in control and implanted bulls. Brethour (1986) reported a trend toward lower marbling score and carcass grade, and a higher incidence of dark-cutting carcasses when implant combinations involved TBA in steers. Johnson and Dikeman (1987) found that young bulls and steers implanted with TBA plus zeranol had similar hot carcass weights, dressing percentages, carcass maturity scores, and marbling scores. Steers and bulls implanted with TBA in combination with zeranol tended to have more backfat, smaller ribeyes and higher yield grades than control bulls, but differences were not statistically significant. There were no differences among treatment groups for lean firmness, texture and color, and a trained sensory panel found no significant differences in flavor intensity, juiciness, overall tenderness, or myofibrillar tenderness. Crouse (1987) conducted studies with heifers and reported carcass muscle characteristics evaluated at the 12th rib interface, including color, firmness, texture, and maturity, were similar among treatments involving TBA. Heifers implanted with TBA did not produce dark colored meat and carcasses tended to possess less fat cover and a lower ($P<.01$) percentage of fat in soft tissue of the 9-10-11th rib section than controls. Implanting heifers with TBA was effective in reducing fat deposition and increased muscle mass.

Residue of Anabolic Agents in Meat Products

Chemical residues in red meat and poultry is a current concern for consumers. This concern is not new to the livestock industry. For more than a decade, the USDA Food Safety and Inspection Service (FSIS), supported by consumer demands, have conducted a strong residue testing program. This National Residue Program tests for residues of pesticides, drugs, and other chemical contaminants in meat and poultry products. Overall, testing has detected very low violative residues, representing about 1% of the total samples analyzed (USDA-FSIS, 1988). No violative residues of currently approved implants have ever been found in beef. Also, research studies have been conducted by commercial sponsors of anabolic implants, and their results have shown no significant residues of hormonal drugs in implanted animals (Cordle, 1988). Toxicologists at the Food and Drug Administration (FDA) have concluded that an increase in hormone level is toxicologically insignificant if the residue in meat from implants containing naturally occurring hormones do not exceed 1% of the daily production rate of these natural hormones in prepuberal children (Farber and Arcos, 1983). Also, the FDA have not required a regulatory testing method for residues prior to approval of these implants (Farber et al., 1983). The scientific community has generally agreed that proper use of approved exogenous anabolic compounds is of no risk to the consumer and will enhance animal performance (Acha, 1983). In contrast to these known acknowledgements, the European Economic Community (EEC) has imposed an import ban on meat products from anabolically treated animals. Studies conducted by the Lamming Committee, a scientific working group commissioned by the EEC's own Scientific Advisory Committee, found no scientific evidence of risks to consumers' health on this issue (Lamming, 1983). At that time, the committee's recommendations of safety for anabolic agents use included: 1) the site of application should be discardable, and 2) the withdrawal periods should be observed. In 1987, this committee established hormone no-effect levels and reported no evidence could be produced which would indicate that the use of any currently approved anabolic agent in the U.S. caused risk to human health

(Lamming, 1987). Nonetheless, the EEC has failed to recognize the findings of their own committee commissioned by the Scientific Advisory Committee.

Prevention of residues in red meat products should be considered in all phases of animal production and responsibility taken seriously by the livestock industry to provide safe and wholesome products to the consumer.

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CHAPTER III

EFFECTS OF FINAPLIX® IN COMBINATION WITH RALGRO® AND SYNOVEX® ON PERFORMANCE AND CARCASS CHARACTERISTICS OF STEERS AND HEIFERS[1]

ABSTRACT

Five field trials were conducted with 762 steers and heifers in cooperation with four commercial feedlots to evaluate the effects of Finaplix in combination with Ralgro or Synovex for growing and finishing programs. Implant dosage rates used in the experimental treatments included: 1) Finaplix-S[2], 140 mg trenbolone acetate; 2) Finaplix-H[2], 200 mg trenbolone acetate; 3) Ralgro[1], 36 mg zeranol; 4) Synovex-S[3], 200 mg progesterone and 20 mg estradiol benzoate; and 5) Synovex-H[3], 200 mg testosterone propionate and 20 mg estradiol benzoate. In Trial 1, 176 spring-born Hereford steers averaging 223 kg were used to study sequential implantation with Synovex-S (S) or Synovex-S + Finaplix-S (S+F) during wheat grazing and the early and late finishing phases of this 267-d trial. During the 108-d wheat pasture phase, the addition of Finaplix increased gains 8.2%. In the

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[1]Appreciation is expressed to International Minerals and Chemical Co., Terra Haute, IN, for financial support of this study.

[2]Hoechst-Roussel Agri-Vet Co., Somerville, NJ.

