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A

THE EFFECT OF DIFFERENT PASTURES FOR BACKGROUNDING AND DIFFERENT GRAIN FINISHING PERIODS ON QUANTITATIVE, QUALITATIVE, AND PALATABILITY CHARACTERISTICS OF SERIALLY SLAUGHTERED ANGUS STEERS

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ABSTRACT

Sixty-eight Angus steers backgrounded on five different pasture types were assigned to groups for finishing on a whole shelled corn ration (fed ad libitum) for 0, 28, 56, 84, or 112 days (DOF) to determine the effect of pasture type and DOF on certain live and carcass quantitative, qualitative and palatability characteristics.

Slaughter weights increased ($P<.01$) from 354.7 kg (0 DOF) to 456.0 kg (112 DOF) and dressing percent ranged ($P<.01$) from 48.3 (0 DOF) to 62.0 (112 DOF). Mean yield and quality grades were 1.7, average standard; 1.6, high standard; 2.1, average good; 2.4, average choice; and 2.5, average choice for 0, 28, 56, 84, and 112 DOF, respectively. Marbling increased linearly ($P<.01$) from traces^{50} at 0 DOF to modest^{0} at 112 DOF.

Ratio of Biceps femoris weight to femur weight increased ($P<.01$) through 56 DOF then remained nearly steady with additional DOF.

Sensory panelists scored beef loin steaks from 84 to 112 DOF higher ($P<.01$) for all palatability traits. Greatest improvement in flavor, tenderness, juiciness, and overall acceptability occurred in the first 84 DOF, after which little improvement was observed. Instron shear values decreased ($P<.01$) from 28 to 112 DOF.

No differences were found in palatability traits of steaks from steers backgrounded on the different pasture types.

Results indicate that 84 DOF was the optimum time on feed for quality and yield grade and palatability.

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CHAPTER I

INTRODUCTION

Pasture is used predominantly in three ways in the production of beef cattle: (1) as the only feed; (2) as the only feed for limited time, followed by full-feeding on pasture or in drylots; and, (3) supplemented by grain, followed by feedlot feeding (Bull, Snapp, and Husk, 1941). Approximately 60% of the world's permanent pasture is not suited for cultivating crops. This land provides roughages in the form of grass and other vegetation that is digestible by ruminant animals.

In the 1930's and 1940's, beef was produced from cattle which consumed predominantly roughages derived from pastures. The poor quality of the feed resulted in slow growth so that three to four years were required for cattle to reach slaughter weights. In addition, grass-fed cattle had lower dressing percentages, more cooler shrinkage, and produced carcasses of lower quality grades.

Starting in the 1950's and developing rapidly in the 1960's, was production of large amounts of feed grains. This large increase was mainly due to new technology and irrigation. The large surplus of grain kept prices fairly low and led to more grain feeding of cattle. This resulted in a larger beef supply to meet the demand of the ever expanding human population. The area which produced the majority of feed grains is referred to as the corn belt and the irrigated areas of the midwest.

Tennessee and other states are referred to as feeder-calf states. Feeder-calf states were unable to provide enough feed grains; therefore, weaned calves had to be shipped to the midwest where feed grains were abundant. Here the calves were finished in feedlots.

At the present time, weaned calves seven months old and at a weight of 400-500 pounds, are backgrounded on pastures until a weight of 600-700 pounds is reached. This is a significant change from the practice of the 1950's and 1960's, when weaned calves were shipped directly to the feedlots and fed grain rations. With the ever increasing cost of grain and energy, it is hard to justify and afford those old feeding practices. In addition, some support the view that this grain could be better used for human consumption. At the same time, the average American has become somewhat wary of consuming animal fat because of a popular theory of a relationship between consumption of animal fat and health, especially heart disease (Schupp, Bidner, McKnight, Smith, Carpenter, and Wiegmann, 1979). Therefore, cattle today are fed much less grain from birth to market than they did 20 years ago.

The present practices of feeding cattle has created new interest in the area of forage or grass-fed beef. Several researchers have reported the palatability characteristics of grass-fed beef as being very undesirable (Lusby, 1977; Bowling, Smith, Carpenter, Dutson, and Oliver, 1977; Brown, Melton, Riemann, and Backus, 1979; and Black, 1981). Researchers at the University of Louisiana, University of Kentucky, and Clemson University have shown grass-fed beef to be less

tender and less juicy than grain-fed beef, but flavor was acceptable. These results are in sharp contrast with those found at the University of Tennessee and the University of Missouri. Both the University of Tennessee and the University of Missouri research involved pastures of predominantly fescue with some orchard grass and Ladino clover. Since the researchers at Kentucky, Louisiana, and Clemson used pastures of Bermuda grass, blue grass, and orchard grass, and no fescue, it seems that the undesirable grass-fed flavor and aroma could be attributed to the fescue. The objectives of this study were to determine the effect different kinds of pasture have on palatability characteristics of cooked beef and to determine the effects of the length of time high-energy diets have on the carcass characteristics of yearling steers serially slaughtered after summer grazing and feedlot finishing for 28, 56, 84, and 112 days.

CHAPTER II

REVIEW OF LITERATURE

I. FEEDING REGIMES AS THEY AFFECT CARCASS TRAITS AND SENSORY CHARACTERISTICS

From the 1950's to the late 1960's, cattle were predominantly finished on feedlots and on relatively cheap grain. This situation created somewhat of a void in the research results on cattle finished on forages. However, due to the higher cost of feed grains and the increased cost of energy, recently there has been much interest in finishing cattle on forages with limited amounts of grain or no grain at all.

Pasture is used predominantly in three ways in the production of beef cattle: (1) as the only feed; (2) as the only feed for limited time; and, (3) as a supplement to grain feeding (Bull et al., 1941). Bull et al (1941) indicated that beef produced by animals fattened on grass alone graded lower and were slightly lower in palatability than animals produced on grains. Wanderstock and Miller (1948) also reported meat from pasture-fed cattle received significantly lower palatability scores than meat from grain-fed cattle. Black, Hiner, Burk, Alexander, and Wilson (1940) showed that the feeding of concentrate in addition to grass had a positive affect on the palatability of the meat. However, Huffman's (1974) results on forage-fed beef was in sharp contrast to research done in the past. The

experiment involved grazing a group of steers on rye, ryegrass, and arrowleaf clover. A second group grazed on the same pasture until 90 days before slaughter. During the 90 days prior to slaughter, this group was placed on a conventional high energy ration. Both groups graded choice and had the same yield grade. Shear values were somewhat higher for the grain finished steers. The two groups showed no significant difference for tenderness, juiciness, and flavor as evaluated by a sensory taste panel.

Oltjen, Ramsey, and Putnam (1971) fed a ration of pelleted alfalfa and timothy hay to one group of steers and a high energy ration of cracked corn to a second group of steers. The two different groups were fed until they reached a constant weight instead of a constant age. The grain-fed steers had a higher yield grade and a superior dressing percent as compared to alfalfa fed steers; but both groups graded choice. Also, taste panel data revealed the alfalfa fed steers were more tender, flavorful, and overall more desirable than the grain finished steers. Since the alfalfa and timothy hay was pelleted, feed consumption improved, therefore, providing a sufficient level of energy and protein for the steers. Oltjen et al. (1971) concluded that the lower plane of nutrition available to cattle on grass, due to low consumption rather than inferiority of the grass, was the reason for slower weight gain in forage-fed cattle. In addition, Oltjen et al. (1971) completed a second trial to see if the results could be repeated and also to compare alfalfa to timothy hay. Similar groups of animals were used and fed the same length of time. Steers in the trial gained weight slower and only graded average good.

However, the taste panel results were similar to those of the first trial.

Meyer, Buckley, and Cole (1960) pair fed eight groups of steers, five pairs were Hereford and three pairs were Angus, over a two year period. One group grazed on orchard grass and Landino clover while the other group received cracked corn and cottonseed meal. The grain-fed group was 100 pounds heavier at slaughter and received two-thirds of a superior quality grade. The grain-fed group had superior organoleptic properties. The greatest sensory difference was noted in the flavor of the fat between the two groups. The grain-fed group was ranked higher for fat flavor than the forage-fed group. This is similar to results obtained by Malphrus (1957), but is in sharp contrast to Black et al. (1940); Hunt, Kincaid, and Carter (1953); and Brown (1954), who reported forage-fed beef had no detectable differences in organoleptic traits. The type of pastures used could be responsible for the sharp contrast. Meyer et al. (1960) found no significant difference between the two groups in tenderness as evaluated by the Warner-Bratzler Shear Test.

Kropf, Allen, and Thouvenelle (1975) selected 30 head of cattle from three different sources, predominantly Hereford, to compare Flint Hills grass-fed cattle to cattle fed 70 days on grass and 150 days on grain. There was over a 100 pound difference in carcass weight and a full quality grade difference between the grass-fed cattle and the 150 day grain-fed cattle. This was similar to the results reported by Meyer et al (1960). Also a significant difference was observed

in the fat color with the grass-fed cattle being more yellow. As the length of grain feeding increased, the eating quality increased. This is in contrast to Huffman (1974). The differences could be related to the type of pasture and the form in which it was fed.

