DETERMINATION OF THE AGE AND CAUSE

OF THE BOTTOM ROUND BLEMISHES

IDENTIFIED IN DAIRY

STEER ROUNDS

By

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INTRODUCTION

Meat processors have determined that scarring in the rounds of dairy steers is a major concern. These sections are scarrous, firm, white areas of fibrosis that are arranged in large nodules up to 10 cm in diameter and found throughout the wholesale cut. Analysis has revealed that these sections contained fibrous connective tissue and collagen that separate bundles of myofibers. These scars in skeletal muscle are chronic, and initial injury likely happened weeks to months prior to slaughter; however, the exact cause and age of the scarring and fibrosis is unknown.

In 1998, 1999, and 2000, 3,190 rounds from cow carcasses were examined as part of the dairy and beef cow round injection-site lesion project and were reported in the National Market Cow and Bull Beef Quality Audit (NMCBBQA). In 2000, injection-site lesions were found in 20% and 35% of beef and dairy cows, respectively (Roeber et al., 2001b). Thus, it is important for dairy producers to develop herd management methods that aid in reducing the prevalence of injection-site lesions in muscle. Although, data from the three year project revealed a decline in the incidence of injection-site lesions of 31% and 60% for beef and dairy cows, respectively in 1998, to the aforementioned 20% and 35% in 2000 (Roeber et al., 2001b); dairy producers could still benefit greatly from additional educational programs, as well as improvement in beef quality assurance practices.

The objectives of this study were to identify the age at which initial injury occurs and cause of the bottom round blemishes identified in dairy steer rounds in an attempt to aid in the improvement of educational efforts and beef and dairy beef quality assurance practices.

CHAPTER II

REVIEW OF LITERATURE

Operation Diversity

Primary revenue in the dairy industry is derived from the sale of milk; however, nearly four million bull calves are born each year. Because of the lack of a suitable use for the majority of bull calves, an additional means of income resides in the sale of dairy bull calves in order to maximize their potential for meat production.

Veal. Traditionally, veal is a young bovine animal only fed milk or milk replacer and is typically slaughtered prior to 5 mo of age. In traditional veal systems, calves are slaughtered at approximately 110 kg of carcass weight (Ketelaar de Lauwere and Smits, 1991). However, today it is more common for veal to be reared in one of three categories: bob veal, formula-fed veal, or red or grain fed veal. Bob veal is characterized as a dairy calf that is slaughtered when only a few days old up to 68.08 kg. The second type formula-fed veal comes from dairy calves that are raised on a nutritionally complete milk formula supplement and are fed to between 205 – 225 kg. The third, and least traditional category, is the non-formula-fed veal; this red or grain fed veal originates from both dairy and beef calves. The meat of red veal is darker in color and more marbling may be exhibited as a result of the grain, hay and other solid foods that are fed in addition to milk. Red veal is typically marketed as calf and harvested between five and six months of age (Veal Information Gateway, 2009).

Generally four types of housing systems are utilized in intensive veal backgrounding operations. Le Neindre (1993) outlined the 4 housing types as: a crate, tethering, group-housing on slatted floors and group-housing with straw bedding. Crate housing utilizes individual crates for each calf. The crate ranges in size from 0.55 m x 1.50 m to 0.80 m x 1.80 m. The second type of housing system, tethering, consists of a stall varying in size from 0.50 m to 0.70 m and small partitions placed between calves to prevent cross-suckling. Group-housing on slatted floors is an area between 1.3 to 1.70 m^2 of surface area per calf. This housing style is uncommon and usually involves tethering during the first six to eight weeks after arrival at the farm, followed by tethering for 30 min/d during feeding. Finally, group-housing with straw bedding provides a similar area as group-housing on slatted floors; however, the calves are muzzled to prevent the consumption of straw. Accordingly, these management systems present welfare concerns. Broom (1991) identified these welfare issues as, 1) calves are isolated from their dams at birth, 2) they are isolated from other conspecifics, 3) space is limited, 4) calves are restricted to an all-milk diet from a bucket, and 5) the general environment is barren. These concerns led to 91/629/CEE directive, stating that calves must be reared in groups after the eighth week of their arrival on the veal farm. Additionally, Le Neindre (1993) proposed that another way to improve welfare could be to limit the age of slaughter, as well as develop new alternative management systems for rearing older animals. The same study shows there are drawbacks to rearing animals in group atmospheres as opposed to individual pens, such that animals in a group pen have higher incidence of mortality and morbidity (Le Neindre, 1993). Additionally, calves that move freely for the first eight weeks on a veal farm have increased difficulty with the ability to rest undisturbed.