[3]Syntex Animal Health Inc., Des Moines, IA.

subsequent early finishing phase, Finaplix treatment tended ($P = .11$) to increase performance. The implant treatments used in the late finishing phase resulted in no significant ($P > .05$) differences in daily gain and carcass characteristics. However, when prior implant treatments were ignored by using orthogonal contrasts, implanting with S+F increased ($P < .05$) average daily gain during both early and late finishing phases, compared with S alone. Overall 267-d gain and carcass weight were increased ($P < .05$), and marbling score was decreased ($P = .06$) when S+F was used in the late finishing phase. In Trials 2 and 3, 374 yearling crossbred steers were allotted to four finishing treatments: 1) Ralgro, 2) Ralgro plus Finaplix-S, 3) Synovex-S and 4) Synovex-S plus Finaplix-S. Implant treatments did not differentially affect gain, carcass weight, backfat thickness, percentage kidney, heart, and pelvic fat or ribeye area in either trial. Finaplix use did not affect carcass quality. However, in Trial 2, Synovex-implanted cattle had lower marbling scores and fewer carcasses graded Choice ($P < .05$) compared to Ralgro steers. In Trial 4, 126 yearling heifers averaging 329 kg were implanted with Synovex-H initially and allotted 49 d later to four finishing reimplant treatments: 1) no implant, 2) Synovex-H, 3) Finaplix-H or 4) Synovex-H plus Finaplix-H. Reimplanting heifers had no effect on gain or carcass characteristics, except for the percentage grading Choice, which was reduced ($P < .05$) in the F and S+F groups. Hide weights and hide pull scores tended to be increased slightly in the heifers implanted with Finaplix. In Trial 5, 86 crossbred steer calves averaging 227 kg were allotted to two

implant treatments: 1) Ralgro alone or 2) Ralgro plus Finaplix-S. In this 77-d drylot growing trial, a 5.4% gain response was obtained with Finaplix plus Ralgro as compared to Ralgro alone. In general, effects of Finaplix on cattle performance were inconsistent across trials. However, implanting cattle with Finaplix and either Ralgro or Synovex tended to result in increased gain, final weight, and carcass weight, with little effect on backfat thickness, ribeye area or percentage kidney, heart, and pelvic fat observed, when compared to cattle receiving only estrogenic implants. Marbling score and the percentage of cattle grading Choice tended to be reduced slightly, although this was not usually significant.

Key words: Steers, Heifers, Anabolic Implant, Performance, Carcass.

INTRODUCTION

Hormonal implants have been approved and used by the beef industry since the mid 1950's. The use of estrogenic growth promoting implants is now a common management practice for cattle producers and commercial feedlots. These products increase rate of gain and improve feed efficiency which results in a lower cost of production and increased profitability for the producer (Trenkle, 1987).

The recent clearance of Finaplix, a synthetic testosterone-like implant for feedlot growing-finishing steers and heifers has stimulated a great deal of interest in its growth-promoting effects when used in conjunction with estrogenic implants. There has been considerable speculation that Finaplix may reduce carcass quality by reducing marbling, and increase the incidence of dark cutters (Brethour, 1986). Additionally, some packers have suggested that cattle implanted with Finaplix may have heavier hides that pull harder, resulting in problems during slaughter. Therefore, these trials were conducted to compare cattle performance and carcass characteristics using Finaplix in combination with Ralgro or Synovex implants under commercial feeding conditions.

EXPERIMENTAL PROCEDURES

Five field trials were conducted with 762 steers and heifers in cooperation with four commercial feedlots. Implant dosage rates involved in the experimental treatments included: 1) Finaplix-S, 140 mg trenbolone acetate; 2) Finaplix-H, 200 mg trenbolone acetate; 3) Ralgro, 36 mg zeranol; 4) Synovex-S, 200 mg progesterone and 20 mg estradiol benzoate; and 5) Synovex-H, 200 mg testosterone propionate and 20 mg estradiol benzoate. All implants were inserted with a needle subcutaneously between the skin and cartilage in the middle of the posterior side of the ear. Of the implants used in these trials, only Ralgro required a withdrawal period of 65 d prior to slaughter. Finaplix-H was labelled for use in feedlot heifers only during approximately the last 63 d prior to slaughter. Finaplix-S was labelled for use in feedlot steers with a suggested reimplantation once after about 63 d.

The experiments conducted included one drylot growing trial, three finishing studies, and one trial that consisted of a wheat pasture, and early and late finishing phases. The length of the feeding periods varied from 77 to 267 d among trials. However, all cattle within a given trial were fed the same number of days. All cattle received standard processing treatments at the start of the trials, which included ear tagging, weighing, vaccinating and treatment for internal and external parasites. Individual unshrunk weights were collected at initial and reimplant times, and final weights were calculated from hot carcass weights and average dressing percentage slaughter in the finishing trials. Overall feed consumption and efficiency was determined on a feedlot pen basis only. After slaughter at a commercial packing plant, carcasses were chilled for approximately 24 h before carcass characteristics were evaluated.

