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Effect of frame score on performance and carcass characteristics of steers finished in the feedlot or backgrounded for various time on pasture and finished in the feedlot

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Abstract

A two-year data of three-year study integrating pasture and drylot feeding systems was used to examine effect of frame score on performance and carcass characteristics of steers. Each year, 84 fall-born and 28 spring-born calves of similar genotypes were used. Fall-born and spring-born calves were started on test in May and October, respectively. Treatments were: 1) fall-born calves directly into feedlot; 2 and 3) fall-born calves put on pasture with or without an ionophore and moved to the feedlot at the end of July; 4 and 5) fall-born calves put on pasture with or without an ionophore and moved to the feedlot at the end of October; 6 and 7) spring-born calves put on pasture with or without an ionophore and moved to the feedlot at the end of October. Frame scores were determined by taking steers' age and live weight into consideration. Cattle that grazed the same duration on pasture were regarded as the same treatment regardless of whether they received an ionophore or not. In the feedlot, steers were provided an 82 % concentrate diet containing whole-shelled corn, ground alfalfa hay, and a protein, vitamin and mineral supplement containing ionophore and molasses. Pens of cattle were harvested at approximately 522 kg. Cattle having a higher frame score at the entry to pasture and grazed until July and October tended to have higher and lower daily gain on pasture than those having lower frame score, respectively ($P>0.05$). Fall-born and spring-born cattle grazed until October, which had higher frame scores at the entry to pasture tended to have higher daily gain in the feedlot showing a compensatory growth. In the feedlot, within each treatment cattle having higher frame score tended to have higher daily gain ($P>0.05$) and had higher dry matter intake ($P<0.05$). Cattle spending longer time in the feedlot have better carcass quality and higher yield grades. Results showed that cattle with higher frame scores had higher growth potentials in the feedlot and if the grazing season is extended then daily gain of cattle having higher frame score decreases.

Keywords: beef cattle, feedlot, Hereford, Angus, frame score, pasture, performance

Zusammenfassung

Einfluss von Rahmenmalen auf Wachstum und Schlachtmerkmale von Bullen bei Fressplatzfätterung oder unterschiedlichen Weidezeiten bei Endmast mit Fressplatzfütterung

Es werden Ergebnisse dreijähriger Untersuchungen zum Einfluss der Rahmenmaße (Hüfthöhe ist bestimmend) bei unterschiedlichen Fütterungssystemen (verschiedene Kombinationen von Fressplatzfütterung und Weidezeiten) auf Wachstum und Schlachtkörpermerkmale von Bullen vorgestellt. Genutzt wurden jährlich 84 im Herbst und 28 im Frühjahr geborene Kälber verschiedener Genotypen. Jeweiliger Versuchsbeginn war für die im Herbst bzw. Frühjahr geborenen Tiere der darauf folgende Mai bzw. Oktober. Folgende Versuchsgruppen wurden gebildet: 1. Herbstkälber direkt zur Fressplatzfütterung, 2. und 3. Herbstkälber in Weidehaltung mit oder ohne Wirkstoffbeigabe und Fressplatzfütterung Ende Juli, 4. und 5. Herbstkälber in Weidehaltung mit oder ohne Wirkstoffbeigabe und Ende Oktober Fressplatzfütterung; 6. und 7. Frühjahrskälber in Weidehaltung mit oder ohne Wirkstoffbeigabe und Ende Oktober Fressplatzfütterung. Die Bestimmung der Rahmenmaße erfolgte jeweils zum Zeitpunkt der Tierwägungen. Das Futter bei Fressplatzfütterung bestand aus 82 % Schrotkonzentrat, Alfalfa Heu sowie eine Eiweiß, Vitamin und Mineralstoffmischung ergänzt durch Wirkstoffbeigabe und Melasse. Das Endgewicht der Bullen am Ende des Versuches betrug durchschnittlich 522 kg. Tiere mit größeren Rahmenmaßen erreichten gegenüber Tieren mit geringeren von Weidebeginn bis Juli bzw. Oktober signifikant höhere tägliche Zunahmen. Herbst und Frühjahr geborene Tiere, die bei Weidebeginn höhere Rahmenmaße aufwiesen und bis Oktober weideten, tendierten bei Fressplatzfütterung zu höheren Zunahmen und kompensatorischem Wachstum. Sie hatten signifikant höhere Trockensubstanzaufnahmen und tägliche Zunahmen. Tiere, welche längere Fressplatzfütterung hatten, erreichten bessere Schlachtkörperqualitäten. Bullen mit größeren Rahmenmaßen zeigten also ein größeres Wachstumspotenzial sowohl bei Fressplatzfütterung als auch bei Weidegang.