Utley, Hellwig, and McCormick (1975) studied feedlot performance, carcass characteristics, and the economical feasibility of each system. The study involved 32 crossbred yearling calves and 36 crossbred steers. A high energy diet was compared to an all forage type diet. Average daily gains, dressing percent, marbling, yield grade, and fat over the rib eye were all higher ($P<.05$) for the high energy diet as compared to the all forage diet. Dinius (1978) also reported higher average daily gains and a higher dressing percent for grain-fed steers. Cost for 100 pounds of gain for the high energy diet per steer was $36.61 versus $23.07 for the all forage diet. All returns on investment for the high energy diet was negative $18.63 per head versus a positive $23.97 per head for the all forage diet. This data indicates the economic feasibility of forage diets with grain supplementation. There must be an optimum time on grain in respect to palatability characteristics and the producers cost.

Burris, Brown, Rogers, Couvillion, and Tyner (1976) performed a 150 day trial using Angus and Hereford crosses, starting at weights of 500 pounds. The animals were divided into two feeding groups, one pasture and the other grain. Fat color was creamy white for both groups which is in conflict with what McCampbell, Greene, and Lowery reported in 1972. There was no significant difference between the two groups for the Warner-Bratzler Shear Test. The meat was then sold

in three stores located in Jackson and Meridian, Mississippi. Consumers given a questionnaire could not tell the difference, and in some stores, the forage-fed beef sold better.

Cross and Dinius (1978) experimented with 114 steers, some receiving alfalfa and orchard grass hay, and the others grazed on orchard grass only. Steaks from the steers fed alfalfa and orchard grass hay were more tender, juicier, and had a more intense flavor compared to the steers backgrounded on orchard grass pasture. Oltjen et al. (1971) obtained similar results which helps back up the theory that the type of forage has a significant effect on palatability.

Schupp et al. (1979) studied 197 animals, comparing a forage-fed diet to a high energy diet. The forages were common and included costal Bermuda grass, rye grass, rye, and white clover. The high energy diet animals had higher average daily gains, dressing percents, and yield grades. The forage-fed carcasses had a yellowish colored fat. There was no significant difference found in the Warner-Bratzler Shear Test between the different groups. A consumer survey evaluation was performed using local supermarkets as distribution points. The consumer took the meat home and evaluated it for palatability characteristics. No discrimination against forage-fed beef was found by the consumer. Also, consumers could not consistently distinguish between grain-fed and forage-fed beef.

Davis, Cole, and Backus (1981) divided 59 steers into three groups; (1) 20 steers were forage-fed on orchard grass, fescue, and Ladino clover; (2) 20 steers were forage-fed on the same pasture as

group one, then finished on grain; and, (3) 19 steers were fed full feed, which consisted of yellow corn and a protein supplement. There was no significant difference between the forage-fed steers and the limited-fed steers for total gain, slaughter weight, carcass weight, or dressing percent. The grain-fed steers had superior total gains, slaughter weights, carcass weights, and dressing percent ($P<.05$). Quality grades were choice for grain-fed steers versus standard for grass-fed steers. The grain-fed steers had a higher percent of fat ($P<.05$) and a lower percent of moisture ($P<.05$) which is similar to Leander, Hedrick, Stringer, Clark, Thompson, and Matches (1978) results. Steaks from the forage-fed steers were less tender ($P<.05$) and less desirable in flavor. Taste panel members noted a grassy milky flavor and a lack of a beefy flavor in the forage-fed steaks. Brown et al. (1979) reported similar results for the flavor of ground beef from grass-fed steers. Also, Davis et al. (1981) reported no difference ($P<.05$) in cooking traits.

Reagan, Carpenter, Bauer, and Lowery (1977) obtained 63 beef ribs from carcasses of known grass and grain feeding regimes. The three feeding regimes consisted of: (1) rye, oats, and rye grass; (2) rye, rye grass, and cracked corn; and, (3) arrowleaf clover for 193 days. The ribs were vacuum packaged and held for 0, 21, and 28 day periods. After each period the ribs were evaluated for flavor, juiciness, tenderness, and overall acceptability. The grain-fed steaks were more desirable for flavor and overall acceptability as compared to grass-fed steaks. No significant difference was found in juiciness

or tenderness scores. Similar findings have been reported by Huffman (1974). Marbling and quality grades of forage-fed steers and clover fed steers did not differ significantly. However, marbling and quality grade was significantly higher ($P<.05$) for the grain-fed steers. Chemical determination of percent fat and protein did not differ significantly among the different feeding regimes. Higher moisture content was observed for muscle tissue from the forage-fed steers when compared to the grain-fed steers. This is in agreement with the findings by Wheeling, Berry, and Carpenter (1975).

McCampbell et al. (1972) performed a similar study as Reagan et al. (1977). Beef ribs were obtained from carcasses of four known feeding regimen. The feeding regimes were (1) silage and grain; (2) winter pasture and self fed grain; (3) pasture only; and, (4) pasture and drylot feeding. A total of 678 rib roasts were evaluated for palatability. Taste panel members scored groups three and four significantly lower for tenderness, juiciness, flavor, and overall acceptability.

Discrimination against forage-fed beef is associated with color (of muscle and fat) and palatability characteristics (flavor and tenderness) which limits its acceptability at the wholesale and retail level according to Bowling et al. (1977). Thirty pairs of carcasses, one forage-fed and one grain-fed with essentially identical U.S.D.A. quality grades were used. The grain-fed carcasses were more tender, more flavorful, and had a higher overall acceptability ($P<.05$). The grain-fed carcasses had twice as much subcutaneous fat, longer

sarcomeres, and lower shear values. Beef from the grain-fed and the forage-fed carcasses did not differ in cooking loss, cooking time, degree of doneness, or initial juiciness ($P<.05$).

Moody (1976) concluded that finishing on high forage (low energy) rations resulted in lower rates of gain, longer feeding periods, reduced feed costs, improved cutability (less fat) grades, and a slightly lower, but acceptable, quality grade. Palatability traits such as tenderness, flavor, and overall acceptability of beef appear to be affected little by altering the energy intake of cattle within certain limits. Color and juiciness appear to be affected adversely by prolonged forage feeding without grain supplementation.

Marketability of forage-fed beef has been enhanced by advances in technology which have improved tenderness, color, stability, and shelf life. Currently consumer acceptance of forage-fed beef is good and appears to be improving as the consumer becomes more knowledgeable on preparation and cooking methods.

Results on forage-fed research varies significantly depending on type of forages used. More research is needed to identify those forages which contribute to the undesirable palatability characteristics.

The ultimate test of a management system for beef cattle is the quality of meat. If the final product is unacceptable to the consumer, then the feeding management system is unacceptable (Cross et al., 1978).

II. GROWTH AND DEVELOPMENT

Carcass composition refers to the proportion of the major tissues, muscle, fat, and bone in the carcass. These proportions may

be influenced by age, weight, breed, nutrition, and other factors. Muscle is the most important tissue because it is most desired by the consumer and a superior carcass for any market has a maximum amount of muscle, a minimum of bone and an optimum amount of fat according to consumers desires (Berg and Butterfield, 1976).

Muscle comprises a high percentage of total body weight at birth, increases slightly, and begins to decrease in percent as the fattening phase begins. Bone at no stage of development exerts a dominant role in the determination of relative proportion of the three major tissues. Fat is the most variable tissue in both amount and distribution (Berg and Butterfield, 1968).

Heiner and Bond (1971) studied the rate and nature of growth of selected muscles. The study involved 51 Angus calves obtained three to ten days after birth. All of the calves received equal amounts of milk for two months. They were then divided into three groups, (1) full feed; (2) restricted to 1.1 pounds of grain per day; and, (3) was the same as two until 180 days prior to slaughter, and then received full feed. The animals were slaughtered at 6, 12, 24, 30, and 36 months of age. Results of the study showed that the most rapid increase in muscle growth occurred between 6 and 12 months. Also, the poas major, biceps femoris, and triceps brachii increased in proportion of total lean, as the animal matured. The semitendonosus remained the same, and the adductor decreased in proportion.

Guenther, Bushman, Pope, and Morrison (1965) also studied how beef calves deposit lean, fat, and bone from weaning to slaughter

weights. These animals were fed moderate or rapid gain rations and were slaughtered on a weight and an age constant basis. This study involved 36 Hereford steers. Dressing percentages increased as the feeding period was extended. Also, the rapid gain ration animals developed faster on both age and weight constant basis. Although a significant increase in the skeletal muscles was found with increases in age and body weight. The data showed that most of the skeletal growth occurred very early in the beef calf's life. This is in agreement with Berg and Butterfield (1978). Also, Guenther et al. (1965) reported as the animal matured more external fat accumulated.

