STUDIES ON BEEF PRODUCTION IN THE MIDDLE EAST

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ABSTRACT

- I -

Twelve steers, corrected to an average weight of 333.3 lbs., were fed to a finish of about "Good +" and processed into the regular U.S. wholesale cuts.

The proportions of lean, fat and bone in each carcass were determined according to the method described by Hopper (1944).

Feed consumption was calculated in terms of Total Digestible Nutrients for each steer when arriving at 1,000 lbs. weight, and as consumed up to slaughter-time.

Whereas no change in rate of gain was observed, the TDN requirements appeared to increase with a prolonged feeding period.

The rate of TDN conversion into liveweight, dressed weight, and edible portion was calculated.

No marked associations were observed among most of the traits recorded. Fat percentage and bone percentage exhibited definite positive and negative associations with carcass grade, respectively.

ABSTRACT

- II -

Two groups, comprising five calves each, were subjected to a comparison as to their performance on the 12th of August, 1961. One group was fed a standard conventional concentrate mixture with alfalfa-hay and corn-fodder for roughages. The other group was fed a concentrate mixture with urea as a partial replacement for the standard protein-supplement, and only wheat straw for roughage. All feed was offered to both groups in equal amounts.

The "urea-fed" group exhibited greater fluctuations in growth-rates and in conversion-efficiency in both roughages and concentrates. Although both groups were observed to start-off on relatively lower rates of gain and conversion,--as was actually expected, since both groups were as yet unadjusted to their respective rations,--the group kept on the urea-supplemented ration showed a much lower efficiency (29.2%) during the first 24 days than the control-group.

The results of 144 days in the feedlot showed 12.5% higher gains in the control group. This trend was maintained throughout the total feeding period, except for very slight advantages in favor of the "urea-fed" group in the course of the second and third phase (60 + 32 = 92 days).

The urea-supplemented ration made for greater economy during the whole 144 day period, and even more so during the first 116 days, than the standard ration.

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INTRODUCTION

Traditionally, Middle Eastern consumers prefer mutton to beef. This is substantiated by the fact that the retail price of mutton is about twenty five percent higher than that of beef. Basically this price differential is a measure of variation in meat quality as judged by consumer preference.

In Lebanon, until very recently, all beef in a given place sold at one price, irrespective of quality. Since some time, however, consumers began to demand and show willingness to pay higher prices for improved beef. This trend is a normal one, as the per-capita income rises and population numbers mount with a simultaneous trend towards urbanization. Another factor is the increasing use of refrigeration and more efficient methods in meat processing, retail handling and distribution. Lastly, the impact of beef-consuming foreigners in the area may well induce a greater appreciation for high quality beef.

It is now commonly accepted that there are wide inherent differences in cattle characteristics such as milking and gaining ability. Several breeds and crosses are available in Lebanon for drylot feeding, but they are of either dairy or dual purpose characteristics. Thus, the first study was conducted to determine the proportions of the various carcass components and wholesale cuts in such animals.

The high expense of feedstuffs in Lebanon,--especially of high--quality roughages--, makes the beef industry a marginal proposition. Moreover, much of the protein supplements required have to be imported, which in turn, further increases expenses. Thus, the second study was conducted to determine the value of Urea as a partial protein-replacement in combination with a locally available, inexpensive, low quality roughage, like wheat straw.

REVIEW OF LITERATURE

The systematic exploration of the knowledge on population genetics and its application to animal improvement has made available effective and efficient mating systems and selection techniques. However, suitable selection criteria must still be developed if these improved breeding plans are to be fully exploited by beef breeders.

One of the major handicaps in the improvement of beef carcasses is the lack of an accurate method of measuring carcass-traits in live animals.

Measurements such as weaning-weight and--grade, rate and efficiency of gain, weight at the end of the feeding--period, and slaughter-weight and--grade have been found important criteria in performance studies (Black and Knapp, 1938).

In addition, certain linear body measurements have been investigated to ascertain changes during growth and fattening (Kidwell, 1955).

A number of investigators (Yao et al., 1953; Good et al., 1961; Kidwell et al., 1955) have reported, that width, depth and circumference measurements of the live animal reflect the degree of finish in the carcass.

Although many workers found that the so-called "Fleshing

Measurements" (width, depth, circumference) are directly related to grade and dressing percentage, only a limited amount of work (White and Green, 1952; Orme et al., 1959; and Green et al., 1955), relating carcass measurements to detailed carcass traits is on record .

Some Factors Influencing Quality In Beef

The gross structure of carcasses and cuts consists of the lean, or muscular tissue; the fat inbedded in, between, or over the muscles; the connective tissue which holds the body together; and the bone or framework.

Such fat as accumulates around some of the internal organs is of minor importance to the consumer. Fat deposited in the connective tissue around the muscles is of value to the housewife. The most important fat deposit, however, is found in the fine network of connective tissue, which binds the muscle fibers together and which is known as "Marbling". It adds greatly to the tenderness of a cut and enriches its flavor. Since it usually is the last adipose tissue formed, animals must be quite fat or "well finished" in order to exhibit the proper marbling.

Wilson et al. (1954) found no consistant increase or decrease in collagen associated with grade or amount of intramuscular fat, Rather, a significantly greater amount of collagen and elastin (50%) was found in the veal than in cow or steer-samples. This is contrary to the common belief (Bull, 1951) that the amount of collagen increases with age and accounts for much of the increase in toughness.

Since a number of workers have demonstrated that differences in tenderness between muscles of the same carcass are related to their collagen content, "It might be postulated that the more hydrated connective tissue in veal would be more easily hydrolized during cooking and therefore have less effect upon the tenderness of the meat" (Wilson et al., 1954).

Hiner et al. (1952) found that with progressing age there was a consistant increase in the average diameter of muscle fibers.

The degree of finish greatly contributes to the grade and subsequent price of beef. This criterion is measured by the fat-cover of the carcass and the degree of marbling. Results (Simone et al., 1958) indicate that differences in tenderness, juiciness and flavor became more apparent with increasingly wider differences in degree of finish and carcass-grade. The relationship of percent carcass--fat with quality--scores did not reveal striking correlations. Flavor, however, seemed to be associated with intramuscular fat; hence, the fat percentage in the eye-muscle correlates better than total carcass-fat with tenderness and flavor. This being in agreement with the finding of Cover et al. (1956).

The area of loin-eye is an objective measure for lean meat or muscle-content of a carcass, and beef breeders are fortunate that the heritability for rib-eye is one of the highest for all traits.

Magee et al. (1958) reported a positive correlation between area of rib-eye muscle and carcass grade. Butler et al. (1956) found a slightly larger area in the left longissimus dorsi, as measured at the 12th rib, and also in the lumbar region, but suspects a variation in technique rather than a real difference in muscular development.

Blumer and Fleming (1959) developed an objective method to estimate the amount and degree of fineness of marbling in the rib-eye muscle by the use of a counter,--normally used in plate-counting of bacterial colonies,--to measure fat deposits. They found ether-extracts of the samples to be highly correlated with the number of fat-deposits and the area of fat per square inch of rib-eye muscle.

Orme et al. (1958) reported that the high relationships between specific gravity and fat indicates the usefulness of the specific gravity as an objective measure of marbling.

Feeding sugar to animals shortly prior to slaughter was reported to significantly influence results, this being dependent on both time and amount of sugar fed.

Wilcox et al. (1952) reported that two pounds of sugar, fed over three days, resulted in slight increases in dressing percentage, in carbohydrate content and in improvement in color of the muscles, but had no effect on tenderness, texture, or flavor.

Bohman and Wade (1958) reported slight increases in body-fat by increasingly higher levels of fat consumed by steers, while Wiley et al. (1952) found high fat-levels in rations of steers to induce a lower percent of fat in the 9-10-11th rib-cut, and a higher percent of lean than in the control. Feeding high levels of energy seemed to have no bearing upon body-fat, though it made a very slight improvement in carcass-grade.

Investigators have developed several methods to study the composition of beef carcasses. Physical separations of wholesale carcasses, half-carcasses, and of wholesale rib-cuts into lean, fat and bone have been performed, but proved to be tedious, time -consuming, wasteful, expensive and thus impractical.

Organic solvents have been employed to extract the fat. However, efforts to develop a more accurate and practical estimation method did not cease: Lush (1926) found that:

1) The percentage of offal-fat/liveweight was the most reliable single indicator of fatness.
2) Dressing percentage was quite reliable where wide ranges of fatness were to be compared.
3) A combination of dressing percentage and of offal-fat/liveweight was recommended as the most reliable indicator of fatness in groups of cattle.
4) The percentage of bone in dressed meat was negatively correlated with dressing percentage to a very high degree. He, moreover, formed prediction equations, but admitted that the

percentage of fat in the wholesale rib-cut is more accurate in indicating the degree of fatness of the entire animal than any of the other indicators studied.

