C79

# EXPRESSIBLE JUICE AND INTERNAL COOKED COLOR OF GROUND BEEF PATTIES FROM VITAMIN E-SUPPLEMENTED STEERS

C.L. LAVELLE, M.C. HUNT, AND D.H. KROPF
Kansas State University, Department of Animal Science, Weber Hall, Manhattan, KS 66506

Keywords: Vitamin E beef, cooked color

## ABSTRACT

The expressible juice and internal color of patties cooked to four endpoint temperatures (55, 65, 71, and 77°C) was determined for ground beef (9% fat) from vitamin E-supplemented (500 and 2000 IU) or nonsupplemented steers. Vitamin E did not affect ($P>0.05$) expressible juice or internal cooked color of the patties, and it did not prevent premature browning or cause persistent redness. Premature browning occurred in all patties which appeared to have their internal myoglobin in an oxidized form prior to cooking.

## INTRODUCTION

Supplementing the diets of cattle with vitamin E results in a 1.6 to 5 d extension in retail display life, without compromising microbiological quality (Arnold et al., 1992, 1993). How vitamin E supplementation affects the internal cooked color of meats is not known. Two types of atypical cooked color have been noted in the literature. In the first type of atypical cooked color, premature browning, patties have a brown interior at endpoint temperatures where they should still be red or pink (Marksberry, 1990; Hague et al., 1994; Warren et al., 1995). This condition represents a potential safety hazard, because patties appear to be cooked thoroughly, yet any pathogens that may have been present are possibly still viable. In the other type of atypical cooked color, persistent pinkness, patties retain an internal pink color at medium- (Van Laack, 1994) and even well-done temperatures (Mendenhall, 1989). The objectives of this research were to determine the effects of vitamin E supplementation on the cooked color development and expressible juice of ground beef patties.

## MATERIALS AND METHODS

Knuckles from 36 Holstein steers were obtained from the University of Wisconsin-Madison. The meat represented two replications of 18 steers each; six received no supplemental Vitamin E, six received 500 I.U., and six received 2000 I.U. daily for approximately 120 d prior to slaughter. The meat was fabricated, vacuum packaged, and shipped fresh to Kansas State University by Packerland (Green Bay, WI). The cuts were stored at 2°C until 17 d postslaughter.

The knuckles were coarsely ground (1.27 cm plate) and mixed with fat trimmed from the knuckles and inside rounds of the same animal to achieve approximately 9% fat. The meat was twice ground through a 0.32 cm plate and formed into 113-g patties using a Hollymatic pattymaker (Jet Flow Super, Model 54, Countryside, IL). The patties were frozen immediately at -40°C, vacuum packaged, and stored at -20°C for approximately 230 d.

One set of frozen, vacuum-packaged patties was thawed overnight at 3°C and then cooked. These patties had a brown interior and developed a premature brown cooked color. Another set of patties was thawed and then held at 22°C for 4.5 hr to further reduce the pigment and then rechilled at 3°C for 2 hr prior to cooking. These patties had a purple-red interior and developed a normal cooked color.

All patties were cooked on a preheated (162.8°C) electric griddle (Presto, Model 0703202) to either 55, 65, 71, or 77°C. Patties were turned every 30 sec and were removed from the griddle 1.5°C prior to the endpoint temperature. Internal temperature was measured using a 20-gauge hypodermic probe-type thermocouple connected to a Doric temperature recorder (Trendicator 410A, San Diego, CA).

The patties were sliced vertically, and the internal color was ranked subjectively to the nearest 0.5 by one panelist on a 5-point color scale (Marksberry et al., 1993). One-half of the patty was sliced horizontally and placed on plastic wrap (Reynolds 914 film, Reynolds Metals Co., Richmond, VA), and the color was measured instrumentally with a LabScan 6000 Spectrocolorimeter (2 cm diameter aperture, Hunterlab, Reston, VA). Average CIE L*, a*, b* (Illuminant A), a*/b* ratio, saturation index, and hue angle were calculated. Reflectance at 630/580 also was determined. Expressible juice color was measured only for the patties that were premature brown. The juice was pressed from the other half of the patty, with a hand-held patty former. A small volume of the juice supernatant was transferred to a clear, plastic, tissue-culture cell, and L*, a* and b* values were measured using a Minolta Chroma Meter (Model CR-200, Japan). Expressible juice color also was scored to the nearest 0.5 by one panelist on a 5-point scale (Marksberry et al., 1993).

The data were analyzed as a split-plot. Significance was determined at $\alpha=0.05$ and differences among means were tested using least square means.

## RESULTS AND DISCUSSION

Vitamin E had no effect ($P>0.05$) on patty internal cooked color when a normal (i.e., decreasing redness with increasing endpoint temperature) cooked color pattern occurred. As expected, the internal color was affected ($P<0.05$) by endpoint temperature (Table 1). With the exception of L* and b* values, all color parameters, including visual scores, were different ($P<0.05$) at each endpoint temperature. Vitamin E also did not prevent ($P>0.05$) premature browning, i.e., all patties thawed without an anaerobic reduction step turned brown at a lower than expected temperature. Color parameters for these patties were also affected by endpoint temperature (Table 1). Vitamin E did not affect ($P>0.05$) expressible juice color. The lightness and yellowness of the juice (L* and b* values) increased up to 71°C (Table 1). Juice had the same redness (a* values) at 55 and 65°C but became less red and lighter thereafter (Table 1).

