EFFECT OF STILBESTROL IMPLANTATION ON THE ECONOMICS OF FATTENING AND CARCASS CHARACTERISTICS OF CATTLE

by

Zaven Kurdian

A Thesis Submitted to the Graduate
Faculty of the School of Agriculture in Partial Fulfillment of
The Requirements for the Degree of
MASTER OF SCIENCE IN AGRICULTURE

Split Major : Animal Science

Approved:

George B. McLeroy
In Charge of Major Work

Ramsay Kleissi

J. Asmar

Salim Mackoud
Chairman, Graduate Committee

American University of Beirut

1959

Effect of Stilbestrol on Cattle

Kurdian

Acknowledgements

The author wishes to express his deep appreciation to Dr. G.B.McLeroy for his guidance and constructive criticism while the present work was being carried on. Thanks are due to Prof. R. Khouri for suggesting the subject. Also, to Dr. J. Asmar and Mr. P. Ananian gratitude is due for their assistance.

Abstract

A controlled feeding experiment was conducted on ten local steers to determine the effect of stilbestrol implantation on rate of gain and carcass characteristics. The results showed 26% increase in daily rate of gain due to stilbestrol implantation (1.98 and 2.49 lbs. daily gain for control and treated steers respectively). When weights of various body parts and organs were calculated as percent of live weight, no significant difference was observed between treatment groups. Also, dressing percent, chemical composition of lean meat, area of ribeye muscle, or Iodine number of mesenteric fat were not affected by stilbestrol. Moreover, meat from both groups proved to be extremely tender and of good quality. Thus, when processed and sold as a quality product, the operation of fattening and processing was profitable. However, the margin of profit to be realized from fattening and selling steers at regular market prices would not justify such a practice.

Table of Contents

List of Tables

List of Figures

Introduction

Meat is a major source of protein in human nutrition. Depending on the prevalent environmental, economic, religious and cultural patterns it is supplied by various classes of livestock in the different areas of the world. Poultry is the favored meat in the Middle East, while mutton, rather than beef or pork, is the preferred red meat.

Sheep are the predominant class of animals under Middle Eastern conditions of livestock production. Their popularity is due to their adaptability to the nomadic husbandry practices that are essential in semi-arid regions. In these areas the seasonal availability of pasture is limited and is usually of poor quality. This, together with the fact that sheep produce meat, milk and wool simultaneously, makes them important and practically an indespensable source of food, shelter and clothing for the beduins.

Lebanon is dependent on the importation of a large proportion of its meat requirements from neighbouring countries which are not ideally suited for beef production. Moreover, the relatively fewer number of cattle that are slaughtered are of low quality because they are not fattened and processed properly. Consequently, over the years, a consumer preference and demand has developed for mutton rather than for beef. Pork is of minor importance in Middle Eastern countries. This is on account of the religeous bans of both the Moslem and Jewish faiths. It is however available in limited quantities in stores that cater to foreigners.

The dynamic status of most Middle Eastern countries will, in the near future, alter the existing picture. Greatly reduced infant mortality has resulted in an expanded human population. Improved standards of

living have created a higher demand for protein, a major source of which is meat. On the other hand, meat supply has not increased collaterally. Agriculture, particularly livestock production, has not kept pace with other phases of national progress. Most domestic animals are kept as scavengers and are allowed supplemental feed only during periods of dire emergency. In low rainfall years the available grazing is even more limited which allows disease to contribute to excessive death losses. Land reforms in certain countries are being instrumental in converting the nomadic shepherds, the principal suppliers of mutton, into settled agriculturalists. This has tended to reduce still further the number of animals raised. The foregoing forces, plus the political atmosphere, have already resulted in a major decrease of sheep entering Lebanon for slaughter purposes from Syria, Iraq and Turkey. Thus, Lebanon, because of its small size and/or restricted agricultural holdings, must consume less per-capita meat or establish new sources of supply from either within or without her frontiers.

The investigation herein reported concerns the possibility of partly solving this problem by salvaging young calves - a by-product of the local cattle industry - fattening them under intensified farm conditions, and selling them on the local and luxury markets.

Review of Literature

The stimulation of weight gains resulting from the administration of hormones to fattening steers is no longer an experimental subject to scientists. Over a decade ago synthetic hormones started to interest researchers in many parts of the world, especially the United States. In the early stages of research, as always, controversial results were obtained by different workers. But now there are a number of important points that can be made without reservation concerning the effects of treating fattening steers with the synthetic, estrogenic hormone, "Diethylstilbestrol".

I. Rate of Gain and Feed Conversion .- Perry et al. (22) found that the daily oral administration of 10 mg. of stilbestrol to 2-year-old steers on a fattening ration significantly increased rate of gain by 50 lbs. per head over a period of 123 days, and that the estrogen treated steers required from 9-12% less feed per unit of gain. The level of administration has been shown to have an influence on the stimulation of gains. Burroughs et al. (4) conducted five experiments using different rations and different levels of the hormone. Feeding 11 mg. per head per day resulted in 3.06 lbs. daily gain as compared with 2.64 lbs. for the 5.5 mg., 2.46 lbs. for the 2.75mg., and 2.23 lbs. for the control lots. In all five experiments, where high-grain fattening rations, high roughage growing rations or rations intermediate in grain and roughage were used, liveweight gains were stimulated by an average of 20%, feed conversion improved by an average of 11%, and daily feed consumption was increased by an average of 5%. Feeding the hormone was equally as effective

in increasing gains during the early part of the feeding period as in the last part. Beeson et al. (2), Andrews et al. (1), and Dyer et al. (11) reported similar results, namely, increased rate of gain of 10-12%, better feed conversion of up to 18% and more feed consumption of approximately 5%.

However, the feeding of stilbestrol is considered by some researchers as troublesome, since the homogeneous mixing of the hormone in the feed is not easy, and not practicable in many parts of the world. Hence, many workers have tried to use pelleted stilbestrol which is implanted subcutaneously, and is allowed to dissolve slowly in the body fluids. To avoid public health hazards, the skin at the base of the ear is considered to be a suitable site, since the head is in most cases inedible material. O'Mary and Cullison (19) reported increased rate of gain when steers on pasture were implanted with 36 mg. of the hormone. The daily gains were 3.02 and 2.33 lbs. for the treated and control groups respectively. The amount of hormone implanted, also, plays an important role in the results to be expected. Kockakian (16) concluded that low levels of implanted estrogens increased body weights of mice, while high levels tended to depress growth. Clegg et al. (7) found that 60 mg. of stilbestrol increased body weights of steers and heifers, and that some heifers developed vaginal prolapse. O'Mary et al. (20) reported that 36 mg. of stilbestrol implanted in the ear resulted in highly significant gains compared to control animals, over a period of 105 days, and that an additional 36 mg. implanted at 42 days failed to give any respone as to better gains. In another experiment, these same workers used 36, 12 and 0 mg. as their treatments, and reported that 36 mg. produced significantly improved gains over the two other treatments, and that 12 mg. did not differ from the control. However, at 8 weeks, an additional 24 mg. administered to the 12 mg. group produced improved gains over the controls.