Schlüsselwörter: Fleischrind, Fressplatz, Hereford, Angus, Rahmenmaße, Weidehaltung, Schlachtmerkmale

Introduction

Frame score is a score based on subjective evaluation of height or actual measurement of hip height. This score is related to harvest weights at which cattle should attain a given quality grade or attain a given amount of fat thickness (BEEF IMPROVEMENT FEDERATION GUIDELINES 1996). Body size is an important genetic factor in beef cattle production (VAN MARLE KÖSTER *et al.* 2000). By 7 months of age, cattle reach about 80 % of mature height but only 35 to 45 % of mature weight. At 12 months, about 90 % of mature height is reached, compared to only 50 to 60 % of mature weight (HAMMACK and GILL 2001). Strong relationship between feeder cattle frame size and following feedlot performance and carcass grade traits has been reported (DOLEZAL *et al.* 1993, TRENKLE 2001). In most countries, beef is produced on pasture (FIELD and TAYLOR 2003). On the other hand, forage-based production systems may present some disadvantages in terms of product quality (DANNENBERGER *et al.* 2006). In the United States, feedlots rely on feed grains to maximize the quantity and quality

of beef produced, however grazing for different duration on pasture before finishing found to be economical without affecting beef quality (KOKNAROGLU and HOFFMAN 2002). Objective of this study was to examine the effect of frame score on performance and carcass charecteristics of steers finished in the feedlot or grazed on pasture for different length and finished in the feedlot.

Materials and methods

Animals and feeding procedures

A three-year study was initiated with establishment of smoothbromegrass pasture in May 1995 at the Western Iowa Research and Demonstration Farm at Castana, Iowa, USA and was concluded in June 1999. In order to provide uniform cattle, steers were obtained from a ranch near Caddo, Oklahoma, USA. Crossbred calves were offspring of Hereford and Angus × Hereford cows mated to either Angus or Hereford bulls. Each year, 84 fall-born and 28 spring-born calves were bought and placed on test. When cattle were accustomed to the environment they were weighed and were allocated to the treatment groups by weight and colour pattern. Seven treatments, which involved six grazing and one control treatment, were assigned at random. The first treatment involved 14 fall-born steers receiving monensin, being stocked on pasture from the beginning of May to the end of July and then moved to the feedlot (seven head per pen) to be fed the finishing diet during the remainder of the trial (JI). A second treatment involved 14 fall-born steers not receiving monensin on pasture and handled in the same manner as cattle in treatment one (JNI). A third treatment involved 14 fall-born steers receiving monensin on pasture and stocked on pasture from the beginning of May to the end of October and then moved to the feedlot (seven head per pen) to be fed the finishing diet during the remainder of the trial (OI). A fourth treatment involved 14 fall-born steers not receiving monensin on pasture and stocked on pasture from the beginning of May to the end of October and handled in the same manner as cattle in treatment three (ONI). A fifth treatment involved 14 spring-born steers receiving monensin on pasture and stocked on pasture from mid-September to the end of October and then moved to the feedlot (seven head per pen) to be fed the finishing diet during the remainder of the trial (SI). A sixth treatment involved 14 spring-born steers not receiving monensin on pasture and stocked on pasture from mid September to the end of October and handled in the same manner as cattle in treatment five (SNI). A seventh treatment involved 28 fall-born steers (seven head per pen) placed directly into the feedlot after acclimation and adapted to an 82 % concentrate diet containing whole shelled corn, ground alfalfa hay, and a natural protein, vitamin and mineral supplement containing an ionophore and molasses (FEEDLOT). In the feedlot when cattle reached 363 kg live weight, the supplement was changed from natural protein to a urea-based 40 % crude protein, vitamin and mineral premix.

Pasture consisted of 12 ha of smooth bromegrass divided into 16 paddocks by using metal T-posts and braided five-wire electric cable. Each grazing group had access to one paddock at a time and cattle were rotated on the forage based upon pasture availability.