Berg et al. (1968) reported that weight at slaughter had an important influence on carcass composition. In normal slaughter ranges, as weight increased, muscle decreased, fat percentage increased, and bone percentages decreased. An increased plane of nutrition increased the percentage of fat and its influence on muscle-bone ratio relative to total muscle plus bone was not clear. Also, breed or genetic differences in relative tissue growth were found in weights at the onset of the fattening phase and in the muscle-bone ratio. In addition, Berg et al. (1968) reported that a heifer tended to have a higher percentage of fat than steers, and the level of nutrition would affect the accumulation of fat proportionately.

Berg and Butterfield (1976) reported that the rate of growth does not affect muscle-bone ratio. Furthermore, muscle and bone growth proceed at the same relative rates to each other irrespective of the ratio of growth as long as positive growth is maintained.

In addition, fat growth relative to muscle and bone growth is dependent on the level of energy intake and a high energy intake produces more fat relative to muscle and bone. Guenther et al. (1965) reported similar findings.

The composition of a meat animal at any given stage of development is of great interest to the producer, packer, retailer, and especially the consumer. Hankin, Knapp, and Phillips (1943) found muscle-bone ratio to be an inherited characteristic. Also, that within certain limits fattening of an animal will increase dressing percent, carcass grade, and percent of fat in the carcass; while decreasing the percent of moisture, protein, lean, and bone. Weseli, Good, and Holland (1958) indicated that steers scored as having larger bones tend to have lower dressing percentages and less external fat thickness. While Lush (1926) reported little or no evidence of any relationship between dressing percentage and the percentage of bone when degree of fatness was constant.

The continuing demand for an increase in the quantity and quality of lean from beef steers emphasizes the importance of learning more about the growth and development of meat animals as they are affected by breeding, feeding, and management. Quantity is measured by rate of gain, age, thickness of fat cover, and size of rib eye. Quality is a subjective attribute of meat-color, texture, marbling, fat distribution and palatability (Heiner et al., 1971).

CHAPTER III

MATERIALS AND METHODS

In the summer of 1981, cattle were available at Ames Plantation, an experiment station located in West Tennessee, that had been backgrounded on different kinds of pasture. These cattle provided an excellent opportunity to investigate forages other than fescue for backgrounding cattle to eliminate or reduce the undesirable flavor and odor of grass-fed beef.

A brief description of each type of pasture is given to provide some general information about grasses used in this experiment.

Fescue is a deeply rooted and strongly turfed perennial with stems 3 to 4 feet high. Fescue is found growing in damp pastures and does best on heavy soils. It is a desirable winter pasture in the South. Also, it is quite drought resistant and aggressive; competes strongly with legumes. It is less palatable than orchard grass or timothy grass.

Sudan grass has a widespread adaptability which has made it one of the most valuable of summer annual forage grasses. Sudan grass grows 4 to 7 feet tall depending on the method of planting and is very tolerant to dry climates. The stems grow in a single clump and can support many leaves. Sudan grass usually is grown in places that have limited moisture. Sudan grass occasionally may contain enough prussic acid to be toxic to livestock.

Bermuda grass is a long lived perennial with a spreading habit of growth. It propagates by runners. Bermuda grass will grow well on almost any soil that is fertile and not too wet. Also, it thrives in warm or hot weather. Bermuda grass is very palatable and nutritious even after frost in the fall.

Orchard grass is a long lived perennial, a distinctly bunch-type grass with folded leaf blades and compressed sheaths. It grows in large contiguous masses. Orchard grass flourishes on rich soil, but will tolerate heat, drought, and low soil fertility. Also, orchard grass is very palatable for livestock and provides a good summer pasture.

A legume is a plant that bears pods, which is referred to as the fruit of the plant. Legumes supply large amounts of nitrogen to the soil. Legumes are higher in percentages of protein than nonlegumes, and have a higher quality protein. They also have large amounts of calcium and phosphorus. Legumes are recognized as the best source of Vitamins A and D. These nutrient qualities of legumes make them an excellent pasture plant. Legumes can be incorporated with other grasses for a more beneficial pasture.

The experiment involved 68 Angus yearling steers that had been grown on five different pastures at Ames Plantation. The cattle were maintained on the same pasture through the summer. The pastures included: (T1) fescue and legume the first part of the grazing period, followed by sudan grass and sorghum pasture (N=14), (T3) Midland Bermuda Grass, fescue, and legume (N=15), (T4) Midland Bermuda Grass,

fescue, plus nitrogen fertilizer (N=15), (T5) fescue and legume (N=13), and (T6) orchard grass and clover (N=11). (T2 was omitted due to lack of enough animals).

On July 22, 1981, an initial weight, wither height, and ultrasonic measurements of the subcutaneous fat over the 12th rib were taken on each animal. The live weight was used as the beginning weight on grass. The cattle were then returned to their designated pastures for the remaining part of the summer.

On September 2, 1981, the cattle were weighed and wither height and ultrasonic measurements of the subcutaneous fat over the 12th rib were taken on each animal. The live weight was used as the weight off grass. The 68 Angus steers were then transported to the Plateau Experiment Station, Crossville, Tennessee. Fifteen cattle, three from each pasture treatment, were slaughtered at Lay's Packing Plant in Knoxville, Tennessee, immediately after coming off pasture. The remaining 53 steers were assigned to grain feeding groups on the basis of weight and fat thickness. At least two steers from each of the five different treatments were in each of the different feeding groups. After a 14 day acclimation period, the groups were grain fed for 28, 56, 84, or 112 days. All steers received whole shelled corn ad libitum and Tend-R-Leen at the rate of 1.1 pounds per head per day.

At each 28 day period, after the 14 day acclimation period, all animals were weighed. Wither height and ultrasonic measurements were also taken. Then the appropriate group was transported to Lay's Packing Plant for slaughter. The feeding schedule and slaughter dates are given in Table 1.

TABLE 1. Feeding Schedule and Slaughter Dates

Slaughter Group	n	Days on Feed	Slaughter Date
1	15	0	Sept. 2, 1981
2	14	28	Oct. 19, 1981
3	14	56	Nov. 16, 1981
4	13	84	Dec. 14, 1981
5	12	112	Jan. 11, 1982

The carcasses were chilled for 48 hours, then ribbed and evaluated by a U.S.D.A. grader for quality and yield grade. Carcass measurements and subjective color evaluations of carcass lean and fat were also made at the packing house by University of Tennessee personnel. In addition, lean firmness and texture were subjectively evaluated. The left hindquarter of each carcass was then transported to the University of Tennessee Meat Lab for further data collection.

Hindquarters were broken into the wholesale loin and round according to the procedure of Wellington (1953). The loins were then separated into the sirloin and short loin after the tenderloin was removed. The rounds were boned out and the various muscles were separated. The femur and biceps femoris were weighed. Also, cross section drawings were made of each biceps femoris to determine the area by a compensating polar planimeter. Length of femurs were also recorded. All of these measurements were used to determine a muscle to bone ratio.

Each short loin was aged 10 days before five steaks were removed from the rib end. The first steak, which was 2.5 cm thick, was stripped of all epimysium tissue, and powdered with liquid nitrogen in a high speed blender. Triplicate powdered samples weighing approximately 2 grams were dried in a vacuum oven at 70°C under a pressure of 25 mg Hg for 5 hours. After drying, the samples were weighed to determine sample moisture content and then put into a Soxhlet apparatus for 24 hours. This allowed the fat to be extracted. Once this was accomplished, the samples were removed from the Soxhlet.

After the ether was evaporated, the samples were dried again at 70°C for 5 hours and then a final weight was obtained and the fat content of the sample was calculated. This procedure is described by the A.O.A.C. (1975).

Steaks two and three, each 2.5 cm thick, were used to determine an objective tenderness value. Both steaks were cooked by a modified oven broiling method to an internal temperature of 70°C. After the steaks cooled to room temperature, ten 1.27 cm cores were removed from each steak. Cores from each steak were objectively evaluated for tenderness by either the Warner-Bratzler or the Instron Model 1132 Shear Test. Also, volatile, non-volatile, and total cooking losses were calculated from steaks two and three.

Steak four, also 2.5 cm thick, was used for sensory evaluation. A 14 member trained panel was used for sensory evaluation. Members of the panel subjectively evaluated tenderness, juiciness, flavor, and overall acceptability using a nine point scale; (1--extremely undesirable, and 9--extremely desirable). Panel members were served one-half square inch samples from the outer portion of the longissimus muscle. Steak five was used for taste panel training.

All data were analyzed by analysis of variance with pasture and days on feed as fixed variables (Snedecor and Cochran, 1971).

CHAPTER IV

RESULTS AND DISCUSSIONS

Tables 2 and 3 show means and standard deviations of certain production traits of steers varying in treatments (Table 2) and days on feed (DOF, Table 3).