Individual Trials

Trial 1. In Trial 1, 176 Hereford spring-born steer calves from one commercial ranch were used. The first phase of this 267-d trial included a 108-d grazing phase on wheat pasture starting on November 14, 1987. The steer calves, averaging 223 kg initially, were allotted randomly to two implant treatments: 1) Synovex-S alone (S) or 2) Synovex-S plus Finaplix-S (S+F). For the second phase of the trial, the steers were transported to a feedlot to begin the 86-d drylot early finishing program. At the start of the early finishing phase, the steers were individually reweighed and reallotted to four reimplant treatments with either S or S+F. At the start of the 73-d late finishing phase, the steers were individually weighed, reallotted within previous implant treatments and reimplanted with either S or S+F such that all possible sequential implant alternatives were studied during the wheat pasture, and early and late finishing phases. During the early finishing phase the steers were fed the following ration: 33% steam flaked (SF) milo, 25% SF wheat, 20% SF corn, 8% alfalfa hay, 4.3% wheat mid pellets, 3.5% molasses, 3.2% premix and 3% fat. The late finishing ration contained 59% SF milo, 8% alfalfa hay, 3.5% molasses, 3.3% wheat mid pellets, 3.2% premix and 2.5% fat. After slaughter, carcasses were chilled for approximately 24 h prior to determination of carcass weight, backfat thickness, ribeye area, percentage KHP (kidney, heart and pelvic) fat, marbling score, and quality and yield grades.

Trial 2. On May 5, 1988, 273 yearling crossbred steers averaging 366 kg were started on a finishing trial at a commercial feedlot. The steers were visually sorted into three weight groups and fed in three separate pens. The steers in each pen were individually weighed and allotted randomly to four finishing implant treatments: 1) Ralgro, 2) Ralgro plus Finaplix-S, 3) Synovex-S and 4) Synovex-S plus Finaplix-S. The steers were fed an ad libitum ration consisting of the following ingredients: 83.25% rolled corn, 6% sorghum silage, 5% alfalfa, 3% molasses and 2.75% protein supplement. Of the 273 animals, one pen (64 steers) was slaughtered after a 99-d feeding period, and the other two pens (209 head) were slaughtered after 109 d on feed. After slaughter, the carcasses were evaluated for hot carcass weight, backfat thickness, percentage KHP fat, ribeye area, marbling score, quality and yield grades and incidence of dark cutters. Individual carcasses were graded for dark cutter characteristics based upon the color intensity of the ribeye surface, and divided into quarter grades as follows: 1/4, 1/2, 3/4, and full dark (Ray, 1977).

Trial 3. In Trial 3, 101 yearling steers averaging 378 kg were fed 97 d on a finishing program at a commercial feedyard. The trial began September 2, 1988, when the steers were individually weighed and randomly assigned to four finishing implant treatment groups: 1) Ralgro, 2) Ralgro plus Finaplix-S, 3) Synovex-S and 4) Synovex-S plus Finaplix-S. The finishing ration consisted of: 82.5% cracked corn, 8.5% alfalfa hay, 6% liquid protein supplement, and 3% of a molasses and blended fat mixture. After the cattle were slaughtered, carcass traits were evaluated including hot carcass weight, backfat thickness, ribeye area, percentage KHP fat, marbling score, quality and yield grades, and incidence of dark cutters.

Trial 4. In Trial 4, 126 yearling, predominantly British-bred heifers averaging 329 kg were utilized in a finishing study. At the beginning of the 127-d finishing period, on August 3, 1988, the heifers were group-weighed and implanted with Synovex-H. After 49 days on feed, heifers were individually weighed and randomly reimplanted as follows: 1) no implant, 2) Synovex-H, 3) Finaplix-H and 4) Synovex-H plus Finaplix-H. The heifers were were fed melengestrol acetate (MGA; .5 mg daily) throughout the trial. The composition of the finishing ration included 50% SF corn, 31% SF milo, 8% alfalfa hay, 5% molasses, 4% premix and 2% fat. At the end of the feeding period, the cattle were sorted at the feedlot into the four implant treatment groups and weighed prior to slaughter. Group hide weights and individual hide pull characteristics were recorded. Hide weights were evaluated as a percentage of live animal weight by treatment groups. Hide pull characteristics were based on the difficulty of mechanically pulling the hides, appraised visually by a trained observer, on a 1 to 5 scale with 5 being most difficult. In addition, carcasses were evaluated for hot carcass weight, back fat, percent KHP fat, ribeye area, marbling score, quality and yield grades and incidence of dark cutters.

Trial 5. In this trial, 86 crossbred steers averaging 227 kg were fed on a corn silage-based growing program at a commercial preconditioning yard. On November 23, 1987, the steers were initially weighed and allotted to two implant treatments: 1) Ralgro alone or 2) Ralgro plus Finaplix-S. At the end of the 77-d growing trial, the steers were individually reweighed.

Statistical Analysis. Data were evaluated by analysis of variance and means were separated using the least squares means procedure of the General Linear Models (GLM) procedure of the Statistical Analysis System package (SAS,1985). Wherever appropriate, initial weight and breed type were included as covariates in the model. In Trial 1, hypotheses about the means were tested using orthogonal contrasts. Results are reported as least squares means. The percentage of Choice carcasses in each trial was analyzed by the Chi Square distribution method.

RESULTS

Trial 1

Animal Performance and Carcass Characteristics. In Trial 1, Synovex-S plus Finaplix-S (S+F) increased ($P<.05$) steer gain over Synovex-S (S) alone during the 108-d wheat pasture phase (Table 2). Average daily gain (ADG) was .61 vs .66 kg for S and S+F, respectively, which resulted in an 8.2% response for calves implanted with Finaplix.