The feedlot facility consisted of pens with concrete floors, 26.5 meters by 4.3 meters with 7 meters of overhead shelter at the north end of each lot. On the south side of each pen a concrete feed bunk providing 53 cm of feed bunk space per animal was provided. Feed level

was determined daily prior to the morning feeding and cattle were fed *ad libitum* and feed intake levels were provided such that feed was always available in the feedbunks. Feeding level was increased when the bunks in approximately one-half of the pens were completely empty at 07:00 prior to the morning feeding. Daily dry matter intake (DMI) was determined for each pen by recording the amount of air-dry feed fed from a feed wagon equipped with a digital scale, and Converting the amount to a dry matter basis. Feed samples were collected twice per week for dry matter determination. Every 28 days steers were weighed individually and average daily gain (ADG) for that period and throughout the experiment were calculated. Dry matter intake by individual steers was represented by pen DMI.

Frame score determination

Hip heights of steers were measured by use of hip height measuring sticks marketed specifically for that purpose. The height sticks are constructed with a sliding arm containing a bubble level on a pole scaled in height increments. To make a measurement, while the steers were in chute the pole was held vertically alongside the animal's hip with the sliding arm positioned level and directly over the hook bones and a measurement was read from the pole where the arm attaches (BEEF IMPROVEMENT FEDERATION 1990). Beef Improvement Federation frame score chart was used to assign frame score of steers by taking steers' age and liveweight into consideration. Since FEEDLOT cattle entered directly to the feedlot, their frame scores were determined at the entry to the feedlot and were assigned accordingly. However frame score of cattle grazed on pasture was determined once at the entry to the pasture and once again at the entry to the feedlot.

Carcass measurements

When the average weight of a pen of steers reached 522 kg, cattle were processed into beef at IBP in Denison, IA, which was 52 km from the farm.

After a 24-h chill, backfat and ribeye area were measured on the 12th rib on the left half of each carcass. Backfat was measured to the nearest 0.13 cm using a ruler along the edge of the ribeye area at a point ¾ the length of the ribeye from the chine bone end. Ribeye area was measured to the nearest 0.65 cm^2 using a plastic grid with 10 dots per 6.452 cm^2.

Carcass quality and yield grades and percent kidney pelvic heart (KPH) fat were called by United States Depratment of Agriculture (USDA) Meat Grading Service personnel. Quality grades were provided to the nearest one-third of a grade and converted to a numerical value. A quality grade of high Select was equal to a value of six, and low Choice was equal to a value of seven.

Statistical analysis

Cattle grazed the same duration on pasture were regarded as the same treatment regardless of receiving an ionophore or not. Thus treatments were fall-born cattle directly went to feedlot and having frame score of 3 (F3) and 4 (F4), fall-born cattle placed on pasture in May and grazed until July then later finished in the feedlot, having frame score of 3 (J3) and 4 (J4), fall-born cattle placed on pasture in May and grazed until October then later finished in the feedlot and having frame score of 3 (O3) and 4 (O4), spring-born cattle placed on pasture

in September and grazed until October then later finished in the feedlot and having frame score of 4 (S4) and 5 (S5). There were eight treatments, each with two replications. The data were analyzed using the General Linear Model (GLM) procedures of SAS (SAS Inst. Inc., Cary, NC) by including treatments in the model and PDIFF statements were used to compare treatment means for dependent variables. As for significance level, (P<0.05) was accepted as statistically significant.

Results and discussion

Performance of cattle both on pasture and in feedlot by frame scores and grazing time is provided in Table 1. Spring-born cattle had frame scores of 4 (S4) and 5 (S5), and S4 were heavier than frame score of 4 in other treatments (P<0.05) with the exception of J4 (P>0.05). Catlle having frame score of 3 had similar initial weights (P>0.05) regardless of treatments. Grazing time for grazing treatments differed from each other (P<0.05). J3 tended to have lower pasture average daily gain (P>0.05) than J4. However, this was reverse in O3 which tended to have higher pasture average daily gain than O4 (P>0.05). O3 had higher pasture average daily gain than J3 (P<0.05) and the reason for this is their weight and age.