Initial weight on grass (Table 2) was 342.5 kg, 355.5 kg, 331.4 kg, 336.0 kg, and 341.4 kg for Treatment 1, 3, 4, 5, and 6, respectively. Final weight on grass (Table 2) was 377.7 kg, 366.8 kg, 357.7 kg, 364.6 kg, and 380.4 kg for Treatment 1, 3, 4, 5, and 6, respectively. Weights vary between treatments for both the initial weights and final weights on grass. These variations could possibly be related to the differences in beginning weights for steers on a particular treatment. Also, the variation could be contributed to the physical condition of the animals when the study started which was earlier than the initiation of this study. Treatment 1 (fescue and legume the first part of the grazing period, followed by sudan and sorghum pasture) and T6 (orchard grass and clover) had heavier steers initially and at the final weights on grass.

Production traits as related to DOF are shown in Table 3. After a 14 day acclimation period, initial weights on grain for the different feeding periods still showed variation. The variations on grass carried over to the initial weight at beginning of the grain feeding periods. However, steers were assigned to feeding groups on the basis of weight and fat thickness. The heavier steers from each

TABLE 2. Means and Standard Deviations of Certain Production Traits of Steers Varying in Treatment

Production Traits	Treatments					Overall
	1	3	4	5	6	
Initial Wt. on Grass (kg)	342.5[a]	355.5[b]	331.4[c]	336.0[c]	341.4[a]	341.4
S.D.[1]	±32.3	±36.3	±59.0	±55.8	±36.3	±43.9
Final Wt. on Grass (kg)	377.7[a]	366.8[b]	357.7[c]	364.6[b]	380.4[d]	369.4
S.D.	±48.6	±47.2	±59.5	±61.3	±34.0	±50.1

[1]Standard Deviation.

[abcd]Means in a row with the different superscripts are significantly different P<.01.

TABLE 3. Means and Standard Deviations of Certain Production Traits of Steers Varying in Days on Feed

Production Traits	Days on Feed 0	28	56	84	112	Overall
Initial Wt.(kg)	369.6[a]	319.8[b]	322.6[bd]	333.8[c]	329.5[cd]	335.1
S.D.[1]	±44.0	±32.23	±38.4	±39.1	±41.9	±47.9
Final Wt.(kg)	369.6[a]	362.4[a]	400.5[b]	455.7[c]	475.0[d]	412.64
S.D.	±44.0	±29.6	±47.8	±53.3	±38.4	±42.6
ADG (kg)		1.5[a]	1.4[b]	1.4[b]	1.3[c]	1.4
S.D.		±.4	±.4	±.3	±.3	±.4
Total Gain (kg)		42.6[a]	77.9[b]	121.9[c]	145.5[d]	97.0
S.D.		±11.9	±21.1	±23.3	±31.2	±21.9
Total Grain Consumption (kg)		225.5	507.4	802.4	1029.0	641.1
S.D.		±18.6	±24.1	±27.5	±52.8	±30.7
Feed Efficiency[2]		5.3[a]	6.5[b]	6.7[b]	7.1[c]	6.4
		±.9	±1.1	±.7	±.7	±.9

[1]Standard deviation.

[2]Feed efficiency = kg of corn/kg total gain.

[abcd]Means in a row with different superscripts are significantly different P<.01.

treatment were assigned to 0 DOF. This could have accounted for some of the variations, along with a fluctuation of water and feed intake. Also, it could have taken animals longer than 14 days to adapt to the new grain ration.

Slaughter weights (final weights) were the same for the 0 and 28 DOF (Table 3, Figure 1). However, slaughter weights for the 56, 84, and 112 DOF groups were significantly higher ($P<.01$) than for the first two feeding groups (0 and 28 DOF). Guenther et al. (1965) reported increased slaughter weights of cattle fed at a high level of energy as compared to cattle fed a low or moderate level of energy. The similar weights for 0 and 28 DOF could be contributed to a longer adjusting period for the 28 DOF steers.

Average daily gain (ADG) was 1.5, 1.4, 1.4, and 1.3 kg for 28, 56, 84, and 112 DOF, respectively. This shows a decrease in ADG as feeding time increased. Total gain was 42.6, 77.9, 121.9 and 145.5 kg for 28, 56, 84, and 112 DOF, respectively. Also feed efficiency was 5.3, 6.5, 6.7, and 7.1 for 28, 56, 84, and 112 DOF, respectively. All three of these production traits are in Table 3. Both ADG and feed efficiency for the 28 and 56 DOF groups were higher than the other two feeding groups. This could be attributed to the cold weather that the last two feeding groups were exposed to. Also, the natural slowing down process of growth and development could contribute to some difference.

Dressing percent is one of the most significant differences that distinguishes forage-fed beef from grain-fed beef. Table 4 shows the

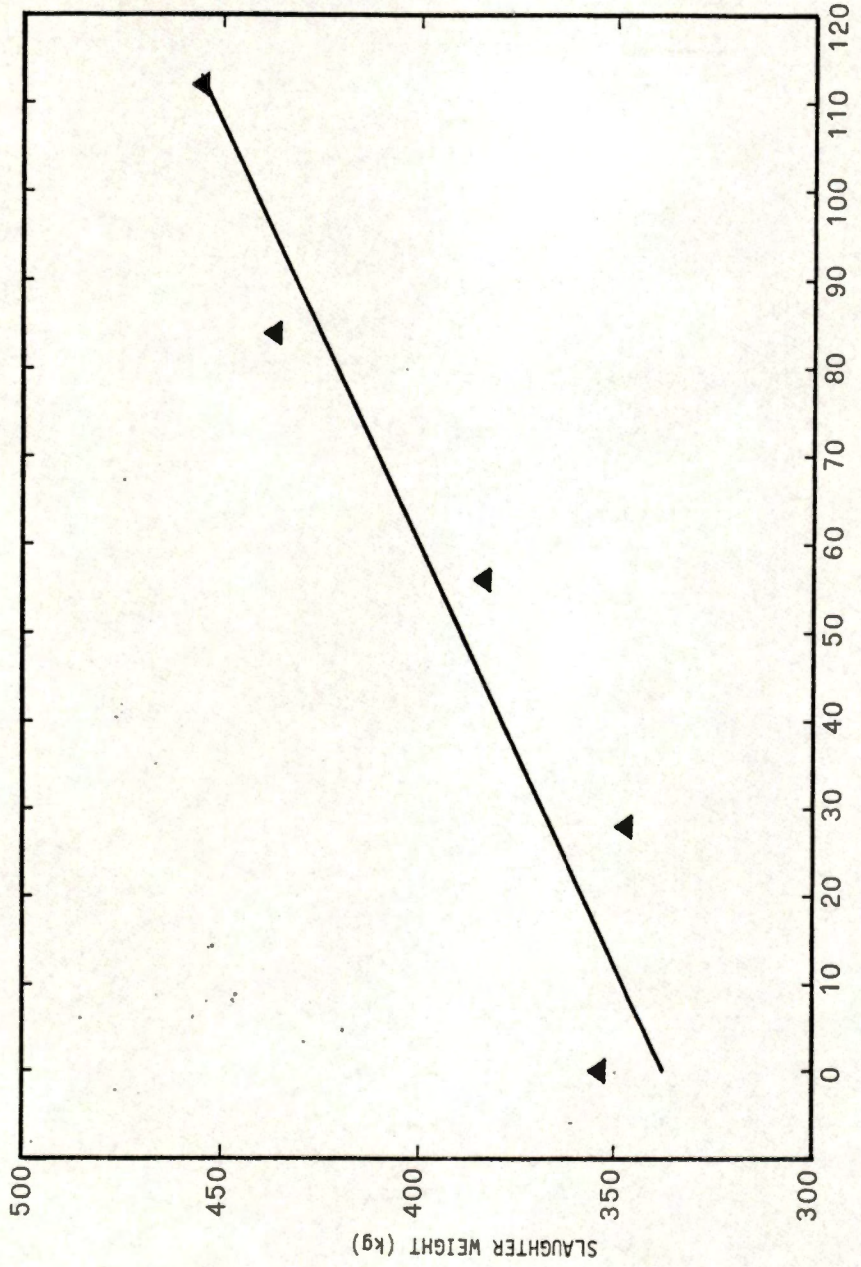


FIGURE 1: Mean Slaughter Weight as Affected by Days on Feed.

