PE2.05 Effects of feeding wet distillers grains plus solubles and vitamin E, and modified atmosphere packaging on beef tenderness 417.00

Chris Calkins (1) ccalkins1@unl.edu, AS de Mello, Jr.(1), K Watanabe 1, L Senaratne 1 M Schnepf 1 G Erickson 1
(1)University of Nebraska, Lincoln, NE, United States of America

***Abstract*: The effects of feeding wet distillers grains plus solubles (WDGS), vitamin E supplementation (E), and modified atmosphere packaging (MAP) on Warner Bratzler shear force (WBSF) and sensorial tenderness were investigate in M. *Longissimus thoracis* aged 7 and 21 days. Steers (n = 90) were allocated to diets containing 35% WDGS with 0, 100, 300, 500, and 1000 I.U. of E daily or corn (no supplemental E). After aging, muscles were displayed for 5 days under O_2-permeable film, high O_2 MAP and low O_2 MAP. Retail display in high O_2 MAP caused a reduction in tenderness after both 7 and 21 d of aging, suggesting the decrease in tenderness occurred as a result of oxidation of myofibrillar or cytoskeletal proteins rather than through oxidation of the calpains. Vitamin E provided a small, but significant protective effect against oxidation-induced toughening, even in meat from animals fed WDGS. However, extended aging minimized the beneficial effects of E.**

C. R. Calkins is with the Department of Animal Science, University of Nebraska, Lincoln, NE 68583 USA (Phone: 402-472-6314, Fax: 402-472-6362, e-mail: ccalkins1@unl.edu).

A. S. de Mello, Jr. is with the Department of Animal Science, University of Nebraska, Lincoln, NE 68503 USA (e-mail: amilton@huskers.unl.edu).

K. Watanabe is with the Department of Nutrition and Health Sciences, University of Nebraska, Lincoln, NE 68583 USA (e-mail: kanaelynn@hotmail.com).

L. S. Senaratne is with the Department of Animal Science, University of Nebraska, Lincoln, NE 68583 USA (e-mail: lasika_ss@yahoo.com).

M. I. Schnepf is with with the Department of Animal Science, University of Nebraska, Lincoln, NE 68503 USA (e-mail: mschnepf1@unl.edu).

G. E. Erickson is with the Department of Animal Science, University of Nebraska, Lincoln, NE 68583 USA (e-mail: geericks@unlnotes.unl.edu).

I. INTRODUCTION

PREVIOUS research showed that feeding wet distillers grains plus solubles leads to higher lipid oxidation and decreased color stability in beef due to an increase in polyunsaturated fatty acids (PUFA) [1]. These fatty acids are more easily oxidized when compared to mono- and unsaturated lipids. When vitamin E is supplemented in animal diets, it is deposited at the cellular membrane and offers protection to PUFA against pro-oxidant factors. Therefore, detrimental effects caused by feeding WDGS to cattle may be mitigated by adding 500 I.U/ of vitamin E daily during the finishing period [4,5]. We hypothesized that feeding WDGS might also affect proteins, which could lower tenderness due to oxidation. The objective of our study was to investigate if feeding WDGS would affect beef Warner-Bratzler shear force or sensorial tenderness and if feeding supplemental levels of vitamin E could diminish or avoid this effect.