Dairy Beef. As an alternative to the controversial veal industry many dairymen are choosing to retain ownership of their cattle and raise them in a similar manner to traditional beef cattle. Knipe et al. (1998) outlined the feeding of dairy beef in four stages. The first stage covers the first eight weeks of life or pre-weaning. Whether selling the calves at a few days of age or retaining ownership, it is essential for calves to receive colostrum shortly after birth. Research states that to ensure a smooth transition from a pre-ruminant calf to a mature functioning ruminant, the utilization of a high energy ration is crucial (Knipe et al., 1998). Pre-weaned calves should gain nearly 1.0 kg/d, with an approximate weight of 90 kg at the end of stage one. In stage 2, calves should be group housed with 1.8 m^2 per steer. During stage 2 calves should reach 181 kg gaining an average of 1.0 kg/d. Stage 3 or the feeding stage should provide rations of 16% crude protein and up to 50% haylage. At this time steers should be allotted 2.3 m^2 of space per steer. The fourth and final stage is the finishing phase. During the finishing phase the cattle should be fed a high energy diet of 80 - 90% corn. Once these cattle begin to reach USDA Choice, dry matter intake will level resulting in a decrease in energy efficiency (Knipe et al., 1998), and they will be harvested.

Injection

Why give an injection. Beef cattle are given injections of biological or antibiotic compounds at various stages throughout their lives to prevent disease and aid in recovery from illness (Taylor, 1984). According to Troxel et al. (2001) clostridial disease can affect beef cattle of all ages; with cattle between 6 mo and 2 yr of age being of primary concern, and since commercial feedlot managers have limited knowledge about the background of many of the cattle entering their feedlots, administration of a clostridial vaccine is cost effective (Galyean and Eng, 1998).

Damage from an injection. Any disturbance of muscle tissue, including giving an injection, will cause tissue damage. Tissue damage caused by an injection is commonly referred to as an injection site lesion. According to Van Donkersgoed et al. (2000), vaccines, antimicrobials, and vitamins are tissue damaging and have been shown to create tough beef, with the extent of damage depending on the calf's age at injection, the volume of the product injected per site, the anatomical site of the injection, the route of injection, and the product. For example, 5-mL of clostridial bacterins injected 255 and 376 d prior to slaughter produced lesion incidence in the sirloin butts of 79.5 and 92.7%, respectively (George et al., 1995a).

Chronological Change of Injection Site Lesions and Appearance of Lesions. Injections administered to calves before weaning, and thus, probably at all stages of the beef production chain are detectable and pose a quality problem to the final end users of beef (George et al., 1995b). In another study, George et al. (1995a) found that an injection-site lesion is proportionate to the total muscle tissue, remaining constant while the calf is growing, subsequently the quantity of trim needed to remove a lesion from an injection given at branding is greater than the quantity needed to remove a lesion from an injection given at weaning. The appearance of an injection site lesion can be summarized in the five point scale outlined by Dexter et al. (1994), which also gives chronology to the stage of healing. The age of the scar is correlated to the stage of healing, not the amount of time that has elapsed between administration of the injection and the time of lesion evaluation. Various things may affect the healing time including the type of pharmaceutical injected, the amount injected, and the immune response time of the specific animal. The stages of healing start with a cystic encapsulated lesion containing fluid, followed by a scar with nodules, which contains a foci of necrosis surrounded by granulomatous inflammation. The third stage is a clear scar lesion, which contains white fibrosis scar tissue and appears as connective tissue and will typically be cut out of the muscle if identified prior to reaching the consumer. The oldest stage of a lesion is woody callus; a woody callus lesion is characterized by the injection site blemish being replaced by organized connective tissue and fat. Although all the stages of a lesion affect tenderness, a woody callus lesion appears as fat and is not typically trimmed because of this misconception. The final type of lesion is a mineralized or metallic scar. Mineralized scars are very rarely identified and are considered to be caused by a chemical reaction between the pharmaceutical administered and the muscle fiber causing a lesion containing mineralized remnants of muscle cells that are typically yellowish to brown in color (Dexter et al., 1994).