TABLE 4. Means and Standard Deviations of Certain Carcass Traits for Steers Varying in Days on Feed

Carcass Traits	Days on Feed 0	28	56	84	112	Overall
Slaughter Wt.[1](kg)	354.7	347.9	384.5	437.5	456.0	396.1
S.D.[2]	±42.3	±28.4	±45.9	±51.2	±36.9	±40.9
Hot Carcass Wt. (kg)	171.5[a]	199.0[b]	232.6[c]	264.9[d]	282.2[e]	230.0
S.D.	±23.0	±18.6	±27.7	±37.8	±31.4	±27.7
Dressing (%)	48.3[a]	57.2[b]	60.6[c]	60.4[c]	62.0[d]	57.7
S.D.	±2.5	±1.9	±3.3	±3.3	±5.0	±3.3
Chilled Carcass Wt. (kg)	170.0[a]	194.8[b]	227.9[c]	259.6[d]	276.6[e]	225.8
S.D.	±22.6	±18.2	±27.2	±37.0	±30.7	±27.14
Cooler Shrinkage (%)	2.00[a]	2.04[b]	2.01[a]	2.00[a]	2.01[a]	2.02
S.D.	±.10	±.06	±.05	±.06	±.06	±.07
Hindquarter Wt. (kg)	40.4[a]	46.6[b]	55.2[c]	59.8[d]	63.7[e]	53.1
S.D.	±4.9	±5.0	±6.4	±8.9	±7.1	±6.5
Adj. Fat Thickness (mm)	3.56[a]	5.08[b]	8.13[c]	10.41[d]	11.94[e]	7.77
S.D.	±2.03	±2.44	±2.21	±3.40	±3.43	±2.70
Rib eye Area(cm^2)	56.1[a]	65.8[b]	70.3[c]	76.8[d]	78.7[e]	69.5
S.D.	±7.1	±7.7	±8.3	±10.3	±9.7	±8.6
Internal Fat(%)	1.0[a]	1.1[a]	1.8[b]	2.3[c]	2.2[c]	1.7
S.D.	±.4	±.3	±.4	±.6	±.5	±.4
Yield Grade	1.7[a]	1.6[a]	2.1[b]	2.4[c]	2.5[d]	2.1
S.D.	±.4	±.4	±.4	±.6	±.6	±.5

TABLE 4. (Continued)

Carcass Traits	Days on Feed 0	28	56	84	112	Overall
Marbling[3]	3.5[a]	3.9[b]	4.6[c]	6.1[d]	6.0[d]	4.8
S.D.	±.6	±.8	±.6	±.6	±.7	±.7
Quality Grade[4]	2.7[a]	3.7[b]	5.1[c]	7.6[d]	7.6[d]	5.3
S.D.	±1.0	±1.5	±1.6	±.8	±.8	±1.1
Fat Color[5]	3.5[a]	4.8[b]	3.5[a]	3.4[a]	2.4[c]	3.5
S.D.	±.7	±.7	±.7	±.4	±.5	±.6
Lean Color[6]	5.2[a]	5.7[b]	6.6[c]	6.1[d]	6.7[c]	6.1
S.D.	±1.4	±.7	±.5	±.6	±.6	±.8
Lean Firmness[7]	5.1[a]	5.8[b]	6.3[c]	6.2[c]	6.7[d]	6.0
S.D.	±1.7	±1.1	±1.0	±.7	±.9	±1.1

[1] Slaughter weight-final weight x .96 (4% shrunk weight). Also used to determine dressing (%).

[2] Standard deviation.

[3] 1-Devoid, 2-practically devoid, 6-modest.

[4] 1-Low standard, 6-high good, 9-high choice.

[5] 1-Creamy white, 3-slightly yellow, 5-yellow.

[6] 5-Slightly dark red, 6-cherry red, 7-very light cherry red, 8-grayish red.

[7] 5-Slightly firm, 6-moderately firm, 7-firm, 8-very firm.

[abcde] Means in a row with different superscripts are significantly different $P<.01$.

means and standard deviations for dressing percent for steers varying in DOF. The greatest increase ($P<.01$) was between 0 to 28 DOF (8.9% which was mainly due to switching the ration from all forage to all grain. Dressing percent ranged from 48.3 (0 DOF) to 62.0 (112 DOF). Dinius (1978) and other researchers have reported higher dressing percent for grain-fed steers as compared to forage-fed steers.

Mean hindquarter weights (Table 4) increased ($P<.01$) from 40.4 kg at 0 DOF to 63.7 kg at 112 DOF. The greatest increase in mean hindquarter weights occurred at 28 to 56 DOF (8.6 kg increase). Evidently the steers started developing tissue at a much faster rate between the 28 and 56 DOF period. Also, the 56 DOF group had a higher percent of internal fat, which could have caused an increase in hindquarter weight.

Yield grade is determined by several factors: (1) hot carcass weight; (2) adjusted fat thickness; (3) rib eye area; and, (4) internal fat (KPH%). Table 4 shows all four factors increased ($P<.01$) from 0 to 112 DOF. Adjusted fat thickness, rib eye area, and internal fat from the steers were 3.56mm, 56.1cm^2, 1.0%; 5.08mm, 65.8cm^2, 1.1%; 8.13mm, 70.3cm^2, 1.8%; 10.41mm, 76.8cm^2, 2.3%; and 11.94mm, 78.7cm^2, 2.2% for 0, 28, 56, 84, and 112 DOF, respectively. As a result of these carcass traits having a linear trend (Figures 2 and 3) yield grade also increased ($P<.01$) in a linear fashion (Figure 4). It should be noted that all steers graded either yield grade 1 or 2.

Degree of marbling (Table 4, Figure 5) also increased ($P<.01$) in a linear fashion which resulted in a similar trend for quality