Hopper (1944) developed a set of prediction formulae employing the percent-values of fat, lean and bone derived from the physical separation of the 9-10-11th rib-section. This method proved to combine practicability with a fair amount of accuracy.

Recently Orme et al. (1959) found that both cannon-bone measurements and radiographs of the lumbar vertebrae are related to muscling; however, the relationships were not high enough to be useful for predictive purposes.

1) Breeding and Heritability as Quality Factors:

Knapp and Clark (Bennett and Mathews, 1955) reported the following values for heritability: Birth weight = 53 %; Weaning weight = 28 %; Final feedlot-weight at 15 months = 85 %; Gain on feed = 65 %; Carcass grade = 33 %; Slaughter steer-grade = 45 %; Area of rib-eye muscle = 68 %.

Koger and Knox (1952) established a value of over 30 % heritability for grade and type in beef cattle upon their study on 1,257 range Hereford calves and their dams, which is in agreement with the estimates of Magee et al. (1958) and of Snapp and Neumann (1960).

Kidwell and McCormick (1956) found that in the Holsteins,--in contrast to the Herefords,--grade is highly associated with weight. Fatness was the critical factor in determining carcass grade in the Holsteins, but in the Herefords,--since all were well finished,--conformation assumed a more important role. The authors, moreover, indicate that dressing-percentage is highly associated with grade in the Holsteins, but not in the Herefords. The former were found to have significantly less rib and plate, but more chuck and round than the latter.

Cross-bred steers (Hereford/Brahman) were heavier at slaughter, yielded a heavier carcass, and dressed-out at 62% compared to 59 % for the Herefords, (Butler et al., 1956).

Cover et al. (1957) observed that breeds and sires, when considered together, lend support to the hypothesis that the heredity of the animal influences both the juiciness and tenderness of the meat.

2) <u>Sex, Birthweight, Age and Rate of Gain</u>:

Several investigators (Nelms and Bogart, 1955; Klosterman et al., 1955; Haring, 1960; Bennett and Mathews, 1955) reported higher birth-weights, higher gains, and higher efficiencies in bulls than in steers and heifers.

Bennett and Mathews (1955) found a significant effect of birth-weight upon rate of gain, which resulted in a negative regression on its efficiency; but Woodward et al. (1954) and Kohli et al. (1951) found it to have no effect upon carcass quality and very little relationship with "Fleshing Qualities".

Snapp and Neumann (1960) stated that faster gaining steers outgraded slower gainers and that heifers acquire a satisfactory finish a few weeks earlier than steers. In contrast, Callow (1950) observed that young animals fatten more slowly than old ones, and that in steers over two and a half years of age 71 % of the increase in carcass-weight was due to chemical fat and only 4.45 % to protein, as compared to 38 % and 10.66 %, respectively, in younger steers.

Results of Kunkle et al. (1954) and of Herschberger et al. (1951) demonstrated that even though bulls gained faster, they were not as well finished at the time of slaughter. It was largely due to this fact that their carcasses yielded higher proportions of lean meat.

3) Castration:

Kunkle et al. (1953) found a higher percent of head, hide and bone in entire males than in steers. In another study (1954) the same workers found no significant differences between early (1 month) and late (7 months) castrated steers in rate and efficiency of gain in the feedlot, dressing percentage, or carcass quality.

The average carcass grade was consistantly highest in the castrated lot, but the edible portion (77 %) of the bull-carcass exceeded the 73-74 % edible portion yield of the steer-carcass.

Eating quality of the bull beef was acceptable (Kunkle et al., 1954). Furthermore, Haring (1960) mentions that, in Germany, young bull-carcasses bring a higher price than those of steers.

Administration of Synthetic Hormones and Antibiotics

It is well recognized that stilbestrol, whether administered daily in the feed, or implanted as pellets, will result in increased gains and efficiencies in beef animals.

Most investigators (Andrews et al., 1954; Klosterman et al., 1955) agree that the subcutaneous implantation of 60 mg. of stilbestrol will result in a reduction of carcass-grade in steers, cows and heifers, a rise in the carcass-grade in bulls (Klostermann et al., 1955; Cahill et al., 1954), an improvement in appetite, an increase in mammary gland development, an elevation of the tail head in steers and heifers, and a 25 % incidence of vaginal prolapse in heifers (Snapp and Neumann, 1960).

Although no significant differences in dressing percentage between treated bulls, steers and heifers were observed (Klosterman et al., 1955; Snapp and Neumann, 1960), bulls had significantly lower carcass yields than steers (Cahill et al., 1954). In both studies stilbestrol implantation appreciably increased the carcass grades in bulls, but lowered the carcass grades in steers.

Clegg and Carrol (1954) and Snapp and Neumann (1960) reported a smaller percentage of fat in contrast to a greater percent of lean and a greater eye-muscle area in the treated animals. Koch et al. (1959) found no difference in eye-muscle area, and work by Bohman and Wade (1958) showed no effect of stilbestrol implantation on the physical composition of the 9-10-11th rib-section.

Koch et al. (1959), comparing implants of stilbestrol, progesterone, estradiol, and testosterone found no significant differences in rate of gain, rib-eye-area, fat thickness, or dressing percentage upon comparison of the various treatments.

Steers which received a total dose of 225 mg. of testosterone propionate did not gain as rapidly as the controls (Andrews et al., 1954) in contrast with the report of Burris et al. (1953) that testosterone produced a slight increase in rate of gain of steers and heifers (using a much higher level of the preparation--1 mg. per kg. body weight--and injected subcutaneously rather than implanted).

Andrews et al. (1954) also found an improvement in efficiency with dienestrol pellets at a rate of 80 mg. per steer.

Burris et al. (1953) failed to stimulate any change in rate of gain, or carcass characteristics by the use of weekly intramuscular injections of methyl androstendiol.

On the other hand, it has been reported that the oral administration of stilbestrol at the daily rate of 10 mg. does not lead to some of the undesirable results observed in conjunction with implantation, and described above.

Gains for both, 10 mg. fed--and 15 mg. implanted--animals were comparable over 150 days (Clegg and Carrol, 1957), but the growth increase of "implanted" cattle was less than that of the "fed" cattle during the subsequent periods. The average percent of fat, lean, bone, moisture and ether extract, and the eye-muscle area were essentially identical. The same workers found, however, that the implantation of 30-60 mg. resulted in an average increase of about 10 percent in daily gain, 10 percent in feed efficiency and a slight reduction in carcass-grade if compared with animals fed stilbestrol.

Kastellic et al. (1956) were unable to find any consistent relationship between carcass composition and dosage.

Perry et al. (1955), on feeding stilbestrol, observed an increased teat-length, some elevation of the tail head, and a relaxation of the lumbar vertebrae.

Before the practice of stilbestrol administration to cattle could be recommended for general application in the supplementation of feeds, it was necessary that the edible and inedible tissues be critically examined with respect to the possible presence of estrogenic residues. Experiments have demonstrated minor amounts of such residues in tissues of stilbestrol-implanted cattle (Stob et al., 1954). Recently, Perry et al. (1955) and Turner (1956) reported no estrogenic activity in the tissues of beef cattle fed synthetic estrogens, in contrast to Stob's finding (1956) of estrogenic residues in muscles, kidney fat, intestines and livers of cattle treated orally with stilbestrol and dienestrol; hexestrol residues only being detected in kidneys and kidney fat.

Feeding antibiotics (chlortetracycline) along with hexestrol improved the appetite of the animals, raised their feed efficiency and their rate of gain with very little difference in their carcass grades (Beeson et al., 1957).

The meat from cattle fed the female hormone alone,--or in combination with antibiotics--, contained significantly less fat and more protein than meat from antibiotic-fed steers and controls. This is contrary to Bohman and Wade's (1958) report according to which neither chlortetracycline nor stilbestrol had any effect on the physical composition of the 9-10-11th rib-cut.

Stob et al. (1956) found that the oral administration of chlortetracycline in combination with hexestrol had no apparent effect on the degree of residual estrogenic activity in the meat of treated cattle.

The inconsistant response to antibiotics makes the value of this additive still doubtful.

Body Measurements

A number of studies utilized body measurements in an attempt to devise quantitative measures of conformation, production and carcass traits.

Several investigators (Good et al., 1961; Yao et al., 1953; Kidwell, 1955; and others) agreed that:

1) The width and circumference measurements were positively correlated with slaughter-grade, carcass--grade and dressing--percent, and could be called "Fleshing Measurements".
2) The hight and length measurements were negatively correlated with slaughter-grade and could be called "Skeletal Measurements".

