Kansas Agricultural Experiment Station Research Reports

Volume 3
Issue 1 *Cattlemen's Day*

Article 33

January 2017

Liver Abscess Severity at Slaughter Does Not Affect Meat Tenderness and Sensory Attributes in Commercially Finished Beef Cattle Fed Without Tylosin Phosphate

E. J. McCoy
Kansas State University, Manhattan, ejsuhr@k-state.edu

T. G. O'Quinn
Kansas State University, travisoquinn@ksu.edu

E. F. Schwandt
Kansas State University, Manhattan, eschwandt@k-state.edu

See next page for additional authors

Recommended Citation

McCoy, E. J.; O'Quinn, T. G.; Schwandt, E. F.; Reinhardt, C. D.; and Thomson, D. U. (2017) "Liver Abscess Severity at Slaughter Does Not Affect Meat Tenderness and Sensory Attributes in Commercially Finished Beef Cattle Fed Without Tylosin Phosphate," *Kansas Agricultural Experiment Station Research Reports*: Vol. 3: Iss. 1. https://doi.org/10.4148/2378-5977.1367

Liver Abscess Severity at Slaughter Does Not Affect Meat Tenderness and Sensory Attributes in Commercially Finished Beef Cattle Fed Without Tylosin Phosphate

Abstract

Liver abscesses are a significant problem in the United States' cattle feeding industry, costing the industry an estimated $15.9 million annually in liver condemnation, trim losses, and reduced carcass weights and quality grades. Recent reported incidence rates of liver abscesses at slaughter range from 10 to 20%. Liver abscess incidence may be influenced by a number of factors including: breed, gender, diet, days on feed, cattle type, season, and geographical location. Liver abscesses typically occur secondary to rumen insults caused by acidosis or rumenitis. It has been proposed that pathogens associated with liver abscess formation enter the blood stream through damaged rumen epithelium and are transported to the liver through the portal vein where they cause infection, manifested as liver abscesses. Severe liver abscesses have been linked to reduction in hot carcass weight, dressing percentage, yield grade, longissimus muscle area, and marbling scores of carcasses when compared to those with normal livers. However, the effect of liver abscesses on meat tenderness and sensory attributes has not been previously investigated.

Keywords

cattle, liver abscesses, meat tenderness

Authors

E. J. McCoy, T. G. O'Quinn, E. F. Schwandt, C. D. Reinhardt, and D. U. Thomson

K-STATE Research and Extension

CATTLEMEN'S DAY 2017

Liver Abscess Severity at Slaughter Does Not Affect Meat Tenderness and Sensory Attributes in Commercially Finished Beef Cattle Fed Without Tylosin Phosphate

E.J. McCoy, T.G. O'Quinn, E.F. Schwandt, C.D. Reinhardt, and D.U. Thomson

Introduction

Liver abscesses are a significant problem in the United States' cattle feeding industry, costing the industry an estimated $15.9 million annually in liver condemnation, trim losses, and reduced carcass weights and quality grades. Recent reported incidence rates of liver abscesses at slaughter range from 10 to 20%. Liver abscess incidence may be influenced by a number of factors including: breed, gender, diet, days on feed, cattle type, season, and geographical location. Liver abscesses typically occur secondary to rumen insults caused by acidosis or rumenitis. It has been proposed that pathogens associated with liver abscess formation enter the blood stream through damaged rumen epithelium and are transported to the liver through the portal vein where they cause infection, manifested as liver abscesses. Severe liver abscesses have been linked to reduction in hot carcass weight, dressing percentage, yield grade, longissimus muscle area, and marbling scores of carcasses when compared to those with normal livers. However, the effect of liver abscesses on meat tenderness and sensory attributes has not been previously investigated.

Key words: cattle, liver abscesses, meat tenderness

Experimental Procedures

Strip loin steaks from carcasses (n = 119) were used in a 3 × 2 factorial treatment arrangement in a completely randomized design to evaluate the interactive effects of liver score and U.S. Department of Agriculture quality grade on meat tenderness and sensory attributes. Cattle originated from the same commercial feedlot and were fed common diets that did not contain tylosin phosphate. All carcasses utilized in this study were from cattle that were slaughtered on a single day at a commercial abattoir in northwest Texas and carcasses were selected after lungs and livers were scored. Only carcasses with healthy, normal lung scores were utilized to avoid any potential effects on tenderness or sensory attributes caused by respiratory disease.