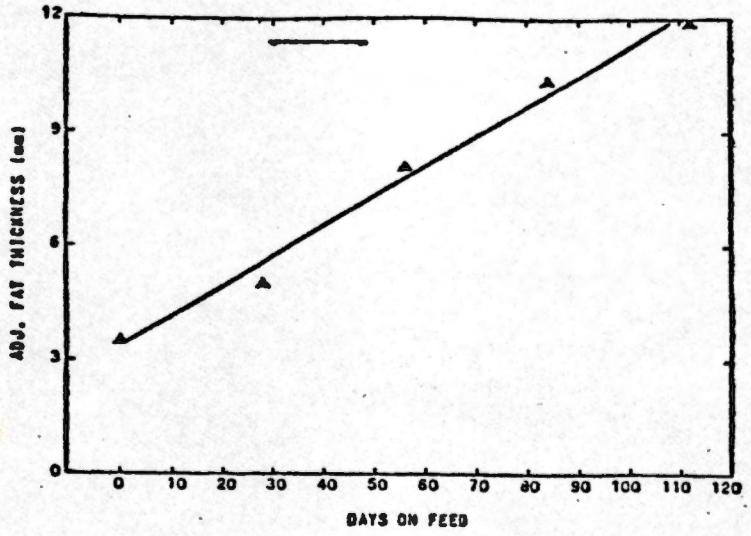


FIGURE 2. Mean Carcass Fat Thickness as Affected by Days on Feed

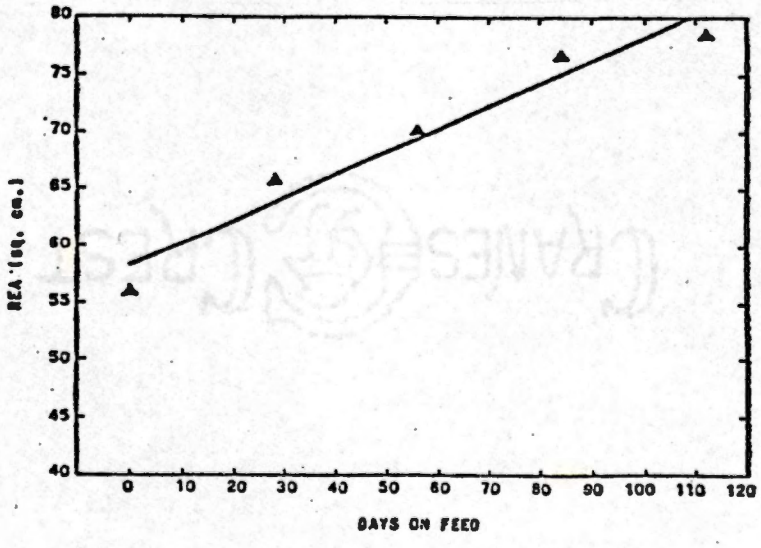


FIGURE 3. Mean Carcass Rib Eye Area as Affected by Days on Feed

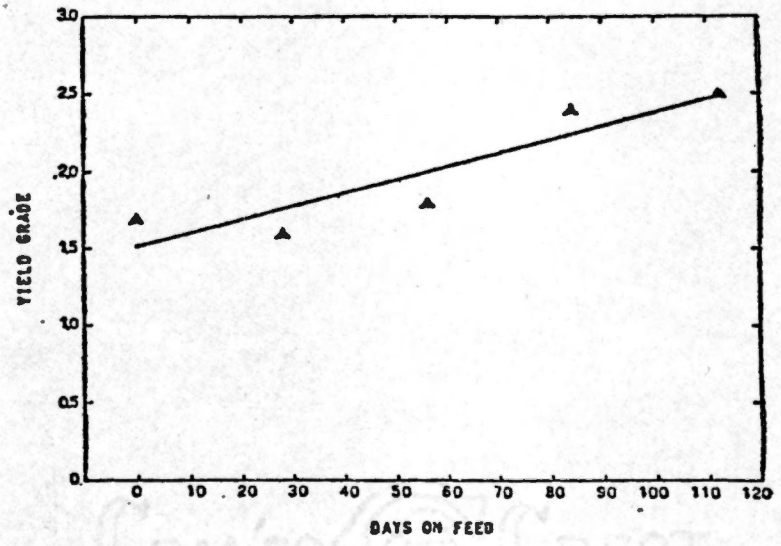


FIGURE 4. Mean Carcass Yield Grade as Affected by Days on Feed

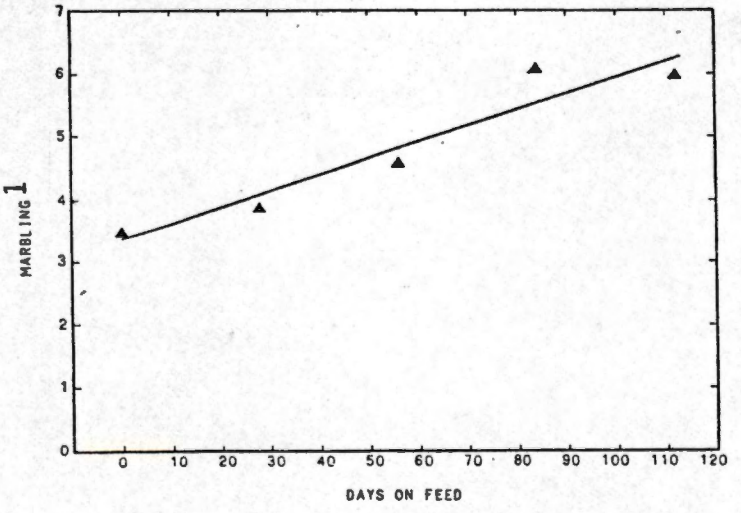


FIGURE 5. Mean Carcass Marbling Score as Affected by Days on Feed.

[1]3.0-Traces, 4-Slight, 5-Small, and 6-Modest.

grade from ($P<.01$) (Table 4, Figure 6) 0 to 112 DOF. Marbling scores were traces^{50}, traces^{90}, slight^{60}, modest^{10}, and modest^{0}, for 0, 28, 56, 84, and 112 DOF, respectively. Quality grades were average standard, high standard, average good, average choice, and average choice, for 0, 28, 56, 84, and 112 DOF, respectively. The 112 DOF group graded two quality grades higher ($P<.01$) than the 0 DOF group. It should be noted that marbling increased 1.1 degrees in the first 56 DOF and then increased 1.5 degrees in the next 28 DOF (Table 4). With the new proposed grading standards which (Federal Register, 1981) would have allowed carcasses to grade choice that had slight^{50} marbling or higher seven out of the 14 steers (50%) would have graded choice at 56 DOF. This means producers can feed animals to an acceptable quality level in a shorter length of time, thus reducing production cost which is very critical today.

Muscle to bone ratio (Biceps Femoris Wt.: Femur Wt.) was 2.3, 2.4, 2.7, 2.6, and 2.7 for 0, 28, 56, 84, and 112 DOF, respectively (Table 5). Significant differences ($P<.01$) were found between 0, 28, and 56 DOF. Muscle comprises a high percentage of total weight at birth, increases slightly and begins to decrease in percent as the fattening phase continues. Bone at no stage of development exerts a dominant role in the determination of relative proportions of muscle, bone and fat (Berg and Butterfield, 1968). At the middle feeding period (56 DOF) there was a leveling off in muscle-bone ratio. This was probably due to the natural slowing down process of growth development. Also, the cold environment could have possibly caused the leveling off in muscle development.

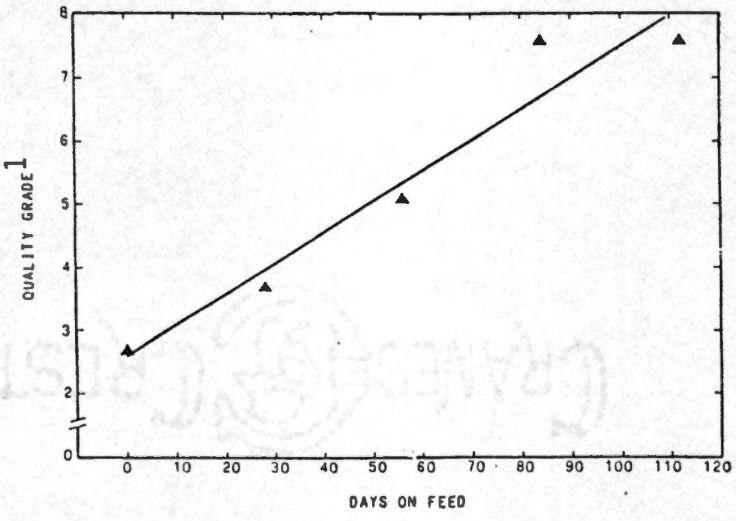


FIGURE 6. Mean Carcass Quality Grade as Affected by Days on feed

[1]2-Average Standard, 5-Average Good, and 8-Average Choice.

TABLE 5. Means and Standard Deviations of Certain Muscle and Bone Traits of Steers Varying in Days on Feed

Muscle and Bone Traits	Days on Feed					Overall
	0	28	56	84	112	
Biceps Femoris Weight (kg)	3.9[a]	4.2[b]	4.7[c]	5.1[d]	5.0[d]	4.6
S.D.[1]	±.5	±.5	±.4	±.6	±.7	±.5
Biceps Femoris Area (cm^2)	101.3[a]	107.1[b]	122.6[c]	120.0[c]	132.9[d]	116.8
S.D.	±16.1	±13.5	±20.0	±12.9	±15.5	±15.6
Femur Weight (kg)	1.7[a]	1.8[b]	1.7[a]	2.0[c]	1.9[d]	1.8
S.D.	±.2	±.2	±.1	±.2	±.2	±.2
Femur Length (cm)	35.6[a]	35.6[a]	35.6[a]	36.3[b]	37.1[c]	36.0
S.D.	±1.5	±1.0	±1.0	±1.5	±1.5	±1.3
Muscle:Bone[2]	2.3[a]	2.4[b]	2.7[c]	2.6[c]	2.7[c]	2.5
S.D.	±.3	±.3	±.2	±.3	±.3	±.3

[1]Standard deviation.

[2]Biceps Femoris weight: Femur weight.

[abcd]Means in a row with different superscripts are signiticantly different $P<.01$.

Instron shear force is an objective tenderness test that can be compared to a subjective tenderness test. Instron values (Table 6) were 3.4, 4.1, 3.9, 3.1, and 2.9 kg for 0, 28, 56, 84 and 112 DOF, respectively. From 28 DOF to 112 DOF there was a significant ($P<.01$) decrease in shear force values which showed the muscle became more tender with increased DOF. However, 0 DOF is significantly lower ($P<.01$) than 28 or 56 DOF. This could be due to human error or the Instron was not calibrated correctly for the 0 DOF group. Also, possibly the 0 DOF steers had less connective tissue and longer muscle fibers due to less muscle contraction during rigor mortis. But, after the 0 DOF group, the rest of the feeding groups decreased in a manner that would be expected.

Volatile cooking loss (Table 6) was 13.3%, 14.8%, 14.6%, 13.6%, and 12.5% for 0, 28, 56, 84, and 112 DOF, respectively. The shorter the time on feed the less fat and more water a steer's muscle would possess. Thus, meat from shorter fed cattle would lose more water to evaporation which would account for a higher percentage of volatile cooking loss. Nonvolatile cooking losses are primarily due to fat. As marbling increases with DOF, percent of fat increases. This results in a higher nonvolatile cooking loss. Nonvolatile cooking loss (Table 6) was 4.4%, 5.8%, 5.7%, 6.1%. and 6.5% for 0, 28, 56, 84 and 112 DOF, respectively. Total cooking loss (Table 6) was 17.7%, 20.7%, 20.4%, 19.8%, and 18.9% for 0, 28, 56, 84, and 112 DOF, respectively. The variation could be due to the average difference in fat thickness, rib eye, and degree of doneness.