Encouraging results were obtained when both oral administration and implant were compared in the same experiment. Clegg and Carroll (9) found that the feeding of 10 mg. of stilbestrol daily in the ration and the implantation of 15 mg. subcutaneously produced similar results, and that both treatments were an improvement over the controls. For both treatments, maximum improvement of gain was obtained during the 60-80 day period following treatment, which is in line with results reported by Clegg and Carroll (8). Both groups were equal in gains for the first 150 days after treatment, thereafter the implanted group lagged behind. This may be explained by the depletion of hormone supply in the implanted group after 150 days. They also report that, in summarizing field data, implantation of 30-60 mg. result in still better improvement over 15 mg. In another comparison of the two methods of hormone administration, Perry et al. (24) reported that feeding 10 mg. daily or 36 mg. implants produced similar results with 14.7-16.0% improved gains, 9-10% increase in feed consumption, and 7.4-8.5% less feed required per unit gain over controls.

II.- Carcass Characteristics .- Stilbestrol has been demonstrated to effect certain changes in carcasses with respect to physical and chemical characteristics.

a. Physical Characteristics : Clegg and Carroll (19) reported an increased cross sectional area of the rib eye muscle, and enlarged kidneys in treated steers. They also reported a stimulated epithelium and increased fibrous tissue of the seminal vesicles. Kastelic et al. (13) also observed an increase of the cross sectional area of the rib eye muscle. Deans et al. (10) did not find any significant differences in dressing percentage, cooler shrink, heart, liver, spleen or hide, cooking shrink, or Warner-Bratzler shear readings. In both treated and control groups adrenal glands were

normal. However, they noticed that hormone treatment by either feeding or implantation caused an increase in diameter of the prostatic portion of the urogenital tract and an increase in size of the bulbourethral glands and seminal vesicles. They also had evidence of secretory activity in the prostate and bulbourethral glands of treated steers. Simone et al. (27) reported the results of a sensory panel, whereby treatment by either method of hormone administration reduced tenderness, but had no effect on juiciness or flavor. Cahill et al. (6) found that treated steers had slightly heavier pituitary glands and significantly heavier adrenal glands. However, they could not detect any difference in thyroid weights as a result of treatment. A greater lumbo-sacral angle was reported in treated steers. They also found an increase of total edible meat from 69.9 to 72% in treated animals, and a larger cross-sectional area of the longissimus dorsi. They also indicated a slight reduction in tenderness as a result of an organoleptic test. Turner (29) reported twice as long teats in steers treated with the hormone as in controls.

b. Chemical Characteristics : While Stob et al. (28) reported slight estrogenic activity in the tissues of cattle implanted with stilbestrol, Perry et al. (23) could not detect estrogenic activity in the tissues of cattle fed the synthetic hormone. Preston et al. (25) reported that lean, fat, liver, heart, kidney, intestines, lungs and spleen did not have estrogenic activity. Their method of assay was sensitive enough to detect 2 µg. of stilbestrol per kg. of tissue. Turner (29), using the method of uterine stimulation of mice, failed to detect any residual hormone in the edible red meat, rib eye, neck trimmings, tongue, liver, heart, spleen, brain, blood, or intestinal tissues. The kidneys showed residues of 4 ppb. Similarly, O'Mary et al. (21) concluded that estrogenic activity produced by livers of steers either implanted or fed stilbestrol was not significantly

different from controls as detected by uterine stimulation of 21-day-old mice. Clegg and Carroll (19) reported decreased fat deposition and increased protein anabolism in treated steers. Also, levels of plasma glucose and non-protein nitrogen, serum protein bound nitrogen, potassium and sodium were not affected by treatment. Kastellic et al. (13) found somewhat similar results, whereby the fat, lean and bone content of the 9-10-11 rib cut were not affected by treatment. Deans et al. (10) reported a greater proportion of separable lean, and significantly lower proportion of separable fat from carcasses of implanted groups as compared to either stilbestrol fed steers or controls, as estimated from the 9-10-11 rib cut. They also reported that moisture of external fat, internal fat, longissimus dorsi and combined separable fat and lean was not significantly different between groups. Bohman and Wade (3) concluded that stilbestrol increased the level of plasma vitamin A but that treatment had no effect on the carcasses of steers. However, Erwin et al. (12) failed to detect any increase of liver vitamin A or carotene in treated animals.

c. Carcass Evaluation : The evaluation of carcasses has been an important subject for researchers. Since it is wasteful and expensive to separate all tissues of a carcass and thus evaluate it, different measurements, such as heart girth, shoulder height, body length and area of rib eye muscle have been correlated to the value of a carcass. Of these, the last has been found to be quite a dependable method for carcass evaluation. Knapp et al. (14, 15) and Shelby et al. (26) reported that heritability estimates of this measurement ranged from 68 to 72%. Woodward et al. (30) found significant correlations of rib eye measurements with borth weight, weaning weight, gain on test, slaughter grade, carcass grade, length of leg and length of body. Cahill et al. (6) obtained a correlation of 0.85

between rib eye and percent edible portion of carcasses. Butler et al. (5) concluded that data taken from the left side of a carcass are satisfactory. Thus, samples of rib sections taken from the left side are considered to be representative of the carcass.

Experimental Procedure

Pre-Experimental Period .

Ten steers of different genetic and environmental backgrounds were used in this experiment. Some were purchased from farmers at approximately 10-15 days of age, while others were born in the A.U.B. Farm herd. Three were of french breeding (Normandy - Fig. 1), two were Shamiyas, (improved local dairy breed - Fig. 2), another two were Beirutis, (common to Beirut - Fig. 3), and the remaining three were crosses between Holstein and local cattle (Fig. 4, 5). All were reared on the University Farm, (located in the Beka'a Valley, at Housh Sneid), according to the common practice which is bucket-feeding 12, 10, 8 lbs. daily for 60, 30, and 30 days respectively, of whole fresh milk containing Aureomycin soluble powder, and access to alfalfa hay and a concentrate mixture. All were castrated at about three weeks of age, and weaned at approximately four months of age. Table 1 summarizes the genetic backgrounds, age, weight, and origin of the ten steers used in this experiment.

Experimental Period.

On August 20, 1958, the ten steers were divided into two groups, with consideration given to breeding and age. Their average age was 267 days, ranging from 178 to 329, and their average weight was 564 lbs., ranging from 330 to 886. Five were individually implanted at the base of the left ear with 30 mg. of stilbestrol. Both groups were kept together in an open shed with adjoining yard, and had free access to feed and water, during the entire experimental period of 103 days. The concentrate to roughage ratio was roughly 2:1. Table 2 shows the composition of the concentrate ration and table 3 the chemical analysis.

A variety of roughages were used during the experimental period.

Table 1. Genetic background, age, weight and origin of the ten steers used in the experiment.