Yao et al. (1953) found hight at withers, length of body, width of chest, circumference at the navel and width of muzzle as most representative measurements for hight-, length-, width-, circumference-, and head-measurements, respectively.

Willey et al. (1951) claims that the most important measurements for high dressing percentage and meat value are a large heart-girth in connection with a shallow chest, a wide loin and a large flank-girth, a small paunch-girth, a head narrow at eye-level and a short hight over the hips. This is in agreement with descriptions of Kidwell (1955), Cook et al. (1951), Yao et al. (1953), and Kohli et al. (1951).

Good et al. (1961) showed that the width of muzzle, width between the eyes and circumference of round have a significant positive correlation with the area of the loin-eye-muscle and dressing percent, but a negative correlation with marbling and fat-cover over the 12th rib.

Orme et al. (1959) reported, that steers with larger body circumference, those with wider rumps and heavier steers tended to have larger rib-eyes, while the steers with a larger leg circumference above the hock tended to have smaller rib-eyes.

White and Green (1952) found a high correlation between weights of wholesale cuts and length measurements, though depth- and width-measurements were, -as a rule-, more highly correlated with the weight of the cut. They conclude, that the actual weight of the parts of the live beef-type animals from which wholesale carcase cuts are derived, can be predicted with considerable accuracy by the use of body measurements. Also, Orme et al. (1959) reported high relationships of live animal weights and various live animal measurements to such wholesale cuts as chuck, rib, shortloin, and sirloin plus round.

Green et al. (1955) found a number of cuts to be statistically significantly correlated, among them some structurally independent ones. The slaughter grade remained appreciably correlated with only the short plate and flank.

Kidwell and McCormick (1956) found a significant negative correlation between percent round and grade in Holstein cattle.

Animals of larger mature size have a longer period of essentially straight-line post-weaning growth. There is a greater rate of increase during this period than in animals of a smaller mature size. At equal weights, animals of greater mature size will tend towards a greater proportion of bone and muscle and a smaller proportion of fat, when fullfed for an equal period not permitting both groups to reach mature weights.

Comparing "comprest" and "regular" type Herefords, Willey et al. (1951) found that the difference in gains in the feedlot was highly significant in favor of the "regular" steers: 112 days on fattening rations were enough to finish the "comprest" steers, compared to 173 days required for the "regular" type. In both growth and fattening phases, the "regular" steers had a slight advantage in feeding efficiency, though no difference in dressing percent nor any significant differences in carcass composition were observed. Results obtained by Stonaker et al. (1952) showed that "comprest" type Hereford steers gained as efficiently per unit of feed consumed as did the "regular" steers, though they exhibited a significantly lower rate of gain and slaughter-weight. "Regular" steers dressed 1 % higher, but an almost identical composition of the carcasses of the two types was found. As confirmed by results of Butler et al. (1956), similar percentages of major cuts were demonstrated.

Small steers had quite yellow fat, compared to larger steers. The medium size were intermediate in coloration (Herschberger et al., 1951). Large type carcasses appeared slightly more wasteful than medium and small type ones. The meat from the large type was least tender, the medium type being the most tender, as was established on the 3rd and 15th day, post mortem.

On the other hand, Knox (1957) stated, that while the only advantage established for the "comprest" type is the ability to fatten at lighter weights, large-type cattle have distinct advantages, especially in regard to the numerous fixed costs of production that tend to decrease when spread out over the greater production of larger cattle.

Results of Butler et al. (1956), indicating a strong tendency towards proportional development of bone and muscling among steers of about the same age, reflect doubt on the importance of compactness as a standard characteristic in grading beef carcasses.

A tendency towards a negative genetic correlation between milk and meat production seems to exist in British dual-purpose breeds.

Mason (Haring, 1960) found negative correlations between daily gain of bulls and milk yield of related cows of -0.2 to -0.6 in dairy Shorthorns. This is contrary to his own finding of a positive correlation of +0.3 between hight at withers and milk yield at Danish progeny testing stations, (hight at withers being used as a measure of growth capacity).

Urea-Supplementation in Beef Rations

The amount of urea which can be utilized by ruminants, or the amounts of protein which can be replaced by urea, has been found to depend largely upon:

1) The amount and nature of true protein contributed by the ingredients of the ration.
2) The amount and kinds of carbohydrates in the ration, and

3) The toxic level of urea.

Factors such as age, amount of certain minerals present and others may be of various effects.

1) The Effect of Protein

The level of protein in a medium inoculated with rumen microorganisms tends to influence the rate of conversion and amount of urea into protein, in vitro.

In vivo experiments showed, that although some urea was converted to protein when the crude protein content of the basal ration was 20-24 %, the utilization of urea-nitrogen decreased decidedly as the crude protein content of the concentrate mixture was increased above 18 %; this even in the presence of a fermentable carbohydrate (Mills et al., 1942; Reid, 1953). When a basal grain mixture, (50 % corn & 50 % oats), not supplemented with protein-meals was fed, increasing additions of urea to a level of 4.5 % were utilized efficiently. This combination of urea, corn and oats represented a concentrate mixture of about 23 % protein-equivalent.

Upon in vivo experiments, McDonald (Reid, 1953) demonstrated that large amounts of amonia are formed from casein and gelatin, but that sein addition caused no change in the amonia content of the rumen liquor. When casein was added to a ration made up of timothy hay, starch and urea, the utilization of the latter was markedly reduced (Mills et al., 1942). It is noteworthy that gelatin is water soluble and readily hydrolized by proteinases, while sein is not soluble in water and resists proteolysis. There is a possibility that in rations containing insoluble proteins, the amount of amonia formed from the protein may be insignificant, favoring a more efficient utilization of urea.

In in-vitro comparisons of urea with protein meals, (soybean, linseed, cottonseed and corn gluten meals) used for ruminants, Belasco (1953) reported the superiority of urea as a nitrogen source in promoting cellulose digestion by rumen microorganisms and concluded that high availability of nitrogen to rumen bacteria is the key to efficient cellulose digestion.

Gallup et al. (1954) found more efficient utilization of nitrogen in soybean-oil-meal incorporated into high molasses-ration, than that of urea; and Thomas et al. (1953) saw no difference in gains in animals fed either where phosphorus was adequate.

2) <u>The Effect of Carbohydrates</u>:

For ruminants, a certain amount of carbohydrates seems to be necessary for optimal utilization of urea as a nitrogen supplement to poor roughages. Presumably, the carbohydrate provides an available source of energy and of carbon fragments required for the synthesis of amino acids from urea nitrogen by rumen microflora. It also appears to meet the energy requirements of the animal itself and to prevent undue wastage of protein in metabolism.

Mills et al. (1942) showed that the addition of starch to a ration of urea and hay resulted in an increased ruminal protein synthesis. They further demonstrated that, in-vivo, starch was superior to molasses in promoting protein synthesis from a urea-ration. Bell et al. (1953) reported a greater improvement in nitrogen retention due to an addition of urea to different cereal grains and to sweet potato rations, in contrast to that resulting from the addition of urea to rations containing cane-molasses.

Belasco (1956) found a more pronounced urea-utilization with starch than with cellulose; utilization with xylane and pectin being intermediate. High input levels of dextrose, when employed in combination with cellulose, inhibited cellulose digestion markedly, while starch had the reverse effect.

Arias et al. (Reid, 1953) concluded that utilization of urea in-vitro is greatest when medium amounts of both readily available carbohydrates and complex carbohydrates are present, or when a small quantity of readily available carbohydrates and a large amount of complex carbohydrates are found in the medium. Yet, results from in-vivo experiments suggest that cellulose and other complex carbohydrates do not assist in an appreciable utilization of urea. This perhaps because inadequate amounts of cellulose are hydrolized soon after ingestion to become available when duly required by the bacterial flora, while urea is rapidly hydrolized. (Reid, 1953).

When concentrate rations fed to ruminants contain usual amounts of cereal grains, a sufficient quantity of starch seems to be provided for satisfactory protein synthesis, other conditions being favorable.

No significant differences were incurred in nitrogen digestion and utilization by using different sugars (like sucrose, glucose, lactose) according to Gallup et al. (1954).

3) Toxicity Level of Urea:

Studies on growing calves and steers in the feedlot suggested that a level of urea between 2.3 and 2.8 % of the total ration may already be harmful (Reid, 1953). However, when mixed with the ration, urea can be offered and consumed at high levels, though the same or even smaller quantities introduced spontaneously into the rumen or esophagus may prove fatal.

Since the quantities of urea generally employed in practice are below toxic levels and, moreover, since urea is quite unpalatable, there appears to be no need for great concern in its application, provided it is uniformly distributed in the feed (Morrison, 1956; Reid, 1953).