Prevention. Cattle producers and veterinarians have been provided with the following recommendations to avoid injection site lesions. The first recommendation is to administer all clostridial bacterins subcutaneously in the neck regions, preferably using the 'tented' technique. Next, they are instructed to avoid multiple or repeated injections of clostridial bacterins, especially late in the feeding period. Additionally, producers are educated to avoid intramuscular injections of all injectable products whenever other routes of administration are listed in the label recommendations, as well as to use acceptable intramuscular and subcutaneous injection locations. Producers are encouraged to use subcutaneous routes whenever possible, and inject no more than 10 ml per injection site (less in lighter claves). Furthermore, they are informed to change needles every 15 injections (more routinely, if cattle are dirty), and immediately discard bent needles; by no means straighten or reuse them. Finally, it is recommended not to use products that damage edible tissue at any time during production, and choose products that are approved for subcutaneous, intravenous or oral administration, as well as products that have low-volume doses whenever possible (George et al., 1997).

Warner-Bratzler Shear Force

Tenderness. Tenderness is one of three fresh meat palatability attributes and accounts for more than 50% of consumer's overall acceptability of beef (Savell et al., 1987, 1989; Smith et al., 1987). Tenderness directly affects eating experience and consumer satisfaction. According to Roeber et al. 2001a, "Injection site lesions are seldom detected at packing plants because damage is concealed within the muscles and below the subcutaneous fat." George et al. (1995b) adds "injection-site lesions," visible or not within a steak, affect tenderness. In agreement, Sullivan et al. (2007) stated "the purveyor or retailer will be responsible for removal of the injection-site area, and the consumer's odds of getting a tough steak increase."

Warner-Bratzler Shear Force. Consumer perception of tenderness varies from one consumer to another; however, Miller (2001) found that 100% of consumers accept beef as tender with a Warner-Bratzler shear force (WBS) threshold of < 3.0 kg; where as 99, 94, and 86% of consumer would be satisfied with WBS values of 3.4, 4.0, and 4.3 kg, respectively.

Severity of Injection-Site Lesions. To accurately quantify the severity of injection-site lesions in the muscles of the beef round, George et al. (1995b) removed one core from the center of the injection-site lesion, as well as four cores taken at 2.54, 5.08, and 7.62 cm from the center of the lesion for WBS. George et al. (1995b) found WBS values were 13.87, 10.00, 7.60, and 5.80 kg, respectively, at 2.54, 5.08, and 7.62 cm in a steak with an injection lesion. These values were extremely different from those of control steaks (no lesion present) measurements WBS values of 4.11 kg, 4.30 kg, and 3.90 kg, respectively, at the same distances. In the overview of the National Beef Tenderness Study, WBS values for all grades of eye of round steaks averaged 3.4 kg and for all bottom round steaks averaged 3.76 kg (Savell et al., 2005). George et al. (1995b) found that WBS core samples as far as 7.6 cm from the center of the injection-site lesion had an average shear force value of 5.8 kg, thus considered tough. As such, damaged beef muscle tissue resulting from intramuscular injections of animal-health products represents a "quality control" problem and an economic loss to the beef industry (Lambert, 1991).

Summary

Injection-site lesions have caused enormous economic loss to the U.S. beef industry and have been a serious quality assurance problem (Roeber et al., 2001a). Although beef quality assurance education has had an impact on the management strategies of producers reducing the national incidence of injection-site lesions in top sirloin butts from 11.4% in November 1995 to 2.1% in July 2000 (Roeber et al., 2001a); there is still an evident need for continuous educational efforts. According to Roeber, et al. (2003), continuous monitoring of the frequency of injection-site lesions in muscles of the round allows educational efforts of state and national quality assurance programs to target, more definitively, management practices of producers that can minimize occurrence of such defects in end products. Therefore, future research and development of additional educational programs is necessary in order to reach the maximum producers possible and to reduce the national incidence of injection-site lesions.

