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Determination of Consumer Color and Discoloration Thresholds for Purchase of Retail Ground Beef When Evaluating Multiple Days of Display Simultaneously

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KANSAS STATE UNIVERSITY CATTLEMEN'S DAY

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Abstract

The objective of this study was to identify the threshold for color and discoloration for consumers to purchase ground beef in a simulated retail display and to determine the best objective measurement to predict consumer purchase intent. One-lb ground beef packages containing 80% lean/20% fat were obtained and assigned to a day of retail display (day 0–9). Consumers (n = 216) evaluated ground beef samples from each day of display simultaneously. The models showed that each of the objective measures evaluated were predictors ($P < 0.05$) of consumer purchasing intent. All logistic regression equations ($P < 0.01$) had high R^2 values of 0.48–0.86, and correctly classified 78.1–90.1% of samples as would/would not purchase. Linear regression equations predicting consumer overall appearance ratings with objective measures also resulted in significant ($P < 0.01$) models, with R^2 values of 0.57–0.93. The a^* (redness) values of 21.6, 24.6, 28.3, and 30.5 correspond with consumers being 50, 75, 90, and 95% likely to purchase the product at full price. However, if the product was discounted, the values were 17.9, 21.4, 25.0, and 27.4. The percentage of metmyoglobin values of 40.1, 33.6, 27.1, and 22.7 correspond with consumers being 50, 75, 90, and 95% likely to purchase the product at full price and 47.8, 40.5, 33.2, and 28.2 if the product was discounted. The models generated from this study provide the ability to predict consumer willingness to purchase ground beef and provide ground beef producers an indication of potential consumer purchasing behaviors based upon objective values that are easy to measure.

Introduction

Recent increases in ground beef demand have shifted ground beef from an industry by-product to an increasingly valuable segment of the meat industry (Speer et al., 2015). Although the United States has transitioned to a "ground beef nation" (Close, 2014), there are many unknowns regarding consumer purchasing intent of ground beef products in the retail setting. Meat color is an extensively researched area, but only limited research exists that evaluates consumer perceptions. Ground beef discoloration leads to an estimated loss of $3.73 billion to the beef industry annually (Ramanathan, 2022). Therefore, the objective of this study was to identify the threshold for color and

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discoloration for consumers to purchase ground beef in a simulated retail display and to determine the best objective measurement to predict consumer purchase intent.

Experimental Procedures

For this study, 180 1-lb 80% lean/20% fat ground beef packages were obtained from a commercial processor in Kansas and transported to the Kansas State University Meat Laboratory. Packages were assigned to a day of retail display (day 0–9). Ground beef packages from each day of display were displayed in coffin-style cooler cases under fluorescent lights. Consumers (n = 216) evaluated ground beef samples from each day of display simultaneously. Consumers were asked to assess the overall appearance and desirability of each sample on a 100-point continuous line scale. Additionally, consumers answered yes/no questions related to whether they would purchase the package if it was full-priced at retail, and if it was discounted at retail. A trained descriptive panel evaluated the samples for redness and percentage discoloration using 100-point continuous line scales. Instrumental L^* (lightness), a^* (redness), and b^* (yellowness) values were collected utilizing a Hunter Lab Miniscan (Model 2500L, Hunter Associates Laboratory Inc, Reston, VA) spectrophotometer, and spectral data were recorded for the calculation of hue angle, chroma, percent oxymyoglobin, and percent metmyoglobin. Logistic regression models were calculated for the probability of a sample being identified as "would purchase" for both full-price and discounted responses by consumer sensory panelists. Simple linear regressions were calculated for consumer overall appearance ratings. Pearson correlation coefficients were calculated for sensory and objective measurements.

Results and Discussion

Overall, the models showed that each of the objective measures evaluated were predictors of consumer purchasing intent. All logistic regression equations ($P < 0.01$) had high R^2 values of 0.48–0.86, and correctly classified 78.1–90.1% of samples as would/would not purchase. Linear regression equations predicting consumer overall appearance ratings with objective measures also resulted in significant ($P < 0.01$) models, with R^2 values of 0.57–0.93. Pearson correlation coefficients showed strong relationships ($P < 0.01$) between consumer appearance score and all other variables ($r > 0.92$), except for L^* ($r = 0.76$). The a^* values of 21.6, 24.6, 28.3, and 30.5 correspond with consumers being 50, 75, 90, and 95% likely to purchase the product at full price (Figures 1 and 2). However, if the product was discounted, these numbers were 17.9, 21.4, 25.0, and 27.4 (Table 1). The percentage of metmyoglobin values of 40.1, 33.6, 27.1, and 22.7 correspond with consumers being 50, 75, 90, and 95% likely to purchase the product at full price (Figures 3 and 4). However, if the product was discounted, these numbers shifted substantially to 47.8, 40.5, 33.2, and 28.2 (Table 1).

