THE RELATIONSHIP OF SLAUGHTER WEIGHT AND AGE TO CARCASS YIELDS AND ECONOMY OF BEEF PRODUCTION

by

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ABSTRACT

During August 23, 1959 to June 3, 1960, an experiment on fattening beef animals was conducted at the A.U.B. Farm. The aim of this particular experiment was to study the economical feasibility of fattening calf steers for quality meat.

Nine steers, each implanted with 30 milligrams stilbestrol were used in this study. The steers were divided into three different groups, to be slaughtered at final weights of: (a) 700 pounds, (b) 900 pounds and (c) 1100 pounds.

After slaughter, the carcasses were processed and evaluated according to quality of meat and yields of the various wholesale cuts.

The results of this experiment have demonstrated the possibility of higher margins from cattle of heavier weights and those with a higher degree of finish than are ordinarily slaughtered in the Near East area. The medium weight group showed a little higher margin than the light weight group. The highest margin was observed in the heavy group.

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INTRODUCTION

Beef production has been a rather undeveloped industry in the Near East. This situation may be due to several reasons.

The first is that cattle used for beef production are not beef type animals, but they are surplus of dairy stock most of which lack natural fleshing characteristics.

The second is the problem of shortage of roughages in many parts of the Near Eastern countries. This situation has led the few cattle feeders to use short time feeding periods and to slaughter at early ages in order to take advantage of economy of gain of young animals. Few feeder calves, if any, are allowed to finish to the point of high quality meat.

The third is importation restrictions practiced in many countries in the Near East which prevent cattle coming in from areas producing beef at much lower cost. Most of these restrictions are imposed because of disease problems.

The fourth is the lack of proper technique of slaughtering, processing and retailing.

However, there is a great opportunity for improving beef production in this area, since there is a reasonable demand for quality beef. The surplus dairy cattle can be improved by introducing improved milk breeds carrying more flesh such as Holstein-Friesians and others. It is possible to produce more beef in this area by feeding the surplus cattle from dairy herds found in the area and also feeding feeder cattle imported from the neighbouring countries. The slaughtering, processing and retailing will require different technical specialities than are presently used or have been used in the past in order to market the various cuts of beef on the bases of relative value and quality.

REVIEW OF LITERATURE

In the study of beef production, one has to take into consideration two very important fundamentals of biology. These two factors are heredity and environment. Both heredity and environment produce a character, hence they are equally important in the development of an individual. An individual is no more than the result or outcome of his heredity, environment, and their interaction.

Heredity is like an architect or foundation of a structure and environment is likened to the builders or materials. The architect, knowing the potentiality of the foundation, designs the type and size of the building that can be built, but does not guarantee that the building will be completed. In the same manner heredity does not guarantee the individual will be developed to full potentiality.

Moreover, making a design and laying a foundation will not make a building; builders and materials are required to complete the construction. In the same way, environment is necessary to bring the individual up to the potentiality that is laid down by heredity.

Winters (1958) states that most characters of economic importance in animals are controlled by many genes (herediditary factors) and the same traits are also greatly influenced by environment.

Winters (1958) in discussing the relationship between heredity and environment has pointed out the following:

An animal with a fast growth rate raised on a deficient diet or in another faulty environment may end with the same growth rate as an animal that has a poor genetic constitution for the rate of growth, but was raised in a good environment. Conversely, an animal with a genotype for a fast rate of gain will be able to express its superiority (over the one with poor genetic constitutions) fully, only if its nutrition is adequate for fast growth, other environmental factors being the same.

Hereditary Influences in Beef Production

Several workers have shown that many economic traits of various species of animals are inherited; moreover, the same traits can be controlled by man.

Man can control hereditary traits by using certain tools - selection, crossbreeding and inbreeding which have provided a means to beef producers to establish superior herds than were commonly used previously.

In the beef cattle improvement program crossbreeding is used to introduce new genes in the population, to develop new breeds, to improve commercial herds by taking advantage of hybrid vigor and the combination of more beef traits than are found in one breed alone. Inbreeding has been used to develop new combinations of traits through segregation and to increase homozygosity (prepotency).

In selecting animals for beef production, the objective is to select the animals on the basis of certain characters that affect the economy of Beef production. Some of these economic traits are discussed below.

1. Birth Weight. In selecting beef animals, it is important to know their prospective value at an early age. A study of birth weight is the first measurement that can be obtained and also one of the earliest records made with reasonable accuracy.

Knapp et al. (1940) showed that birth weight was of limited value as an index of a calf's growth potentialities. Dawson et al. (1947), however, found that the largest calves at birth tended to reach standard weaning weights and slaughter weights at the youngest age. In a further study, Dahmen and Bogart (1952) found that birth weight had a significant effect on both rate and economy of gain.

Several research workers have spent a great deal of their time to investigating the degree of heritability of many characters that are of economic importance. Numerical values have been given depending upon different breeds and environment. Heritability estimates obtained by different workers vary greatly from breed to breed and even within the same breed due to differences in environment. These numerical values are of some importance in that they indicate the relative influence of environment upon the character.

In two different heritability studies based on different breeds of cattle using the half-sib correlation method, it was reported that birth weight was 23 percent (Knapp et al., 1946) and 26 percent (Knapp and Clark, 1950) heritable.

2. Weaning Weight. Weaning weight is the next measurement that can be obtained in selecting cattle for beef production at an early age. This record is of great value to beef producers because the rate of gain made from birth to weaning is recognized as one of the important traits in beef production, since it indicates the general gaining ability of the individual.

Heritability studies made in 1946 and 1950 pointed out weaning weight to be 12 percent (Knapp et al. 1946) and 7 percent (Knapp and Clark, 1950) heritable, based on different breeds and using the half-sib correlation method.

