

## The Effect of Enhancement on Trained Panel Beef Palatability Scores Is Dependent Upon USDA Quality Grade

*K.V. McKillip, A.K. Wilfong, J.M. Gonzalez, T.A. Houser, E.A.E. Boyle, J.A. Unruh, and T.G. O'Quinn*

### Introduction

Quality grades are used to determine beef value. The U.S. Department of Agriculture grading system categorizes beef into levels of eating satisfaction with the highest being Prime and decreases until reaching the Canner quality grade. Currently the premium of Prime graded carcasses over Select is \$16.73 (USDA, 2015). Traditionally, USDA Select cuts are known to have lower palatability ratings for juiciness, tenderness, and overall liking. Select steaks also fail to meet consumer eating expectations more than 33% of the time (Corbin, 2015). This failure rate represents a large cost for the industry. Product enhancement utilizing a water, salt, and phosphate solution is commonly used in the pork and poultry industries to increase product eating satisfaction. This technology offers an opportunity for the beef industry to improve palatability as well. Previous research has shown enhancing beef results in a higher juiciness, tenderness, and overall liking ratings by consumers and trained panelists (Pietrasik and Janz, 2009). Previous research has shown enhancing Select cuts results in products that rate similar to Prime (Woolley, 2015). To date, it is unknown if enhancement of higher quality beef (Choice and Prime) results in the same increase in palatability observed in lower quality cuts. Therefore, the objective of this study was to determine the effect of enhancement on trained panel beef palatability scores of strip loins of three quality grades when cooked to three degrees of doneness.

Key words: enhancement, palatability, grade

### Experimental Procedures

Beef strip loins (n=72; 12/treatment) were selected at a Midwestern processing plant to represent six treatment groups: USDA Prime, Low Choice, Low Select, Prime Enhanced, Low Choice Enhanced, and Low Select Enhanced. Within each quality grade, half were enhanced to 108% of raw weight with a solution formulated to result in 0.35% salt, and 0.4% phosphate in the final injected product. On the day of evaluation, steaks were cooked on a clamshell grill (Cuisinart, East Windsor, NJ) either to rare (140°F), medium (160°F), or very well-done (180°F). During panels, six samples were fed to panelists. Degree of doneness and treatment of each sample were predetermined by a partially balanced incomplete block design. Once cooked, steaks were cut into

0.50 in by 0.50 in cubes that were immediately served to panelists. An eight member panel trained according to AMSA protocols evaluated each sample. The eight trained panelists then evaluated samples for: initial juiciness, sustained juiciness, myofibrillar tenderness, amount of connective tissue, overall tenderness, beef flavor identity, flavor intensity, salt flavor intensity, and off flavor intensity. All traits were evaluated on 3.94 in line-scales, anchored on both ends and the midpoint with descriptive terms.

## Results and Discussion

An interaction ( $P=0.0256$ ) of degree of doneness and treatment for trained panel ratings of initial juiciness was found. The initial juiciness ratings increased ( $P<0.05$ ) as the degree of doneness decreased. Within each degree of doneness evaluated, the enhanced samples were similar ( $P<0.05$ ) in initial juiciness rating to the Prime non-enhanced. In the medium and very well-done degree of doneness Low Choice non-enhanced and Low Select non-enhanced were rated lower ( $P<0.05$ ) than the enhanced samples and Prime non-enhanced.

Similar to initial juiciness ratings, all enhanced samples were juicier ( $P<0.05$ ) than Low Choice and Low Select non-enhanced samples for sustained juiciness. However, all enhanced samples were similar ( $P>0.05$ ) for sustained juiciness and all were similar ( $P>0.05$ ) to Prime. For both myofibrillar tenderness and overall tenderness, enhanced treatments were rated as more tender ( $P<0.05$ ) than non-enhanced samples. Moreover, non-enhanced Low Select samples were the toughest ( $P<0.05$ ). For beef flavor identity and intensity Prime samples rated the highest ( $P<0.05$ ). As was expected, all enhanced treatments rated higher ( $P<0.05$ ) than non-enhanced samples for salt flavor intensity, with non-enhanced samples having close to no salt-flavor present. Prime non-enhanced and enhanced samples were found to be similar ( $P>0.05$ ) for beef flavor identity and intensity, but different in salt flavor. This shows that the inherent beef flavor is able to remain identifiable despite flavors imparted due to the enhancement solution. In the current study, enhancement was shown to increase the ratings of samples and improve the eating quality of Low Select steaks to a similar level as non-enhanced Prime; however, when Prime was enhanced, it rated similar to enhanced Low Select, indicating no additive palatability effect for marbling and enhancement.