Snapp and Neumann (1960) suggested a urea level not exceeding 1% by weight in complete mixed rations, or 5% urea by weight in protein concentrates. Morrison (1956) suggests that no more than 2-3 % of urea should be included in the concentrates.

4) The Effect of Other Factors:

The degree of development of the rumen and its microflora influences the ability of animals to utilize urea: It appears that calves as young as two months of age are capable of converting considerable amounts of urea nitrogen into protein nitrogen, (Morrison, 1956; Snapp et al., 1960; Reid, 1953).

Several minerals (phosphorus, sulphur, iron, sodium, potassium, calcium, magnesium, chlorine and others) are required for efficient utilization of urea, (Morrison, 1956; Snapp and Neumann, 1960).

Thomas et al. (1953) found that steers fed on rations adequate in phosphorus made significantly greater gains as compared to others offered low phosphorus rations. When P was adequate, gains were similar on both urea- and soybean- supplemented rations.

STUDY I

OBJECTIVES

This study was conducted to determine the efficiency of conversion of Total Digestible Nutrients into lean, fat, bone and edible portion (lean + fat), as well as the proportions of lean, fat, and bone in the carcasses of steers of dairy breeds available in the area, together with the proportions of standard U.S. wholesale-cuts in such carcasses.

EXPERIMENTAL PROCEDURE

Pertinent data of the twelve calves used in this study are shown in Table 1. All calves were weighed at 3 weeks intervals, and all but two animals (195 & 201) were put under observation as from the 4th of July, 1960.

The initial age upon entering the feedlot was interpolated or corrected for each animal to an initial weight of 300 lbs. Calves No. 195 and 201 joined the other ten animals on the first of November, 1960, their initial age being corrected to a weight of 500 lbs.

The whole lot of twelve steers, hence, went under study at an average initial weight of 333.3 lbs. and an average initial age of 139 days (range from 110-197 days). They were fed to an average slaughter weight of 1095 lbs. at an average final age of 456 days, (range from 394-525 days)as per Table 1.

All twelve steers were castrated when reaching about two months of age. Each animal under trial was implanted with 30 mg. of stilbestrol on the 10th of December, 1960.

The steers were maintained under an open-shed construction at the American University Farm, Northern Bekaa area. Table 2 indicates such climatic characteristics as temperature and relative humidity prevailing, as recorded at the farm.

The concentrate mixture was fed twice a day, morning and evening, roughages being fed in the afternoon and evening. Water was available ad lib. throughout the day.

Table 1. Breeding Origin, Initial and Final Ages and Weights of the Twelve Steers Under Study

Steer No.	Breeding	Source of origin	Starting Date	Initial		Final		Duration of Expt.(days)
				Age (days)	Weight (lbs.)	Age (days)	Weight (lbs.)	
F7	3/4 Holstein 1#4 Baladi	Anjar	1.7.60	144	300	525	1095	381
F8	3/4 Holstein 1/4 Baladi	Anjar	5.7.60	148	300	456	1010	308
F9	3/4 Holstein 1/4 Baladi	Anjar	6.7.60	153	300	510	1020	357
10	Red Dane	Umitrade	10.7.60	132	300	479	1100	347
12	Red Dane	Umitrade	22.7.60	144	300	516	1080	372
13	Danish Friesian	Umitrade	22.7.60	111	300	397	1042	285
14	Danish Friesian	Umitrade	23.7.60	113	300	455	1120	342
78	3/4 Friesian 1/4 Shamia	AUB Farm	30.7.60	110	300	394	1060	284
81	3/4 Friesian 1/4 Holstein	AUB Farm	20.10.60	114	300	413	1145	299
195	Holl. Friesian	Turbol	26.10.60	197	500	481	1228	284
201	Holl. Friesian	Turbol	18.11.60	171	500	426	1150	255
Av.				139	333.3	456	1095.5	318

Table 2. Temperature and Relative Humidity Conditions as Recorded at the Weather Station A.U.B. Farm *

Month	Air Temperature °C			Relative Humidity (%)		
	Mean	Max.	Min.	Mean	Max.	Min.
July, 60	23.09	32.40	13.78	32.87	55	14
Aug., 60	23.71	32.77	14.65	34.22	52	12
Sept., 60	21.18	30.23	12.13	34.34	47	11
Oct.,60	17.15	24.40	9.90	30.00	65	14
Nov., 60	12.70	18.70	6.70	64.50	94	36
Dec., 60	9.29	15.61	2.96	65.46	94	38
Jan., 61	5.57	10.12	1.02	76.73	99	33
Feb., 61	5.07	9.56	0.58	71.53	98	37
March, 61	7.47	13.91	1.02	61.06	93	22
April, 61	12.89	20.56	5.22	57.53	94	24
May, 61	18.03	26.20	9.46	41.19	83	23
June, 61	21.81	30.40	13.21	37.93	83	10
July, 61	23.50	33.20	13.80	32.70	53	17
Aug., 61	23.55	34.00	13.10	33.24	51	20
Av.	16.07			48.09		

Source: American University Farm Meteorological Data, Bekaa Valley, Lebanon, July, 1960 - August, 1961.
Salah S. Abu-Shakra, Observer
Fouad M. Maaluf, Recorder.

Table 3: Concentrate Mixes Used During Period

Date Mixed	Corn %	Barley %	Beet Pulp %	P.O.M. % **	Vit. Mix. * %	C.S.M. % **	Wheat Bran %	Mola-sses %	Salt %	Lime-stone %	Bone-meal %	Soy-bean %	Days Fed
1.7.60	30	3	30	-	-	20	7	5	1	1	1	5	59
29.8.60	20	20	20	6	-	17	10	5	1	1	1	3	238
24.4.61	20	20	20	12	0.09	5	15	5	1	1	1	-	35
29.5.61	25	23	26	12	1	1	5	1	1	1	1	-	75
10.8.61	20	25	25	5	1	6	10	5	1	1	1	-	11

* Vitamins were added to all mixes as a routine at 5,000,000 I.u. vit. A (Stabilized) and 1,200,000 I.u. vit. D_2/2000 lbs. feed.

** P.O.M. = Peanut Oil Meal

C.S.M. = Cottonseed Meal

Table 4. Total Digestible Nutrients Content of the Five Mixes (%)

Date Mixed	Corn TDN	Barley TDN	Beet Pulp TDN	P.O.M. TDN	P.O.M. & Vit. TDN	C.S.M. TDN	Wheat Bran TDN	Molasses TDN	Salt TDN	Limestone TDN	Bonemeal TDN	Soybean TDN	Total TDN
1.7.60	24.0	23	20.6	-	-	12.8	4.7	3.0	-	-	-	3.9	71.3
29.8.60	16.0	15.0	13.7	4.6	-	10.9	6.7	3.0	-	-	-	2.3	72.2
24.4.61	16.0	15.0	13.7	9.3	0.07	3.2	10.1	3.0	-	-	-	-	70.4
29.5.61	20.0	17.3	17.9	9.3	0.08	0.6	-	3.0	-	-	-	-	68.2
10.8.61	16.0	18.8	17.2	3.9	0.08	3.8	6.7	3.0	-	-	-	-	69.5

Table 5. Average Total Digestible Nutrients Level in the Concentrate Ration Consumed by Each Steer during the Feeding Period

Steer No.	1000 lbs. Weight		Final Weight	
	No. Days	T.D.N. %	No. Days	T.D.N. %
F7	339	71.8	381	71.4
11	272	72.0	301	71.9
F8	294	72.0	308	72.0
10	295	72.0	347	71.6
F9	315	71.9	357	71.5
13	271	72.1	285	72.0
14	277	72.1	342	71.5
12	342	71.5	372	71.3
78	270	72.1	284	72.0
195	196	72.1	284	71.2
81	247	72.2	299	71.0
201	181	72.2	255	71.4

The concentrate mixtures had to be changed several times due to temporary shortages in the different feed ingredients. On the whole, five mixes were employed for varying periods as indicated in Table 3, and interpolated into TDN values (Table 4) using Morrison's (1956) estimates.

It was necessary, however, to estimate the amount of TDN consumed by each steer, considering the periods during which the animals were fed on one or the other ration.

Table 5 provides the average TDN level of all mixes consumed by each steer until arriving at 1,000 lbs. and up to the slaughter weight.

Table 6 interprets the total TDN consumed by each steer, in the form of roughages and concentrates, up to each of the two final weights under comparison (1,000 & 1095 lbs.). The feed consumption data from Table 7 were used.

Rate and efficiency of gain, final weights, degree of finish and the availability of the processing and storage facilities were taken into account in arranging for the date and the order of slaughter.