In a recent publication, Nehms and Bogart (1956) reported that the suckling gains have been used in several studies as a criterion of cows' productivity and that these gains or weaning weights adjusted for age should be included in the selection index for beef cattle improvement.

3. Other Characters. Rate of gain is one of the important economic traits in beef production and it is highly heritable. In 1955, Warwick and Cartwright (1955) showed a high heritability estimate for the rate of gain in Hereford crossbred cattle. Heritability estimates for rate of gain in the feed lot was reported as low as 37 to 72 percent (Knapp and Clark, 1947) and as high as 99 percent (Knapp et al. 1946). Knapp and Clark also reported that the final feed lot weight was 54 percent heritable.

Several studies have shown that efficiency of feed utilization is highly heritable. Knapp et al. (1946) indicated efficiency of gain to be 75 percent heritable. In a study in poultry, Hess and Jull (1946) reported a definite inherent difference in efficiency of feed utilization.

Size as determined by body measurements was found to be highly heritable according to study by Tyler et al. (1948) in Holstein and Ayrshire cattle.

Slaughter and carcass grade affect the economy of beef production since these characters are measures of the quality of beef. Reports of Knapp and Nordskoq (1946), Knapp and Clark (1950) and Dawson et al. (1955) showed that slaughter and carcass grades were heritable to the degree that considerable improvement could be made through breeding and selection.

Many studies have shown that the area of eye muscle (Knapp and Nordskoq, 1946; Knapp and Clark, 1950) and dressing percent (Knapp and Nordskoq, 1946; Knapp and Clark, 1950; Dawson et al., 1955) have a sufficiently high degree of heritability.

Sex is also noted to affect the economy of beef production to a certain limit. Experimental results with pure Hereford and Aberdeen Angus bulls and heifers indicated that the bull calves decreased in efficiency more rapidly than heifers within the range of 500 pounds to 800 pounds body weight. Bulls, however, continued to be more efficient than heifers at 800 pounds (Nehma George and Ralph Bogart, 1955).

Environmental Influences in Beef Production

It is well known that the growth rate of animals is influenced by a level or balance of macronutrients (proteins, carbohydrate and fat), certain minerals and micronutrients (vitamins, unidentified growth factors and trace minerals).

A detailed discussion of this work is beyond the scope of this paper and most of it has been well established in general practice and included in such textbooks as Morrison (1956), Maynard (1947), Crampton (1956) and Snapp (1958).

In recent years certain non-nutrients, such as hormones, antibiotics and tranquilizers have been intensively investigated and have been shown to promote growth rate and efficiency of feed utilization. Most of these are discussed below.

The importance of the endocrine system in regulating growth has long been known. During the past decade it has been shown that the administration of hormone (implants or feeding) has increased the rate of gain and efficiency of feed utilization in beef cattle of various weights under different systems of management.

A number of papers have reported an increased growth stimulatory effect of the female hormone-like substance (stilbestrol) when fed to young and fattening beef cattle (Burroughs et al., and Perry et al., 1955; Andrews et al., and Beeson et al. 1956). Implants of 24 milligrams of stilbestrol and implants containing 200 milligrams progestrone and 20 milligrams estradiol benzoate increased daily gains by 8 to 11 percent in steers grazed under range conditions (Koch et al. 1959).

In 1953, Burris et al. (1953) reported that the weekly intramuscular injection of testosterone at the rate of 1 milligram per kilogram body weight resulted in an increase in rate of gain and a decrease in food required per unit gain.

However, hormone treated steers produced less fat (Andrews et al. and Beeson et al. 1956) and less tender beef (Simone et al. 1958) and lowered the carcass grade. Andrews et al. (1958) showed evidence that carcass grade has been improved by using both antibiotic and androgen administration and also by using tranquilizing agents.

The effect of castration on the economy of gain has been reported by some workers. In 1954, Klosterman et al. (1954) working with cattle, some castrated at one month of age and others castrated at seven months of age, indicated that the late castrated bulls made faster gain and utilized their feed more efficiently than the early castrated steers. This indicated that the male hormone produced by normal bulls has a definite stimulatory effect on growth, particularly muscular tissue. However, the above experiments showed that the early castrated steers had a higher degree of finish and a higher carcass grade than the late castrated bulls.

The discovery in 1949 that certain antibiotics can increase the rate of growth of chickens and young pigs (Morrison, 1956) opened up a new development in swine and poultry feeding. Since then, many experiments have been conducted with other livestock. The addition of suitable antibiotic feed supplements in the ration of young animals will generally, but not always, promote growth. It is also believed that in most cases antibiotics will slightly improve feed efficiency and reduce the incidence of scours.

In 1953, Macklay et al. (1953) reported significant increase in growth, stimulated appetite and improved general appearance from feeding 30 milligrams terramycin per 100 pounds body weight to young dairy calves. The addition of 20 milligrams terramycin hydrochloride per 100 pounds body weight per day also stimulated additional growth (Kesler, 1954). Twenty four percent increase in weight was obtained when 80 milligrams of aureomycin was included in the ration of Holestein heifers from birth to eight weeks of age (Buckalew and Merrilan, 1955).

With regard to the effective level of antibiotics that should be used, Perry et al. (1954) noted that beneficial results were obtained when a low level of antibiotics was used. However, Thomas and Williams (1954) indicated that the effect of antibiotics was not obtained in environments in which detrimental bacteria were absent.

Considerable research in nutrition has been carried out in many laboratories to determine whether tranquilizing drugs, which are used in human medicine to alleviate (lessen) anxiety or tension through their action on certain nerve centers, could influence growth rate of animals. Sherman et al. (1957) and Cherman et al. (1959) found that low levels of tranquilizing drugs enhanced growth rate and feed efficiency. In a very recent publication, Hemerickson et al. (1960) showed that a chlorpromazine hydrochloride intravenous injection of 0.25 milligram per pound body weight depressed docile animals. For more easily excited range stock a dosage of 0.4 milligram per pound body weight was required.