Steer No.	Beginning Age-days.	Beginning Weight-lbs.	Origin	Breeding
1	328	886	Sa'b Farm	Normandy
2	329	593	A.U.B. Farm	Shamiya
3	290	696	A.U.B. Farm	Holstein x Shamiya
4	264	600	Beirut	Beiruti
5	266	330	A.U.B. Farm	Shamiya
6	264	541	Beirut	Beiruti
7	256	539	Beirut	Holstein x Beiruti
8	264	500	Beirut	Holstein x Beiruti
9	239	526	Sa'b Farm	Normandy
10	178	424	Sa'b Farm	Normandy

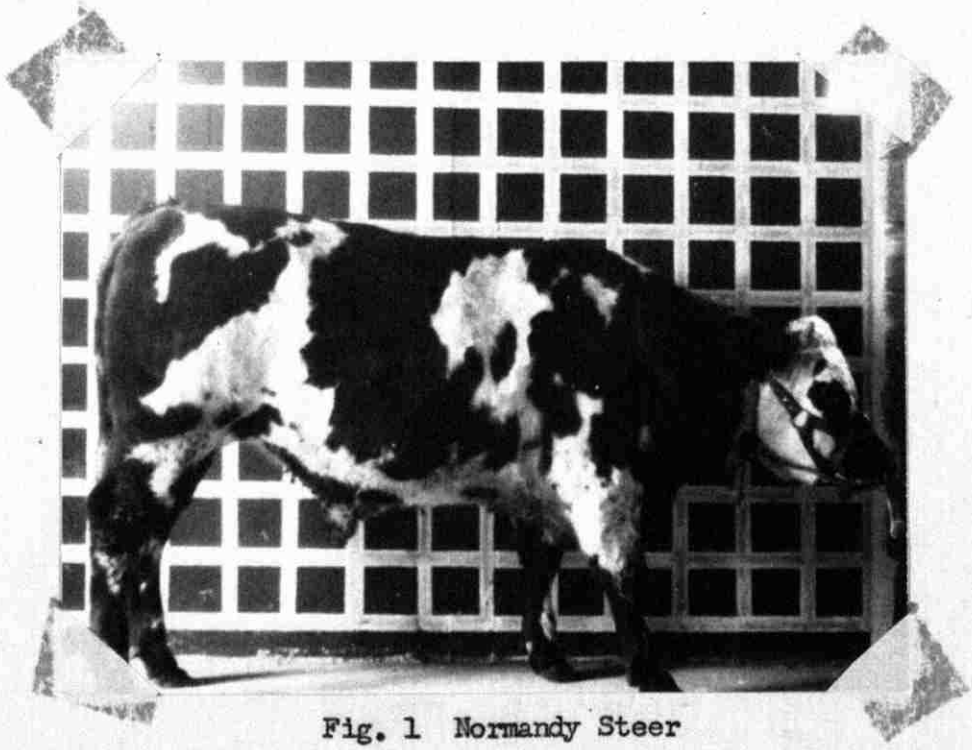


Fig. 1 Normandy Steer

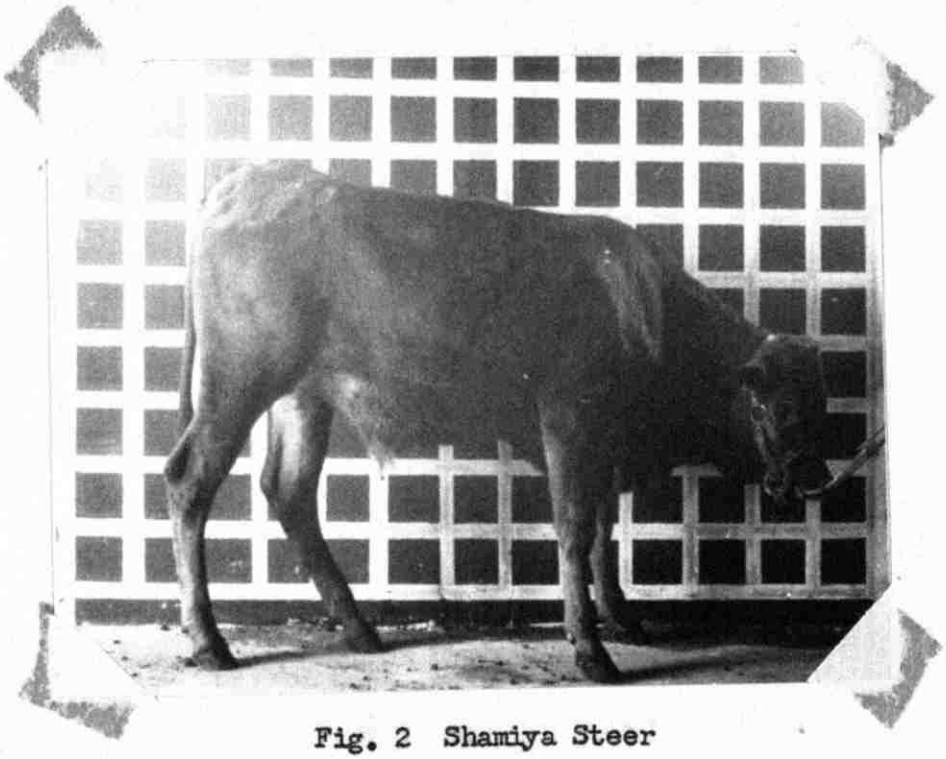


Fig. 2 Shamiya Steer

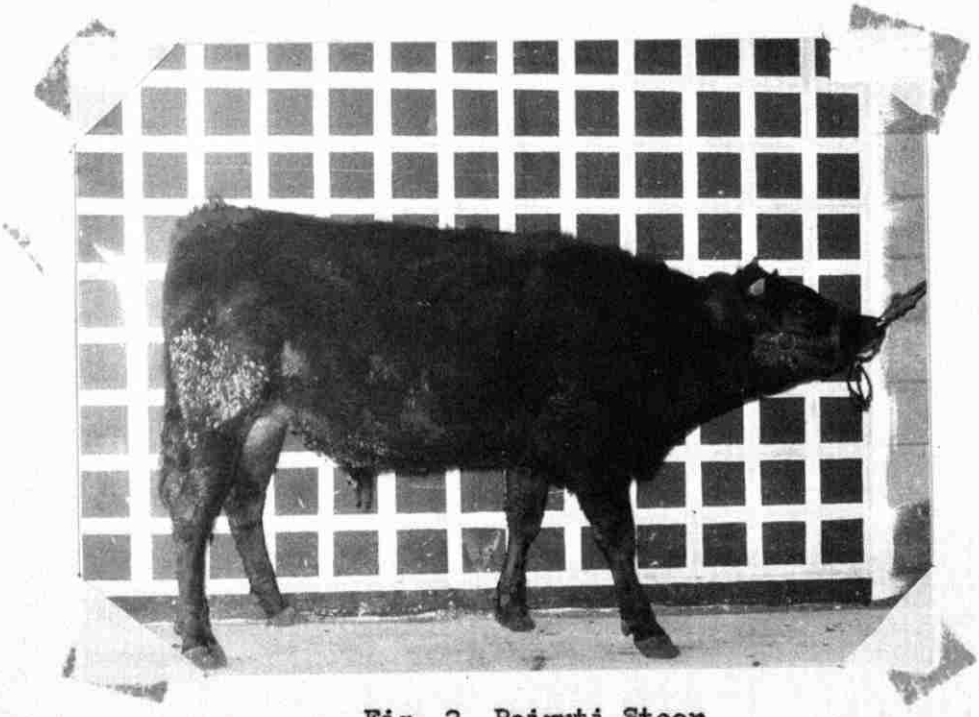


Fig. 3 Beiruti Steer

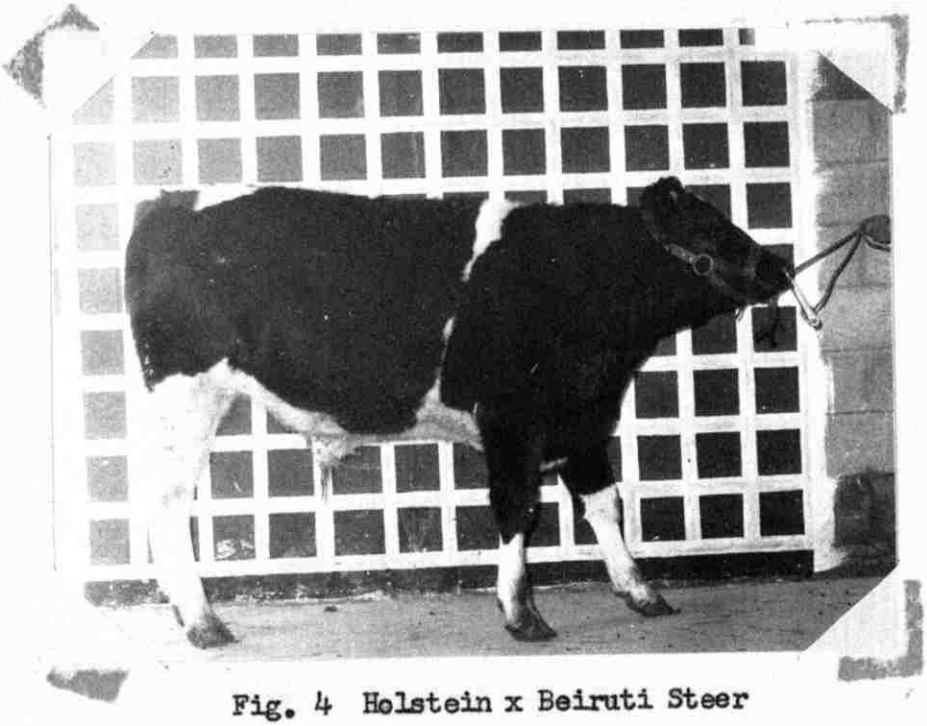


Fig. 4 Holstein x Beiruti Steer

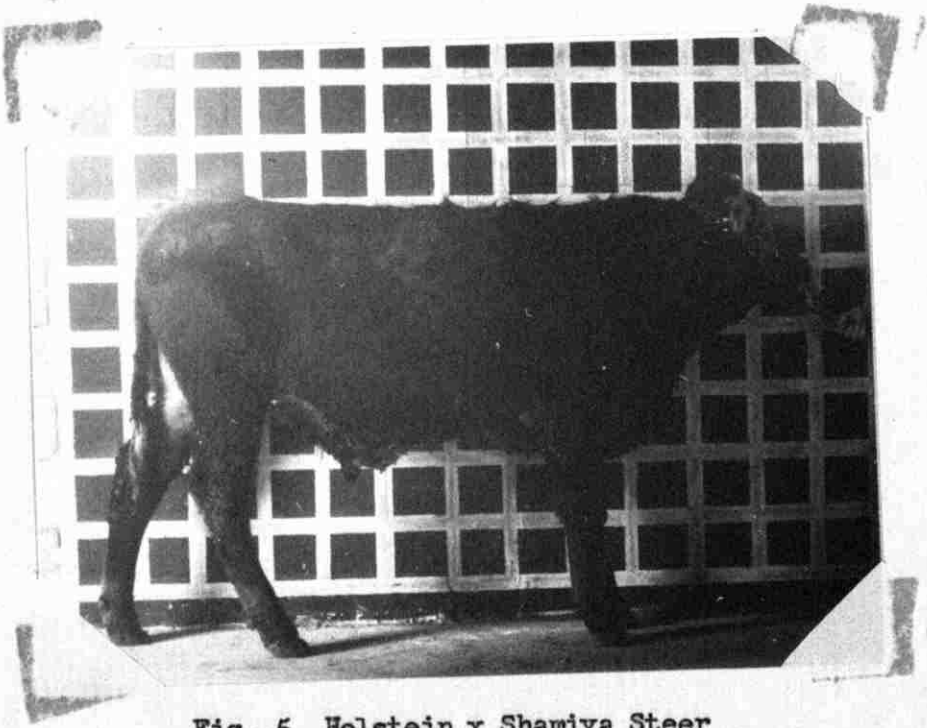


Fig. 5 Holstein x Shamiya Steer

Table 2. Concentrate Rations

Constituent	Ration I Aug.20-Oct.21 Percent	Ration II Oct.22-Dec.1 Percent
Barley °	10	10
Cotton Seed Meal	40	30
Wheat Bran	10	10
Date Pits °	10	10
Carob °	20	30
Molasses	10	-
Corn Cobs °	-	10

° Ground.

Table 3. Chemical Analysis of Concentrate Rations .

Component	Ration I Percent	Ration II Percent
Moisture	12.34	14.00
Crude Protein	15.75	13.15
Fat	3.34	2.51
Crude Fiber	14.41	12.49
Ash	4.82	4.20
Nitrogen Free Extract	49.34	53.65

Although the main roughage supply was alfalfa hay, tiben, sugar beets, green corn and sorghum were also fed when they were available. Whereas, concentrate was fed ad libitum, roughage feeding was limited, averaging about 7 lbs. per head daily, the reason being a generally limited supply and high price of fodder in the area. The high concentrate to roughage ratio fed to the animals is a reflection of the respective prices. Contrary to the condition in the United States, roughages are more expensive than concentrate feeds in Lebanon. While alfalfa hay costs 30-35 piasters per kg., barley and cotton seed oil meal cost only 12-16 and 20-25 psts. respectively. This is a result of two major causes. In the first place, most of the agricultural land in the area is non-irrigated. Hence, grain farming is the traditional practive. Secondly, due to the relatively under-developed livestock industry, crop growers have not felt the need of producing good quality roughage. The very few pioneers who have recently started to grow alfalfa on irrigated land are not enough to meet the market demand. As a result, good quality roughage is extremely expensive.

