Project Summary

Mitigation of Off-Flavor in Fed and Non-Fed Cow Beef

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Background

Perception of flavor relies on the ability of taste receptors on the tongue to interact or bind specific molecules and/or ions which in turn generate the 5 taste sensations: salt, sour, sweet, bitter, and umami. Flavor is the interaction between taste receptors, ions, airborne, and dissolved molecules to elicit a complex neurological response. Past approaches to off-flavor were either to remove the troublesome compound or counteract the response (i.e. drown it out by another taste). In a new molecular era of taste, there is a third option. By identifying compounds that interfere with the transduction mechanism of taste in a taste-receptor cell, it is now possible to prevent the taste cells from ever being activated (McGregor, 2004). In this way, the brain never even knows that a compound is present in the mouth. This technology has been associated with the pharmaceutical and beverage industries to manage inherent bitter compounds (Matheis, 1999).

The objectives of this project were:

1. Collect specific off-flavored (i.e. 'livery') beef through an intensive flavor screening process.
2. Evaluate commercially available flavor maskers to reduce or eliminate off-flavors (i.e. 'livery') in a ground beef system.
3. Evaluate application of top performing flavor maskers in a whole muscle system.

Methodology

Whole Muscle Materials and Methods

Fed (n=10) and non-fed (n=10) cows were harvested and strip loins were collected. The 'fed' strips were taken from a premium program comprised of cows 30 months of age or older that have been fed a high energy diet for at least 60 days, posses white fat, grade commercial or higher, and posses a lean score of 1-4 on a ten point scale with 1= cherry red and 10= extremely dark. The 'non-fed' strips were taken from a commodity program comprised of cows that do not fall into the branded program. Half of the strip loins were assigned to either trained or consumer panels. A replication (n=5) consisted of steaks from one strip loin, to which were applied five treatments.

For the trained panel samples, five 2.54 cm thick steaks were removed in succession from anterior to posterior. For the consumer panel 10 steaks were removed in the same manner and grouped (1 with 2, 3 with 4, etc.). Either individual or paired steaks were trimmed of external fat and randomly assigned to one of five treatments: a control or one of four commercial bitter blockers. A preliminary screening of 12 bitter blockers took place to identify the most promising compounds for this application. Screening involved applying the 12 bitter blockers at industry-recommended levels to a sample of liver-like tasting ground beef. A total of three evaluators conducted an informal evaluation of each product to see if the liver-like off-flavor notes were masked; if the product masked or showed masking potential the products were selected for the study. After the screening, four products were selected and utilized on whole, longissimus muscle steaks at industry-recommended levels: Wixon #12006611 at 0.25%, International Fragrance and Flavor (IFF) #13559607 at 0.20%, IFF #13673888 at 0.20%, and Givaudan #513409 at 0.05%. Five treatments were represented in each strip loin. For distribution purposes, each treatment (including control) was mixed with water such that addition of 1% of steak weight would deliver the industry-recommended level, 0.05%-0.25%, in the final product. Steaks were combined with 1% water or 1% of the appropriate bitter blocker, vacuum packed and tumbled (Model TU-120; Roshermatic,

Osanabruck, W. Germany) by replication (loin) for 15 min. After equilibrating for 24 h, samples were frozen and stored at -20°C. Seven trained panelists and 300 consumer panelists were utilized.

Ground Beef Materials and Methods

Five, 60-lb. boxes of 90/10 non-fed cow trim, and five fed cow inside rounds were collected. The 'fed' inside rounds were taken from a premium program comprised of cows 30 months of age or older that have been fed a high energy diet for at least 60 days, posses white fat, grade commercial or higher, and posses a lean score of 1-4 on a ten point scale with 1= cherry red and 10= extremely dark. The 'non-fed' trim was taken from a commodity program comprised of cows that do not fall into the branded program. Trim and inside rounds were assigned to either a trained or consumer panel. A replication (n=5) consisted of an inside round or a box of trim to which were applied six treatments.

Five, inside rounds from fed cows and five boxes of non-fed cow trim were obtained and randomly assigned to one of five replications. Replications were trimmed, manually weighed out to be 90% lean and 10% fat (verified by proximate analysis), and coarse ground on a Hobart Model 4732 grinder (Hobart Mfg. Co., Troy, OH) with initial grind through a kidney plate and a second grind through a 4.76 mm plate. Six, 150 g samples were removed from each replication of ground beef, and randomly assigned to one of six treatments: a control or one of five commercial bitter blockers. Screening and evaluation was conducted as described in the whole muscle section above. Trained and consumer panels were also conducted as described in the whole muscles section above. Ground beef samples were powdered in liquid nitrogen and analyzed for moisture, fat, protein and ash.