Slaughter and Carcass Data

Upon appraisal, each animal was weighed one day prior to slaughter, only water being offered the rest of that day.

After the killing and dressing operations the carcass was split as accurately as possible into two equal halves. The carcass was then washed and transferred to a cooler, operating at 32-34 degrees Fahrenheit, in order to age for a period of ten days.

The following carcass measurements were taken (Table 8):

1. Length of the carcass, as measured from the frontal edge of the first rib to the tip of the aitchbone.
2. Depth of the carcass at the 6th rib-level.
3. Circumference of round at the thickest part.
4. Thickness of fat over the midpoint of the m. longissimus dorsi, at an incision made between the twelfth and thirteenth rib.
5. Length and depth of m. longissimus dorsi at the same site as in (4).

Upon termination of the alloted aging period, the carcass was divided into the regular U.S. wholesale cuts as described by Bull, Sleeter (1951). The weight of each cut was recorded in terms of pounds and percentages of the dressed carcass (Table 9).

The 9-10-11th rib-sections were taken from both wholesale rib-cuts and carefully separated into lean, fat and bone, recording the weight of each portion.

The percentage of lean, fat and bone in the whole carcass was calculated according to the formulae developed by Hopper (1944) as follows:

1. $Y = 0.80173\,x + 15.71220$, for % lean in the carcass,

2. $Y = 0.81774\,x + 2.27664$, for % fat in the carcass,

3. $Y = 0.70750\,x + 3.47863$, for % bone in the carcass,

where X is the percentage of the particular component in the 9-10-11th rib-section, and Y the estimated percentage of that component in the whole carcass (Table 10).

Table 6. Pounds of T.D.N. Consumed by Each Steer in Roughage and in Concentrate

Steer No.	lbs.T.D.N.Consumed up to 1000 lbs. Wt.			lbs. T.D.N.Consumed up to Final Wt.		
	in Concent.	in Rough.*	Total	in Concent.	in Rough.*	Total
F7	3073.8	1246.7	4320.5	3506.5	1404.3	4910.8
11	2354.4	1030.2	3384.6	2705.6	1112.2	3817.8
F8	2639.5	553.7	3193.2	2782.1	1136.3	3918.4
10	2680.6	1099.9	3780.5	3226.3	1292.8	4519.1
F9	2625.1	1075.8	3700.9	3331.2	1325.0	4656.2
13	2342.5	1001.3	3343.8	2668.3	1081.7	3750.0
14	2341.1	985.2	3326.3	3261.1	1295.5	4556.6
12	2925.1	1177.1	4102.2	3580.0	1409.7	4989.7
78	2351.2	945.0	3296.2	2501.3	995.4	3496.7
195	2088.7	708.6	2797.3	3004.6	1036.6	4041.2
81	2236.0	789.1	3034.1	3153.8	1111.1	4264,9
201	1988.4	622.8	2611.2	2758.9	900.5	3659.4
Av.			3407.6			4215.1

* Roughage: 90% Corn Fodder(medium in water) TDN 53.9% (Morrison)

10% Alfalfa hay(all analysis) TDN 50.7%

100% TDN 53.6%

Table 7. Feedlot Performance of the Twelve Steers

Steer No.	Initial wt. lbs.	Gain:Final Wt.(a) * (1000 lbs.) lbs.	Gain Final Wt.(b)* lbs.	Period (a) days	Period (b) days	Gain/ day (a) lbs.	Gain/ day (b) lbs.	Feed Concentration (a) Concen-trate lbs.	Feed Concentration (a) Roughage lbs.	Feed Concentration (b) concen-trate (lbs.)	Feed Concentration (b) Roughages lbs.
F7	300	700	795	339	381	2.1	2.1	4281	2326	4911	2620
11	300	700	791	272	301	2.6	2.6	3270	1922	3763	2075
F8	300	700	710	294	308	2.4	2.3	3666	1033	3864	2120
10	300	700	800	295	347	2.4	2.3	3723	2052	4506	2412
F9	300	700	720	315	357	2.2	2.0	3651	2007	4659	2472
13	300	700	742	271	285	2.6	2.6	3249	1868	3706	2018
14	300	700	820	277	342	2.5	2.4	3247	1838	4561	2417
12	300	700	780	342	372	2.1	2.1	4091	2196	5021	2630
78	300	700	760	270	284	2.6	2.7	3261	1763	3474	1857
195	500	500	728	196	284	2.6	2.6	2897	1322	4220	1934
81	300	700	845	247	299	2.6	2.8	3097	1489	4442	2073
201	500	500	650	181	255	2.8	2.6	2754	1162	3864	1680
Av.	333.3	666.7	761.8	274.9	317.9	2.425	2.425	3432.3	1748.2	4249.3	2192.3

* (a) Up to a final weight of 1000 lbs.

(b) Up to the actual final weight at slaughter time (Av. 1095 lbs.)

Table 8. Carcass Measurements (In Inches)

Steer No.	Length	Depth	Circum. of Round	Fat Thickness over Rib Eye	Length of Rib Eye	Width of Rib Eye
F7	51.3	25.6	44.5	0.2	5.4	2.8
F8	50.5	23.0	43.5	0.2	5.8	2.8
F9	50.5	23.0	37.0	0.2	5.8	2.5
10	54.2	26.5	40.7	0.12	5.0	3.0
11	51.0	36.0	44.0	0.2	5.8	2.5
12	52.5	23.5	44.0	0.1	6.5	2.4
13	49.0	27.3	43.6	0.2	5.9	2.75
14	50.0	24.5	46.0	0.5	5.3	2.9
78	50.2	26.5	43.7	0.4	5.2	2.7
81	51.0	25.0	44.5	0.4	6.3	3.0
195	51.0	26.0	47.0	0.3	5.6	3.5
201	50.5	25.0	45.0	0.2	5.0	2.25
Av.	51.0	26.0	44.4	0.25	5.6	2.75

Table 9. Average Yields of Wholesale Cuts (Based on Cold Carcass Weight)

Steer No.	Front Quarters		Hind Quarters		Rounds		Sirloins		Shortloins		Flanks		Ribs		Chucks		Fore Shanks		Plates		Briskets		Kidney Knobs	
	lbs	%	lbs	%	lbs	%	lbs	%	lbs	%	lbs	%	lbs	%	lbs	%	lbs	%	lbs	%	lbs	%	lbs	%
F7	331.5	53.6	287.5	46.4	148.5	24.0	48.0	7.8	41.5	6.6	32.5	5.3	53.0	8.6	152.0	24.6	41.5	6.7	44.0	7.1	40.0	6.5	15.5	2.5
F8	298.0	53.1	263.0	47.0	140.0	25.0	49.5	8.8	34.0	6.1	36.5	6.5	46.0	8.2	108.5	19.4	54.0	9.6	46.0	8.2	41.0	7.3	17.5	3.2
F9	306.5	52.8	274.5	47.2	145.0	25.0	53.0	9.1	40.0	6.9	34.5	5.9	27.0	8.1	130.0	22.4	45.0	7.7	47.0	8.1	35.5	6.1	19.2	3.3
10	316.0	52.2	289.5	47.8	150.0	24.8	52.5	8.7	41.5	6.8	29.0	4.8	50.5	8.3	138.5	22.9	43.0	7.1	47.0	7.8	34.0	5.6	12.0	2.0
11	313.5	53.9	268.0	46.1	139.0	23.9	50.0	8.6	41.5	7.1	34.5	5.9	52.5	9.0	83.5	14.3	45.0	7.7	49.5	8.5	46.5	7.9	19.0	3.3
12	299.5	51.5	282.5	48.5	148.5	25.5	51.5	8.8	39.0	6.7	32.0	5.5	49.0	8.4	132.5	22.8	41.5	7.1	42.0	7.2	34.5	5.9	11.0	1.9
13	327.5	53.2	293.0	48.0	159.5	26.1	52.5	8.6	35.5	5.8	27.0	4.4	50.0	8.2	117.0	29.0	58.5	9.6	48.5	7.9	41.0	6.7	16.6	2.7
14	350.5	51.3	332.0	48.6	156.5	22.9	55.5	8.1	52.5	7.7	45.0	6.6	64.0	9.3	153.5	22.5	42.0	6.1	53.5	7.8	40.5	5.9	21.5	3.1
78	354.0	52.3	322.5	47.7	162.0	23.9	58.5	8.6	45.5	6.7	39.5	5.8	59.0	8.7	130.0	19.2	57.0	8.4	57.7	8.5	47.5	7.0	15.8	2.3
81	334.0	51.5	314.5	48.5	154.5	23.8	55.5	8.6	48.0	7.4	39.5	6.1	55.0	8.5	144.0	22.2	44.0	6.8	51.0	7.9	38.5	5.9	19.0	2.9
195	369.0	51.5	347.5	48.4	167.5	23.3	59.5	8.3	48.0	6.3	42.5	5.9	60.0	8.4	154.5	21.6	46.5	6.5	65.0	9.1	42.0	5.9	28.0	3.9
201	331.0	51.8	308.0	48.2	159.0	24.9	56.5	8.8	40.5	6.3	37.0	5.8	57.0	8.9	136.0	21.3	48.0	7.5	50.5	7.9	38.5	6.0	14.0	2.2
Av.	327.6	52.4	298.5	47.6	152.5	24.4	53.5	8.6	42.3	6.7	35.8	5.7	51.9	8.6	132.5	21.9	47.2	7.6	50.1	8.0	39.9	6.4	17.4	2.8

OBSERVATIONS

Feedlot Performance

Data for gains and feed consumption are presented in Table 7. Table 6 provides the total TDN consumption (concentrate and roughage) throughout the feeding period for each steer.