During the early finishing phase, there was no significant ($P>.05$) effect on gain among the implant treatment groups. However, steers implanted with S+F exhibited higher ($P=.11$) ADG than those implanted with S alone. Similar trends in ADG were observed in the finishing phase. When prior implant treatments were ignored by using orthogonal contrasts, S+F significantly increased ($P<.05$) steer ADG during both early finishing (1.43 vs 1.36 kg) and late finishing (1.50 vs 1.41 kg) phases compared to S alone (Table 3). Implanting with S+F increased ($P<.05$) steer final weight (525 vs 513 kg) and overall daily gain (1.13 vs 1.09 kg) as compared to S alone. An additional data analysis was conducted on steer performance during the early and late finishing periods, ignoring the prior wheat pasture phase. This analysis evaluated the sequence of implant alternatives and considered the implantation of S followed by reimplanting with S or S+F, or the implantation of S+F followed by S or S+F. Reimplantation with S after S+F had

TABLE 2. EVALUATION OF SYNOVEX OR SYNOVEX PLUS FINAPLIX COMBINATIONS ON STEER PERFORMANCE DURING WHEAT PASTURE, AND EARLY AND LATE FINISHING PHASES (TRIAL 1)

Wheat Pasture Treatments:	S[1]	S+F[1]
No. Steers	88	88
Initial Wt, kg	222	222
Ending Wt, kg	289	294
Daily Gain, kg	.61[a]	.66[b]

Early Finishing Treatments:	S	S+F	S	S+F
No. Steers	60	28	31	57
Ending Wt, kg	408	416	408	415
Daily Gain, kg	1.39	1.44	1.32	1.41

Late Finishing Treatments:	S	S+F	S+F	S	S	S+F
No. Steers	30	30	28	31	26	31
Daily Gain, kg	1.45	1.54	1.46	1.43	1.34	1.49
Final Wt, kg	513	522	525	514	513	527
Carcass Wt, kg	323	329	330	324	323	332
Backfat thickness, cm	1.35	1.50	1.42	1.37	1.42	1.27
KHP Fat, %	2.25	2.25	2.19	2.30	2.30	2.13
Ribeye Area, sq cm	84.5	84.5	85.8	85.2	84.5	89.7
REA/cwt, sq. cm/ 100 kg[2]	26.2	25.9	26.2	26.4	26.3	27.0
Yield Grade	2.81[a]	2.99[a]	2.84[a]	2.78[ab]	2.88[a]	2.50[b]
Marbling Score[3]	165	167	155	164	172	146
% Choice	13[a]	13[a]	11[a]	19[a]	31[b]	10[a]
Overall Daily Gain, kg	1.09	1.12	1.13	1.08	1.09	1.15

[1]Steers were implanted sequentially with either Synovex-S alone (S) or Synovex-S plus Finaplix-S (S+F).

[2]Ribeye area per 100 kg hot carcass weight.

[3]100-199 = slight, 200-299 = small, 300-399 = modest degrees of marbling.

[ab]Values in the same row with unlike superscripts differ ($P<.05$).

TABLE 3. EFFECTS OF SYNOVEX OR SYNOVEX PLUS FINAPLIX ON STEER FINISHING PERFORMANCE IGNORING PREVIOUS IMPLANT TREATMENTS (TRIAL 1)

Item	Synovex (S)	Synovex + Finaplix (S+F)
Early Finishing Phase Treatments:		
No. Steers	91	85
Daily Gain, kg	1.36[a]	1.43[b]
Late Finishing Treatments:		
No. Steers	87	89
Daily Gain, kg	1.41[a]	1.50[b]
Final Wt, kg	513[a]	525[b]
Carcass Wt, kg	323[a]	330[b]
Backfat Thickness, cm	1.38	1.40
Ribeye Area, sq. cm	84.7	86.7
REA/cwt, sq. cm/100 kg[1]	26.2	26.3
KHP Fat, %	2.28	2.19
Marbling Score[2]	167	156
% Choice	21[a]	11[b]
Overall Daily Gain, kg	1.09[a]	1.13[b]

[1]Ribeye area per 100 kg hot carcass weight.
[2]100-199 = slight, 200-299 = small, 300-399 = modest degrees of marbling.
[ab]Values with unlike superscripts differ ($P<.05$).

a negative ($P<.02$) effect on ADG compared to reimplantation with S+F. When overall finishing performance was evaluated by combining both early and late finishing periods, lower ($P<.02$) gains were associated with reimplantation with S alone following initial implantation with S+F. Reimplantation with S+F produced higher ($P<.03$) overall finishing gains.

Unfortunately, feed conversion could not be obtained for each implant treatment since the steers were fed together in one commercial feedlot pen. Overall feed conversion for all steers in the finishing period was 5.72 on a dry matter basis.