The steers were individually weighed at 21 day intervals throughout the entire experimental period (Fig. 6). At the end of 103 days, the first steer was shrunk for about 18 hours, photographed for later comparison, (Figs. 1,2,3,4,5), and slaughtered, with various carcass data being collected. A sample of the mesenteric fat was obtained for determination of the Iodine number (grams of Iodine absorbed by 100 gms. of fat). The carcass was then cut into left and right halves and aged for seven days at about 38° F. After aging, the left half was photographed against a grid (Fig. 8). The whole carcass was then cut into American retail cuts of short ribs, loin steaks, round steaks, pot and oven roasts, and hamburger meat (Fig. 9). The 12th rib and a loin steak corresponding to the 3rd

lumbar vertebra were taken from the left side for additional experimental study. The various cuts were then weighed and wrapped in polyethylene bags and frozen in deep-freeze at -26° C until sold on the quality retail market. The same procedure was used for the remaining nine steers, the last of which was slaughtered 48 days after the first (all ten steers could not be processed at the same time because of limited facilities).

All experimental loin and rib sections were held in deep-freeze until the last carcass was cut. The rib sections were then collectively photographed for comparison. (Fig. 7). The longissimus dorsi muscle of the rib eye was traced on paper and the area determined with a planimeter. A sample of the lean from the loin sections was analized for moisture, fat, protein and ash content.

Fig. 6 Weighing operation

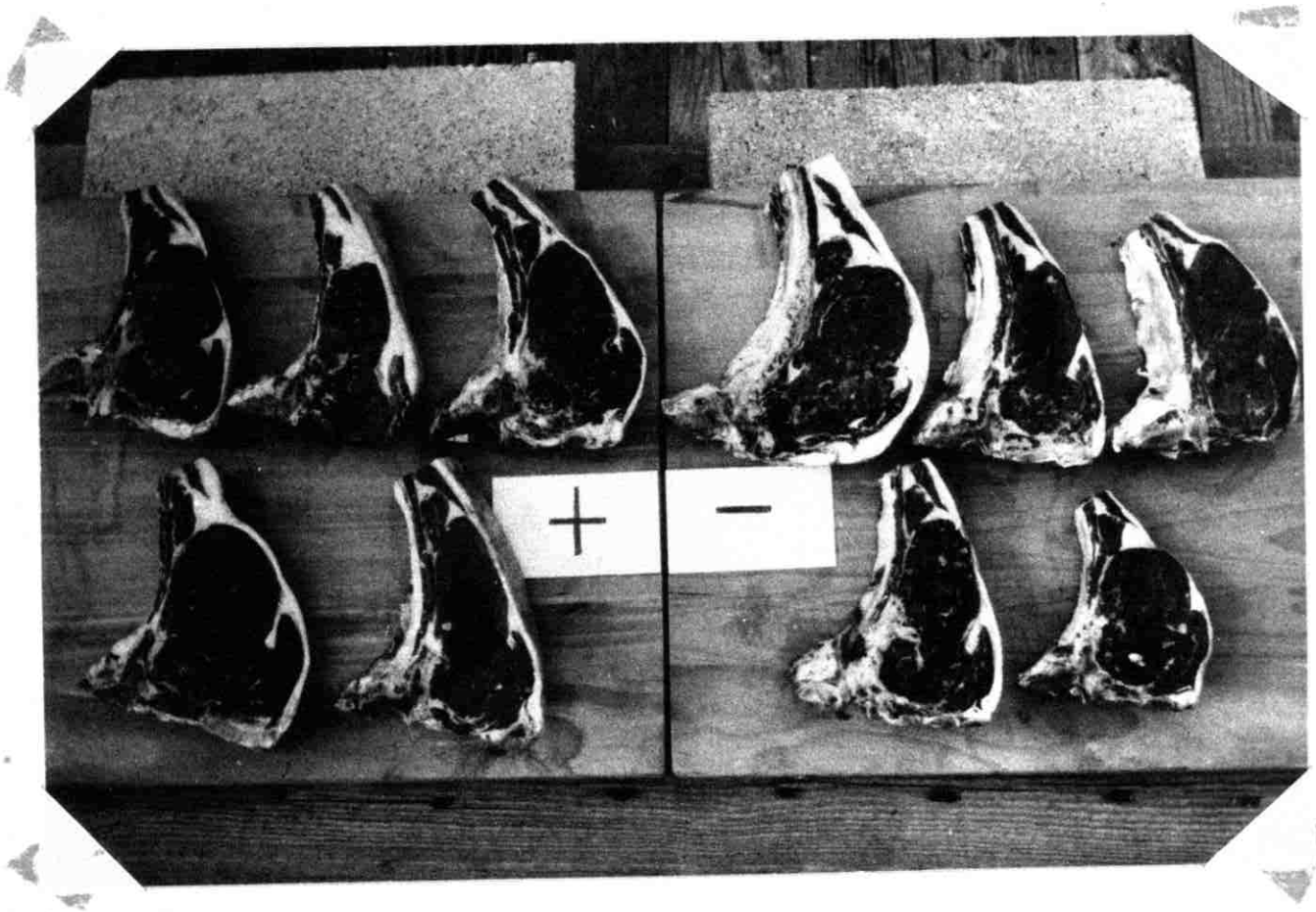


Fig. 7 Experimental 12th rib sections

\+ Treated
\- Control

Results and Discussion

The results obtained in this experiment confirm the findings of many workers in the field. Stilbestrol treated cattle gained an extra 0.51 lbs. per day over non-treated animals. The daily gains were 1.98 and 2.49 lbs. for control and treated cattle respectively, which is considered excellent. Throughout the entire experimental period, treated steers did better than the controls with respect to gain as reflected by the regular 21 day weights. Table 4 summarizes all weigh data.

Table 4. Weight Changes of Steers (lbs.)

	Steer No.	Beginning Weight Aug. 20	Sept. 10	Oct. 1	Oct. 22	Nov. 12	Dec. 1	Total Gain	Average Daily Gain
Control	1	886	41	68	25	80	29	243	2.36
	5	330	43	37	40	40	17	177	1.72
	6	541	34	40	50	55	20	199	1.93
	4	600	56	44	45	55	22	222	2.16
	8	500	50	35	30	45	21	181	1.76
	Average Daily Gains		2.13	2.15	1.81	2.62	1.15	1.98	
Treated	3	696	67	57	30	80	20	254	2.47
	2	593	44	45	38	60	17	204	1.98
	7	539	71	50	60	65	27	273	2.65
	9	526	89	51	54	70	10	274	2.66
	10	424	67	59	50	55	45	276	2.68
	Average Daily Gains		3.22	2.50	2.21	3.14	1.25	2.49	

The total gains between the two treatment groups were significantly different, as shown by the analysis of variance Table 5).

Table 5. Analysis of variance for total weight gains.

