

Determination of Bloom Time and Caselife of Nolan Ryan Ground Beef

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SUMMARY

This study was designed to evaluate bloom time and retail caselife of Nolan Ryan ground beef. Chubs weighing 10 lbs. each (N = 3) were partitioned by one-half chub units (Table 1). After storage for 5, 7, 9, 11, and 13 days each chub was ground to generate four samples weighing one pound each. Samples were placed for display at 32^oF under controlled lighting environment and monitored objectively and subjectively by a trained panel. Bloom time was not affected by the age of the product. Results suggested the optimal storage time for extended caselife to be 7 days.

Key Words: Nolan Ryan, Ground Beef, Caselife.

INTRODUCTION

Color is one of the most important quality attributes of beef, the trait that consumers consider the most when making a purchase and the attribute that determines how appealing the product looks in the retail case. When customers sort through beef cuts in the retail case they are trying to find cuts that excel in taste, tenderness and juiciness -- three things they can't see -- what they do see that might be indicative of palatability is color (Smith et al., 1994). Today's consumers are very demanding and quality driven, they have learned through experience that the desirable color of fresh/ground beef is bright cherry-red, and any deviation from what they perceive to be acceptable will not be purchased. Retailers discount or discard cuts that have color characteristics outside the marketable range resulting in economic losses to the company. Current estimates are that the value loss of fresh beef due to discoloration costs the retail beef industry 4 to 5 percent of the wholesale price or up to one billion dollars a year (Hoffman-La Roche Inc., 1993). Beef that is perfectly wholesome and safe to eat is discounted or thrown away every

day because it has lost its bloom, or cherry red color, and become visually unappealing to consumers (Westcott et al., 1997).

This study was designed to evaluate the bloom time and retail caselife of a branded ground beef product.

MATERIALS AND METHODS

Product Selection. Nolan Ryan 96% lean ground beef chubs (N = 3) weighing 10 lb. each were shipped from the Sam Kane plant (EST. 7143) overnight to Colorado State University. Chubs were manufactured on July 28 (sell-by date, August 10) and arrived at Colorado State University on July 29 at temperatures averaging 35.1^oF. The product was immediately stored at 35^oF. The Experimental Design is presented in Table 1.

Preparation for Simulated Retail Display. One-half chub (5 lb.) was used for the 5-day storage treatment and the other two 10 lb. Chubs were halved and immediately repackaged under vacuum to generate a total of four, 1 lb. samples. After storage at 35^oF for 5, 7, 9, 11, and 13 days, each chub was ground through a grinder plate with 1/8 inch orifices and approximately 4, 1 lb. packages (polystyrene tray overwrapped with polyvinyl chloride film) were generated for retail display.

Simulated Retail Display. Following preparation, all 4 packages of ground beef from each chub were placed on display tables at 32^oF under a controlled lighting environment, using conditions recommended by AMSA (900 to 1365 lux) to determine retail caselife.

Bloom Time Evaluation. During the course of this study (10 days), individual packages of ground beef were evaluated every 10 minutes after completion of packaging, for the first hour to determine the amount of time it took for the ground beef samples to bloom (reach the bright cherry-red color stage).

Color Evaluation. The product's retail caselife was monitored (3,500 observations) objectively using a Hunter Lab MiniscanTM XE hand-held spectrophotometer to determine L*, a*, and b* values. Moreover, a subjective evaluation was conducted by trained Colorado State University personnel to evaluate visual color attributes at 10-minute intervals for the first hour, and

at 6 hr. intervals thereafter during retail display.

Objective measurements of the ground beef samples yielded values for L* (brightness; 0 = black, 100 = white), a* (red = positive values, green = negative values), and b* (yellow = positive values, blue = negative values). L*, a*, and b* values were determined by computing the average of three readings taken at random locations on the surface (through the PVC film) of the ground beef sample.

For the subjective evaluation, each package was evaluated until 50% of the packages in that batch had been assigned a mean overall desirability score of 3.75. Colorado State University personnel assigned visual color scores to each ground beef sample according to: (a) muscle color (8 = extremely bright cherry-red, 1 = extremely dark-red or brown), (b) surface discoloration (8 = no discoloration, 1 = 76 to 100% discoloration), and (c) overall desirability (8 = extremely desirable, 1 = extremely undesirable). Subjective evaluation was determined following AMSA guidelines.

STATISTICAL ANALYSIS

The data were analyzed separately for each age (days prior to grinding) group. All statistical analyses, including elementary statistics, and simple correlation analysis were performed using SAS (1998). Simple correlation coefficients were used to determine the relationship between visual color scores and the Hunter Lab MiniscanTM L*, a*, and b* values.