Implications

All objective measurements were predictors of consumer purchasing intent of 80% lean/20% fat ground beef. Objective measurements shown to be the best included the a^* value and calculated percent metmyoglobin. The models generated from this study provide the ability to predict consumer willingness to purchase ground beef of varying days of retail display and provide ground beef producers an indication of potential consumer purchasing behaviors based upon objective values that are easy to measure.

Acknowledgments
This project was funded by Cargill Meat Solutions.

References
Close, D. 2014. Ground Beef Nation: The Effect of Changing Consumer Tastes and Preferences on the U.S. Cattle Industry. Rabobank, Rabobank AgFocus.

Ramanathan, R., Lambert, L. H., Mahesh, N. N., Morgan, B., Feuz, R. Mafi, G., and Pfeiffer, M. 2022. Economic Loss, Amount of Beef Discarded, Natural Resources Wastage, and Environmental Impact Due to Beef Discoloration. Meat Muscle Biol. 6. doi:10.22175/mmb.13218.

Speer, N., T. Brink, and M. McCully. 2015. Changes in the Ground Beef Market and What it Means for Cattle Producers. The Angus Foundation, St. Joseph, MO.

Table 1. The 50, 75, 90, and 95% likeliness thresholds for various objective quality measures for consumer purchase intent of 80% lean/20% fat ground beef

Measurement	50%	75%	90%	95%
Product sold at full price				
*L**	50.6	51.7	52.8	53.6
*a**	21.6	24.9	28.3	30.5
*b**	20.4	21.8	23.2	24.2
Metmyoglobin[1]	40.1	33.6	27.1	22.7
Oxymyoglobin[1]	58.5	64.9	71.4	75.8
Chroma[1]	30.5	33.9	37.4	39.7
Hue angle[1]	0.77	0.73	0.68	0.65
Trained sensory panel redness score[2]	53.6	67.4	81.1	90.4
Trained sensory panel discoloration score[3]	37.8	19.5	1.1	-
Consumer appearance score[4]	49.8	60.8	71.8	79.3
Product sold at discounted price				
*L**	49.5	50.8	52.2	53.2
*a**	17.9	21.4	25.0	27.4
*b**	18.9	20.3	21.8	22.8
Metmyoglobin[1]	47.8	40.5	33.2	28.2
Oxymyoglobin[1]	50.1	57.4	64.7	69.7
Chroma[1]	25.8	29.2	32.7	35.0
Hue angle[1]	0.84	0.78	0.72	0.68
Trained sensory panel redness score[2]	40.9	56.6	72.3	82.9
Trained sensory panel discoloration score[3]	64.0	42.0	20.1	5.2
Consumer appearance score[4]	36.9	49.1	61.3	69.6

[1]Calculated utilizing the equations presented in the AMSA Meat Color Measurement Guidelines (AMSA, 2012).
[2]Sensory scores: 0 = extremely dark red, 100 = bright cherry red.
[3]Sensory scores: 0 = no visible discoloration, 100 = complete discoloration.
[4]Sensory scores: 0 = extremely undesirable, 100 = extremely desirable.