CHAPTER III

DETERMINATION OF THE AGE AND CAUSE OF THE BOTTOM ROUND BLEMISH IDENTIFIED IN DAIRY STEER ROUNDS

ABSTRACT

Several meat packers have identified scarring in bottom rounds of dairy steers. This is a major concern because of the decrease in tenderness and consumer acceptability caused by injection-site lesions. The objective of this study was to differentiate the regularity and severity of bottom round blemishes identified in dairy steer rounds. Holstein calves (n = 30) were selected and divided into three harvest groups. Calves from each harvest group were randomly sub-divided into treatment groups neck injection (CON; n = 5 per harvest group) and bottom round injection (BRI; n = 5 per harvest group). Harvest group 1 was fed for 25 d, representing pre-weaning; harvest group 2 was fed for 59 d, representing milk weaning; finally, harvest group 3 was fed for 398 d or market weight. Control calves received an injection on the right side in the neck, and BRI calves received the same adjuvant, also on the right side, in the bottom round. Carcass rounds were fabricated to IMPS #158 (NAMP, 2006) and evaluated for visual identification of lesions, and two 2.5 cm cutlets IMPS #1170A (NAMP, 2006) were identified for WBS value determination. Visual identification of injection-site lesions was higher ($P < 0.05$) in cutlets from BRI cattle than CON cattle from harvest group one.

However, there was no difference in identification of injection-site lesions from BRI compared to CON for harvest groups two or three. Treatment had no effect on WBS value within each harvest group. Warner-Bratzler shear values were not affected by evidence of a visually identified injection-site lesion in cutlets from harvest group one, two, or three. Overall, BRI treatment does not have a significant impact on lesion presence or WBS values. Additionally, lesion presence does not have a significant impact on WBS values. Further investigation should be conducted utilizing calves from multiple farms and focusing on handling practices to determine the cause of bottom round lesion.

INTRODUCTION

Meat processors have identified injection-site lesions in rounds of dairy steers as a major concern. Investigation has revealed that these sections contained fibrous connective tissue and initial injury likely happened weeks to months prior to slaughter; however, the exact cause and age of the scarring and fibrosis is unknown.

In 1998, 1999, and 2000, 3,190 rounds from cow carcasses were examined for presence and results were reported as part of the National Market Cow and Bull Beef Quality Audits (NMCBBQA). Data from the three year project documented a decline in the incidence of injection-site lesions from 31% and 60% for beef and dairy cows, respectively in 1998 to 20% and 35% in 2000 (Roeber et al., 2001b). Although a decrease in the incidence of injection-site lesions was found, dairy producers could still benefit greatly from additional educational programs, as well as improvement in beef quality assurance practices.

Consumers use tenderness as the main criterion to determine fresh meat palatability. Although, acceptable tenderness varies from consumer to consumer; reducing the incidence of injection-site lesions, reduces the chance of a tough steak. Accordingly, injection-site lesions cause a "quality control" problem and in turn an economic loss to the beef industry (Lambert, 1991). Every negative eating experience has a negative impact on the beef industry as a whole.

Thus, the objectives of the study were to identify the age at which initial injury occurs and cause of the bottom round blemishes identified in dairy steer rounds in an attempt to aid in the improvement of educational efforts and beef and dairy beef quality assurance practices.

MATERIALS AND METHODS

Cattle Selection

Cattle (n = 30) were selected from Braums Dairy, Federick, OK, representing the Holstein breed. The calves were transported on September 12, 2008, 322 km to the OSU Dairy, Stillwater, OK. Bulls (n = 28) and free martin heifers (n = 2) were selected and randomly assigned to three harvest groups (n = 10 per group). Calves from each harvest group were randomly sub-divided into one of two treatments, control neck injection (CON; n = 5 per harvest group) or bottom round injection (BRI; n = 5 per harvest group).

Animal Feeding

All calves were fed 0.91 kg of Advance Excelerate Calf Milk Replacer (MSC, Dundee, IL 60118) at 12 h intervals starting at 5:30 pm on September 12. Fresh water was provided each afternoon and replenished each morning. Calves were introduced to Medicated-D-046 Calf Grain (Oklahoma State University, Stillwater, OK, 74078) on September 15, during the afternoon feeding. Harvest group 1 was fed for 25 d, September 12 through October 7. Harvest groups 2 and 3 received free choice Bermuda grass hay beginning on October 8. The milk weaning process was initiated on October 17, at 5:30 pm by feeding 0.91 kg per day in 24 h intervals. Harvest group 2 and 3 were weaned from milk on November 9. Harvest group 2 was fed for 59 d, through weaning, November 12, and harvest group 3 was fed a typical finishing ration for 339 d to an average carcass weight of 230 kg. Additionally, harvest group 3 received an implant of Revalor IS (Intervet Inc. Millsboro, DE) in the left ear on days 150, 210, 245, and 335.