II. MATERIALS AND METHODS

A. Treatments and tenderness analyses.

Yearling steers (n = 90) were randomized into six dietary treatments (Corn, WDGS, WDGS +100E, WDGS+300E, WDGS+500E, WDGS+1000E) where the level of WDGS was 35% (DM basis) and vitamin E was 100, 300, 500, or 1000 I.U. daily. Dietary treatments lasted 128 days. After 7 d aging, M. *Longissimus dorsi* (LD) were excised from vacuum packaged short loins. One side was aged for 7 d and one for 21 d. After aging, four 2.54 cm steaks were cut from each strip loin. One steak was vacuum packaged and frozen after cutting or displayed for 5 days under O_2-permeable film, low O_2 MAP, or High O_2 MAP. Four display cases (Hussmann Climate Control Technologies, Bridgeton, MO) were set at 2 ± 2°C and light intensity varied from 60 to 200Lx (lamp type= F32T8/TL730 Phillips, Inc., New Jersey, USA). All steaks were vacuum packaged and frozen after the display period. For WBSF and sensorial analysis, steaks were thawed over night, grilled to 35°C and then turned once. The final internal temperature was 70°C at the geometric center. A nine-member panel was screened, selected, and trained [3] to evaluate tenderness on an eight-point hedonic scale (from 1 = extremely tough to 8 = extremely tender). For WBSF, after cooking, steaks were cooled for 1 h at 4°C and cores were removed with a drill press parallel to muscle fiber orientation. From each steak, 6 cores (1.27 cm in diameter) were sheared on an Instron Universal Testing Machine (model 55R1123, Instron Corp., Canton, MA) with a Warner-Bratzler blade. The crosshead speed was 250 mm/min with a 500 kg load cell. The tenderness differential between d 0 and d 5 of retail display was calculated by subtracting d 5 values (WBSF and sensorial tenderness) from d 0 values. Thus, a negative value indicates a loss of tenderness during retail display.

B. Statistical Analysis

Data were analyzed as a split split plot design where diet was the whole plot, aging the split plot, and MAP the split split plot. Animal (both muscles) within diet was considered the whole plot, aging by diet the split, and MAP by aging by diet the split split plot error terms. Data were analyzed using the GLIMMIX procedure of SAS (Version 9.1, Cary, N.C., 2002). When significance ($P \leq 0.05$) was indicated by ANOVA, means separations were performed using the LSMEANS and DIFF functions of SAS.

III. RESULTS AND DISCUSSION

High O_2 MAP resulted in greater shear force values and lower TP tenderness ratings compared to the other two packaging systems, likely due to protein oxidation. In addition, display under high O_2 MAP conditions caused a significant decrease in tenderness, measured by shear force or taste panel tenderness ratings, during the display period. This implies that the decrease in tenderness occurred as a result of oxidation of myofibrillar or cytoskeletal proteins rather than through oxidation of the calpains as the tenderness decrease was observed even after 21 d post mortem, when most of the proteolytic activity from calpains would have been complete.

Vitamin E provided a small, but significant protective effect against oxidation-induced toughening in that beef from cattle fed WDGS and E had lower shear force values and higher sensorial tenderness ratings compared to corn-fed beef with no supplemental E.

The beneficial effects of E were evident when comparing beef from cattle fed WDGS without supplemental E to cattle fed WDGS with E – those without the supplemental E became tougher during retail display after 7 d of aging. After 21 d of aging, however, there were no differences among treatments, suggesting that aging reduced the capacity of the meat to resist oxidation, regardless of the amount of supplemental dietary E..

The tenderness response to supplemental dietary vitamin E was quadratic in nature, with the lowest shear force values and among the highest sensorial tenderness ratings for cattle fed WDGS + 100 E. The curvilinear nature of these relationships is difficult to explain.

IV. CONCLUSION

Storing beef in high O_2 MAP caused a reduction in tenderness. Feeding supplemental dietary vitamin E provided a small, but significant protective effect against this oxidation-induced toughening, even in meat from animals fed WDGS. However, extended aging minimized the beneficial effects of E. The reduction in tenderness caused by protein oxidation appeared to be independent of calpain oxidation.

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Table 1. Tenderness of steaks displayed under different packaging systems.

	Packaging System			Standard
Trait[a]	High O_2 MAP	Low O_2 MAP	O_2-Permeable	Error
WBSF, kg	3.63^{c}	3.39^{b}	3.37^{b}	0.03
Delta WBSF, kg	-0.19^{c}	0.04^{b}	0.05^{b}	0.05
Tenderness rating	5.87^{c}	6.16^{b}	6.16^{b}	0.04
Delta tenderness rating	-0.13^{c}	0.17^{b}	0.08^{b}	0.04

[a] WBSF = Warner-Bratzler shear force; Tenderness rated on an 8-point hedonic scale where 1 = extremely tough and 8 = extremely tender.

[b,c] Means in the same row with different superscripts are significantly different ($P < 0.05$).