Results indicate that, although an average rate of gain of 2.425 lbs. per day was observed, the longer the steers were fed, the more feed or TDN they required per unit gain. Such trends are confirmed by several investigators (Snapp, 1960; Morrison, 1956). Feeding up to a 1095 lbs. weight required 0.4 lbs. more of TDN per pound of gain, 0.5 lbs. more of TDN per pound of slaughter weight and 0.9 lbs. more of TDN per day in the feedlot than when fed to 1,000 lbs. only.

Average TDN conversion values were calculated for the liveweight upon slaughter, the dressed carcass, and also for the edible portion (lean + fat) (Table 11).

Carcass Results

Carcass data for all steers under study are presented in Tables 8, 9, and 10.

Table 8 provides the major five carcass measurements considered having a correlation with the composition, grade and quality

Table 10. Slaughter Data, Carcass Grade and Physical Composition of the Carcasses

Steer No.	Weight		Dressed %	Est.Lean*		Est.Fat*		Est.Bone*		Carcass Grade	Edible Meat	
	Slaughter	Dressed		Total	%	Total	%	Total	%		Total	%
F7	1095	619.0	56.5	364.7	58.9	158.2	25.6	98.9	16.0	Good+	522.9	84.0
F8	1010	560.0	55.5	343.0	51.3	130.8	23.4	88.5	15.8	Good	473.8	84.2
F9	1021	581.0	56.9	359.6	61.9	115.8	19.9	105.7	18.2	Commercial	475.4	81.8
10	1100	605.5	55.0	357.6	59.1	120.1	19.8	125.9	20.8	Commercial	477.7	79.2
11	1091	581.5	53.3	334.3	57.5	146.7	25.2	101.9	17.5	Good	480.9	82.5
12	1080	582.0	53.9	368.4	63.3	113.0	18.4	101.3	17.4	Commercial	481.4	82.6
13	1042	610.0	58.6	368.3	60.4	156.9	25.7	103.9	15.4	Good+	525.3	84.6
14	1120	682.5	60.9	398.3	58.4	194.2	28.5	95.1	13.9	Good +	592.6	86.1
78	1060	676.5	63.8	344.7	51.0	242.2	35.8	95.5	14.1	Choice	586.9	85.9
81	1145	648.0	56.6	381.5	58.9	173.5	26.8	96.8	14.9	Good +	555.0	85.7
195	1228	716.5	58.4	405.9	56.7	198.9	27.8	115.0	16.0	Choice	604.9	84.4
201	1150	639.0	55.6	355.0	55.6	171.7	26.9	113.7	17.8	Good +	526.7	82.4
Av.	1095.2	625.1	57.1	365.1	58.6	160.2	25.4	102.7	16.5	Good +	525.3	83.6

* The physical composition was calculated according to Hopper (1944).

Table 11. Efficiency of TDN Conversion into Edible Meat, Dressed Carcass and Slaughter Weight in each of the twelve Steers under study

Steer No.	Edible Meat lbs. (y)	Dressed Carcass lbs. (y)	Slaughter (live) wt. lbs. (y)	T. D. N. Consumed lbs. (x)	Lbs./T.D.N. consumed per lb. of		
					Edible Meat (Final Wt.)	Dressed Carcass	Slaughter Wt.
F7	522.9	619.0	1095	4910.8	9.39	7.93	4.48
11	480.9	581.5	1091	3817.8	7.94	6.57	3.50
F8	473.8	560.0	1010	3918.4	8.27	7.00	3.88
10	477.7	605.5	1100	4519.1	9.46	7.46	4.11
F9	475.4	581.0	1021	4656.2	9.79	8.01	4.56
13	525.3	610.0	1042	3750.0	7.14	6.15	3.60
14	592.6	682.5	1120	4556.6	7.69	6.68	4.07
12	481.4	582.0	1080	4989.7	10.36	8.57	4.62
78	586.9	676.5	1060	3496.7	5.96	5.17	3.30
(500 lbs.) 195	604.9	716.5	1228	4041.2	6.68	5.64	3.29
81	555.0	648.0	1145	4264.9	7.68	6.58	3.72
(500 lbs.) 201	526.7	639.0	1150	3659.4	6.95	5.73	3.18
Av.	525.3	625.1	1095	4215.1	8.11	6.79	3.86
Range	473.8-592.6	560.0-716.5	1010-1228	3496.7-4989.7	5.96-10.36	5.17-8.57	3.18-4.62

(x) As per Table 6. (y) As per Table 10.

of beef carcasses. Insignificant differences in magnitude of these measurements, however, did not allow for neither marked nor consistent differences in any of the carcass traits observed. In order to establish further relations, the carcasses were pooled into two groups representing the highest and the lowest measures as to length, depth, or circumference of round. As a result, 1.24 % more bone was found in the longer carcasses, and no differences in the proportions of the wholesale-cuts were being observed. Furthermore, no effect of depth on either the proportion of wholesale cuts or on the proportions of the separable constituents of the carcasses were observed. In dressing percentage for the group with the larger round circumference, an advantage of 0.8 % was observed.

These average group-differences, however, were even less pronounced than the individual differences within either group under all comparisons. Hence, no conclusive evidence may be advanced here as a result of these measures.

No associations could be observed between the thickness of fat over the 12th rib and the fat deposit in the whole carcass, which is in agreement with findings of Cover et al. (1956) and of Simone et al. (1958).

The similarity among the dimensions of the rib-eye muscles resulted in inconsistant differences in the proportion of the separable lean.

The weights (lbs.) and percentages of the various wholesale of beef carcasses. Insignificant differences in magnitude of these measurements, however, did not allow for neither marked **nor** consistent differences in any of the carcass traits observed. In order to establish further relations, the carcasses were pooled into two groups representing the highest and the lowest measures as to length, depth, or circumference of round. As a result, 1.24 % more bone was found in the longer carcasses, and no differences in the proportions of the wholesale-cuts were being observed. Furthermore, no effect of depth on either the proportion of wholesale cuts or on the proportions of the separable constituents of the carcasses were observed. In dressing percentage for the group with the larger round circumference, an advantage of 0.8 % was observed.

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The similarity among the dimensions of the rib-eye muscles resulted in inconsistant differences in the proportion of the separable lean.

The weights (lbs.) and percentages of the various wholesale cuts (Table 9) are in close agreement with data reported by Willey et al. (1951), Green et al. (1955), Burris et al. (1953), Butler et al. (1956), and by Stonaker et al. (1952).

Carcass composition as estimated from the physical separation of the 9-10-11th rib-section into lean, fat and bone (Table 10), corresponds to most other reports.

The proportion of bone seems to be the most uniform among the carcass constituents, averaging 16.5%, at a range of 6.9 %; confirmed by reports of Bohman et al. (1958), Clegg et al. (1957), Bull (1951), and Wallantine et al. (1961).

A range of 18.7 - 19.8 % bone was established by Hopper in 1944; Bull (1951) reported 13.2 %, 14.7 %, 17.0 % and 18.7 % of bone in a prime, choice, good and utility carcass, respectively.

In contrast, the proportion of fat in the carcass seems to be the most variable, as confirmed by other workers (Butler et al., 1956). It averaged in this study 25.4 %, with a range of 16.4 %. Similar values were arrived at by other workers (Cover et al., 1956), though higher and lower values are also on record.

Lean, on the other hand, was observed to be intermediate in variability: It averaged 58.6 %, with a range of 12.3 %, which is also in agreement with most of the estimates of the average grade under study.

Some marked differences in dressing percentages among individuals were observed, the highest being 10.5 %. This, however, may be only an individual variation.