Little work has been done that relates directly to that in the present study. However, Morrison (1956) and Snapp (1958) found out that younger cattle grew more and fattened less during the first phase of their feeding period than older ones. They also pointed out that the younger cattle produced lower carcass grades and carcass yields than the older well finished cattle. Morrison (1956) showed within the same breed of cattle the well fattened steers dressed higher than the less fattened steers.

OBJECTIVES

The objectives of this study are as follows:

1. To compare the relative value of Friesian and Friesian X Baladi steers fed out to and slaughtered at 700 pounds, 900 pounds, and 1100 pounds live weight in regard to:

    a) Total carcass yields

    b) Yields of the various wholesale cuts of meat based upon the U.S. methods of cutting beef carcasses.

    c) Yields of lean, fat, bone, and edible meat in the carcasses.

    d) Quality of beef produced based upon U.S. grading techniques.

2. To determine the economic feasibility of producing quality beef from surplus dairy cattle fed out to heavier live weights than is the general practice within the Near East Area.

EXPERIMENTAL PROCEDURE

Source of Data

Nine Calves, of which one was a Holestein-Friesian and the other eight were Holestein-Friesian X Baladi cross-beds (four from the A.U.B. Farm and the others from the village of Anjar), were put into the experiment on August 23, 1959. All the experimental animals were steers except one which was a free martin heifer.

The experimental animals were weighed and each was implanted with 30 milligrams of stilbestrol a day before the experiment started. At that time they averaged 410 pounds live weight (range, 303 to 466 pounds) and were 132 to 215 days old (average, 181 days). Data for age, weight, origin and breeding of the nine cattle are provided in Table 1.

The value of the calves at the beginning of the experiment was calculated from a base market value (value for beef at that time) of L.L. 1.25 per Kilogram live weight.

Three and three-quarter months from the beginning of the fattening period, the calves were graded according to their condition, and were divided into three weight groups:- group 1 (2 steers and the free-martin) to be slaughtered at 700 pounds live weight, group 2 (3 steers) to be slaughtered at 900 pounds live weight, and group 3 (3 steers) to be slaughtered at 1100 pounds live weights. They were divided equally at this time according to weight, grade, and degree of finish.

Table 1. Initial Ages and Weights, Origin and Breeding of the Nine Steers Used in the Experiment

Steer No.	Initial age (days)	Initial weight (Pounds)	Origin	Breeding
66	189	465	AUB Farm	Friesian x Shamiya
67	165	466	AUB Farm	Friesian
69	132	303	AUB Farm	¾ Friesian, ¼ Shamiya
70	132	333	AUB Farm	¾ Friesian, ¼ Shamiya
188	191	393	Anjar	Friesian x Baladi
189	191	403	Anjar	Friesian x Baladi
191	215	459	Anjar	Friesian x Baladi
193	212	408	Anjar	Friesian x Baladi
194	205	456	Anjar	Friesian x Baladi

Feeding Procedures

The three groups of steers were put in the same pen and fed together. The concentrate mixture was fed twice a day, in the morning and evening. Roughages were fed in the afternoon and evening. Alfalfa and sugar beets, when available, were fed in the afternoon and tiben (wheat straw) and corn stober were fed in the evening.

The concentrate rations were changed several times during the experiment due to temporary shortages of different feed ingredients from time to time. On the whole, six rations (I,II,III,IV,V,VI) were used. Ration VI was fed for the longest period of time. With the exceptions of steers 188 and 193 in group 1, the steers were fed all six fattening rations, though the amount of the ration VI fed to each steer varied considerably depending upon the time each reached his final weight. Steers 188 and 193 were fed only the first four rations. The rations used in this experiment and their cost per pound are listed in Table 2. The current prices of the different ingredients and their crude Protein and TDN contents are given in Table 3.

Table 2. Concentrate Rations Used by Feeding Periods (Pounds) and Their Costs

Feeding Period	1959			1960		
	I Aug.23 to Sep.27	II Sep.28 to Oct.31	III Nov.1 to Dec.31	IV Jan.1 to Jan.18	V Jan.19 to Jan.23	VI Since Jan. 24
Vitasni[1] Cattle Concentrate	xxx					
Beetpulp		125	200	200	200	200
Barley		125	250	250	250	200
Corn		125	205	230	200	200
Wheat Bran			200	200	200	100
Soybean oil meal		85			100	
Peanut oil meal						50
Cottonseed meal			50	70		200
Molasses		25	50	50	50	50
Urea (262% Protein equivalent)			15	10		
Limestone		10	20	20	20	20
Salt		5	10	10	10	10
Crude Protein, %[2]		14.3	15.0	14.1	13	17.3
Cost (LL per pound	0.113	0.109	0.086	0.087	0.091	0.097

1. Feed analysis of Vitasni Cattle concentrate: Protein 20 percent, fat 4 percent, fiber 8 percent, mineral (ash) 8 percent.

2. Calculated (Morrison, 1956)

Table 3. Cost, Protein and TDN Contents of the Different Ingredient[s]
Used in the Concentrate Rations and of the Roughages

Feed Stuff	Cost (LL per Pound)	Crude Protein, %	TDN, %
Beetpulp	0.077	8.8	68.7
Barley	0.100	8.7	78.8
Corn	0.109	9.1	80.1
Wheat bran	0.064	16.1	65.6
Soybean oil meal	0.163	45.7	78.0
Peanut oil meal	0.163	52.3	77.3
Cottonseed meal	0.127	41.6	65.2
Molasses	0.048	3.0	53.7
Urea	0.078	26.2	-
Limestone	0.014	-	-
Salt	0.036	-	-
Alfalfa hay	0.136	13.7	50.3
Corn stover	0.064	5.9	51.9
Tiben (Wheat straw)	0.073	3.9	40.6
Sugar beet	0.023	1.6	13.7

Slaughter and Carcass Data

Each steer was slaughtered when it reached the final weight for its particular group regardless of age. After the process of killing, skinning and removal of viscera, the carcass was split as accurately as possible into two equal halves. Then the carcass was washed, weighed, shrouded and placed in a cooler (operating at 32 to 34 degree Fahrenheit) to age for a period of 10 days.