TABLE 6. Means and Standard Deviations of Certain Physical and Chemical Traits of Steaks from Steers Varying in Days on Feed

Physical and Chemical Traits	Days on Feed 0	28	56	84	112	Overall
Instron (kg)	3.4[a]	4.1[b]	3.9[b]	3.1[c]	2.9[c]	3.5
S.D.[1]	±1.0	±1.2	±1.0	±1.1	±.8	±1.0
Volatile Cooking loss (%)	13.3[a]	14.8[b]	14.6[b]	13.6[a]	12.5[c]	13.8
S.D.	±2.3	±2.3	±1.9	±1.7	±2.1	±2.1
Non-volatile Cooking loss (%)	4.4[a]	5.8[b]	5.7[b]	6.1[c]	6.5[d]	5.7
S.D.	±.7	±1.2	±1.3	±1.1	1.4	±1.1
Total Cooking loss (%)	17.7[a]	20.7[b]	20.4[bc]	19.8[c]	18.9[d]	19.5
S.D.	±2.7	±3.1	±2.7	±2.1	±2.8	±2.7
Water (%)	75.4[a]	74.1[b]	73.2[c]	70.7[d]	70.2[e]	72.7
S.D.	±.6	±.9	±1.0	±1.5	±1.5	±1.1
Fat (%) Wet Basis	2.3[a]	3.1[b]	4.6[c]	7.1[d]	6.5[e]	4.7
S.D.	±.4	±.8	±1.6	±1.8	±1.9	±1.3
Fat (%) Dry Basis	9.6[a]	12.1[b]	17.3[c]	23.9[d]	21.8[e]	16.9
S.D.	±1.8	±2.9	±5.2	±4.9	±5.1	±4.0

[1]Standard Deviation.

[abcde]Means in a row with different superscripts are significantly different $P<.01$.

Time on feed affected all four palatability characteristics as shown in Table 7 (Figures 7, 8, 9, and 10). The steaks from the steers fed for 84 and 112 DOF scored higher ($P<.01$) for flavor, tenderness, juiciness, and overall acceptability. Instron shear values (Table 6) were lower ($P<.01$) for 84 and 112 DOF groups which agrees with subjective tenderness values.

Figure 7 and Table 7 showed a substantial increase ($P<.01$) in flavor score from 0 to 28 DOF. As DOF continued there was a linear increase from 28 to 84 DOF. After the 84 DOF period, flavor scores plateaued. This indicates that as far as flavor scores, 84 DOF was the optimum time on feed.

Tenderness (Figure 8, Table 7) showed a significantly higher ($P<.01$) score for 0 DOF compared to 28 and 56 DOF. The decrease in tenderness could be due to the sensory panel not consistently being able to distinguish tough from tender. Another possible cause could be due to the fact 0 DOF steers possibly possessed less connective tissue and had less muscle contraction during rigor mortis than the 28 or 56 DOF group. From 28 to 84 DOF there was a large increase in tenderness scores. Tenderness increased very little between 84 and 112 DOF.

Juiciness (Figure 9) was similar from 0 to 56 DOF. Between 56 and 84 DOF there was a significant increase ($P<.01$) in juiciness scores (Table 7). Again, a leveling off was noted between 84 and 112 DOF.

TABLE 7. Means and Standard Deviations of Palatability Characteristics of Loin Steaks from Steers Varying in Days on Feed

Palatability[1] Characteristics	Days on Feed					Overall
	0	28	56	84	112	
Flavor	4.5[a]	5.1[b]	5.5[bc]	5.9[cd]	5.9[d]	5.4
S.D.[2]	±1.8	±1.7	±1.5	±1.6	±1.6	±1.6
Tenderness	5.8[a]	5.2[b]	5.6[ab]	6.3[c]	6.5[c]	5.9
S.D.	±1.6	±1.7	±1.4	±1.5	±1.5	±1.5
Juiciness	5.6[a]	5.8[a]	5.9[a]	6.3[b]	6.4[b]	6.0
S.D.	±1.4	±1.4	±1.2	±1.2	±1.2	±1.3
Overall	4.6[a]	5.0[ab]	5.4[bc]	5.9[cd]	6.0[d]	5.4
Acceptability	±1.7	±1.6	±1.3	±1.5	±1.5	±1.5

[1]Measured on 1-9 point scale; 1 = extremely undesirable, extremely tough, extremely dry, extremely undesirable; 9 = extremely desirable, extremely tender, extremely juicy, extremely desirable.

[2]Standard Deviation.

[abcd]Means in a row with different superscripts are significantly different $P<.01$.

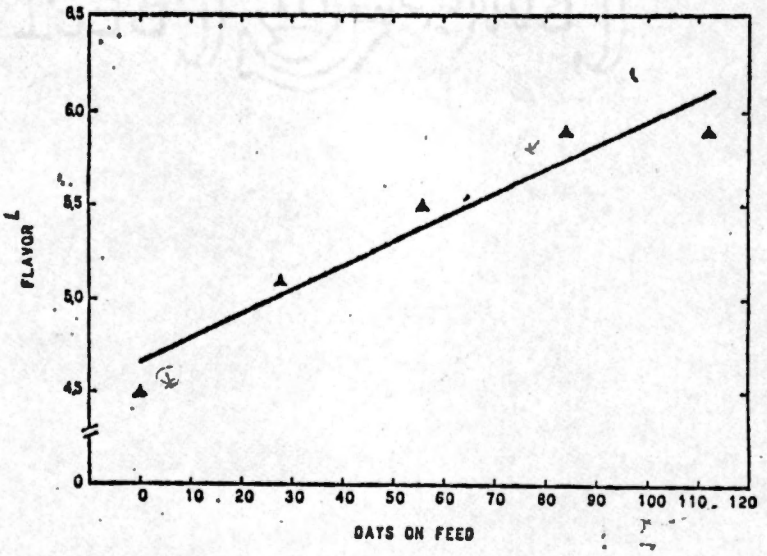


FIGURE 7. Mean Flavor Score as Affected by Days on Feed

[1]1-Extremely Undesirable and 9-Extremely desirable.

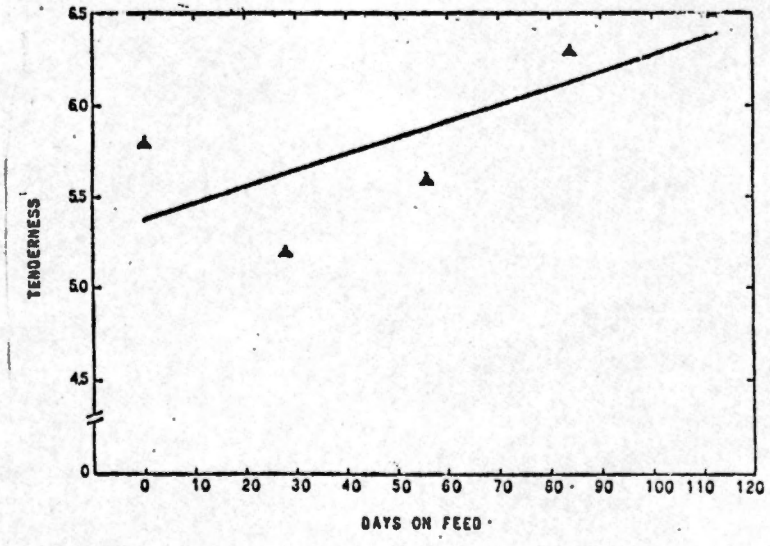


FIGURE 8. Mean Tenderness Score as Affected by Days on Feed

[1]1-Extremely Tough and 9-Extremely Tender.

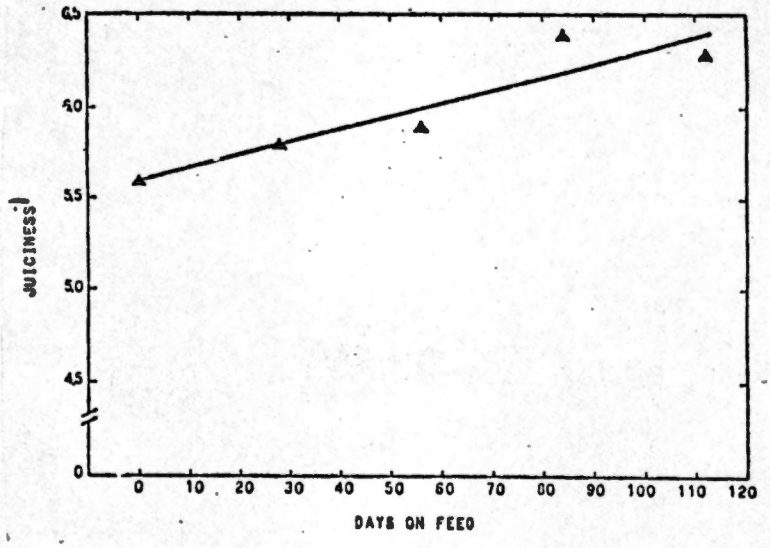


FIGURE 9. Mean Juiciness Score as Affected by Days on Feed

[1]1-Extremely Dry and 9-Extremely Juicy.