The carcass grade, despite the similar finish, did not exhibit as marked a variation as might have been expected in such a heterogeneous group of dairy-type steers. Except for the three commercial carcasses, there were two "good", five "good +", and two "choice" grade carcasses.

A positive association was obvious between carcass-grade and fat percentage, whilst a negative association existed between carcass-grade and bone-percentage.

The percent lean seemed to follow a negative association with carcass-grade.

In general, it appears that the proportion of bone to the edible portion tends to decrease with a decline in carcass-grade.

Pounds of Total Digestible Nutrients consumed per pound of edible meat, dressed carcass, and slaughter weight yield, are computed in Table 11. They exhibit an average of:

a) 3.86 lbs. TDN consumed per pound of slaughter weight, with a slight degree of variation (1.44 lbs.).

b) 6.79 lbs. TDN consumed per pound of dressed carcass, with a 3.40 lbs. range, and

c) 8.11 lbs. TDN consumed per pound of edible portion (lean + fat), with a range of 4.46 lbs.

SUMMARY

Ten steers, adjusted to an initial weight of 300 lbs., were put on feed on July 4, 1960. Two other steers joined the study on November 1, 1960, being adjusted to an initial weight of 500 lbs. The whole group was fed an average of 318 days.

Five concentrate mixes were used throughout the period, and corn fodder and alfalfa hay were given as roughages.

As soon as a steer arrived at the proper finish, it was killed, dressed, and aged for 10 days at 32-34 degrees Fahrenheit.

Some measurements were taken on each carcass that was then separated into wholesale-cuts, the weight of each being recorded. The 9-10-11th rib-sections were taken from both sides of each carcass, and dissected into lean, fat and bone. These values were used to calculate the percentage of each portion in the whole carcass according to Hopper's (1944) estimation formulae.

No marked, nor consistent associations between the various carcass measurements and carcass traits could be observed.

Bone was the most uniform component of the carcasses, averaging 16.5 %; lean was intermediate in variability, averaging 58.6 %, while fat was the most variable component, averaging 25.4 %. Thus, an estimated average of 84.0 % edible portion was observed.

A positive association between carcass-grade and fat-percentage was observed, whilst a negative association between the former

and bone-percentage prevailed.

Conversion-efficiency data obtained exhibit an average requirement of:

a) 3.86 lbs. TDN per lb. slaughter-weight,

b) 6.79 lbs. TDN per lb. dressed carcass, and

c) 8.11 lbs. TDN per lb. edible portion.

STUDY II

OBJECTIVES

Taking the local feed conditions into consideration this test was conducted to study the rate and economy of gains on an inexpensive, low-quality roughage (tibn or wheat straw), urea being used as a replacement for peanut-oil-meal to balance the low protein content of the feeds. The control group was fed a standard concentrate mixture along with a high-quality roughage (corn fodder and alfalfa hay).

EXPERIMENTAL PROCEDURE

The experimental batch consisted of ten calves, of which two were Red Danes, one was a Friesien/Shamia cross, and the other seven were Friesien/Balady cross-breds (two from the A.U.B. Farm and the rest purchased from the village of Anjar). They were treated for worms on April 4, 1961.

Eight of the animals were bull-calves and two were heifer-calves.

These animals were weighed on August 12, 1961, graded according to their condition, and divided into two grade-lots. Lot I was to be fed a diet comprising of a standard-concentrate ration and high-quality roughage. Lot II was to be given a urea-supplemented ration and low-quality roughage.

At that time Lot I averaged 547 lbs. liveweight, (range 370-715 lbs.) at an age of 253 days (range 200-290 days), while Lot II averaged 572 lbs. liveweight (range 410-695 lbs.) at an age of 324 days (range 239-414 days).

Data for age, weight, breeding, origin, grade and sex of the ten cattle are furnished in Table 12.

The two lots were confined in two segregated pens, being fed separately throughout the 144 days of the experiment. The concentrate mixtures were offered twice a day, morning and evening. Roughages were fed in the afternoon and evening.

Lot I received corn fodder and alfalfa hay at a 4:1 weight-ratio daily, and Lot II received only tibn (wheat straw) at the same rate by weight.

The composition of the concentrate mixtures was not changed for the duration of the experiment, equal amounts of the mixtures being fed to the two lots.

Table 13 lists the rations for the two lots, mentioning the crude protein and TDN content of each.

RESULTS AND DISCUSSION

All experimental animals were weighed on September 9, November 4, December 6, 1961 and finally on January 3, 1962. Weights were recorded and gains computed as per period between weighings and then as per day for each period and animal.

During the first 24-day period, gaining at a rate of 0.54 lbs. more per day, Lot I markedly outgained Lot II by 12.8 lbs., which represents a 29.2 % advantage.

Lot II, unexpectedly, boosted up its gains during the following 60-day period, showing an even higher increase in weight during the third 32-day period, thus outgaining Lot I by 0.8 lbs. and 4.0 lbs. respectively.

Considering these data, it was found that by the 116th day the advantage in favor of Lot I had declined to 8.0 lbs. (Lot I gained 269.0 lbs., and Lot II 261.0 lbs.).

The balance of gains, however, was again markedly tipped in favor of Lot I during the last 28-day period, with an advantage of 35.0 lbs., or 50.7 % in gains.

In comparing the two lots over the total 144-day period in the feedlot, Lot I showed an average rate of gain of 2.35 lbs. per day, while Lot II added at an average rate of 2.05 lbs. per day; in other words, Lot I gained at 12.5 % advantage over Lot II.

Expressed in terms of percent of the average total gain of each lot, Lot I made 12.9, 42.9, 23.7 and 20.5 % during the four respective periods, while Lot II made 10.5, 49.5, 28.5 and 11.5 % during the same periods, respectively.

In Table 15, data for feed consumption and conversion are provided in terms of pounds of feed consumed per hundred-weight (cwt.) of average gain in both lots for each period and for the total 144 days in the feedlot.

Lot I averaged a consumption of 561.9 pound of concentrate and 284.3 pounds of roughage per cwt. of gain, while Lot II averaged 643.7 pounds and 325.8 pounds respectively during the same period (144 days). Thus, Lot I required 81.9 lbs. (or 12.7 %) less concentrate and 41.5 lbs. (or 12.7 %) less roughage for each 100 lbs. of gain than Lot II. Yet, when scrutinized more critically, greater fluctuations in efficiency of conversion in Lot II would be observed, in contrast to Lot I.

During the first period, Lot II required 238.5 lbs. more concentrate and 281.9 lbs. more roughage per cwt. of gain which represents an advantage of 29.2 % in favor of Lot I.

During the second period (60 days), Lot II consumed 3.0 lbs. less concentrate and 1.4 lbs. less roughage per cwt. of gain than did Lot I. This improvement in efficiency was even more pronounced

Table 12. Initial Ages and Weights, Origin, Sex, Grade and Breeding of the Ten Calves Used in the Experiment

Lot	No.	Breeding	Source of Origin	Grade	Sex	Initial Age (Days)	Days in Feedlot	Starting Date in Feedlot	Initial Weight in Feedlot
LOT I	85	Friesian x Shamya	A. U. B. Farm	2	Male	280	144	12.8.61	715
	180	Friesian x Baladi	Anjar	5	Female	200	144	12.8.61	370
	181	Friesian x Baladi	Anjar	4	Male	212	144	12.8.61	430
	186	Friesian x Baladi	Anjar	3	Male	290	144	12.8.61	600
	187	Red Dane	Anjar	4	Male	285	144	12.8.61	620
	Ave.			3.6		253	144		547
LOT II	80	Friesian x Baladi	A. U. B. Farm	4	Female	414	144	12.8.61	695
	182	Friesian x Baladi	Anjar	3	Male	352	144	12.8.61	535
	183	Friesian x Baladi	Anjar	4	Male	239	144	12.8.61	410
	184	Red Dane	Anjar	4	Male	269	144	12.8.61	560
	185	Friesian x Baladi	Anjar	3	Male	294	144	12.8.61	660
	Ave.			3.6		324	144		572

Table 13. Concentrate Mixes and Roughages fed to the two Lots: Composition and Cost