Implanting with S+F compared to S alone did not affect ($P>.05$) carcass weight, backfat thickness, ribeye area per 100 kg hot carcass weight (REA/cwt), or percentage of KHP fat. Ribeye area was increased ($P=.08$), yield grade decreased ($P=.06$) and marbling reduced ($P=.14$) due to S+F treatment. By using orthogonal contrasts, consideration was given only to two treatments, F+S or S as final implants. This analysis showed that carcass weight was significantly ($P<.05$) increased (330 vs 323 kg) with S+F compared to S alone. There was a reduction ($P=.06$) in marbling score by S+F use in the late finishing phase. Repeated implantation with the combination of S+F had little effect on carcass characteristics compared to S alone, although ribeye area increased ($P=.08$) and marbling score and percentage Choice reduced ($P=.14$). When analysis was conducted on implant treatments during the early and late finishing periods, ignoring prior wheat pasture treatments, marbling score was reduced (P<.05) with sequential implantation of S+F during the early and late finishing phases, compared to other treatments. Also in this analysis, ribeye area was increased (P<.07) with early and late implantation of S+F.

Trial 2

Animal Performance and Carcass Characteristics. In Trial 2, ADG of feedlot steers were 1.49, 1.50, 1.48 and 1.53 kg for Ralgro (R), Ralgro + Finaplix (R+F), Synovex-S (S) and Synovex-S + Finaplix-S (S+F), respectively (Table 4). Differences in gains among treatments were not significant (P>.05), although there tended to be an increase in ADG in the S+F group compared to the S alone.

Finaplix use in combination with estrogenic implants did not affect carcass traits including carcass weight, backfat thickness, ribeye area, REA/cwt, or percentage KHP fat. However, Synovex-S implanted cattle had lower marbling scores and fewer graded Choice (P<.05) compared to Ralgro implanted steers.

This trial also compared the percentage of dark cutters among treatment groups since this is an important factor in determining carcass quality and economic value. The incidence of dark cutters (DK) in each implant group were: R, one 1/4 DK and one 1/2 DK; R+F, one 1/4 DK and one 1/2 DK; S, three 1/4 DK, one 3/4 DK and one full dark cutter; and S+F, six 1/4 DK, one 1/2 DK, one 3/4 DK and two full dark cutters. There was a general trend for increased dark cutters in the

TABLE 4. EFFECT OF RALGRO AND SYNOVEX, WITH OR WITHOUT FINAPLIX, ON PERFORMANCE OF FEEDLOT STEERS (TRIAL 2)

Item	Ralgro	Ralgro + Finaplix	Synovex	Synovex + Finaplix
No. Steers	67	70	71	65
Inital Wt, kg	367	366	366	366
Final Wt, kg	522	522	520	524
Daily Gain, kg	1.49	1.50	1.48	1.53
Carcass Wt, kg	328	329	327	330
Backfat thickness, cm	1.37	1.35	1.35	1.27
Kidney Fat, %	1.87	1.85	1.85	1.84
Ribeye Area, sq cm	79.4	79.4	80.0	81.9
REA/cwt, sq. cm/100 kg[1]	24.3	24.3	24.4	24.9
Yield Grade	3.02	3.00	2.97	2.81
Marbling Score[2]	211[a]	202[ab]	192[bc]	181[c]
% Choice	48[a]	49[a]	31[b]	27[b]

[1]Ribeye area per 100 kg hot carcass weight.
[2]100-199 = slight, 200-299 = small, 300-399 = modest degrees of marbling.
[abc]Values in the same row with unlike superscripts differ ($P<.05$).

S and S+F implanted cattle. Cattle were slaughtered in August at a time of extreme heat stress.

Trial 3

Animal Performance and Carcass Characteristics. The experimental design of this trial was similar to Trial 2. Implant treatments resulted in no (P>.05) effect on steer ADG, although gain tended to be increased when Finaplix was used in conjunction with Ralgro or Synovex-S (Table 5). Average daily gains were: R, 1.73; R+F, 1.79; S, 1.68; and S+F, 1.76 kg. Overall pen feed conversion to live weight gain was 6.90 on a dry matter basis.

There was no (P>.05) effect of implant treatments on carcass characteristics in this trial. Although not significant, there tended to be a slight increase in carcass weight with the combination implant treatments. The incidence of dark cutters in each implant group was minimal with only one carcass scoring a 1/2 DK in the R+F group. Results were very similar among treatment groups in backfat thickness, percentage KHP fat, ribeye area, REA/cwt, yield grade, marbling score and percentage of Choice carcasses.

Trial 4

Animal Performance and Carcass Characteristics. Trial 4 was the only study that involved heifers, and the results are presented in Table 6. Reimplanting heifers

TABLE 5. EFFECT OF RALGRO AND SYNOVEX ALONE AND IN COMBINATION WITH FINAPLIX, ON FINISHING STEER PERFORMANCE (TRIAL 3)

Item	Ralgro	Ralgro + Finaplix	Synovex	Synovex + Finaplix
No. Steers	24	25	26	26
Initial Wt, kg	378	377	378	378
Final Wt, kg	546	551	541	548
Daily Gain, kg	1.73	1.79	1.68	1.76
Carcass Wt, kg	349	353	346	351
Backfat Thickness, cm	1.19	1.19	1.19	1.24
KHP Fat, %	1.94	2.25	2.09	1.91
Ribeye Area, sq. cm	84.5	86.5	87.1	85.2
REA/cwt, sq. cm/100 kg[1]	24.2	24.7	25.3	24.4
Yield Grade	2.81	2.80	2.67	2.81
Marbling Score[1]	194	167	185	190
% Choice	50	44	46	54

[1]Ribeye area per 100 kg hot carcass weight.
[2]100-199 = slight, 200-299 = small, 300-399 = modest degrees of marbling.