Liver and lung scores were evaluated and recorded by trained university observers at harvest. Livers were scored as 0 = no abscesses, A- = 1 to 2 abscesses with diameter less than 0.77 in., A = 2 – 4 abscesses with diameter between 0.77 and 1.57 in., A+ = 1 abscess with diameter greater than 1.57 in. or more than 4 small abscesses, A+/AD = A+ criteria with adhesions to the body cavity. For this study, 0 represented the normal liver population, A- and A represented the mild liver abscess population, and A+, and A+ with adhesions represented the severe liver abscess population.

Quality grades of USDA Low Choice and Select and liver abscess scores of normal, mild, and severe were used for this study. Steaks from a total of 119 carcasses were collected and consisted of the following: 22 Low Choice-normal; 20 Low Choice-mild; 20 Low Choice-severe; 21 Select-normal; 20 Select-mild; and 16 Select-severe. Carcasses were chilled for approximately 36 hours post-mortem and all steaks were cut from the carcasses on a single day. Strip loin steaks were cut approximately 2.5 in. thick from the left side of the carcass at the 13th rib by a trained abattoir employee. Steaks were individually bagged and identified before being transported back to Manhattan, Kansas on ice. Steaks were vacuum-packaged, aged at 37 ± 1.8°F for 14 days post mortem. Steaks were stored for 48 hours at –4°F then faced and cut into two 1 in. steaks.

Warner Bratzler shear force and slice shear force were conducted according to the American Meat Science Association Research Guidelines for cookery, sensory evaluation, and instrumental tenderness measurements of meat. Steaks were randomized using a random number generator and thawed for 24 hours at 37°F. Steaks were weighed before and after cooking to calculate cook loss. Before cooking, a 30 gauge copper/constantan thermocouple was inserted into the geometric center of each steak. Steaks were cooked on clamshell grills (Cuisinart Griddler Deluxe, Cuisinart, East Windsor, NJ) set to 350°F that had been sprayed with nonstick cooking spray. Internal temperatures were monitored until an internal temperature of 150°F was reached, with a target endpoint temperature of 160°F. Once maximum rise in temperature was reached, thermocouples were removed and steaks were cut for slice shear force using a slice shear force kit. An Instron testing machine (Model 5569, Instron Corp., Norwood, MA) was used in combination with a slice shear blade (crosshead speed of 19.67 in./minute). After slice shear force, the remaining portion of the steak was cooled overnight at 37°F and used for Warner Bratzler shear force. Six 0.5 in. cores, parallel to the muscle fiber orientation, were removed and sheared on the Instron testing machine with a v-blade (G-R Manufacturing Co., Manhattan, KS; crosshead speed of 250 mm/min). The values of the 6 cores were averaged to obtain a single Warner Bratzler shear force value for each steak.

Panelists were trained over a series of training sessions with a minimum number of 3 trainings attended. Trainings were attended during a 5 day period. Characteristics on which panelists were trained included initial juiciness, sustained juiciness, myofibrillar tenderness, connective tissue, overall tenderness, beef flavor intensity, and off-flavor intensity. Anchors were provided at each training session and were used to set the 100 point scales.

Steak samples for sensory analysis were stratified by liver score and USDA quality grade and randomly assigned to one of 20 sensory panels so that each panel had one

steak from each treatment combination. Six samples were evaluated per panel with a maximum of two panels per day. Steaks were prepared in the same manner as described above for Warner Bratzler shear force and slice shear force.

Immediately after peak temperature was reached, steaks were cut into uniform 0.5 × 0.5 × 1 in. cubes and placed into a metal double boiler to remain warm until served. Panels consisted of 20 sessions with 7 to 9 trained panelists per panel session. Panelists were seated in individual sensory analysis booths lit with red and green incandescent light to mask any color differences. Unsalted crackers, apples, and deionized, distilled water were provided as palette cleansers. Digital tablets (Toshiba Encore 2, Toshiba, Tokyo, Japan) were used to record sensory data on each steak with each category having a continuous line scale from 0 to 100 on which to mark a score. Qualtrics analytics software (Qualtrics, Provo, UT) was used to record and summarize data.

Sensory panel, Warner Bratzler shear force, and slice shear force data were analyzed using the GLIMMIX procedure of SAS. Sensory panel data were averaged within each steak and averages were used for analysis. Quality grade, liver score, and their interactions were analyzed as fixed effects and panel number was used as a random effect. Warner-Bratzler shear force and slice shear force data were analyzed with quality grade, liver score, and their interaction as fixed effects, and peak temperature used as a covariate. A Kenward-Roger adjustment was applied to the degrees of freedom. Significance was determined at $P<0.05$.