After aging, the carcass was weighed again to determine shrink and then divided into the fore and hind quarters. Then the carcass was cut into the regular U.S. wholesale cuts according to the standard procedures described by Bull (1951) and weights for each of these cuts were taken.

Before cutting the halves into quarters the following carcass measurements were taken:

1. The length of the carcass was measured from tip of the aitchbone to the frontal edge of the first rib.
2. Total depth of the carcass, along the 6th rib.
3. The circumference of the carcass, measured around the half carcass in line with the 6th rib.
4. The circumference of the round, measured above the aitchbone around the thickest part.

5. The length of the longissimus dorsi muscle, measured at a cut made between the 12th rib and the 13th rib.
6. The depth of the longissimus dorsi muscle, measured from the same cut as 5 across the midpoint of the muscle.
7. The thickness of the fat over the longissimus dorsi muscle was taken directly over the midpoint of the muscle half way from the dorsal side.

The carcasses were graded according to the U.S.D.A. standards as described by Bull (1951) and a numerical value was assigned to each grade using the system of Kunkle (1959). Price values (LL per Kilogram) for each grade were then established from a base of LL 3.00 per Kilogram for utility grade and corresponding values were assigned to each of the other grades according to differentials established by Bull (1951) - see table 10.

To estimate the percentage of lean, fat and bone in the carcass was determined by the procedure developed by Hopper (1944). The 9-10-11th rib cut was taken from the wholesale rib on each side. The lean, fat and bone were then carefully separated from this cut and each component was weighed individually and recorded. Then the percentages of lean, fat and bone were calculated according to the formula and equations given by Hopper as follows:

1. $Y = 0.80173X + 15.71220$, for percentage of lean in the carcass.
2. $Y = 0.81774X + 2.27664$, for percentage of fat in the carcass.
3. $Y = 0.70750X + 3.47863$, for percentage of bone in the carcass.

Where X is the percentage of the particular component in the 9-10-11 rib cut and Y is the estimated percentage of that component in the whole carcass.

RESULTS AND DISCUSSION

Feed Lot Performance. The feed consumption, growth and efficiency data for the three different weight group of steers are shown in table 4. Group 3 made the highest daily gains and group 2 the least. These differences are statistically significant, as pointed out in table 5. The explanation for these differences was that at the first half of the feeding period the environment was unfavourable, especially in the months of December and January when the weather was noticeably changing from high temperature during the day to low temperature at night. This condition affected the animals by lowering the average daily feed intake and reduced the average daily gains. Group 3 made faster gain after the environment became favourable (less changeable weather) and they made up for the loss, while the other two groups were killed before the weather conditions settled down. Possibly another factor giving group 3 an advantage over the other two lots was the fact that a better balanced ration (ration VI) with a higher content of protein was available to them for a longer period of time. Group 2 had a longer exposure to the unfavourable weather than group1.

Table 4. Feed Lot Performance of the Three Groups of Steers

Comparison	Group 1	Group 2	Group 3
No. of steers	3	3	3
Av. feeding period, days	146.0	217.0	273.3
Av. initial weight, pounds	368.0	442.7	418.0
Av. daily gain, pounds	2.43	2.14	2.53
Av. total gains, pounds	354.0	465.3	692.0
Av. final weight, pounds	722.7	908.0	1110
Feed consumed (average per steer):			
Concentrate, pounds	1950	2935	3757
Alfalfa hay, pounds	193	311	466
Corn Stover, pounds	246	364	395
Tibin, pounds	246	364	570
Sugar beet, pounds[1]	313	313	313
Salt, pounds	8	10	12
Feed per 100 pounds gain (Average):			
Concentrate, pounds	551	631	546
Alfalfa hay, pounds	55	67	68
Corn stover, pounds	70	78	58
Tibin, pounds	70	78	82
Sugar beets, pounds[2]	30	23	15
TDN per 100 pounds gain (Average):			
Concentrate, pounds	380	437	378
Alfalfa hay, pounds	28	34	34
Corn stover, pounds	36	41	30
Tibin, pounds	28	32	34
Sugar beets, pounds	4	3	2
Total, pounds	476	547	478

1. Sugar beets on wet basis.

2. Sugar beets were calculated on their dry weight basis (1/3 wet weight)

As indicated in table 4, group 1 and 3 required less TDN per 100 pounds of gain. The mean difference tested by the use of the "t" test indicated that there was a significant difference (t 5 percent) in TDN requirements per 100 pounds of gain between the groups, group 2 required the most and groups 1 and 3 were about equal. From the data presented it is reasonable to assume that the reason for this low efficiency in group 2 was because they were exposed to the unfavourable environment more than group 1 and did not get opportunity to catch up as well as group 3.

However, when adjustments were made for differences in age of the cattle, those ranging from 290 to 350 days old required 476 pounds TDN per 100 pounds gain, those ranging from 350 to 425 days old required 505 pounds TDN per 100 pounds gain and those ranging from 425 to 482 days old required 519 pounds TDN per 100 pounds gain. The cattle of the lower ranges in age required less TDN per 100 pounds of gain but produced carcasses of lower grades and value per unit weight. Many workers have shown that as cattle become older and fatter more TDN or feed is required per pound of gain since the lay down of fat requires a high energy intake (Morrison, 1956; Snapp, 1958).