RESULTS AND DISCUSSION

Simulated Retail Display. Descriptive statistics for visual color scores and L*, a* and b* values are presented in Table 2. Presented in Table 3 are mean visual color scores assigned by trained CSU personnel for muscle color, surface discoloration, and overall desirability. Each mean is the average of scores for all 4 samples in that age group. A graphic presentation of overall desirability scores, which were used to determine retail caselife of the samples, is presented in Figure 1. The plots indicate that, with progression of time, overall desirability scores decreased, as was expected, revealing a generally linear inverse relationship between these 2 factors. Moreover, the

trend lines depict a very subtle change in the slope of the lines from day 5 through day 13, indicating that the age of the product had no major effect on the rate at which the overall desirability score declined.

Mean hours of simulated retail caselife at which 25% to 50% of the samples in each age group were assigned scores of “moderately undesirable” in overall appearance are presented in Table 4. The caselife for product ground on days 5, 7, 9, 11, and 13 was 66, 90, 78, 84, and 78 hr, respectively, (Table 4) or 2.75, 3.75, 3.25, 3.5, and 3.25 days, respectively, (data not presented in tabular form).

Simple correlation coefficients between visual color scores and Hunter Lab Miniscan™ L*, a*, and b* values are presented in Table 5. L* values were not correlated with muscle color scores, surface discoloration scores, or overall desirability scores ($r = .03, .04,$ and $.04,$ respectively). Values for a* were highly correlated with muscle color, surface discoloration, and overall desirability scores ($r = .86, .85,$ and $.85,$ respectively) and values for b* were moderately correlated with muscle color, surface discoloration, and overall desirability scores ($r = .69, .70,$ and $.66,$ respectively). This suggests that a* and b* values, singularly or in combination can be used, along with overall desirability scores, to predict hours of caselife.

Bloom Time. The time required for ground beef in each age group to reach the bright cherry-red color stage (bloom time) is presented in Table 4. All age groups (5, 7, 9, 11 and 13 days) bloomed in less than 10 minutes, usually while the samples were being prepared, or well before they were displayed.

IMPLICATIONS

Results of this simulated retail display study suggest that the optimal product age (prior to grinding) for extended caselife is 7 days. Inexplicably, 5-day samples had a shorter caselife (by 24 hr) than did 7-day samples.

Bloom time did not seem to be affected by the age of the product prior to grinding inasmuch as product from all age groups bloomed within 10 minutes after exposure to air and was well before the samples were displayed. Bloom time can be affected by

management and handling/processing practices and abuse of storage temperature could dramatically affect both bloom time and caselife.

The simple correlation coefficient between overall desirability scores and the Hunter Lab Miniscan™ a* values ($r = .85$) indicates that mean a* values can predict hours of caselife almost as accurately as can the mean overall desirability scores. Overall desirability scores and a* values predicted caselife for ground beef generated from raw material stored for 5, 7, 9, 11 or 13 days prior to grinding resulted in caselife expectations of 66, 90, 78, 84 or 78 hr (overall desirability scores) and 78, 72, 78, 78 and 84 hr. (a* values), respectively.

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Table 1. Experimental Design: Number of ground beef chubs (N = 3) partitioned by one-half chub units and day prior to grinding.

Chubs (10 lb.)	Days of Storage	Batch (5 lb.)	Overall Population
1	5	4 samples (1 lb. each)	4
2 {	7	4 samples (1 lb. each)	4
	9	4 samples (1 lb. each)	4
3 {	11	4 samples (1 lb. each)	4
	13	4 samples (1 lb. each)	4
Total			20

Table 2. Descriptive statistics for visual color scores assigned by CSU personnel and L*, a* and b* values determined by use of the Hunter Lab Miniscan™.

Score / Value	N	Mean	SD	Minimum	Maximum
Muscle Color Score	492	5.75	2.2	1	8
Surface Discoloration Score	492	5.90	2.0	1	8
Overall Desirability Score	492	5.91	2.1	1	8
L* Value	492	38.51	1.8	31.1	42.9
a* Value	492	13.77	2.9	4.9	20.5
b* Value	492	16.47	2.4	8.2	22.1

Table 3. Mean visual scores for 96% lean ground beef for a 108-hour period of simulated retail display.

Hour of Display	Muscle Color ^{ab}					Surface Discoloration ^{ac}					Overall Desirability ^{ad}				
	Days of Storage														
	5	7	9	11	13	5	7	9	11	13	5	7	9	11	13
66	4	4.5	4.25	4.75	3.75	4.75	5.25	3.5	4.75	4.5	3.75	5	4.5	4.75	4.75
72	4	4	4	4.5	3.25	4.5	5	3.5	4.5	4.5	3.25	5	4.5	4.5	4.25
78	4.25	4	3.75	4	2.75	4.5	4.75	3	4.25	3.75	3.25	5	3.5	4.5	3.5
84	4	3.5	3	3.25	2.25	4.75	4	3	3.5	3.25	3.25	4	2.5	3.5	3.25
90	4	3	3	2.25	2	4	3	3	3.25	2.5	3.25	3.75	3	2.75	2.75
96	3	2.75	2.5	2	2	4	3	2.5	2.75	2.25	3	3	2.5	2	1.75
102	2.25	1.75	2	1.25	-	3.5	2	2.25	2	-	2.5	2.25	2	1.75	-
108	1.25	1.5	1	1.25	-	2.75	2	1.25	1.75	-	1.75	2.25	1.75	1.75	-

^aAverage of all four samples for each age group.