Table 1
Performance of cattle both on pasture and in feedlot by frame scores
Mastleistungen der Versuchsgruppen nach Anfangsrahmenmaßen

Variable	FEEDLOT		JULY		OCTOBER		SPRING	
Initial frame score	3 (F3)	4 (F4)	3 (J3)	4 (J4)	3 (O3)	4 (O4)	4 (S4)	5 (S5)
Initial weight, kg	160^{d}	198^{bc}	166^{d}	191^{c}	161^{d}	190^{c}	210^{b}	223^{a}
Days on pasture, day	-	-	83^{a}	83^{a}	166^{b}	166^{b}	22^{c}	22^{c}
Pasture gain, kg/day	-	-	0.44^{b}	0.57^{ab}	0.62^{a}	0.54^{ab}	0.09^{c}	−0.08^{d}
Off pasture weight, kg	-	-	202^{e}	239^{c}	263^{b}	279^{a}	211de	221^{d}
Frame score at the entry of feedlot	3	4	3	4	3	4	4	5
Feedlot gain, kg/day	1.29^{b}	1.36^{ab}	1.33^{ab}	1.35^{ab}	1.29^{b}	1.35^{ab}	1.31^{ab}	1.37^{a}
Overall gain, kg/day	1.29^{b}	1.36^{a}	1.09^{e}	1.16^{d}	0.98^{f}	0.96^{f}	1.21^{cd}	1.24^{bc}
DMI (in feedlot), kg/day	7.94^{c}	8.62^{ab}	8.05^{c}	8.74^{a}	8.21^{bc}	8.71^{a}	8.03^{c}	8.39^{abc}
FE (in feedlot), kg feed/kg gain	6.18^{bcd}	6.38^{abc}	6.05^{d}	6.51^{a}	6.36^{abc}	6.44^{ab}	6.16^{cd}	6.13^{cd}
Days in feedlot	279^{c}	267^{d}	233^{b}	236^{b}	192^{a}	184^{a}	224^{e}	230^{e}
Total days fed	279^{c}	267^{d}	316^{b}	319^{b}	358^{a}	350^{a}	246^{e}	252^{e}
Final weight, kg	520^{bc}	559^{a}	517^{bc}	558^{a}	514^{bc}	533^{bc}	507^{c}	538^{ab}

^{abcdef} Means with different superscript within the same row differ (P<0.05).

OCTOBER cattle were stocked until the end of October and when they were moved to the feedlot they were weighing 263 kg whereas JULY cattle were weighing on average 202 kg when placed in the feedlot. Thus, they have greater intestinal tract capacity relative to body size while basal metabolic rate is related to surface area of the animal (VAN SOEST 1982). This assumes the animal's capacity to consume forage increases faster than its surface area thus resulting in an increasing proportion of the consumed forage utilized for gain rather than maintenance (BAGLEY and FEAZEL 1988). Even though S4 had relatively low pasture average daily gain (0.09 kg/d) this was higher than those of S5 which lost body weight on pasture

(−0.08 kg/d; $P<0.05$). SPRING cattle had lower pasture gain than JULY and OCTOBER cattle ($P<0.05$). One reason for SPRING cattle gaining less than other pasture treatments is the forage availability and quality. These cattle were stocked on pasture in the beginning of October and were removed around the end of October when the forage availability and quality was lower than other months. Forage quality and availability and its dependence upon season and physiological maturity have been studied extensively. BURRIT *et al.* (1984) found that there was an increase in concentration of esterified non-core lignin components in grasses with the increased physiological maturity. CASLER (1986) suggested that lignin concentration was the most important limiting factor for smooth bromegrass fiber fermentability. Cell walls, which are composed primarily of cellulose microfibrils embedded in hemicellulose and lignin matrix are the main reasons for variation in voluntary intake and digestibility of forages consumed by ruminants (BUXTON, 1990). MULLAHEY *et al.* (1992) found that total crude protein generally decreased with maturity in switchgrass and smooth bromegrass harvested in different times. Longer retention time in the rumen, decreased digestible DMI, higher stem to leaf ratio with increased maturity are factors affecting performance of SPRING cattle (POPPI *et al.* 1980, POPPI *et al.* 1981).

In feedlot, cattle with higher frame score within the same treatment tended to have higher ADG ($P>0.05$; Table 1). It is reported that ADG increased as initial body weight increased (KOKNAROGLU *et al.* 2006, KOKNAROGLU *et al.* 2005, CEVGER *et al.* 2003).