Table 5. Analysis of Variance of Average Daily Gains

Sources of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F	F at 5 percent level
Between groups	2	0.19	0.095	5.28	5.14
Errors	6	0.11	0.018		
Total	8				

Carcass Data. The carcass data for all three groups are shown in tables 6, 7, 8 and 9. To study the body development of the steers in each group carcass measurements were taken. The data in table 6 show the relative differences in development as to length of carcass, depth at 6th rib, circumference at 6th rib, circumference of round and size of the longissimus dorsi muscle. The difference in magnitude of the above carcass measurements seemed to be dependent upon the growth of the animals. The largest measurements for the parts mentioned above was obtained from the heavy weight group in all respects with the exception of the depth of longissimus dorsi muscle. This muscle depth was surprisingly low for medium and heavy weight group and comparatively higher for light weight group, a difference undoubtedly due to inherent individual variations.

There was no marked difference in dressing percentage among the three group of steers. The heavy weight group dressed 0.8 percent more than group 1 and 1.5 percent more than group 2.

There was a marked difference in grade between the three group of steers. The lowest carcass grades were found in group 1 while the highest grades were represented in group 3. The difference in grade between groups 1 and 3 was statistically significant (t 5 percent). There was a noticeable, but not statistically significant, difference in grade between group 1 and 2, and between group 2 and 3.

The yields of the fore and hind quarters were surprisingly similar in all three groups. There was very small difference in the fore quarters between group 1 and 3. The hind quarters were practically the same for all the three groups of steers.

Table 6. Carcass Measurements

Parts	Group 1	Group 2	Group 3
Av. length of carcass, inches	46.0	48.0	52.0
Av. depth at 6th rib, inches	22.0	23.8	24.3
Av. circumference at 6th rib in.	51.7	55.3	58.2
Av. Circumference of round, in.	39.0	40.3	42.7
Av. longissimus dorsi muscle:			
length, inches	5.2	5.4	5.5
depth, inches	2.8	2.7	2.5
fat thickness, inches	0.1	0.3	0.5

With the exception of flank, the percentage yields of the wholesale cuts of all group of steers were about the same in magnitude, There were small differences but not of economic significance. The heavier animals developed larger flanks, probably due to their higher degree of finish.

From the data presented it is reasonable to assume that there was a strong tendancy towards the same proportional development of all of the parts of the carcass in these three weight groups. Differences were due primarily to quality of meat and degree of finish.

Previous work has established the fact that the compo-sition of the 9-10-11th rib cut of the beef carcass is very closely related to the composition of the whole carcass (Hankins et al., 1943, 1946; Hopper, 1944). Estimates on lean, fat and bone composition in the carcasses from the steers used in this study are given in table 9. In general the results are in close agreement with those of Carroll et al., (1955) and Butler et al. (1956). However, there are rather large differences among the three weight groups studied.

The difference in percentage of lean in the carcass was statiscally significant (t 5 percent) between groups 1 and 3 and between groups 2 and 3; there was essentially no difference between groups 1 and 2.

The difference in percentage of fat in the carcass was significant (t 5 percent) between groups 1 and 3. There was a greater difference between groups 2 and 3 and a very small difference between groups 1 and 2.

The difference in percentage of bone in the carcass was significant (t 5 percent) between groups 1 and 3, and between groups 2 and 3.

Table 7. Slaughter Data by Weight Groups

	Group 1	Group 2	Group 3
Av. age, days	323.0	406.7	448.7
Av. live weight at slaughter, pounds	722.7	908.0	1110.0
Av. cold carcass weight, pounds (excluding kidney and kidney fat)	409.5	507.3	635.0
Av. dressing percentage	58.4	57.7	59.2
Av. carcass shrink, percent	2.2	2.4	2.5
Av. carcass grade[1]	2.9	2.6	2.0

1. See table 10 for the carcass grades used and table 12 for carcass grades of the individual steers.

Table 8. Average yields of the wholesale Cuts by Weight Groups.

	Group 1	Group 2	Group 3
Cold Carcass weight, pounds	409.5	507.3	635.0
Fore quarters, percent	53.3	53.9	54.0
Hind quarters, percent	46.7	46.1	46.1
Rounds, percent	25.0	24.8	23.2
Sirloins, percent	9.9	9.3	9.5
Short loins, percent	7.6	7.1	7.1
Ribs, percent	9.6	9.7	10.0
Chucks, percent	23.2	23.7	22.6
Fore shanks, percent	7.1	6.9	7.2
Briskets, percent	6.1	6.0	5.9
Plates, percent	6.7	7.6	8.4
Flanks, percent	3.4	4.5	5.9

NOTE: The yields of the various cuts are based upon the cold carcass weight.

Table 9. Average Physical Composition[1] of the Carcass from the Different Weight Groups

	Group 1	Groups2	Group 3
Percentage of lean in carcass	56.3	56.2	52.8
Percentage of fat in carcass	23.3	28.3	34.4
Percentage of bone in carcass	16.8	16.0	13.7
Total estimated lean in carcass, pounds	230.7	285.2	336.5
Total estimated fat in carcass, pounds	113.4	144.4	218.0
Total estimated edible meat in carcass, pounds	344.1	429.5	554.5

1. The physical Composition was calculated according to Hopper (1944).

The difference in yields of edible meat of the carcass was statistically significant (t 5 percent) between all group of steers. Group 1 yielded more lean and bone and less fat which affected the amount of edible meat in the carcass, while heavier weight groups yielded higher amount of fat which contributed to an increase in the amount of edible meat.

Marginal Return: Table 11 shows the average cost of production and the average value (per kilogram) of carcasses from the three groups. Group 2 had the highest cost of production due to lack of efficiency of gain. There was no significant difference in average cost of production per kilogram of carcass between groups 1 and 3.

The difference in carcass value (per kilogram) among the three groups is given in table 13. These differences in carcass values were due to the higher degree of finish and carcass grades of those in group 3, followed in order by group 2 and group 1 being the lowest (see table 7 and 12).