TABLE 5. EFFECT OF REIMPLANTING WITH FINAPLIX AND SYNOVEX, USED SINGLY OR IN COMBINATION, ON HEIFER PERFORMANCE (TRIAL 4)

	Initial Implant / Reimplant			
Item	Synovex None	Synovex Synovex	Synovex Finaplix	Synovex Synovex + Finaplix
No. Heifers	33	31	31	31
Initial Wt, kg	329	329	329	329
Reimplant Wt, kg	389	389	389	389
Final Wt, kg	501	497	496	499
Daily Gain, kg	1.43	1.38	1.38	1.42
Carcass Wt, kg	306	304	302	306
Backfat, cm	1.17	1.14	1.19	1.30
Kidney Fat, %	2.41	2.51	2.05	2.37
Ribeye Area, sq. cm	86.5	83.2	85.8	84.5
REA/cwt, wq. cm/100 kg[1]	28.3	27.4	28.3	27.9
Yield Grade	2.40	2.54	2.38	2.63
Marbling Score[2]	323	280	256	278
% Choice	97[a]	94[ab]	87[bc]	77[c]
Hide Pull Score[3]	2.0	2.0	2.3	2.2
Hide Wt, % of Live Wt	5.9	6.2	6.5	6.2

[1]Ribeye area per 100 kg hot carcass weight.
[2]100-199 = slight, 200-299 = small, 300-399 = modest degrees of marbling.
[3]Difficulty of mechanically pulling hides at slaughter appraised visually on a 1 to 5 scale, 5 = most difficult.
[abc]Values with unlike superscripts differ (P<.05).

78 d before slaughter with either Synovex-H (S), Finaplix-H (F), or a combination of Synovex-H and Finaplix-H (S+F) had no (P>.05) effect on ADG. Heifer ADG were: control, 1.43; S, 1.38; F, 1.38; and S+F, 1.42 kg. Overall feed conversion to live weight gain averaged 6.37 on a dry matter basis.

Implant treatments resulted in no (P>.05) effect on hot carcass weight, backfat thickness, ribeye area, REA/cwt or yield grade. However, the F reimplant group had a reduced (P=.08) percentage of KHP fat and lower (P=.16) marbling score. This trial indicated reduction (P<.05) in the percentage of animals grading Choice in the F and S+F groups compared to controls. There was no incidence of dark cutters among implant treatment groups.

In this heifer study, hide pull scores and group hide weights were evaluated among implant treatments. Although not (P>.05) significant, hide weights and hide pull scores tended to be increased slightly by treatments including Finaplix.

Trial 5

Animal performance. In the 77-d growing study, ADG were 1.10 vs 1.16 kg for Ralgro and Ralgro plus Finaplix treatment groups, respectively (Table 7). This resulted in a 5.4% gain response with the Finaplix combination treatment. Carcass characteristics were not obtained in this growing feeding trial.

TABLE 7. INFLUENCE OF RALGRO AND FINAPLIX ON GROWING STEER GAINS (TRIAL 5)

Item	Ralgro Alone	Ralgro + Finaplix
Initial Wt., kg	227	227
Final Wt., kg	312	316
Total Gain, kg	84.9	89.4
Daily Gain, kg	1.10	1.16

DISCUSSION

Animal Performance. Implantation with Synovex-S plus Finaplix-S (S+F) increased ($P<.05$) steer gain over Synovex-S (S) alone during a 108-d wheat pasture grazing program. Brethour (1985) also reported positive findings in a pasture study involving the combination of Ralgro plus trenbolone acetate (TBA). His results included an increase ($P<.01$) in gain of 33.6% over non-implanted steers and a 17.6% advantage in gain over solitary Ralgro implantation. Roche and Davis (1978) also found that implantation with 300 mg TBA alone increased ($P<.01$) ADG, resulting in pasture gains of .88 vs. 1.05 kg for control and Finaplix groups, respectively. Our results are in contrast to those of Brandt (1988) who conducted an 85-d wheat pasture grazing study and found no difference in daily gains of steers implanted with S or the combination of S+F. However, steers implanted with S, F, or S+F were 7.7% higher ($P<.05$) than nonimplanted steers.

In the drylot growing study, steers implanted with (R+F) gained 5.4% faster than (R) steers. This finding is similar to that of Brethour and Schanbacher (1983), who indicated that implantation of R+F in prepubertal bulls resulted in an 11% increase in gain. Grandadam (1975) reported similar results with Friesian veal calves in which ADG was increased 17.4% over controls with implantation of TBA plus estradiol-17-β.