Overal gain throughout experiment is given in Table 1. FEEDLOT cattle had the highest gain throughout the experiment ($P<0.05$) and overall gain decreased as cattle spent longer time on pasture. Since FEEDLOT cattle spent all their time in the feedlot their lot gain is their gain throughout the experiment. Because of this fact this difference would be expected. SPRING cattle were second in terms of gain throughout the experiment because this group spent a relatively short time on pasture and most of their time in feedlot. Within treatment, overall gain increased as frame score increased in FEEDLOT and JULY cattle ($P<0.05$) whreas tended to increase in SPRING cattle and to decrease in OCTOBER cattle ($P>0.05$). Thus, the steers on a continuous high concentrate diet showed an advantage in ADG over the entire feeding trial. Similar results were also obtained by BERGE *et al.* (1991) who reported experiments in which a feedlot system was compared with a system in which cattle were grazed initially and then finished in feedlot. The results of their experiments showed higher gains for the continuous feedlot cattle for the overall periods. Cattle with higher frame score within the same treatment had higher dry matter intake (DMI) ($P<0.05$) except SPRING cattle with higher frame score tended to have higher DMI ($P>0.05$; Table 1). The reason for increase in DMI with increasing frame score could be the increasing initial weight of cattle with increasing frame size. KOKNAROGLU *et al.* (2005), SCHOONMAKER *et al.* (2002) found that heavier cattle consumed more feed. Heavier cattle to consume more feed is related to their body sizes. These results are in agreement with NRC (1996). Their prediction equation for DMI was DMI, kg/d $= 4.54 + 0.0125 \cdot$ Initial body weight, thus, this relationship reveals that DMI increases linearly with increases in initial body weight. KOKNAROGLU *et al.* (2008) developed a DMI prediction equation in feedlot by using information generated by Iowa State University Feedlot Performance and Cost Monitoring program and found that DMI prediction for steers was found as, DMI $= 5.81 + 0.0125 \cdot$ Initial body weight, whereas DMI prediction for heifers was found as DMI $= 5.03 + 0.0144 \cdot$ Initial body weight. When steers

and heifers were combined, DMI prediction was found as DMI = 5.49 + 0.0133 · Initial body weight. These results clearly show that initial weight of cattle is related to average DMI during a feeding period. THORNTON *et al.* (1985) found that DMI increased about 1.5 kg per 100 kg increase in initial body weight. Within the same frame score, JULY and OCTOBER cattle tended to have higher DMI than FEEDLOT cattle ($P>0.05$). Lower dry matter intake of cattle started in the feedlot compared to cattle started on pasture and then moved to the feedlot later has been documented by other researcher (GILL *et al.* 1993).

Feed efficiency (FE) of cattle in feedlot is given in Table 1. F3 and O3 tended to have better FE than F4 and O4 ($P>0.05$) and J3 had better FE than J4 ($P<0.05$; Table 1). Among frame score of 3, J3 had better FE than O3 ($P<0.05$). S4 had beter FE than O4 and J4 ($P<0.05$).

Within the same frame score FEEDLOT and SPRING cattle tended to have better feed efficiency than OCTOBER cattle ($P>0.05$). The reason for these animals to be more efficient was their relatively younger age when they entered the feedlot. These cattle spent less time on pasture (SPRING) or did not spend any time at all (FEEDLOT) and when they were finished they were younger than OCTOBER cattle. The same results were also obtained by, LEWIS *et al.* (1990), GILL *et al.* (1992), GILL *et al.* (1993), BRANDT *et al.* (1995) and MYERS *et al.* (1999). They compared either longer grazed cattle with shorter grazed cattle and finished in the feedlot or initially grazed cattle finished in the feedlot with those that went directly to the feedlot.

The fact that lighter or younger animals are more efficient than heavier or older animals can be explained by their growth potential due to growth hormone level circulating in their blood plasma. VERDE and TRENKLE (1987) found that the concentration of growth hormone was highest in young cattle and gradually decreased with increasing age. As cattle age, concentration of hormones circulating change and extent of chewing feed decreases. As hormones may change body composition and less chewing can reduce digestibility of incompletely processed diets, aging can reduce energetic efficiency (GILL *et al.* 1993). As GILL *et al.* (1992) suggested, cattle spenting more time on pasture could be less efficient because of prolonged intakes of lower quality forages' effect on chewing extensiveness and digestibility or on maintenance requirements.

In the study attempt was made to finish cattle around 522 kg. FEEDLOT, JULY and SPRING cattle having higher frame scores had heavier final weights than those having lower frame scores ($P<0.05$; Table 1). O3 tended to have lighter final weight than O4 ($P>0.05$). It would be expected cattle having lower frame score to have lighter final weight since they were lighter when they started on feed.

Carcass characteristics of cattle by frame scores is given in Table 2. FEEDLOT, JULY and SPRING cattle having higher frame scores had heavier hot carcass weights than those having lower frame scores ($P<0.05$; Table 2). This would be expected because carcass weight is a function of final weight and cattle having higher frame scores had heavier final weights (Table 1). Dressing percentage did not differ regardless of treatment and frame score ($P>0.05$). J3, O3 and S3 had similar ribeye area compared to frame score of 4 ($P>0.05$). Whereas F4 had larger ribeye area than F3 ($P<0.05$; Table 2).