Animal Injection

An injection of Bovi Shield Gold (Pfizer Animal Health, New York, NY) was administered by Dr. John Gilliam, DVM on September 13, using a 16 gauge 1.9 cm needle, on the right side of the calf in one of the two assigned injection locations, the neck (CON; n = 15) or the bottom round (BRI; n = 15) in the muscle. All other injections, maintenance or antibiotic treatment, were given on the left side of the calves. All calves reaching a temperature ≥ 40.2°C received 2 mL of Exenel (Pfizer Animal Health, New York, NY) once daily subcutaneously under the left front leg for 3 d as per the recommended dosage. Calves that displayed signs of scouring were given a Sustain III calf bolas (Pfizer Animal Health, New York, NY) as well as, Enterolyte HE electrolytes (Pfizer Animal Health, New York, NY) twice daily at feeding until signs of scouring subsided.

Harvest

Five calves representing each treatment group (CON and BRI) were slaughtered on each of three harvest days. Calves were transported to the Oklahoma Food and Agriculture Products Center (FAPC) in Stillwater, OK, and processed following normal pilot plant procedures. After steam pasteurization, carcasses from harvest groups one and two were wrapped in chilled wet frocks to prevent dehydration in the cooler. Carcasses were then placed in the cooler and chilled under normal pilot plant conditions for 48 h at 2°C.

Carcass Fabrication and Further Processing

Carcass rounds were fabricated to IMPS #158 beef round primal (NAMP, 2006) and evaluated by a trained Oklahoma State University faculty member for identification of injection-site lesions in bottom rounds. Types of lesions considered for identification were: clear scar, scar with nodules, cystic, mineralized, and woody callus. A clear scar lesion is characterized by white fibrous scar tissue. A scar with nodules is described by central foci of necrosis surrounded by granulomatous inflammation. Cystic cars are depicted by an encapsulated lesion containing fluid. Mineralized scars are recognized as a lesion containing mineralized remnants of muscle cells. Finally, woody callus lesions are older lesions that are typified by the injection-site blemish being replaced by organized connective tissue and fat. Two 2.5 cm cutlets, IMPS #1170A Beef Round, Bottom Round Steak (NAMP, 2006) were cut for Warner-Bratzler Shear force (WBS) value determination. The steaks were vacuum packaged and frozen at -23°C for 3d and then stored at -20°C until further evaluation.

Warner-Bratzler Shear Force

The frozen steaks were thawed at 4°C for 24 h prior to cooking. Steaks were cooked in an impingement oven (XLT Impinger, Model 3240-TS, BOFI Inc., Wichita, KS) at 190°C to an internal temperature of 71°C. Internal temperature was measured using an Atkins AccuTuff 340 thermometer (Atkins Temtec, Gainesville, FL). If steaks had not yet reached the desired temperature, they were placed back in the oven until an internal temperature of 71°C was achieved. Once cooked, steaks were allowed to cool at 4°C for 24 h. Six 1.27 cm diameter cores were removed parallel to muscle fiber orientation. Shears were measured using an Instron Universal Testing Machine (Model 4502, Instron Corporation, Canton, MS) with a Warner-Bratzler head attachment. The Warner-Bratzler head moved at a crosshead speed of 200 mm/min. An IBM PS2 (Model 55 SX) recorded peak load (kg) of each core using software provided by the Instron Corporation. Mean peak load (kg) of each sample was analyzed.

Statistical Analysis

Comparisons of frequency of injection-site lesions by treatment for each harvest group were tested for significance ($\alpha < 0.05$) using Chi-Square test. Data were analyzed using the mixed model ANOVA procedures of SAS (SAS Inst. Inc., Cary, NC). Warner-Bratzler shear force data were analyzed with treatment as the fixed main effect and sample as the random effect. A second analysis of variance model for WBS was used with lesion as the fixed main effect and sample as the random effect. Least squares means are reported

RESULTS AND DISCUSSION

Blemish evidence by harvest group

The number and type of injection-site are provided for each harvest group in Table 1. Harvest group one, pre-weaning, had a total of three injection site lesions present in the BRI cattle. Those lesions were classified as clear scar (n = 2) and scar with nodules (n = 1). The weaning harvest group had a total of two clear scar lesions present with one each in the CON and BRI. Furthermore, the finishing group had a total of five lesions present. Three of the five lesions were found in CON rounds with two being identified as woody callus and one a clear scar. The remaining two lesions were found in BRI rounds with one being identified as a clear scar and one as woody callus. Overall, clear scar was the most prevalent type of lesion identified with six out of ten scars that were found. When comparing the visual evidence of a blemish by harvest group, few significant differences were observed. The BRI cattle in harvest group one had more ($P < 0.05$) blemishes than CON cattle (Table 1). Bottom round injected cattle from harvest group two showed no significant difference of visual blemishes between BRI and CON groups. In contrast to both groups one and two, although no significant difference was found, harvest group three indicated numerically a greater number of blemishes in the CON rounds than in the BRI rounds.