The cost of production, value of the carcass, and margins for the individual steers are found in tables 12 and 13. The marginal returns were markedly different for the three groups (statistically significant at the 5 percent level) as indicated by an analysis of variance given in table 14. The gross margins were: LL. 637.33, LL. 722.33 and 1270.14 for group 1, 2 and 3 respectively. Group 3 yielded LL. 632.81 over group 1 and LL. 547.82 over group 2, while the return of group 2 exceeded group 1 by LL. 84.99.

Table 10. Price Index for Different Carcass Grades Used in Calculating the Values of the Carcasses

Carcass Grades U.S.System	Numerical Grades	Carcass value (LL. per kilogram)
Top choice	1.0	
Av. choice	1.4	
Low choice	1.7	4.18
Top Good	2.0	4.05
Av. good	2.4	3.87
Low good	2.7	3.74
Standard	3.0	3.61
Top commercial	3.4	
Av. commercial	3.7	
Low commercial	4.0	
Utility	4.4	

<u>Note</u>: A base value of LL. 3.00/kilogram of beef carcass for utility grade was used to establish values for the other grades. For each 0.1 difference in numerical grade there was a corresponding difference of LL. 0.0437 per kilogram.

Table 11. Average Costs of Production and Carcass Values per Steer in each of the Weight Groups

	Group 1	Group 2	Group 3
Initial cost per steer, LL[1]	209.09	251.52	237.50
Feed costs per steer:			
Concentrates, LL	191.57	286.71	366.53
Alfalfa hay, LL	26.31	42.39	63.46
Corn stover, LL	15.65	23.11	25.14
Tibin, LL	17.89	26.42	41.40
Sugar Beets, LL	7.12	7.12	7.12
Salt, LL	0.30	0.39	0.45
Total, LL	258.84	386.15	504.11
Total cost per steer, LL	467.93	637.67	741.61
Total cost per kilogram of carcass, LL	2.44	2.68	2.49
Total carcass value, LL	680.37	878.42	1164.98
Value per Kilogram of carcass, LL	3.65	3.80	4.03

1. Initial costs per steer were established at LL 1.25 per kilogram live weight.

Table 12. Carcass Yields, Value of Carcass, Cost of Production and Margins for the Nine Steers.

Groups	1			2			3		
No. of steer	193	188	69	67	191	189	66	194	70
Grade	Standard	Low good	Standard	Standard	Standard	Low choice	Low choice	Top Good	Av.good
Numerical Grade	3.0	2.7	3.0	3.0	3.0	1.7	1.7	2.0	2.4
Carcass yield, Kilograms	181.23	195.50	181.64	225.45	223.86	242.41	299.09	284.09	282.73
Value of Carcass, LL	654.23	731.17	655.72	813.87	808.13	1013.27	1250.20	1150.57	1094.17
Production Cost of Carcass, LL	479.52	471.01	453.26	625.47	645.47	642.01	736.13	771.25	717.42
Margin, LL	174.71	260.16	202.46	188.40	162.66	371.26	514.07	379.32	376.75

Table 13. Yields of Carcass Lean, Fat and Edible Meat and their Cost of Production and Margins for the Nine Steers

Groups	1			2			3		
Yields	193	188	69	67	191	189	66	194	70
Weight of Carcass lbs.	398.7	430.1	399.6	496.0	492.5	533.3	658.0	625.0	622.0
Amt. of lean lbs.	223.3	240.9	227.8	282.7	295.5	277.3	348.7	325.0	335.9
Amt. of fat lbs.	107.6	124.7	107.9	143.8	113.3	176.0	223.7	218.8	211.5
Amt. edible meat, lbs.	330.9	365.6	335.7	426.6	408.8	453.3	572.4	543.8	547.4
Cost/kg. lean, LL	4.73	4.31	4.38	4.86	4.80	5.10	4.64	5.21	4.71
Av. cost/kg. lean LL		4.47			4.92			4.85	
Cost/kg. edible meat, LL	3.19	2.82	2.97	2.23	3.48	3.12	2.83	3.12	2.88
Av. cost/kg. edible meat LL		2.99			3.28			2.94	
Value/kg. Carcass, LL	3.61	3.74	3.61	3.61	3.61	4.18	4.18	4.05	3.87
Cost/kg. Carcass, LL	2.57	2.33	2.43	2.69	2.80	2.55	2.40	2.60	2.46
Margin/kg. Carcass, LL	1.04	1.41	1.18	0.92	0.81	1.63	1.78	1.45	1.41

Table 14. Analysis of Variance for Marginal Values of the Nine Steers

Source of Variation	Degree of freedom	Sum of Squares	Mean of Squares	F	F 5 percent
Between Groups	2	78,638.5	39,319.3	5.61	5.14
Errors	6	42,022.6	7,003.8		
Total	8				

However, because of the limited number of steers in this experiment, the author suggests that additional studies be done along this line in the near future with more steers in each group.

Assuming that the offal, viscera (liver, lungs, kidneys, kidney fat, heart, stomach, intestines, spleen and visceral fat), hide, head and manure pay the cost of housing, equipment, labour, management, processing, storing, marketing, interest on investment, the margins shown in this study are considerably large for a beef producing enterprise. Margins of these magnitudes would also require very careful processing procedures and marketing techniques in the Near East Area to be realizeable.