Results of these studies and previously cited trials illustrate that the use of Finaplix in combination with estrogenic compounds in growing programs offers inconsistent improvement in performance. The explanation for variable response is not readily available. However, variation in growing steer performance is influenced by factors such as growth potential, level of nutrition, and the level of hormonal activity in the forage. Research evaluation of the interaction of these factors with implants is limited and has not shown any clear relationships (Simms et al., 1988).

In the finishing phase of Trial 1, when prior implant treatments were ignored by using orthogonal contrasts, S+F significantly increased ($P<.05$) steer ADG compared to S alone. This is in agreement with numerous researchers who have demonstrated TBA in combination with an estrogenic implant improves daily gain and feed efficiency in steers (Galbraith and Geraghty, 1982; Heitzman, 1983; Lobley et al., 1985; Steen, 1985). Our findings are similar to those of Brandt (1988), who conducted a 119-d finishing trial comparing the effects of implants on performance and found that steers implanted with S+F gained faster ($P<.05$) than those given S alone.

In Trials 2 and 3, implanting with Finaplix in combination with either Ralgro or Synovex did not significantly improve ADG of finishing steers. Johnson and Dikeman (1987) indicated similar findings with 200 mg TBA in combination with Ralgro. Their results showed no differences in ADG among treatments with bulls and steers. These results are in contrast to other previous studies that found significant improvement in live animal performance with TBA in combination with estrogenic compounds (Galbraith, 1982; Galbraith, 1983; Brethour, 1986; Bohorov, 1987; Istasse, 1988). Results from Trials 2 and 3 indicate that Finaplix in combination with Ralgro or Synovex offers an inconsistent improvement in finishing performance. One possible explanation for this finding is that Finaplix was administered only once at the beginning of these finishing trials. Moreover, the dosage rate used (140 mg TBA) was lower than that employed in most previous studies. Several studies, especially in the European countries have administered TBA at the dosage rate of 200 to 300 mg to steers in finishing programs.

Reimplanting with Finaplix or Synovex plus Finaplix did not improve ($P>.05$) ADG of finishing heifers. These results are in contrast to several research studies which have indicated a increased ($P>.05$) growth rate with implantation of TBA in combination with estrogenic compounds (Heitzman and Chan, 1974; Little et al., 1979; Galbraith, 1980; Henricks et al., 1982). Crouse (1987) reported that, although not ($P>.05$) statistically significant, heifers implanted with estradiol plus TBA had greater live weight gain than other treatment groups.

In Trial 1, implantation with S+F in the wheat pasture growing phase did not reduce finishing performance. This trial indicated a positive growth effect from Finaplix implantation in the early and late finishing phases. Brethour (1985) reported that implanting steers with TBA plus estrogenic agents in the growing phase improved performance and did not adversely affect subsequent feedlot gain or carcass quality. Simms et al. (1988) reported similar findings on the effect of sequential implanting with zeranol on lifetime performance. Animals receiving four successive Ralgro implants were 25 kg heavier (P<.05) than control steers at the time of slaughter.

In Trial 1, it was observed that the sequential implantation with S+F followed by S alone resulted in reduced daily gain. This suggests that once Finaplix use has been initiated, it should be repeatedly administered at regular intervals until slaughter.

Carcass Characteristics. Carcass data were collected on four of the five trials in this study. In three of the four trials, implanting with Finaplix did not increase (P>.05) carcass weight. However, in Trial 1, when prior implant treatments were ignored by using orthogonal contrasts, implanting with Finaplix significantly increased carcass weight. Roche and Davis (1978) also found increased carcass weight in steers with TBA use. Steen (1985) also reported an increase in carcass weight with TBA in combination with Ralgro or estradiol.

In the four trials, implantation with Finaplix or Finaplix in combination with either Ralgro or Synovex had no (P>.05) effect on backfat thickness, ribeye area or percentage of KHP fat. However, in Trial 1, ribeye area was increased (P=.08) in the Finaplix treatment groups. In the heifer study, the percentage of KHP fat was decreased (P=.08) in the Finaplix treatment group. Steen (1985) indicated that KHP fat and ribeye area were not significantly affected by Finaplix use in steers.

Crouse (1987) reported that heifers implanted with TBA possessed less fat cover and also had a lower ($P<.01$) percentage of fat in the soft tissue of the 9-10-11th rib section than controls.

In regard to marbling, Finaplix implanted cattle in two of the four trials tended to have reduced marbling scores ($P=.06$ to .16). An interesting result in Trial 2 was the reduction ($P<.05$) in marbling score and percentage of Choice grading steers when implanted with S or S+F as compared to Ralgro or Ralgro plus Finaplix. This finding is in agreement with those of Brethour (1986). The percentage of cattle grading Choice was reduced ($P<.05$) with implantation of Finaplix in the heifer trial. In Trial 1, the percentage of Choice cattle tended to be reduced ($P=.14$) with repeated S+F use. Brethour and Schanbacher (1983) and Fisher et al.(1986b) also reported that TBA in combination with estradiol tended to reduce marbling score and carcass grade. Brethour (1986) indicated a trend toward lower marbling score and quality grade in steers when Finaplix was used in combination with Ralgro or Synovex.