^bMuscle color scores: 8 = extremely bright cherry-red, 7 = bright cherry-red, 6 = moderately bright cherry-red, 5 = slightly bright cherry-red, 4 = slightly dark cherry-red, 3 = moderately dark cherry-red, 2 = dark red, and 1 = extremely dark-red or brown.

^cSurface discoloration scores: 8 = no discoloration, 7 = 1 to 10% discoloration, 6 = 11 to 20% discoloration, 5 = 21 to 30% discoloration, 4 = 31 to 40% discoloration, 3 = 41 to 50% discoloration, 2 = 51 to 75% discoloration, and 1 = 76 to 100% discoloration.

^dOverall desirability scores: 8 = extremely desirable, 7 = desirable, 6 = moderately desirable, 5 = slightly desirable, 4 = slightly undesirable, 3 = moderately undesirable, 2 = undesirable, and 1 = extremely undesirable.

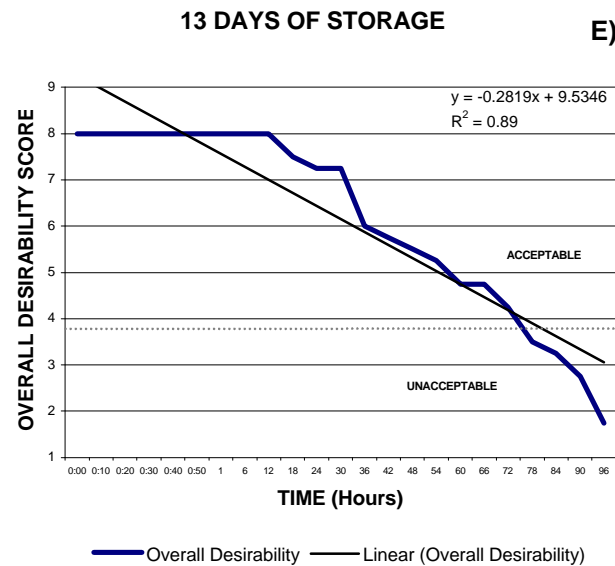
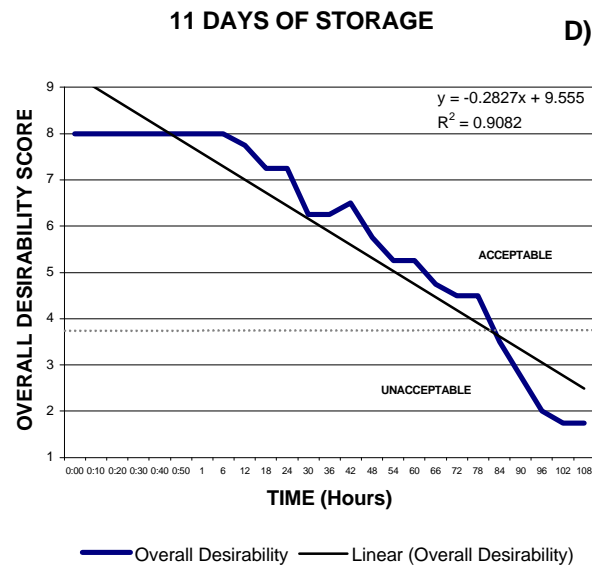
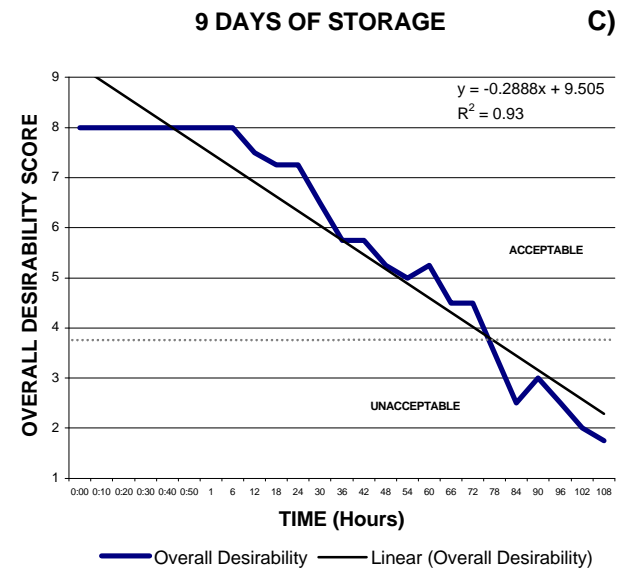
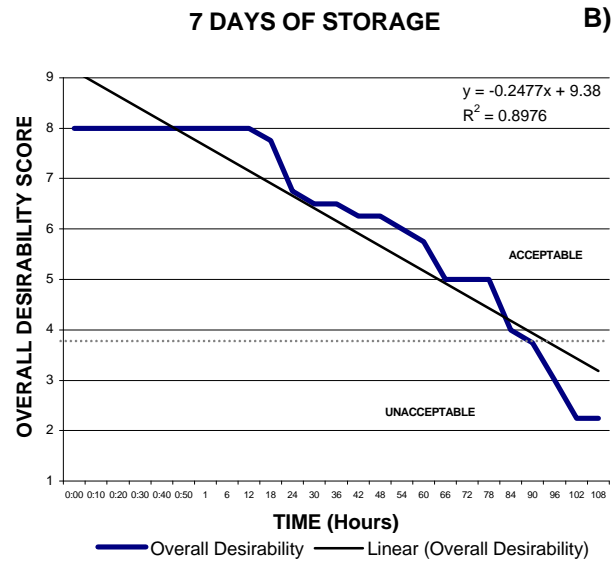
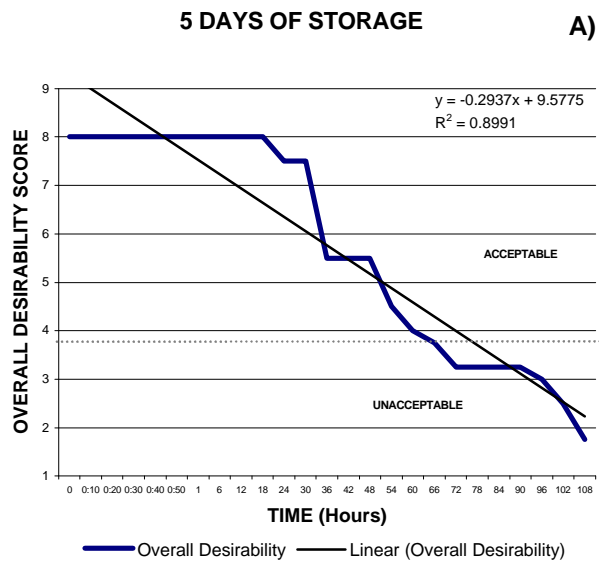