Source of Variation	d.f.	s.s.	m.s.	F	F5%
Between treatments	1	6708.1	6708.1	7.83°	5.32
Error	8	6848.0	856.0		
Total	9	13556.1			

However, stilbestrol treatment did not affect significantly the weights of the various organs and body parts shown in table 6. Likewise, treatment did not significantly affect the chemical composition of the lean meat (moisture, ash, protein, fat) taken from the longissimus dorsi of the third lumbar vertebra or the Iodine number of the mesenteric fat (table 7). Similarly, treatment had no significant effect on either the weights of the hind-half, loin steaks and round steaks (expressed as percent of the aged carcass weight), or the cross-sectional area of the rib eye and sales value of the animals. (table 8). Contrary to the findings of some workers, no significance was found between treatment groups when the analysis of variance was applied to the cross-sectional area of the rib eye muscle. This lack of significance may be explained by the great variation in type of the limited number of animals used in the study. In this connection, when divided into breed groups, a significant difference ($P < .05$) was found between the Normandies, Crossbreds and the Shamiyas, which had average cross-sectional areas of 79.8, 72.7, and 53.1 cm^2 respectively. Although the numbers were not great enough for correlation tests, it was interesting to find an indicated

Table 6. Percent body parts and organs based on shrunk live weight.

	Steer No.	Live Wt. lbs.	Head°	Feet+	Hide	Spleen	Liver	Lung & Trachea	Heart	Kidney	Tail	Carcass
Control	1	1104	3.98	1.64	6.11	0.18	1.22	2.15	0.38	0.20	0.16	62.70
	5	570	4.52	2.49	6.80	0.31	1.54	2.32	0.44	0.26	0.26	56.84
	6	800	3.88	1.77	5.94	0.17	1.26	2.00	0.44	0.25	0.21	58.31
	4	841	3.98	2.16	6.84	0.21	1.41	2.29	0.47	0.20	0.19	55.20
	8	764	4.45	2.39	6.22	0.20	1.19	1.90	0.46	0.25	0.26	57.85
	Average	815.8	4.16	2.09	6.38	0.21	1.32	2.13	0.44	0.23	0.22	58.18
Treated	3	930	4.35	1.88	7.18	0.16	1.38	1.83	0.35	0.24	0.22	60.59
	2	765	4.38	2.22	7.65	0.35	1.56	2.03	0.41	0.23	0.24	58.30
	7	880	4.05	2.02	6.65	0.20	1.34	1.99	0.39	0.28	0.23	58.06
	9	887	4.39	2.00	7.05	0.22	1.13	1.89	0.51	0.20	0.20	59.75
	10	775	4.55	2.13	7.39	0.19	1.32	2.06	0.32	0.26	0.26	59.35
	Average	847.4	4.34	2.05	7.18	0.22	1.34	1.96	0.40	0.24	0.23	59.21

° Unskinned

+ Metacarpus & Phalanges, skinned.

Table 7. Percent chemical composition of lean and Iodine number of mesenteric fat.

	Steer No.	Moisture	Ash	Protein	Fat	Iodine No.
Control	1	73.08	1.036	22.10	2.56	37.78
	5	74.23	1.087	22.66	1.57	48.01
	6	73.32	1.106	22.21	2.49	39.48
	4	73.36	1.072	21.72	2.28	36.73
	8	73.63	1.063	21.86	2.40	37.78
	Average	73.52	1.073	22.11	2.26	39.96
Treated	3	72.84	1.081	22.12	3.36	42.06
	2	72.82	1.075	23.06	2.20	40.47
	7	73.38	1.056	21.72	2.91	41.24
	9	74.02	1.087	22.34	1.70	33.74
	10	74.21	1.102	22.52	1.51	34.50
	Average	73.45	1.080	22.35	2.34	38.40

relationship between rib eye area, and weight of loin and total monetary value of the ten steers.

In conformity with the reports of other workers, the tail-heads of treated steers were observed to be elevated. Contrarywise, excessive riding was not observed.

The meat quality of all standard cuts from both control and stilbestrol treated animals satisfied even the most discriminating taste. All animals had excellent finish (Fig. 8). Further, the experimental 12th rib section, when oven broiled, confirmed the opinion of customers. Thus, it follows that stilbestrol treatment of slaughter steers can be judged

Table 8. Carcass data and sales value of steers

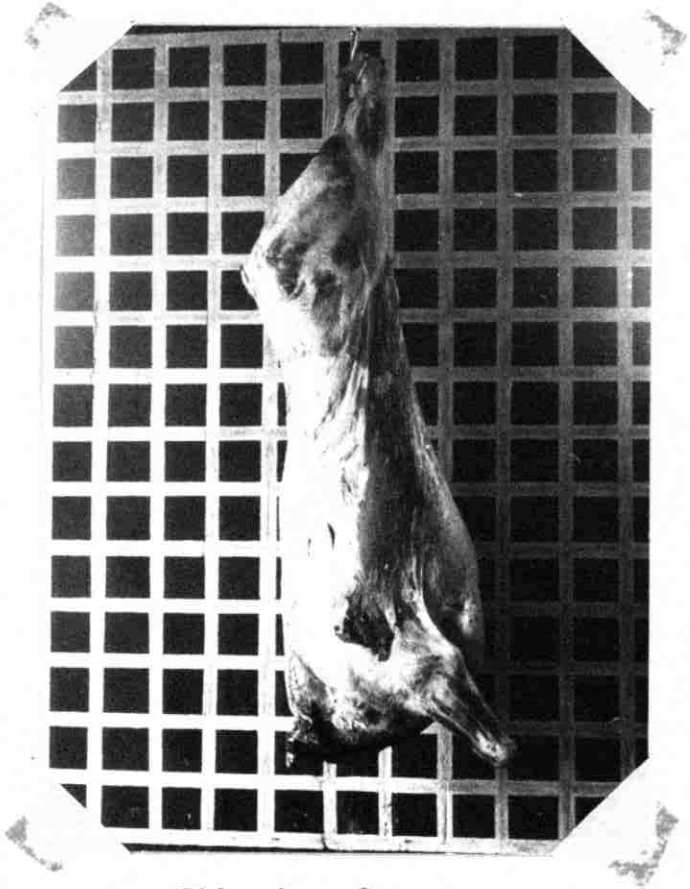
	Steer No.	Percent of Carcass			Area of rib eye in cm^2.	Total sales value LL
		Loin	Round	Hind half		
Control	1	13.72	8.73	47.52	90.5	1272.75
	5	13.24	8.61	50.23	56.0	524.60
	6	10.86	9.88	50.91	72.3	770.10
	4	13.27	8.21	49.22	65.2	779.20
	8	13.94	9.57	49.66	71.5	768.75
	Average	13.01	9.00	49.51	71.1	823.08
Treated	3	12.78	8.18	48.94	85.9	974.35
	2	14.56	8.29	50.67	59.5	763.45
	7	13.05	7.44	49.90	68.7	845.65
	9	13.89	8,85	47.78	74.0	908.80
	10	14.26	8.91	48.48	73.8	770.55
	Average	13.71	8.33	49.15	72.4	852.56

to impart no detrimental effect on either physical or chemical characteristics of the carcass. Certainly, in Lebanon, where only two grades of beef are recognized, (regular and high quality which is mostly imported), there results only beneficial effects from stilbestrol treatment.