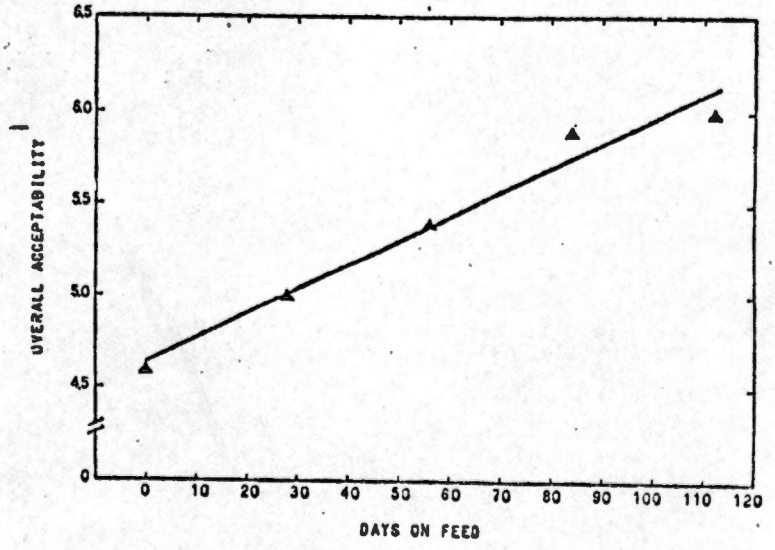


FIGURE 10. Mean Overall Acceptability Score as Affected by Days on Feed

[1]1-Extremely Undesirable and 9-Extremely desirable.

Overall acceptability (Figure 10) shows a gradual increase as DOF increased up to 84 DOF. As seen in flavor, tenderness and juiciness, there was also a leveling off at 84 and 112 DOF.

All four palatability characteristics plateaued after 84 DOF. This indicates as far as palatability characteristics 84 DOF was the optimum feeding time.

R-squared values between palatability traits and certain variables are shown in Table 8. Marbling (variable 1) had a R-squared value of .05, .06, .05, and .07 for flavor, tenderness, juiciness, and overall acceptability, respectively. Adjusted fat thickness (variable 2) had a coefficient of .06, .06, .05, and .07 for flavor, tenderness, juiciness, and overall acceptability, respectively. Combinations of variables did not increase the R-squared values.

Table 9 shows a grouping of sensory panel members by cluster analysis for flavor. Flavor was chosen as the main palatability characteristic for cluster analysis because grass-fed beef has a significantly detectable milky-oily flavor. Table 9 shows three different groups (clusters): Group A, consisting of sensory panel members 6, 7, 10, and 11; Group B, consisting of sensory panel members 1, 2, 3, 4, 5, 8, 9, 12, and 13; and, Group C, consisting of sensory panel member 14. However, panel member 3 was deleted from Group B due to missing evaluations. Also, panel member 14 was deleted because of the great variation in sensory scores compared to other panel members.

Table 10 shows mean flavor scores of the sensory panel groups created by cluster analysis for loin steaks by DOF. Group A's flavor

TABLE 8. R-squared Values Between Palatability Traits and Certain Variables

Variables[1]	Palatability Trait			
	Flavor	Tenderness	Juiciness	Overall Acceptability
1	.05	.06	.05	.07
2	.06	.06	.05	.07
1, 2	.06	.07	.05	.08
1, 2, 3	.08	.07	.06	.09

[1]Variables: 1 = Marbling
2 = Adjusted fat thickness
3 = Hot carcass weight

TABLE 9. Grouping of Sensory Panel Members by Cluster Analysis for Flavor

Group	Panel Members
A	6, 7, 10, 11
B	1, 2, 3[1], 4, 5, 8, 9, 12, 13
C	14[2]

[1]Panel member was deleted because of missing evaluations.

[2]Panel member was deleted because of great variations in sensory scores compared to other panel members.

TABLE 10. Mean Flavor Scores[1] of Sensory Panel Groups Created by Cluster Analysis for Loin Steaks by Days on Feed

Sensory Panel Groups	Days on Feed				
	0	28	56	84	112
Group A	4.0	4.7	4.8	5.0	5.0
Group B	5.0	5.2	5.8	6.3	6.0

[1]1=extremely undesirable, 5=acceptable, 9=extremely desirable.

scores were 4.0, 4.7, 4.8, 5.0, and 5.0 for 0, 28, 56, 84, and 112 DOF, respectively. Group B's flavor scores were 5.0, 5.2, 5.8, 6.3, and 6.9 for 0, 28, 56, 84, and 112 DOF, respectively. Essentially the sensory panel was made up of three subgroups in which panel members within the subgroup were consistant with one another. Also, Group B (eight panelists) was able to distinguish between DOF much better than Group A. This indicates that Group B as a whole was more consistantly able to evaluate flavor by DOF.

CHAPTER V

CONCLUSION

Sixty-eight Angus steers backgrounded on five different pasture types (Treatments) were assigned to feeding groups for 0, 28, 56, 84, and 112 DOF to determine the effect of pasture type and DOF on certain live and carcass quantitative, qualitative, and palatability characteristics.

Initial weight on grass was 342.5 kg, 355.5 kg, 331.4 kg, and 341.4 kg for Treatment 1, 3, 4, 5, and 6, respectively. Final weight on grass was 377.7 kg, 366.8 kg, 357.7 kg, 364.6 kg, and 380.4 kg for Treatment 1, 3, 4, 5, and 6, respectively. These variations in both initial and final weight on grass were related to the differences in beginning weights for steers on a particular treatment. Also, the variation could be contributed to the physical condition of the animals when the study started. T1 and T6 had heavier steers initially and at the final weight on grass. No other variations were found by treatment.

The heavier steers (n=15) from each treatment were slaughtered directly off grass (0 DOF). After a four percent shrinkage (due to transportation to the Packing Company) these steers averaged 354.6 kg at slaughter. Also, the 0 DOF steers dressed out 48.3% (hot carcass weight). The 0 DOF steers had an average hot carcass weight of 171.5 kg with an average of 3.56 mm of fat. Rib eye area averaged 56.1 cm^2

and the 0 DOF group yield graded a 1.7 and quality graded average standard. Subjective fat color averaged 3.5 (1 = creamy white and 5 = yellow) and was not considered by the evaluators to be yellow enough to cause a marketing problem. In addition, the 0 DOF group was ranked lowest for flavor, juiciness, and overall acceptability. Tenderness ranking was higher than was expected.

The 28 DOF group averaged 319.8 kg after the 14 day acclimation period. Slaughter weight was 347.9 kg, with a dressing percent of 8.9% higher (57.2%) than the 0 DOF group. The 28 DOF group had ADG of 1.5 kg and a feed efficiency of 5.3. Carcasses of the 28 DOF group had a fat thickness of 5.08 mm and rib eye area of 65.8 cm^2. This group yield graded 1.6 and had a marbling score of $traces^{90}$. Palatability attributes were acceptable (score of 5) for the 28 DOF group.

The 56 DOF group averaged 384.5 kg at slaughter with 60.6 dressing percent (12.3% higher than 0 DOF group). Hindquarter weight averaged 55.2 kg which was 15 kg higher than the 0 DOF group. In addition, it took the 56 DOF group 1.2 kg more feed per kilogram gained as compared to the 28 DOF group. Steers had 8.13 mm of fat, a rib eye area of 70.3 cm^2 and 1.8% KPH. The 56 DOF group yield graded 2.1 and quality graded average good. Seven of the 14 steers in this group would be choice under the new U.S.D.A. grading system, but only four graded choice under the present standards. Also, the most noticeable muscle development was from 28 DOF to 56 DOF. The 56 DOF group received palatability scores slightly higher than the 28 DOF group.

The 84 DOF group had an average slaughter weight of 437.5 kg with a 60.4 dressing percent. This group had 10.41 mm of fat and a rib eye area of 76.8 cm^2 which was 20 cm^2 more than the 0 DOF group. The 84 DOF group yield graded 2.4 and quality graded average choice, almost 2 quality grades higher than the 0 DOF group. Also, the 84 DOF group showed a leveling off in muscle development from 56 to 84 DOF as compared to the 28 to 56 DOF groups.

Palatability traits for 84 DOF were significantly higher ($P<.01$) than the 0, 28, and 56 DOF groups. This was in agreement with Instron shear value which was lower ($P<.01$) for the 84 DOF group as compared to the 0 to 56 DOF groups.

The 112 DOF group was the least efficient of all the groups and required almost 2 kg of feed more per kg gained as compared to the 28 DOF group. Slaughter weight was 456.0 kg which was 100 kg more than the 0 DOF group. The 112 DOF group had a 62.0% dressing percentage with a chilled carcass weight of 276.6 kg. This was 106.6 kg higher than the 0 DOF group. Rib eye area was 78.7 cm^2 and KPH was 2.2%. Yield grade was 2.5 and quality grade was average choice, which was similar to the 84 DOF group.

Between the 84 and 112 DOF groups there was a definite leveling off in slaughter weight rib eye area, yield grade, marbling score, quality grade, Instron shear value, and all of the palatability characteristics. This trend indicated that not much could be gained in production, carcass traits, or palatability after 84 DOF and that 84 DOF was the optimum time on feed.

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