Results and Discussion

There were no quality grade × liver abscess score interactions for initial or sustained juiciness, connective tissue amount, overall tenderness, beef flavor identify, or off flavor ($P>0.05$). There was a quality grade × liver abscess score interaction for myofibrillar tenderness ($P<0.05$). Choice steaks did not differ in myofibrillar tenderness between liver abscess scores, but Select-mild steaks had greater myofibrillar tenderness than both the Select-normal and Select-severe groups ($P<0.05$). Low Choice Steaks had greater initial and sustained juiciness, and overall tenderness, and had less connective tissue than the Select steaks ($P<0.05$). There were no differences among liver abscess scores for any of the sensory panel traits ($P>0.05$).

There was no quality grade × liver abscess score interaction for Warner Bratzler shear force, slice shear force, or cook loss ($P>0.05$). There was also no effect of quality grade or liver abscess score on Warner Bratzler shear force, slice shear force, or cook loss ($P>0.05$).

Implications

Results from this study indicate that liver abscesses present at the time of slaughter do not have an effect on beef tenderness or sensory analysis characteristics in cattle fed in commercial feedlots without tylosin phosphate. Tenderness is an important trait for beef consumers, therefore, it is desirable for the beef industry and consumers alike that liver abscesses do not affect meat tenderness. Further research on liver abscess prevention is still warranted due to the decrease in profit caused by severe liver abscesses.

Table 1. Least squares means of effect of liver abscess score on Warner-Bratzler shear force, slice shear force, and cook loss for USDA Low Choice and Select beef strip loin steaks

Treatment	Warner Bratzler shear force, lb	Slice shear force, lb	Cook loss, %
Quality Grade			
Select	9.99	62.77	15.96
Low Choice	9.30	59.37	16.03
SEM[1]	0.29	2.84	0.29
P-value	0.09	0.39	0.87
Liver abscess score[2]			
None	9.77	63.98	16.42
Mild	9.57	58.84	15.57
Severe	9.59	60.43	16.00
SEM[1]	0.37	3.57	0.37
P-Value	0.91	0.52	0.21
Quality grade × liver abscess			
P-value	0.38	0.61	0.15

[ab] Means with different superscripts differ at the P≤0.05 significance level.
[1]Standard error of the least squares mean.
[2]None: healthy liver, no abscess; Mild: abscess less than 0.77 in diameter to 4 abscesses less than 1.57 in diameter; and Severe:1 abscess greater than 1.57 in diameter or greater than 4 small abscesses.

Table 2. Least squares means of effects of liver abscess score on sensory analysis panel items for USDA Low Choice and Select beef strip loin steaks

Treatment	Initial juiciness[1]	Sustained juiciness	Myofibrillar tenderness	Connective tissue amount	Overall tenderness	Beef flavor identity	Off flavor
Quality Grade							
Select	55.11[a]	46.20[a]	57.51[a]	17.05[a]	53.96[a]	47.05	0.91
Low Choice	59.06[b]	49.58[b]	62.41[b]	13.89[b]	58.81[b]	48.39	0.60
SEM[2]	1.42	1.26	1.53	1.38	1.65	0.87	0.31
P-value	0.01	0.01	0.02	0.03	0.03	0.27	0.38
Liver abscess score[3]							
None	57.83	48.18	59.84	15.24	56.62	48.39	0.84
Mild	56.50	47.62	60.84	14.84	57.20	47.67	0.61
Severe	56.93	47.86	59.21	16.33	55.33	47.10	0.81
SEM[2]	1.61	1.45	1.90	1.60	2.05	1.10	0.37
P-value	0.71	0.94	0.81	0.70	0.79	0.68	0.85
Quality grade × liver abscess							
P-Value	0.37	0.66	0.03	0.06	0.08	0.10	0.65

[ab] Means with different superscripts differ at P≤0.05 significance level.
[1]Sensory Scores: 0 = Extremely dry/tough/none/bland; 100 = Extremely juicy/tender/abundant/intense; 50 = neither dry nor juicy, neither tough nor tender.
[2]Standard error of the least squares mean.
[3]None: healthy liver, no abscess; Mild: 1 abscess less than 0.77 in diameter to 4 abscesses less than 1.57 in diameter; and Severe: 1 abscess greater than 1.57 in diameter or more than 4 small abscesses.