Feed-stuff	Cost (L.Pts./lb.)	Feed Offered to Lot I						Feed Offered to Lot II					
		Content of Ration %	Amount/ 1000 lb. mix(lbs.)	Crude Protein %	Crude Protein Total (lbs.)	T D N %	T D N Total (lbs.)	Content of Ration %	Amount/ 1000 lb. mix (lbs.)	Crude Protein %	Crude Protein Total (lbs.)	T D N %	T D N Total (lbs.)
Corn	10.5	28	280	9.1	25.5	80.1	224.3	-	-	-	-	-	-
Barley	9	28	280	8.7	24.4	78.8	250.6	41	410	8.7	35.7	78.8	323.1
Beet Pulp	7	25	250	8.8	22.0	68.7	171.8	41	410	8.8	36.1	68.7	281.7
Wheat Bran	6	4	40	16.1	6.4	65.6	262	8	80	16.1	12.9	56.6	45.3
C.S.M.	10.5	7	70	41.6	29.1	65.2	45.6	8	80	41.6	33.3	65.2	52.2
P.O.M.	10.5	8	80	52.3	41.8	77.3	61.8	-	-	-	-	-	-
Urea	20	-	-	-	-	-	-	1.4	14	26.2	36.7	-	-
Vitamin Mix	-	0.1	1	-	-	-	-	0.2	2	-	-	-	-
Lime-stone	1.5	0.5	5	-	-	-	-	0.5	5	-	-	-	-
Bone-meal	-	0.5	5	-	-	-	-	0.5	5	-	-	-	-
Salt	3.5	1.0	10	-	-	-	-	1.0	10	-	-	-	-
Total	(a)	102.1	1021		149.2		780.3	101.4	1014		154.7		702.3
Corn Feeder	8	80	-	6.8	5.4	53.9	43.1	-	-	-	-	-	-
Alfalfa Hay	15	20	-	13.7	2.7	50.3	10.1	-	-	-	-	-	-
Tibn	2.5	-	-	-	-	-		100		3.9	3.9	40.6	40.6
Total	(b)	100			8.1		53.2	100			3.9		40.6

(a) Lot I Costs 9.025 L. Pts./lb.
Lot II Costs 8.225 L. Pts./lb.

(b) Lot I Costs 9.4 L. Pts./lb.
Lot II Costs 2.5 L. Pts./lb.

during the third period (32 days), when Lot II consumed 30.5 lbs. less concentrate and 9.5 lbs. less roughage per cwt. of gain than Lot I. This amounts to an advantage of 5.5% in favor of Lot II.

By the 116th day, i.e. at the end of the third period, Lot I had made only a slight advantage in feed conversion: Whereas Lot II consumed 573.6 lbs. concentrate and 314.6 lbs. roughage per cwt. of gain, Lot I consumed as much as 560.2 lbs. and 305.2 lbs. respectively. That is, Lot I consumed only 13.4 lbs. concentrate and 9.4 lbs. roughage less per cwt. of gain than did Lot II. In other words, the efficiency of feed conversion of Lot I was not higher than 2.3 % and 2.9 % in concentrates and roughages, respectively. The gains of Lot II declined during the last period (28 days), and consequently a lower efficiency of conversion was calculated. Yet, Lot I maintained a higher rate of conversion, resulting in the total values presented above.

Computing the cost of each ration per pound, the urea-supplemented mixture proved to be 0.8 L.Pts. cheaper. Tibn, or the roughage fed to the same lot (Lot II) was 6.9 L.Pts. cheaper than that fed to Lot I.

Since each Lot consumed 1899 lbs. of concentrate, and 691 lbs. of roughages during the total 144-day feeding period, less expense was incurred in feeding Lot II than Lot I.

A total saving in feed expense, amounting to 81.50 L.L. in

Table 14. Weights and Gains of the Two Lots During Period

Lot	No.	12.8.61 Initial Wt. (lbs)	Weights (lbs) 5.9.61	4.11.61	6.12.61	3.1.62	Gain (lbs) Per Period Days 24	Days 60	Days 32	Days 28	Days 144	Gain (lbs)/Day/Period 24	60	32	28	144
LOT I	85	715	755	920	1015	1080	40	165	95	65	365	1.7	2.75	2.96	2.32	
	180	370	425	570	660	715	55	145	90	55	345	2.3	2.42	2.81	196	
	181	430	472	625	710	775	42	153	85	65	345	1.8	2.55	2.7	2.32	
	186	600	627	725	795	885	27	98	70	90	285	1.1	1.63	2.18	3.2	
	187	620	675	849	900	970	55	165	60	70	350	2.3	2.75	1.87	2.5	
	Av.	547	590.8	736.0	816.0	885	43.8	145.2	80.0	69.0	338	1.83	2.42	2.50	2.46	2.350
							12.9%	42.9%	23.7%	20.5% (of the total gain 338#)						
LOT II	80	695	725	905	985	1035	30	180	80	50	340	1.25	3.00	2.50	1.80	
	182	535	580	725	795	850	45	145	70	55	315	1.9	2.42	2.50	1.96	
	183	410	440	620	735	780	30	180	115	45	370	1.3	3.00	3.59	1.60	
	184	560	590	700	790	800	30	110	90	10	240	1.3	1.83	2.81	0.35	
	185	660	680	795	860	870	20	115	65	10	210	0.8	1.92	2.03	0.28	
	Av.	572	603	749	833	867	31.0	146.0	84.0	34.0	295	1.29	2.43	2.63	1.21	2.050
							10.5%	49.5%	28.5%	11.5% (of the total gain 295#)						

Table 15. Feed Consumption and Conversion of the Two Lots

	L O T - I			L O T - II		
Period	Gain (lbs.)	Consumption Concent. Rough. (lbs.)	Conversion (lbs.feed/ cwt. gain)	Gain (lbs.)	Consumption Concent. Rough (lbs.)	Conversion (lbs. feed/ cwt. gain)
24 days	43.8	253 299	577.6 682.6	31.0	253 299	816.1 964.5
60 days	145.2	806 362	555.1 249.3	146.0	806 362	552.1 247.9
32 days	80.0	448 160	563.8 200	84.0	448 160	533.3
28 days	69.0	392 140	568.1 202.9	34.0	392 140	1152.9 411.8
144 days	338.0	1899 961	561.8 284.3	295.0	1899 961	643.7 325.8

Lot II over Lot I was realized (15.20 L.L. in concentrates and 66.30 LL. in roughages, respectively). This was, however, accompanied by a lag of 43 lbs. in gains in Lot II.

Assuming a market value of 1.50 L.L. per lb. of live beef, the lag in Lot II would represent 64.50 L.L., which still leaves a 17.00 L.L. economy in favor of Lot II.

A 116-day feeding period, on theother hand, would have left Lot II with an 8.0 lbs. lag in gains, representing 12.00 L.L. compared to a 68.70 L.L. economy in feed expense. This results in a 56.70 L.L. advantage in Lot II over Lot I.

Comparing the expense of feeding Lot I for 116 and 144 days, 48.40 L.L. more worth of feed was consumed during the 28 days compared to 69 lbs. gain in body weight, which amounts to a 103.50 L.L. margin. This represents an advantage of 55.10 L.L. in favor of the longer period of feeding.

At the 116 day-mark, Lot I had made 190.20 L.L. compared to 247.00 L.L. in Lot II, i.e. Lot I had a lag of 56.80 L.L. behind Lot II.

At the 144 day-mark, Lot I realized 245.30 L.L. compared to the 262.50 L.L. of Lot II, i.e. a lag of 17.20 L.L. behind Lot II. Thus, Lot I remained economically behind Lot II at both marks.

SUMMARY AND CONCLUSIONS

A group of ten calves of mixed breeding were divided into two grade-lots on August 12, 1961, and fed for 144 days. Lot I was fed on a urea-supplemented concentrate mixture and an inexpensive roughage (tibn). The other lot received a standard concentrate mixture and high-quality roughage (alfalfa hay and corn fodder).

Lot I started with an average weight of 547 lbs. at an age of 253 days, while Lot II weighed an average of 572 lbs. at an average age of 324 days. Both lots were weighed after 24, 84, 116 and 144 days (i.e. at 24, 60, 32 and 28 days intervals).

The "urea-feeding" lot (II) had 29.2 % lower gains during the first 24 days than the control group (Lot I). In the course of the second and third period (60 & 32 days), however, Lot II improved its gains sufficiently to even slightly surpass the control group in gains. Yet, beyond the third period-mark (after the 116th day), the gains of Lot II again declined markedly, while Lot I maintained its former rate, resulting in a 50.7 % difference in gains between the two lots. Over the whole 144-day feeding period, Lot I added weight at an average rate of 2.35 lbs. per day and Lot II at a rate of 2.05 lbs. per day, i.e. a 12.5 % difference in gains was observed in favor of the control group.

The higher cost of the feedstuffs offered to Lot I, especially of the roughages, counterbalanced the higher gains in that Lot. Consequently, Lot II cleared 56.70 L.L. by the 116th day, and 17.00 L.L. by the 144th day in the feedlot over Lot I. Thus, the use of urea-supplemented rations and cheap roughages locally available could be considered as feasible and economical in feeding cattle under such conditions as are prevalent in the area, even though it supports lower gains than the standard mixes and high-quality roughages.

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