Figure 1. Overall desirability score plots by product age for the prediction of hours of caselife.

Overall desirability scores: 8 = extremely desirable, 7 = desirable, 6 = moderately desirable, 5 = slightly desirable, 4 = slightly undesirable, 3 = moderately undesirable, 2 = undesirable, 1 = extremely undesirable.

Table 4. Mean hours of retail caselife and bloom time for 96% lean ground beef.

Days of Storage	Caselife (hr) ^a	Bloom Time (min.) ^b
5	66	< 10
7	90	< 10
9	78	< 10
11	84	< 10
13	78	< 10

^aA mean score of 3.75 (moderately undesirable) was considered the point at which the product would be discounted.

^bColor was analyzed every 10 minutes for the first hour to monitor bloom time (bright cherry-red color stage).

Table 5. Simple correlation coefficients between visual color scores and the Hunter Lab Miniscan™ L*, a*, and b* values.

	Visual Score		
	Muscle Color ^a	Surface Discoloration ^b	Overall Desirability ^c
L* Value ^d	0.03	0.04	0.04
a* Value ^e	0.86	0.85	0.85
b* Value ^f	0.69	0.70	0.66

^aMuscle color scores: 8 = extremely bright cherry-red, 7 = bright cherry-red, 6 = moderately bright cherry-red, 5 = slightly bright cherry-red, 4 = slightly dark cherry-red, 3 = moderately dark cherry-red, 2 = dark red, and 1 = extremely dark-red or brown.

^bSurface discoloration scores: 8 = no discoloration, 7 = 1 to 10% discoloration, 6 = 11 to 20% discoloration, 5 = 21 to 30% discoloration, 4 = 31 to 40% discoloration, 3 = 41 to 50% discoloration, 2 = 51 to 75% discoloration, and 1 = 76 to 100% discoloration.

^cOverall desirability scores: 8 = extremely desirable, 7 = desirable, 6 = moderately desirable, 5 = slightly desirable, 4 = slightly undesirable, 3 = moderately undesirable, 2 = undesirable, and 1 = extremely undesirable.

^dL*: brightness; 0 = black, 100 = white.

^ea*: redness/greenness; positive values = red, negative values = green.

^fb*: yellowness/blueness; positive values = yellow, negative values = blue.

All correlations differed from zero (P<.0001)