The incidence of dark cutting carcasses were evaluated in three of the four finishing trials. There was little effect of Finaplix on dark cutters. However, it was interesting that in the summer finishing trial, there was a higher incidence of dark cutting carcasses with steers implanted with Synovex or Synovex plus Finaplix compared to Ralgro or Ralgro plus Finaplix implant groups. Brethour (1986) indicated a similar finding with steers implanted with TBA in combination with

Synovex in one trial. In his subsequent trials, cattle were slaughtered immediately upon arrival at the packing plant which seemed to reduce stress and no additional dark cutters were observed. In order to evaluate these findings, further research should be considered to determine the effects of Synovex and Synovex plus Finaplix during summer feeding periods.

In the heifer trial, hide pull score and hide weight as a percentage of live weight were evaluated. Although not significant ($P>.05$), there was a tendency for increased difficulty in hide pull and increased hide weight in heifers implanted with Finaplix. Fisher et al. (1986) reported that steers implanted with TBA and estradiol-17β had slightly heavier hides and reproductive organ weights. Our findings are similar to those of Apple (1989) who found that implantation of Synovex or Ralgro in combination with Finaplix increased hide pull scores.

Conclusions. The results of our study indicate that the effects of Finaplix on cattle performance and carcass characteristics were inconsistent across trials. However, in general, implanting cattle with Finaplix, in combination with either Ralgro or Synovex tended to result in increased gain, final weight and carcass weight, with little effect on backfat thickness, ribeye area, or KHP fat. Hide weight and hide pull scores tended to be increased with Finaplix use, while marbling score and the percentage of cattle grading Choice tended to be reduced slightly, although this was usually not significant.

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EFFECTS OF FINAPLIX® IN COMBINATION WITH RALGRO® AND SYNOVEX® ON PERFORMANCE AND CARCASS CHARACTERISTICS OF STEERS AND HEIFERS

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ABSTRACT

Five field trials were conducted with 762 steers and heifers in cooperation with four commercial feedlots to evaluate the effects of Finaplix in combination with Ralgro or Synovex for growing and finishing programs. Implant dosage rates used in the experimental treatments included: 1) Finaplix-S, 140 mg trenbolone acetate; 2) Finaplix-H, 200 mg trenbolone acetate; 3) Ralgro, 36 mg zeranol; 4) Synovex-S, 200 mg progesterone and 20 mg estradiol benzoate; and 5) Synovex-H, 200 mg testosterone propionate and 20 mg estradiol benzoate. In Trial 1, 176 spring-born Hereford steers averaging 223 kg were used to study sequential implantation with Synovex-S (S) or Synovex-S + Finaplix-S (S+F) during the wheat grazing, and the early and late finishing phases of this 267-day trial. During the 108-day wheat pasture phase, the addition of Finaplix increased gains 8.2%. In the subsequent early finishing phase, Finaplix treatment tended ($P = .11$) to increase performance. The implant treatments used in the late finishing phase resulted in no significant ($P > .05$) differences in daily gain and carcass characteristics. However, when prior implant treatments were ignored by using orthogonal contrasts, implanting with S+F increased ($P < .05$) average daily gain during both early and late finishing phases, compared with S alone. Overall 267-day gain and carcass weight were increased ($P < .05$), and marbling score was decreased ($P = .06$) when S+F was used in the late finishing phase. In Trials 2 and 3, 374 yearling crossbred steers were allotted to four finishing treatments: 1) Ralgro, 2) Ralgro plus Finaplix-S, 3) Synovex-S and

4) Synovex-S plus Finaplix-S. Implant treatments did not differentially affect gain, carcass weight, backfat thickness, percentage kidney, heart, and pelvic fat or ribeye area in either trial. Finaplix use did not affect carcass quality. However, in Trial 2, Synovex-implanted cattle had lower marbling scores and fewer carcasses graded Choice ($P < .05$) compared to Ralgro steers. In Trial 4, 126 yearling heifers averaging 329 kg were implanted with Synovex-H initially and allotted 49 days later to four finishing reimplant treatments: 1) no implant, 2) Synovex-H, 3) Finaplix-H or 4) Synovex-H plus Finaplix-H. Reimplanting heifers had no effect on gain or carcass characteristics, except for the percentage grading Choice, which was reduced ($P < .05$) in the F and S+F groups. Hide weights and hide pull scores tended to be increased slightly in the heifers implanted with Finaplix. In Trial 5, 86 crossbred steer calves averaging 227 kg were allotted to two implant treatments: 1) Ralgro alone or 2) Ralgro plus Finaplix-S. In this 77-day drylot growing trial, a 5.4% gain response was obtained with Finaplix plus Ralgro as compared to Ralgro alone. In general, effects of Finaplix on cattle performance were inconsistent across trials. However, implanting cattle with Finaplix and either Ralgro or Synovex tended to result in increased gain, final weight, and carcass weight, with little effect on backfat thickness, ribeye area or percentage kidney, heart, and pelvic fat observed, when compared to cattle receiving only estrogenic implants. Marbling score and the percentage of cattle grading Choice tended to be reduced slightly, although this was not usually significant.

Key words: Steers, Heifers, Anabolic Implant, Performance, Carcass.