The BRI lesions were most prevalent in harvest group 1 cattle. Harvest groups two and three did not show a significant difference in the evidence of blemishes as a direct result of bottom round injections.

Warner-Bratzler Shear force

The rounds from BRI calves in harvest group one had numerically higher WBS values than CON calves (Figure 1); however, WBS value was not significantly impacted by BRI. Moreover, the difference in WBS between CON and BRI increased in harvest group two; however, that difference was not significant. Finally, there was no significant impact of BRI on WBS values in harvest group three. Across all harvest groups, there was not a significant impact ($P > 0.05$) of BRI on WBS.

The comparison of average WBS from steaks with and without blemishes is summarized in Figure 2. When comparing the WBS values from steaks with visually identified blemishes and those with no blemish identified, harvest group one and two displayed no significant difference (Figure 1). Although no significant difference was found for harvest group three, numerical differences suggest higher WBS values from steaks without a visible lesion. This finding is in agreement with George et al. 1995b, who also found that injection-site lesions, visible or not within a steak, still affect tenderness. Overall, BRI treatment had no significant effect on WBS values within harvest group one, two, or three. Additionally, WBS values were not significantly different when a lesion was visually identified in comparison to when no lesion was identified by visual inspection.

CONCLUSION

Overall harvest groups combined, BRI cattle produced the most lesions, but it is important to note that CON cattle had lesions as well, indicating that BRI is a cause for lesions, but there are other causes that are likely related to animal handling and injury. No significant differences were found for WBS values amongst BRI and CON cattle from each harvest group. The frequency of identification of injection-site lesions was greater ($P < 0.05$) for BRI cattle in than the CON cattle from harvest group one. However, in harvest group three, although not significantly different, there was numerically a higher incidence of blemishes found in CON cattle than in BRI cattle. Accordingly, this indicates that there is an alternate source causing blemishes found in CON cattle. Beef Quality Assurance (BQA) programs are in place to aid cattle raisers, beef and dairy beef, in the production of high quality, safe products. The goal of these programs is not only increase producers profits by informing them of production practices that reduce product defects, but also to aid in the production of beef that the consumer has confidence in. Further investigation should be conducted utilizing calves from multiple farms and focusing on handling practices to more effectively determine the cause of blemishes in bottom rounds.

Table 1. Presence and classification of injection-site lesion by harvest group

	Pre-weaning[a]		Weaning[b]		Finishing[c]	
Classification	CON[d]	BRI[e]	CON	BRI	CON	BRI
Clear scar[f]	0	2	1	1	1	1
Scar with nodules[g]	0	1	0	0	0	0
Cystic[h]	0	0	0	0	0	0
Mineralized scar[i]	0	0	0	0	0	0
Woody callus[j]	0	0	0	0	2	1
Total	0[y]	3[z]	1	1	3	2

[a] Pre-weaning = Harvest group 1.
[b] Weaning = Harvest group 2.
[c] Finishing = Harvest group 3.
[d] CON = calves that received injection in the neck.
[e] BRI= calves that received injection in the bottom round.
[f] Clear scar = white, fibrous scar tissue.
[g] Scar with nodules = central foci of necrosis, surrounded by granulomatous inflammation.
[h] Cystic = encapsulated lesion containing fluid.
[i] Mineralized scar = lesion containing mineralized remnants of muscle cells.
[j] Woody callus = older lesions that are characterized by the injection-site blemish being replaced by organized connective tissue and fat.
[y,z] Within a harvest group, total lesion by treatment with different superscripts differ ($P < 0.05$).

Figure 1. Warner-Bratzler shear force values (kg) of bottom round steaks from control and Bottom round injected (BRI) calves by harvest group.

