

Project Summary

Cause and Prevention of Liver Flavor in Five Muscles of the Beef Chuck

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Background

The infraspinatus, or flat iron muscle is one example of a shoulder steak that has received widespread market acceptability in recent years. However, several of the chuck steaks, including the infraspinatus, have a higher than normal incidence of liver and metallic flavor after cooking. There is a need to better understanding factors associated with liver flavor development, so that preventative measures may be implemented.

The objectives for this project were to:

1. Measure hemoglobin level of 5 muscles of the beef chuck, and determine the possible relationship between hemoglobin level, cooking temperature and liver off-flavor after cooking.
2. Evaluate the effects of packaging methods and antioxidant treatment on liver flavor development.

Methodology

Objective 1

Hemoglobin and myoglobin content were measured for 5 beef chuck muscles using the HPLC method. These muscles include the supraspinatus (chuck mock tender), infraspinatus (flat iron steak), teres major (petite tender) serratus ventralis and longissimus dorsi. For each muscle, 12 individual steaks were analyzed from 3 different plant sources (2 fed cattle plants and one commercial cow plant) in order to account for how plants can differ in the extent of blood removal during bleeding. All steaks selected from the fed cattle plants were Select quality grade.

L^* , a^* , b^* color measurements were taken on all raw steak samples. Trained panelists also evaluated color on a scale of 1 to 5 where 1 = purple-red and 5 = tan or brown. Steaks were cooked to internal temperatures of 71 or 82°C and then subjected to analysis for thiobarbituric acid reactive substances as a measure of lipid oxidation or rancidity, and trained sensory panel evaluation to evaluate cooked steaks for cooked beef intensity, liver flavor intensity, metallic flavor intensity and rancid flavor intensity on a scale of 1 to 5.

Objective 2

Based on observations from Objective 1, the chuck muscle most prone to liver off-flavor development was the infraspinatus (flat iron muscle) and that muscle was further evaluated in Objective 2. Infraspinatus steaks were subjected to 3 packaging methods (CO-modified atmosphere packaging (MAP), 80% Oxygen MAP, and PVC overwrap) and 2 antioxidant treatments with 12 steaks for each package x antioxidant treatment for a total of 72 steaks.

Packaged steaks were stored at 2°C for a period typical for each packaging method as follows: CO-MAP for 21 days, 80% oxygen for 10 days and PVC overwrap for 5 days. At the end of the storage period, 2 steaks were selected for determination of subjective and objective color evaluation, HPLC determination of hemoglobin levels, TBA values and sensory panel scores for beef flavor intensity, liver, metallic and rancid flavors.

Findings

Objective 1

Hemoglobin concentrations were low and not significantly different among the 5 Select muscles of the chuck. The teres major had significantly lower myoglobin and total heme pigment content than other muscles, while infraspinatus and teres major had the highest levels of total pigment.

Hemoglobin and total pigment concentrations were not different among muscles from the 2 fed cattle processing plants, but all muscles from the commercial cow plant had higher total pigment content and darker visual color.

After cooking, infraspinatus steaks had the highest scores for liver flavor. Scores were low and not significantly different among Select grade muscles for rancid and metallic off flavors. However, liver flavor scores were higher for the infraspinatus muscles from commercial cows. Rancid flavor scores were significantly increased as internal temperature increased and mean TBA values (rancidity) also increased as cook temperature increased. However, sensory panel metallic and liver flavor scores were not significantly affected by cook temperature.

Objective 2

Infraspinatus steaks were packaged and held at 2C for 5, 10, and 21 days for PVC, 80% oxygen MAP, and CO-MAP, respectively. After storage, steaks in 80% oxygen MAP were visually gray-brown, steaks in PVC wrap were reddish-brown in appearance and CO-MAP steaks had a uniform, bright red appearance. After cooking, mean beef flavor intensity score was lower for PVC steaks, compared to steaks in 80% oxygen. Intensity of metallic flavor was also significantly higher in PVC steaks. Antioxidant injection treatment slightly but significantly increased beef flavor scores in PVC wrapped steaks and decreased metallic flavor scores in CO-MAP treated steaks.

There was substantially more exudate (drip) in steaks receiving the antioxidant injection treatment. TBA values as a measure of rancidity were significantly higher in steaks packaged in 80% oxygen compared to TBA values of steaks in PVC or Co-MAP.

A slight to moderate liver flavor was detected by some panelists in cooked infraspinatus steaks, particularly in infraspinatus steaks from older (commercial grade) animals. Packaging method and antioxidant injection treatment did not affect liver flavor scores of cooked steaks, but beef flavor scores were highest in steaks packaged in an anaerobic environment (CO-MAP). Metallic flavor intensity was highest in PVC wrapped steaks, and TBA values were highest in steaks packaged in 80% oxygen.

Implications

The infraspinatus muscle (flat iron steak) from older (commercial grade) animals was susceptible to development of liver flavor. Packaging method and antioxidant injection treatment did not affect liver flavor scores of cooked steaks, but beef flavor scores were highest in steaks packaged in an anaerobic environment (CO-MAP)

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