SUMMARY AND CONCLUSIONS

Eight steers and one free-martin heifer of Holstein Friesian and Holstein Friesian X Baladi breeding were fed out at the American University ofBeirut Farm and slaughtered in three groups of three cattle each at final weights close to 700 pounds, 900 pounds and 1100 pounds. The average initial weights were 368 pounds, 443 pounds and 418 pounds and the feeding periods, 146 days, 217 days, and 273 days respectively for the three groups. These cattle received the same fattening ration made up from locally available feeds for the most part and balanced with imported protein concentrates. After slaughter the feedlot performance, carcass yields, and carcass value were determined for each animal. The slaughtering, and cutting of the carcasses into the wholesale cuts, were done according to standard procedures used by largest packing plants in the United States. U.S.D.A. beef grading standards were used to establish carcass grades and relative carcass values. Estimates of the total yield of lean, fat and bone in each carcass were made from the physical separation of each of these tissues from the 9-10-11 rib cut according to the techniques of Hopper (1944).

The following results were obtained from this study:

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Eight steers and one free-martin heifer of Holstein Friesian and Holstein Friesian X Baladi breeding were fed out at the American University ofBeirut Farm and slaughtered in three groups of three cattle each at final weights close to 700 pounds, 900 pounds and 1100 pounds. The average initial weights were 368 pounds, 443 pounds and 418 pounds and the feeding periods, 146 days, 217 days, and 273 days respectively for the three groups. These cattle received the same fattening ration made up from locally available feeds for the most part and balanced with imported protein concentrates. After slaughter the feedlot performance, carcass yields, and carcass value were determined for each animal. The slaughtering, and cutting of the carcasses into the wholesale cuts, were done according to standard procedures used by largest packing plants in the United States. U.S.D.A. beef grading standards were used to establish carcass grades and relative carcass values. Estimates of the total yield of lean, fat and bone in each carcass were made from the physical separation of each of these tissues from the 9-10-11 rib cut according to the techniques of Hopper (1944).

The following results were obtained from this study:

1. Those cattle fed out to 1100 pounds live weight made more efficient gains than those fed to 900 pounds (69 pounds TDN less per 100 pounds gain). There was no significant difference in efficiency of gain between the group slaughtered at 700 pounds and those finished at 1100 pounds. These results do not present a true picture of the situation since the 900 pound group were exposed to rather adverse feeding conditions in this study for a longer period of time than the 100 pound group and probably the efficiency was the same for all groups.

2. The average daily gains were practically the same for all three groups when one takes into consideration the disadvantages imposed upon the 900 pound group.

3. The 1100 pound steers dressed out (had a higher dressing percentage) a little higher than the other two groups due to a higher degree of finish.

4. The yields of the various wholesale cuts (based upon the percentage of the cold carcass weight) were essentially the same for all weight groups, except that the 1100 pound steers produced markedly heavier flanks.

5. The carcasses from the 700 pound group yielded the highest percentage of pure lean and those from the 1100 pound group the lowest percentage. Conversely, the 1100 pound group had the highest percentage of fat and the 700

pound group the least. The difference in the former case amounted to only 3.5 percent and in the latter case, 11.1 percent. The 1100 pound steers produced the highest proportion of edible meat, 87.2 percent, the 900 pound group, 84.5 percent, and the 700 pound group 79.6 percent.

6. There was a marked difference in bone content of the carcasses between the light weight steers and the heaviest group, 16.8 percent in the former case and 13.7 percent in the latter.

7. When the carcasses were graded, there were two of the standard grade and one low good carcasses among those slaughtered at 700 pounds, two standard and one low choice carcasses among those slaughtered at 900 pounds, and two good, one low choice carcasses in the 1100 pound group. Based upon a value of LL 3.00 per kilogram of carcass in the utility grade, those in the 700 pound group would average LL 3.65 per kilogram, in the 900 pound group the average value would be LL 3.80 per kilogram, and LL 4.03 per kilogram would be the value for those in the 1100 pound group.

8. For all practical purposes the carcasses from all weight groups cost approximately the same (LL 2.54 per kilogram) on the unit weight basis, except for the 900 pound group which had a longer exposure to poorer feeding conditions.

The margins between cost of production and carcass value per kilogram of carcass were in the following order: the 1100 pound cattle with LL 1.54, the 900 pound cattle LL 1.12, and those in the 700 pound group LL 1.21. In total effect if the carcasses were to be sold on a quality and yield basis the three 1100 pound steers would yield LL 547.82 over those slaughtered at 900 pounds and the latter would have brought LL 84.99 over the light weight group.

9. The general results of this study have shown that there could be a very profitable enterprise in the Near East Area in fattening surplus cattle from the dairy industry where Friesian cattle are being used, and where cattle are carried to much heavier weights than are commonly considered final, and where meat can be properly processed and sold on a quality basis.

BIBLIOGRAPHY

1. Andrews, F.N., T.W. Perry, Martin Stop and W.M. Beeson 1958. The effects of diethylstilbestrol, testostrerone and reserpine on growth and carcass grade of lamb. Jour. An. Sci. 17: 157.

2. ______. 1956. The oral administration of diethylstilbestrol, dienestrol and hexestrol for fattening calves. Jour. An. Sci. 15: 685.

3. Beeson, W.M., F.M. Andrews, Martin Stop and T.W. Perry, 1956. The effect of oral estrogens and androgens singly and in combination on yearling steers. Jour. An. Sci. 15: 679.

4. Buckalew, J.M. and Merrilan, 1955. Growth and rate of gain of calves and in-vitro metabolism of liver and thymus tissue as effected by antibiotics. Res. Bul. 596, pps. 24.

5. Bull, Sleeter. 1951. Meat for the Table. McGraw-Hill Company, Inc. New York.

6. Burris, M.J., R. Bogart and A.W. Oliver. 1953. Alteration of daily gain, feed efficiency and carcass characteristics in beef cattle with male hormones. Jour. An. Sci. 12: 740.

7. Burroughs, Wise, C.C. Culbertson, Edmund Cheng, W.H. Hale and Paul Homever. 1955. The influence of oral administration of diethylstilbestrol to beef cattle. Jour. An. Sci. 14: 1015.