Economics. Stilbestrol treatment was undoubtedly profitable, since its cost was negligible, yet there resulted an additional 262 lbs. of liveweight. When considering the overall economics of beef production in Lebanon, the following picture is presented.

During the period between August 20 1958, when the experiment

Back view of carcass



Side view of carcass

Fig. 8.

started and January 29 1959, when the last animal was slaughtered, a total of 9924 kgs. of concentrate and 4942 kgs. of a variety of roughages (largely succulent) were consumed, at a total feed cost of LL 1935. The total purchase or birth price of the ten calves was estimated at LL 835. A total of 4960 kgs. of milk was consumed by the calves, which was worth LL 1984. Until weaning, an estimated 5000 lbs. of concentrate was consumed, as according to Morrison (18) a calf consumes 500 lbs. of concentrate while suckling. Between weaning and the beginning of the experiment, another 16600 lbs. of concentrate was consumed, with an estimated 10 lbs. per head per day for 1660 calf-days, costing LL 1500. During the same period, approximately 3300 lbs. of alfalfa hay was consumed, with a cost of LL 265. Thus, the total production cost, assuming manure to pay for the labor, becomes LL 6860. The ten calves, when processed and marketed, brought LL 8378. Since this experiment can be considered chiefly as a teaching by-product, the only processing expense was LL 100 for wrapping material. In this light, total income minus actual incurred expenses yields a profit of LL 1418. Considering that refrigeration, interest and other overhead expenses might conceivably amount to LL 418, there is left a total net profit on the ten steers of LL 1000. Certainly, a profit of LL 100 per animal is at best only a modest return. However, by increasing the number of animals processed and/or shortening the investment period (e.g. purchasing animals of 6-12 months of age), such a business could be made much more attractive.

Commercial.- The production, processing and marketing of the beef discussed in this study was all handled by one concern (the American University of Beirut). Commercially, however, the whole operation is divided into several specialized phases, which may be called, calf raising, fattening, processing, and marketing. Each of these operations requires different

technical specialties and facilities. Therefore, it would probably be expedient, from a commercial standpoint, for different operators to specialize singly in the various phases. In Lebanon, though currently there is no so-called beef industry, in case one is developed in the near future, it would be wise to consider each of the various commercial phases, and the expected profits from each.

Starting with baby calves.- By utilizing ample whole milk, high quality roughage, concentrate and antibiotic supplementation, the calves in this experiment showed a calf-hood daily gain of 1.7 lbs. on the average (17). It is certain that no profit would have been realized had the steers been sold to local butchers. Rather, it was necessary to resort to processing and selling on a special market for a profit to be forthcoming. Thus, in order for a commercial enterprise, devoted to raising calves for beef, to be profitable, it would be mandatory to cut calf-hood raising costs and in addition sell fattened animals at above average prices. Calf-hood expenses can be reduced by utilizing powdered milk, skimmilk, commercial calf-starters and antibiotics. Further research is badly needed on this phase of beef production in the Middle East.

Starting with weanling calves.- Weaned calves of 6-12 months of age should be an economical source of feeder animals. The main advantage of starting with weanlings is the fact that milk would no longer be a necessity. However, attention must be given to the selection of animals. Extremely stunted and sick animals should not be bought for fattening, because they will not perform well in the feed-lot. Thus, carefully selected weanlings or even yearlings, when castrated and implanted with stilbestrol, are expected to gain about 2 lbs. daily under good management. Such animals, when kept for 150 days in the feed-lot should make a profit of LL 50-75 when sold on the common market. None of the aforementioned

phases, however, would be as profitable as the processing phase. When reasonably fat steers are slaughtered, aged, cut and wrapped as retail meat (Fig. 9), and sold on a special market as quality beef, a profit of about LL 150 should be realized. At present, there is a small market for such beef. It is probable that the limited market may expand considerably once such beef is produced locally. The assumption is based on the fact that tourism is one of the main national revenues of Lebanon, and tourists are willing to pay high prices for quality beef. Besides tourists high-income-class Lebanese may also be part of the market, and the success of the rapidly developing local poultry industry supports the above assumption.