In summary, vitamin E supplementation had no effect on cooked color development or expressible juice, and there were no indications that vitamin E would promote the persistent redness commonly associated with high pH meats or prevent the premature browning that results when patties are cooked from an oxidized pigment state.

## CONCLUSION

Vitamin E supplementation does not affect the internal cooked color or expressible juice of patties. It also does not prevent premature browning or cause persistent redness.

## ACKNOWLEDGEMENTS

This research was supported in part by the Kansas Value Added Center. The authors wish to thank Dr. Dan Schaefer and Kristine Scheller for assistance in procurring the meat.

## REFERENCES

Arnold, R.N., Scheller, K.K., Arp, S.C., Williams, S.N. and Schaefer, D.M. 1993. Dietary $\alpha$-tocopheryl acetate enhances beef quality in Holstein and beef breed steers. J. Food Sci. 58(1): 28-33.

Arnold, R.N., Scheller, K.K., Arp, S.C., Williams, S.N., Buege, D.R. and Schaefer, D.M. 1992. Effect of long- or short-term feeding of $\alpha$-tocopheryl acetate to Holstein and crossbred beef steers on performance, carcass characteristics and beef color stability. J. Anim. Sci. 70: 3055-3065.

Hague, M.A., Warren, K.E., Hunt, M.C., Kropf, D.H., Kastner, C.L., Stroda, S.L. and Johnson, D.E. 1994. Endpoint temperature, internal cooked color and expressible juice color relationships in ground beef patties. J. Food Sci. 59(3): 465-470.

Marksberry, C.L., Kropf, D.H., Hunt, M.C., Hague, M.A. and Warren, K.E. 1993. Ground beef patty cooked color guide. Department of Animal Sciences and Industry. Kansas State Univ., Manhattan, KS.

Marksberry, C.L. 1990. The effect of fat level, pH, carcass maturity and compaction on the cooked internal color of ground beef patties at five end-point temperatures. M.S. Thesis, Kansas State Univ., Manhattan.

Mendenhall, V.T. 1989. Effect of pH and total pigment concentration of the internal color of cooked ground beef patties. J. Food Sci. 54: 1-2.

Van Laack, R.L.J.M. 1994. Variations in internal color of beef patties cooked to 71C. Paper no. 47D-9, presented at 54th Annual Meeting of Inst. of Food Technologists, Atlanta, GA, June 25-29.

Warren, K.E., Hunt, M.C., Kropf, D.H. and Kastner, C.L. 1995. Chemical properties of ground beef patties exhibiting normal and premature brown internal cooked color. In prep. J. Food Sci.

**Table 1 Expressible juice and internal color characteristics[g] of normal (NRM) and premature brown (PMB) patties at four endpoint temperatures (°C)**

| | NRM | | | | PMB | | | |
|---|---|---|---|---|---|---|---|---|
| Trait | 55°C | 65°C | 71°C | 77°C | 55°C | 65°C | 71°C | 77°C |
| *Patty Traits* | | | | | | | | |
| L* | 55.3a | 57.3b | 57.1b | 56.9b | 55.3w | 56.2x | 55.9wxy | 54.5wy |
| a* | 22.4a | 19.3b | 16.3c | 13.2d | 14.3w | 12.4x | 11.6y | 11.5y |
| b* | 17.8a | 17.0b | 16.2c | 15.7c | 15.9w | 14.8x | 14.4x | 15.0x |
| a*/b* | 1.26a | 1.14b | 1.01c | 0.85d | 0.89w | 0.85x | 0.81y | 0.77z |
| Saturation index | 28.6a | 25.7b | 23.0c | 20.5d | 21.4w | 19.3x | 18.6y | 18.8xy |
| Hue angle | 38.6a | 41.6b | 45.0c | 49.9d | 48.5w | 49.8x | 51.1y | 52.4z |
| 630/580 nm | 2.4a | 2.0b | 1.7c | 1.4d | 1.4w | 1.3x | 1.3y | 1.2y |
| Visual score[e] | 1.6a | 2.1b | 3.0c | 4.3d | 4.0w | 4.2x | 4.5y | 4.6z |
| *Juice Traits* | | | | | | | | |
| Juice visual score[f] | ---- | ---- | ---- | ---- | 2.0w | 3.0x | 3.7y | 4.1z |
| Juice L* | | | | | 70.5w | 73.9x | 76.6y | 76.6y |
| Juice a* | | | | | 10.4w | 9.2w | 5.4x | 3.9y |
| Juice b* | | | | | 15.4w | 17.7x | 19.1y | 19.8y |

a-d Means for NRM within a trait and across temperatures with a different letter are different (P<0.05).

e Visual score ranges from 1 = pink to 5 = brown (Marksberry et al., 1993).

f Expressible juice visual score ranges from 1 = red to 5 = yellow (Marksberry et al., 1993).

g Data were pooled for replication and vitamin E.

w-z Means for PMB within a trait and across temperatures with a different letter are different (P<0.05).