Among degrees of doneness, sustained juiciness, myofibrillar tenderness, and overall tenderness, they all increased ( $P<0.05$ ; rare>medium>very well-done) as degree of doneness decreased. Very well-done had a greater ( $P<0.05$ ) beef flavor intensity than rare or medium samples, potentially due to increased browned beef flavor that is associated with the longer cooking times.

## Implications

These data indicate large palatability differences between non-enhanced and enhanced samples; however, there were few differences among enhanced treatments. Therefore, enhancement largely increases beef palatability, but the overall improvement potential is limited by quality grade. As a result, the industry should continue utilizing lower quality grades for enhancement.

## Acknowledgments

This project was funded by the Beef Checkoff through the National Cattlemen's Beef Association.

**Table 1. Least squares means for trained sensory panel ratings<sup>1</sup> of grilled strip loin steaks of varying quality treatments and degrees of doneness**

| Treatment                   | Sustained juiciness  | Myofibrillar tenderness | Connective tissue amount | Overall tenderness   | Beef identity      | Beef intensity     | Salt intensity      | Off flavor intensity |
|-----------------------------|----------------------|-------------------------|--------------------------|----------------------|--------------------|--------------------|---------------------|----------------------|
| <b>Non-enhanced</b>         |                      |                         |                          |                      |                    |                    |                     |                      |
| Prime                       | 51.78 <sup>b</sup>   | 71.57 <sup>b,c</sup>    | 13.85 <sup>b</sup>       | 67.29 <sup>b,c</sup> | 63.89 <sup>a</sup> | 47.48 <sup>a</sup> | 0.14 <sup>d</sup>   | 5.50 <sup>a</sup>    |
| Low Choice                  | 38.45 <sup>c</sup>   | 67.80 <sup>c</sup>      | 12.89 <sup>b</sup>       | 63.63 <sup>c</sup>   | 60.17 <sup>b</sup> | 39.03 <sup>b</sup> | 0.00 <sup>d</sup>   | 2.96 <sup>b,c</sup>  |
| Low Select                  | 32.92 <sup>d</sup>   | 55.04 <sup>d</sup>      | 22.66 <sup>a</sup>       | 47.63 <sup>d</sup>   | 53.74 <sup>c</sup> | 32.83 <sup>c</sup> | 0.12 <sup>d</sup>   | 5.84 <sup>a</sup>    |
| <b>Enhanced<sup>2</sup></b> |                      |                         |                          |                      |                    |                    |                     |                      |
| Prime                       | 60.30 <sup>a</sup>   | 78.41 <sup>a</sup>      | 9.98 <sup>b</sup>        | 75.60 <sup>a</sup>   | 63.86 <sup>a</sup> | 50.95 <sup>a</sup> | 13.36 <sup>c</sup>  | 1.65 <sup>c</sup>    |
| Low Choice                  | 56.98 <sup>a,b</sup> | 79.14 <sup>a</sup>      | 9.15 <sup>b</sup>        | 76.88 <sup>a</sup>   | 54.81 <sup>c</sup> | 41.59 <sup>b</sup> | 20.62 <sup>b</sup>  | 4.92 <sup>a,b</sup>  |
| Low Select                  | 55.73 <sup>a,b</sup> | 75.27 <sup>a,b</sup>    | 11.20 <sup>b</sup>       | 72.12 <sup>a,b</sup> | 53.83 <sup>c</sup> | 39.85 <sup>b</sup> | 26.04 <sup>a</sup>  | 2.46 <sup>b,c</sup>  |
| SEM <sup>3</sup>            | 2.04                 | 2.07                    | 1.76                     | 2.51                 | 1.12               | 1.42               | 0.94                | 0.91                 |
| <i>P</i> - value            | < 0.0001             | < 0.0001                | < 0.0001                 | < 0.0001             | < 0.0001           | < 0.0001           | < 0.0001            | 0.0032               |
| <b>Degree of doneness</b>   |                      |                         |                          |                      |                    |                    |                     |                      |
| Rare (140°F)                | 68.52 <sup>a</sup>   | 76.88 <sup>a</sup>      | 13.09                    | 72.64 <sup>a</sup>   | 56.77 <sup>b</sup> | 40.93              | 11.58 <sup>a</sup>  | 3.54                 |
| Medium (160°F)              | 50.78 <sup>b</sup>   | 70.24 <sup>b</sup>      | 13.72                    | 66.35 <sup>b</sup>   | 58.29 <sup>b</sup> | 42.00              | 9.97 <sup>a,b</sup> | 4.32                 |
| Very well done (180°F)      | 28.79 <sup>c</sup>   | 66.49 <sup>c</sup>      | 13.06                    | 62.58 <sup>c</sup>   | 60.09 <sup>a</sup> | 42.93              | 8.54 <sup>b</sup>   | 3.80                 |
| SEM <sup>3</sup>            | 1.38                 | 1.08                    | 0.88                     | 1.32                 | 0.77               | 0.94               | 0.69                | 0.57                 |
| <i>P</i> - value            | < 0.0001             | < 0.0001                | 0.4863                   | < 0.0001             | 0.0009             | 0.1839             | 0.0028              | 0.4849               |