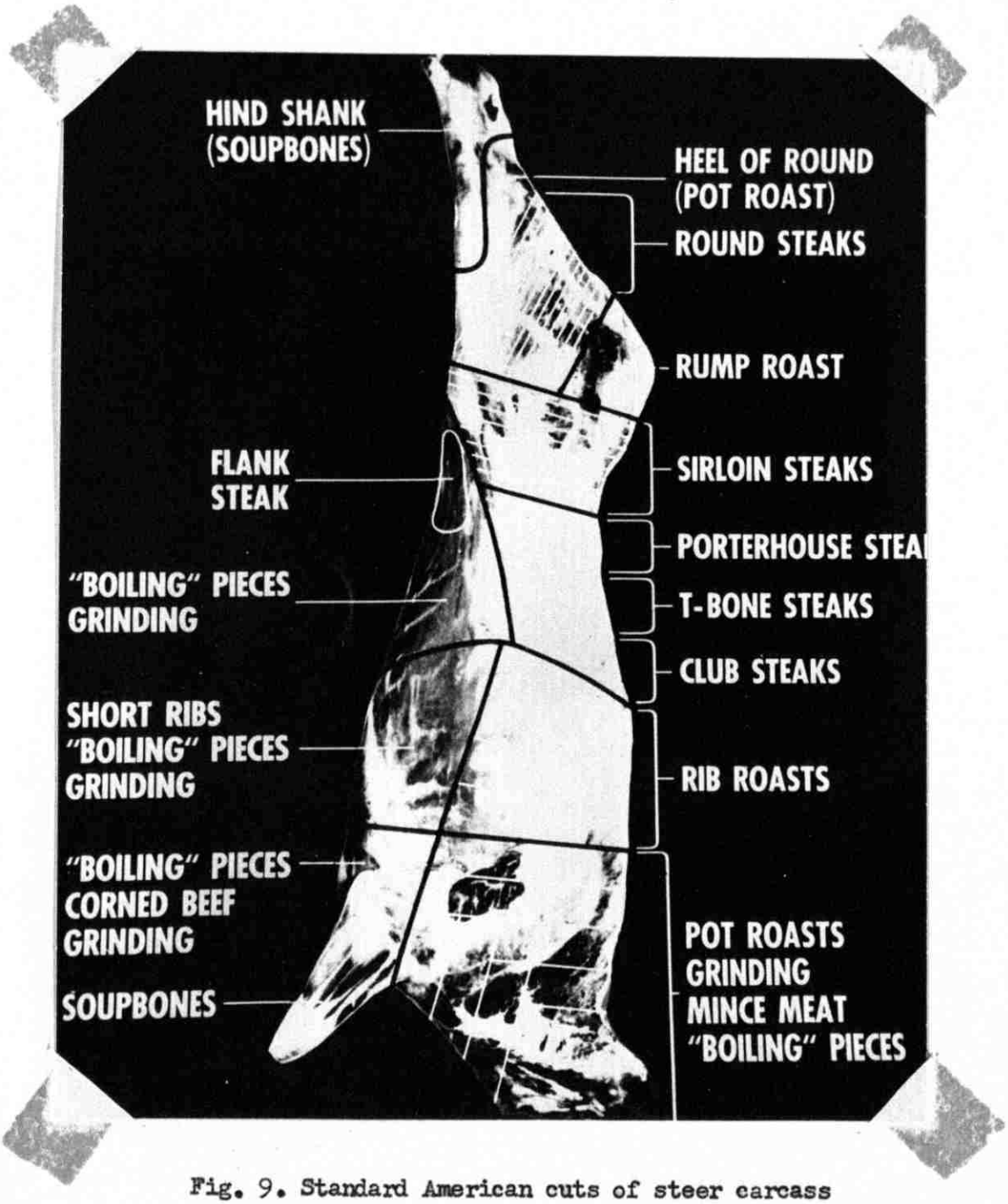


Fig. 9. Standard American cuts of steer carcass

Summary and Conclusions

Ten steers, five of which were implanted with 30 mg. of stilbestrol, were fattened for 103 days. The treated group had significantly higher weight gains of 0.51 lbs. per head daily (1.98 and 2.49 lbs. for control and treated groups respectively). Treatment did not significantly affect heart, liver, kidney, spleen or lung weights, nor did it affect dressing percent, composition of lean meat taken from the longissimus dorsi in the loin region, Iodine number of the mesenteric fat, cross-sectional area of the rib eye muscle, or percent of loin or round steaks taken from each carcass. Elevation of tail heads was noticed in the treated group, but no excessive riding was observed. Meat from both groups was tender and of high quality.

Considering the negligible cost of treatment, stilbestrol implantation was economical, and is recommended. The overall operation of fattening and processing was profitable. As a partial solution to the problem of meat shortage in Lebanon, it is recommended that weanlings or yearlings - a by-product of the local cattle industry - be fattened, and processed.

Bibliography

1.- Andrews, F.N., Martin Stob, T.W. Perry and W.M. Beeson. 1956. The oral administration of diethylstilbestrol, dienestrol, and hexostrol for fattening calves. Jour. Anim. Sci. 15:685.

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

3.- Bohman Verle Rand and Marven A. Wade. 1958. The effect of certain feed additives on the tissues of fattening beef cattle. Jour. Anim. Sci. 17:124.

4.- Burroughs, W., C.C.Culbertson, Edmund Cheng, W.H.Hale. 1955. The influence of oral administration of diethylstilbestrol to beef cattle. Jour. Anim. Sci. 14:1015.

5.- Butler, O.D., L.E. Smith and M.J. Garber. 1956. Beef carcass composition and yield of wholesale cuts as estimated from left and right sides. Jour. Anim. Sci. 15:891.

6.- Cahill, V.R., L.E. Kunkle, Earle W. Klesterman, F.E. Deatherage and Eugen Wierbicki. 1956. Effect of diethylstilbestrol implantation on carcass composition and the weight of certain endocrine glands of steers and bulls. Jour. Anim. Sci. 15:701.

7.- Clegg, M.T., H.H. Cole and H.R. Guilbert. 1951. Effects of stilbestrol on beef heifers and steers. Jours. Anim. Sci. 10:1074.

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

9.- Clegg, M.T. and F.D. Carroll. 1957. A comparison of the method of administration of stilbestrol on growth and carcass characteristics of beef steers. Jour. Anim. Sci. 16:662.

10.- Deans, R.J., W.J. Van Arsdell, E.P. Reineke and L.J. Bratzler. 1956. The effect of progesterone-estradiol implants and stilbestrol feeding on feed lot performance and carcass characteristics of steers. Jour. Anim. Sci. 15:1020.

11.- Dyer, I.A., M.E. Ensminger and R.L. Blue. 1957. Effects of fat, oxytetracycline, and stilbestrol on performance and hepatic stores of carotene and vitamin A in steers. Jour. Anim. Sci. 16:828.

12.- Erwin, E.S., I.A. Dyer and M.E. Ensminger. 1956. The influence of fat, chlortetracycline, and stilbestrol on vitamin A and carotene storage in the liver of beef steers. Jour. Anim. Sci. 15:1147.

13.- Kastelic, Joe, Paul Homeyer and E.A. Kline. 1956. The influence of the oral administration of dietylstilbestrol on certain carcass characteristics of beef cattle. Jour. Anim. Sci. 15:689.

14.- Knapp, Bradford, Jr. and A.W. Nordskog. 1946. Heritablity of growth and efficiency in beef cattle. Jour. Anim. Sci. 5:62.

15.- _____, and R.T. Clark. 1950. Revised estimates of heritability of economic characteristics of beef cattle. Jour. Anim. Sci. 9:582.

16.- Kockakian, Charles D., 1947. Effects of estrogens on the body and organ weights and the arginase and "alkaline" and "acid" phosphatases of the liver and kidney of castrated male mice. Am. Jour. Physiol. 151:126.

17.- McLeroy, G.B., and Ramsay Khouri. 1959. The influence of antibiotics on the growth rate of young dairy calves. A.U.B. - School of Agriculture Progress Report Project 33.

18.- Morrison, F.B. 1950. Feeds and Feeding. The Morrison Pub. Co., Ithaca, N.Y. p. 820.

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

20.- _____, E.P. Warren, T.J. Davis and H.H. Pierce, Jr. 1956. Effects of low level implantations of stilbestrol in steers fattened on dry lot rations. Jour. Anim. Sci. 15:52.

21.- _____, A.E. Cullison and J.L. Carmon. 1959. Implanted and oral stilbestrol for fattening steers. Jour. Anim. Sci. 18:14.

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

23.- _____, _____, _____, _____,. 1955. The Effect of oral administration of hormones on growth rate and deposition in the carcass of fattening steers. Jour. Anim. Sci. 14: 329.

24.- _____, _____, _____, _____, and M.T. Mohler. 1958. The comparative effectiveness of oral and subcutaneous implantation of dietylstilbestrol in combination with chlortetracycline. Jour. Anim. Sci. 17:164.

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

26.- Shelby, C.E., R.T. Clark and R.R. Woodward. 1955. The heritability of some economic characteristics of beef cattle. Jour. Anim. Sci. 14:372.

27.- Simone, Marion, M.T. Clegg and Floyd Carroll. 1958. Effect of methods of stilbestrol administration on quality factors of beef. Jour. Anim. Sci. 17:834.

28.- Stob, Martin, F.N.Andrews, M.X. Zarrow and W.M. Beeson. 1954. Estrogenic activity of the meat of cattle, sheep and poultry following treatment with synthetic estrogens and progesterone. Jour. Anim. Sci. 13:138.

29.- Turner, C.W. 1956. 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. Jour. Anim. Sci. 15:13.

30.- Woodward, R.R., J.R. Quesenberry, R.T. Clark, C.E. Shelby and O.G. Hankins. 1954. Relationship between preslaughter and post slaughter evaluations of beef cattle. U.S.D.A. Circ. 945.