Table 2
Carcass characteristics of cattle by frame scores
Schlachtmerlanale der Versuchsgruppen nach Anfangsrahmenmaßen

Variable	FEEDLOT		JULY		OCTOBER		SPRING	
Frame score at the entry of feedlot	3 (F3)	4 (F4)	3 (J3)	4 (J4)	3 (O3)	4 (O4)	4 (S4)	5 (S5)
Hot carcass weight, kg	318^{cd}	348^{a}	320^{cd}	345^{ab}	317^{cd}	328^{cd}	316^{d}	332^{bc}
Dressing percentage	61.10	61.51	61.85	61.81	61.74	61.24	61.14	61.72
Ribeye area, cm^2	79.38^{c}	85.90^{a}	81.05^{bc}	84.43^{ab}	81.59^{bc}	80.25^{bc}	81.37^{bc}	81.23^{bc}
Back fat, cm	1.59^{a}	1.56^{a}	1.32^{ab}	1.35^{ab}	1.07^{b}	1.21^{b}	1.31^{ab}	1.17^{b}
KPH, %	2.40^{ab}	2.50^{a}	2.64^{a}	2.52^{a}	2.31^{ab}	2.11^{b}	2.65^{a}	2.61^{a}
Yield grade	2.76^{a}	2.76^{a}	2.47^{abc}	2.73^{ab}	2.22^{c}	2.43^{bc}	2.52^{abc}	2.34^{c}
Quality grade	7.90^{a}	7.5^{6a}	7.22^{ab}	7.86^{a}	7.81^{a}	6.86^{b}	7.35^{ab}	7.44^{ab}

^{abcd} Means with different superscript within the same row differ ($P<0.05$).

FEEDLOT cattle had the highest backfat and differed significantly from O3, O4 and S5 ($P<0.05$). On the other hand there was a tendency for cattle spending more time on pasture to deposit less backfat.

Kidney pelvic heart (KPH) fat values are provided in Table 2. As can be observed, in general cattle spending more time on pasture (OCTOBER) had lower KPH than cattle spending less time on pasture (JULY and SPRING). O4 had lower KPH than F4, J4 and S4 ($P<0.05$).

Combining back fat and KPH values, cattle spending more time on pasture (OCTOBER) were leaner than other cattle. The reason for this is the relatively longer time spent on pasture. During the restrictive period, beef calves continue to develop skeletal structure, accumulate less body fat and more body protein than calves fed at a higher rate of gain (PHILLIPS *et al.* 1991). Some research has shown that differences in body composition induced during feed restriction could be retained through the finishing period (COLEMAN and EVANS 1986). Cattle spending longer time in the feedlot were fatter than those spending less time in the feedlot. SMITH *et al.* (1984) reported that backfat thickness and the activities of several enzymes involved in lipogenesis were greater in steers fed a high concentrate, corn based diet versus steers fed a forage based, alfalfa pellet diet, even though the metabolizable energy intake was higher for the pelleted alfalfa diet. Thus a longer stay in the feedlot increased fat accumulated in the body. DUCKET *et al.* (1993) used 48 yearlings to assess the effect of time on feed on the nutrient composition of beef longissimus muscle. Day-0 served as grass fed control cattle and other cattle were fed concentrate and were serially slaughtered at 28 day intervals during a 196 day feeding period. They found that fat thickness, KPH and yield grade increased with increase time on feed.

Within each treatment frame score of 3 did not differ from frame score of 4 in terms of yield grade ($P>0.05$; Table 2). O3 had the lowest yield grade and was different from F4 and J4 ($P<0.05$). Quality grades are provided in Table 2. Within each treatment frame score of 3 did not differ from frame score of 4 with the exception of O4 having lower quality grade than O3 ($P<0.05$). O4 had the lowest quality grade and was different from F4, J4 and O3 ($P<0.05$).

In general cattle spending longer time in the feedlot had better quality grades and higher yield grades. The only exceptions for this were SPRING cattle which spent a long time in the feedlot and had low yield and quality grades. Research showed that increasing time in the feedlot increased marbling scores, quality grades and yield grades. (DANNENBERGER *et al.* 2006, HOLLO *et al.* 2004, SCHROEDER *et al.* 1980, HEDRICK *et al.* 1983).

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