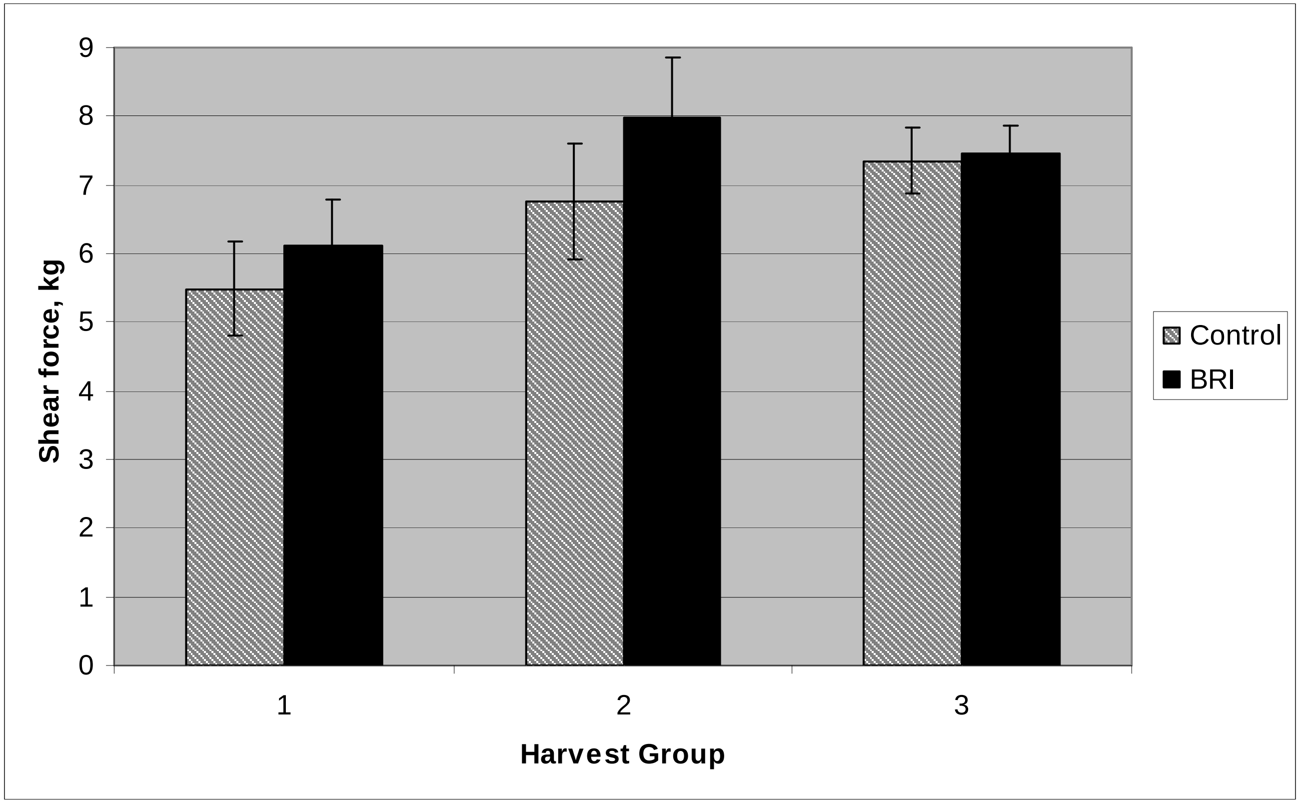
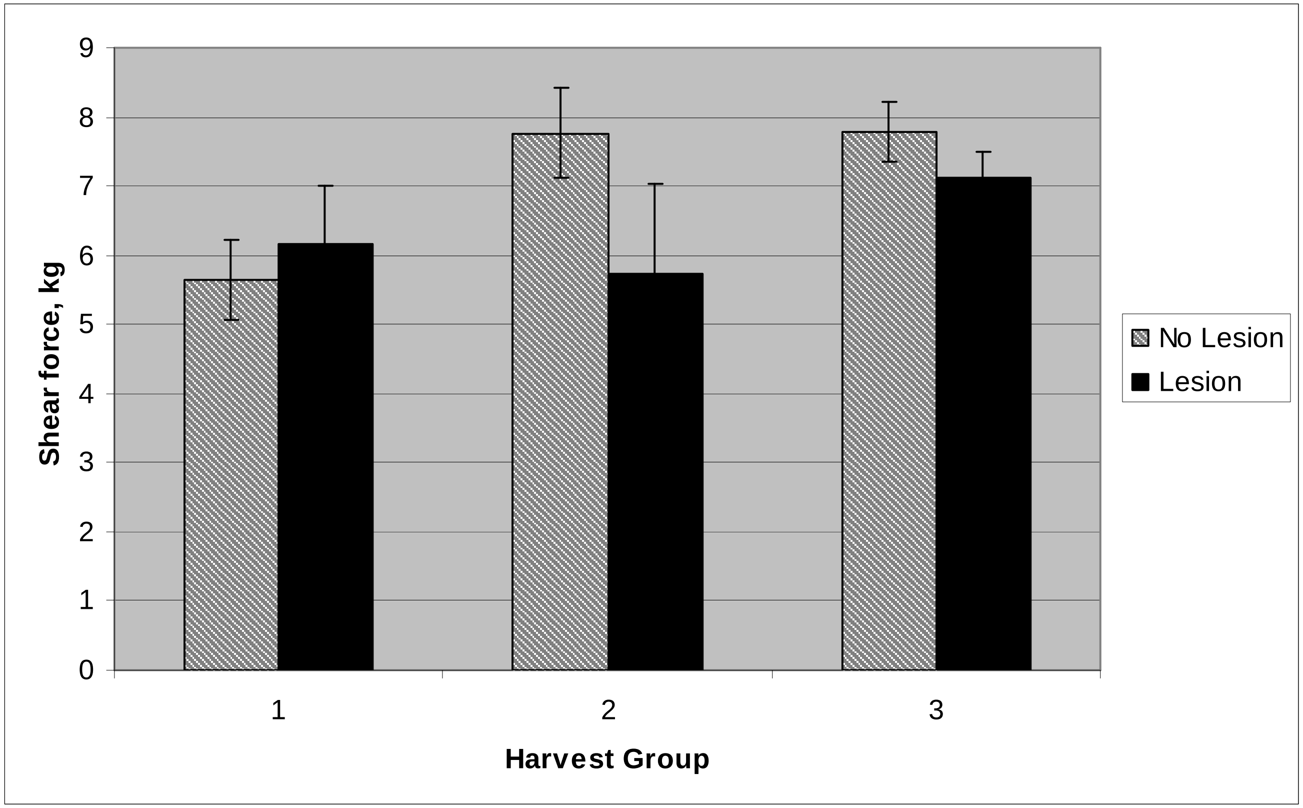