8. Butler, O.D., B.L. Warwick and T.C. Cartwright. 1956. Alaughter and carcass characteristics of shortfed yearling, Hereford and Brahman-Hereford steers. Jour. An. Sci. 15: 93.

9. Carroll, F.D., W.C. Rollins and N.R. Ittner, 1955. Brahman-Hereford crossbreeds and Herefords gains, carcass yields and carcass difference. Jour. An. Sci. 14: 218.

10. Crampton, E.W. 1956. Applied Animal Nutrition. W.H. Freeman and Co., San Francisco.

11. Dahmen, J.J. and Ralph Bogart, 1952. Some factors affecting rate and economy of gains in beef cattle. Oregon Agr. Exp. Sta. Tech. Bul. 26.

12. Dawson, W.H., R.W. Phillips andW.H. Black. 1947. Birth Weight as a criterion of selection in beef cattle. Jour. An. Sci. 6: 247.

13. Dawson, W.M., T.S. Yao and A.C. Cook, 1955. Heritability of growth, beef characters and body measurements in milking shorthorn steers. Jour. An. Sci. 14: 208.

14. Hankins, O.G., B. Knapp Jr., and R.W. Phillips, 1943. The muscle-bone ratio as an index of merit in beef and dual-purpose cattle. Jour. An. Sci. 2: 42.

15. Hankins, O.G., and P.E. Howe, 1946. Estimation of the composition of beef carcasses and cuts. U.S.D.A. Tech. Bul. 926.

16. Henerickson, R.L., G.V. Odell, W.J. Costello and H.W. Reuber, 1960. Chlorpromazine residues in beef tissues. Jour. An. Sci. 19: 26.

17. Hess, Carl W. and Morley A. Jull, 1948. A study of the inheritance of feed utilization efficiency in the growing domestic fowl. Poultry Sci. 27: 24.

18. Hopper, T.H. 1944. Method of estimating the physical and chemical composition of cattle. Jour. Agr. Res. 68: 239.

19. Kesler, E.M. 1954. Effect of terramycin fed Holestein calves on growth in-vitro cellulose digestions and B-vitamin synthesis. Jour. An. Sci. 13: 10.

20. Klosterman, E.W., L.E. Kunkle, Paul Gerlaugh and V.R. Cahill, 1954. The effect of age of castration upon rate and economy of gain and carcass quality of steer calves. Jour. An. Sci. 13: 817.

21. Knapp, Bradford Jr., and Arne W. Nordskoq. 1946. Heritability of animal scores, grades and certain carcass characteristics in beef cattle. Jour. An. Sci. 5: 194.

22. ______. 1946. Heritability of growth and efficiency in beef cattle. Jour. An. Sci. 5: 62.

23. Knapp, Bradford Jr., and R.T. Clark, 1947. Genetic and environmental correlations between growth rates of beef cattle at different ages. Jour. An. Sci. 6: 174.

24. ______. 1950. Revised estimates of heritability of economic characteristics in beef cattle. Jour. An. Sci. 9: 582.

25. Knapp, Bradford Jr., W.V. Jambert and W.H. Black, 1940. Factors influencing length of gestation and birth weight in cattle. Jour. Agr. Res. 61: 277.

26. Kock, R.M., K.E. Gregory, J.E. Ingalls and V.H. Arthand, 1959. Influence of hormone implants on gains made on native pastures and in the feed lot, and on carcass characteristics of yearling steers. Jour. An. Sci. 18: 1010.

27. Kunkle, L.E. and V.R. Cahill, 1959. Evaluation of dairy beef carcasses (Part II Ohio Agr. Exp. Sta. Res. Bul. 833, pps. 34.

28. Mackay, A.M., W.H. Riddell and R. Fitzsimmons, 1953. Terramycin supplement for dairy calves. Jour. An. Sci. 12: 19.

29. Maynard, L.A. 1947. Animal nutrition. McGraw-Hill Book Co., Inc., New York.

30. Morrison, F.B. 1956. Feeds and Feeding, 22nd Ed. Morrison Pub. Co. Ithaca, New York.

31. Nehms, G.E. and Ralph Bogart, 1956. The effect of birth weight, age of dam and time of birth on suckling gains of beef calves. Jour. An. Sci. 15: 662.

32. Nehms, George and Ralph Bogart, 1955. Some factors affecting feed utilization in growing beef cattle. Jour. An. Sci. 14: 970.

33. Perry, T.W., W.M. Beeson, E.C. Hornback and M.T. Mohler, 1954. Aureomycin for growing and fattening beef animal. Jour. An. Sci. 13: 3.

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

35. Sherman, W.C., W.H. Hale, W.M. Reynolds and H.G. Luther. 1957. Nutritional use of tranquilizers in cattle and lamb rations. Jour. An. Sci. 16: 1020 (abstract).

36. ______. 1959. The effect of tranquilizers, diethylstilbestrol and oxytetracycline alone and in combination on performance of steers. Jour. An. Sci. 18: 198.

37. Simone, M., M.T. Clegg and F. Carroll, 1958. Effect of methods of stilbestrol administration on quality factors of beef. Jour. An. Sci. 17: 834.

38. Snapp, R.R. 1958. The importance of age in growth and fattening beef cattle pps. 228-237. John Wiley & Sons, New York.

39. Thomas, H.J. and W.L. Williams, 1954. Nutritional effects of antibiotics. Fine Chemical Technical Bul. 3, pps. 48.

40. Tyler, W.J., George Hyatt, A.B. Chapman and G.E. Dickerson, 1948. The heritability of body size of Hollstein-Friesian and Ayrshire cattle. Jour. An. Sci. 7: $16. (abstract).

41. Warwick, B.L. and T.C. Cartwright, 1955. Heritability of rate of gain in young and growing beef cattle. Jour. An. Sci. 14: 363.

42. Winters, L.M. 1958. Animal Breeding, pps. 94-101. John Wiley & Sons, New York.