<sup>1</sup>Sensory Scores: 0 = Extremely dry/tough/none/unbeef-like/bland, 100 = Extremely juicy/tender/abundant/beef-like/intense

<sup>2</sup>Enhanced to 108% of raw weight with a water, salt, and alkaline phosphate solution.

<sup>3</sup>SE (largest) of the least squares means.

<sup>a,b,c,d</sup>Least squares means in the same main effect without a common superscript differ ( $P < 0.05$ ).

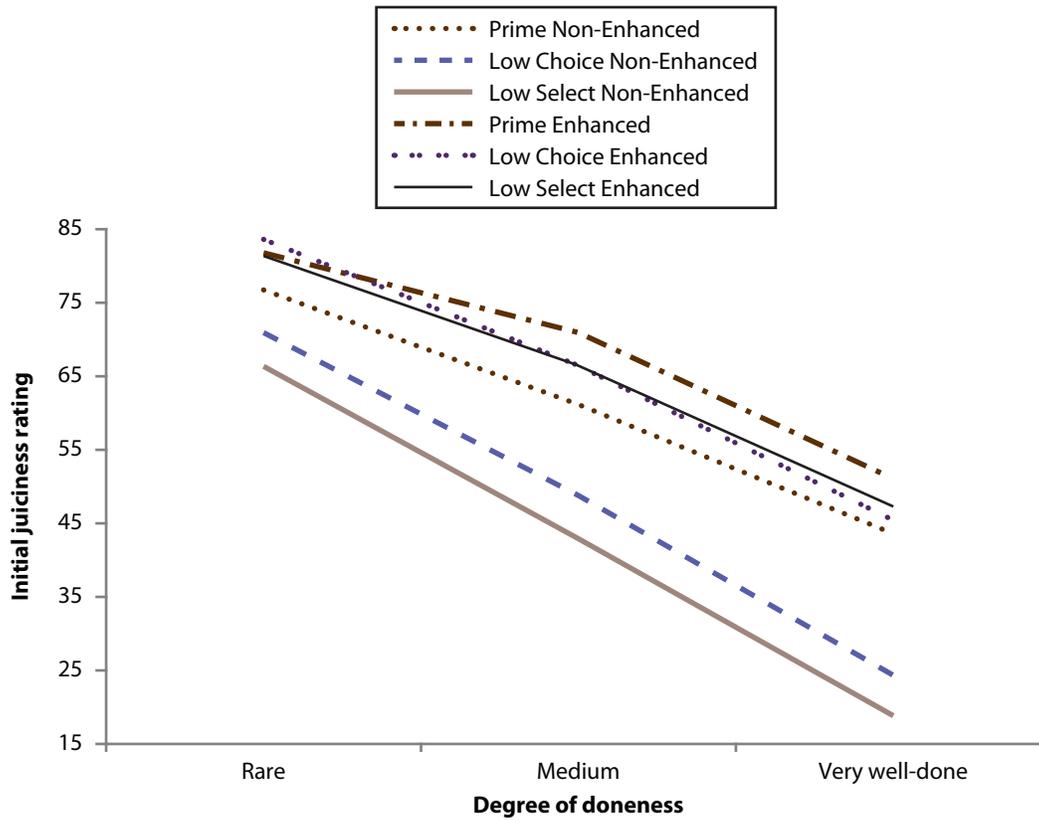


Figure 1. Interaction ( $P=0.0256$ ) between degree of doneness and quality treatment of least squares means for trained sensory panel ratings of grilled strip loin steaks.