Figure 2. Warner-Bratzler shear force values (kg) of steaks with and without visual evidence of an injection-site lesion by harvest group.



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VITA

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Candidate for the Degree of

Master of Science

Thesis: DETERMINATION OF THE AGE AND CAUSE OF THE BOTTOM ROUND BLEMISHES IDENTIFIED IN DAIRY STEER ROUNDS

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Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: DETERMINATION OF THE AGE AND CAUSE OF THE BOTTOM ROUND BLEMISHS IDENTIFIED IN DAIRY STEER ROUNDS

Pages in Study: 25 Candidate for the Degree of Master of Science

Major Field: Animal Science

Scope and Method of Study: Scars identified in bottom rounds of dairy steers is a major concern because of the decrease in tenderness and consumer acceptability. The objective of this study was to differentiate the regularity and severity of bottom round blemishes. Holstein calves (n = 30) were divided into three harvest groups. Within each harvest group half the calves were assigned to one of two treatments, bottom round injection (BRI) or control (CON). The BRI calves received an injection on the right side in the bottom round, and CON calves received the same adjuvant on the right side in the neck. The harvest groups were fed to pre-weaning, weaning, finishing stages. Carcass rounds were fabricated first to IMPS #158 and then further to 2.5 cm cutlets IMPS #1170A. The cutlets were used for Warner Bratzler Shear force (WBS) value determination.

Findings and Conclusions: Visual identification of injection-site lesions was higher in cutlets from BRI cattle than CON cattle from harvest group one. There was no difference in identification of injection-site lesions for harvest group two or three. Treatment had no effect on WBS value within each harvest group. The WBS values were not affected by evidence of a visually identified injection-site lesion in cutlets from harvest group one, two, or three. Overall, BRI treatment does not have a significant impact on lesion presence or WBS values. Additionally, lesion presence does not have a significant impact on WBS values. Further investigation should be conducted utilizing calves from multiple farms and focusing on handling practices.

ADVISER'S APPROVAL: Gretchen Hilton