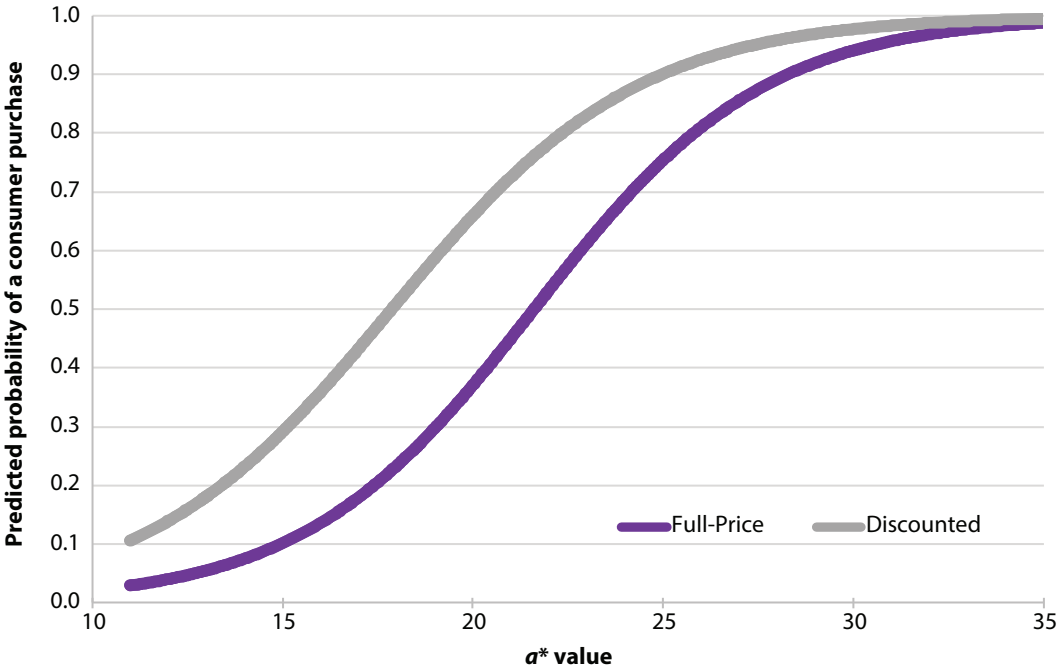

Figure 1. Probability of a consumer purchasing an 80% lean/20% fat ground beef package based on *a (redness) value and pricing.**

Day of Display: 0
*a** Value: 36.07

Day of Display: 5
*a** Value: 25.27

Day of Display: 9
*a** Value: 14.47

Figure 2. Sample photos with corresponding *a (redness) values.**

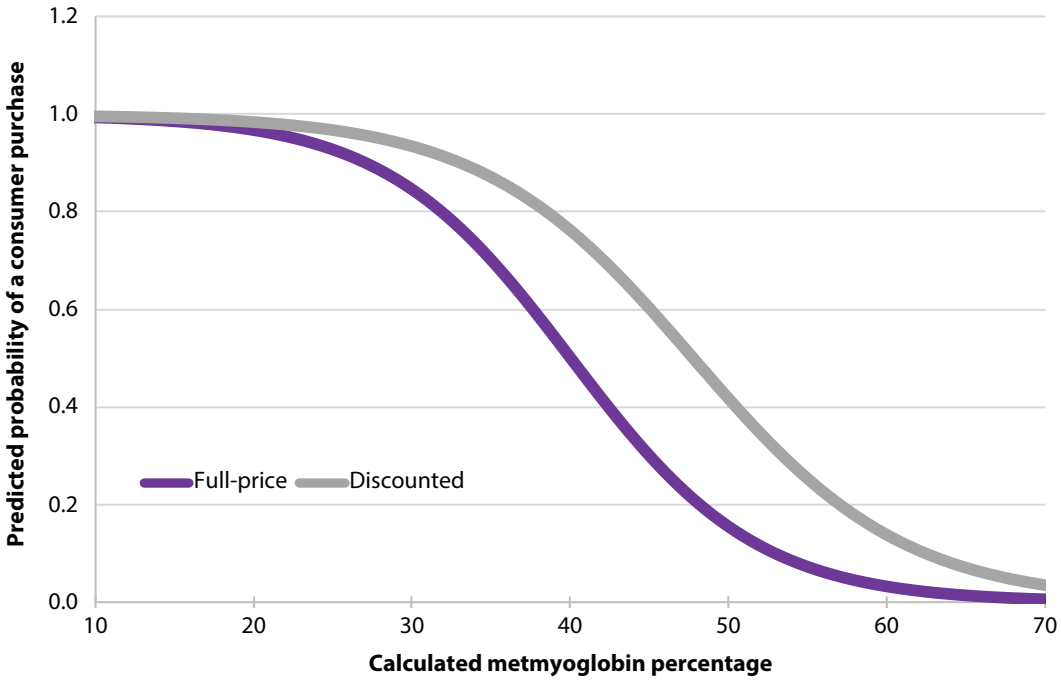

Figure 3. Probability of a consumer purchasing an 80% lean/20% fat ground beef package based on calculated metmyoglobin percentage and pricing.

Day of Display: 0

Calculated Percentage Metmyoglobin: 22.73

Day of Display: 5

Calculated Percentage Metmyoglobin: 29.92

Day of Display: 9

Calculated Percentage Metmyoglobin: 54.23

Figure 4. Sample photos with corresponding calculated percentage metmyoglobin values.