Findings

Whole Muscle

Overall off-flavor scores were generally low; as a result there were no significant treatment effects for reducing off-flavor. Trained panelists showed that treatments did not contribute to off-flavor ratings (P =0.10), however a trend was evident for Givaudan to increase the intensity of off-flavor (P =0.02 versus the control if means could have be separated). Furthermore, the trained panel found no significant differences (P >0.05) between fed and non-fed cow beef in regards to tenderness and juiciness. This is in contradiction to Hilton et al. (1998), who showed an increase in beef carcass maturity was associated with a decrease in tenderness and juiciness.

If off-flavors were present, panelists were asked to identify them. The trained panel characterized 30-40% of cow meat samples as having metallic and sour notes and 10-20% of the samples as having rancid, bloody, salty, and bitter flavor notes. Although the trained panel found no significant differences (P >0.05) in off-flavor between fed and non-fed cows, they found non-fed cow meat more frequently had bloody and bitter off-flavor notes than meat from fed cows (P =0.03 and 0.02, respectively). This is similar to Schnell et al. (1997), who showed no significant changes in flavor attributes occurred over supplementation of cull cows with high-energy diets for 0, 14, 28, 42, or 56 days. In contrast, Boleman et al. (1996) reported meat from cows fed 0 d had more intensive (P<0.05) off-flavor than that from cows fed 28, 56, or 84 d.

In contrast to the trained panel, the consumer panel characterized 30% of cow meat samples as having bloody notes and 10-20% of the samples as having livery and metallic flavor notes. This may reflect a difference in how consumers interpret the meaning of off-flavor descriptors. Consumers found that treatments did not significantly add off-flavor notes, however, rancidity was approaching

significance (P =0.07) as Givaudan had a higher frequency versus the control (data not shown). Similar to the trained panel, consumers found no significant difference (P >0.05) in frequency of off-flavor notes between fed and non-fed cows. Consumers found non-fed cow meat to be significantly (P =0.02) less tender and have more connective tissue, with a tendency to have more off-flavor (P =0.15) and lower ratings for overall like (P =0.10). This is comparable to Hilton et al. (1998) who showed an increase in beef carcass maturity was associated with a decrease in tenderness and juiciness and a higher incidence of flavors. In conclusion, the hypothesis that the incorporation of commercially available flavor mitigation systems would improve acceptability of off-flavored beef was not supported. The greatest differences for both consumer and trained panel were in regards to comparison of fed versus non-fed cow beef rather than between the treatments within a feeding regime.

Ground Beef

Overall off-flavor scores were generally low; as a result there were no significant treatment effects for reducing off-flavor. In addition, both consumer and trained panelists showed no significant differences (P >0.05) in regards to off-flavor ratings. This is similar to Schnell et al. (1997), who showed no significant changes in flavor attributes when supplementing cull cows with high-energy diets over 0, 14, 28, 42, or 56 days. In contrast, Boleman et al. (1996) reported meat from cows fed 0 d had more intensive (P<0.05) off-flavor than that from cows fed 28, 56, or 84 d.

If off-flavors were present, panelists were asked to identify them. Consumers found no significant difference in frequency of off-flavor notes between fed and non-fed cow beef. The trained panel found non-fed cow meat more frequently had sour, fatty and rancid off-flavor notes than meat from fed cows (P =0.001, 0.05 and 0.002), with livery approaching significance (P =0.06, respectively). Fed cow meat more frequently had metallic off-flavor notes (P =0.008) than meat from non-fed cows.

Consumers found a treatment by feeding interaction for overall like and juiciness (P =0.04 and 0.02). The IFF #13673888 showed significantly (P =0.04) higher overall like rating (0.79) for fed versus non-fed cows. The Wixon #12006611 and Givaudan #513409 treatments showed a significantly (P =0.001 and 0.03) higher consumer juiciness ratings (0.94 and 0.55) for non-fed versus fed cow beef. Within non-fed cow meat, Wixon #12006611 yielded significantly (P <0.05) higher taste panel ratings for juiciness than the other ingredients. Similarly, the trained panelists found a treatment by feeding interaction for salty (P =0.01), and juiciness was approaching significance (P =0.06). Control, Wixon #12006611 and IFF #13559607 showed a significantly (P =0.001, 0.007 and 0.002) higher incidence for salty (16.2, 12.9 and 14.8% versus <0.01%) in fed versus non-fed cow beef. Within fed cow meat, control, Wixon #12006611 and IFF #13559607 showed significantly (P <0.05) higher percentage incidence of salty off-flavor notes. While the interaction was not significant (P =0.06), Wixon #12006611 and Givaudan #513409 showed trends (P =0.02 and 0.04 if differences could have been separated) for higher taste panel juiciness ratings (0.99 and 0.83) in non-fed versus fed cow beef. In conclusion, the hypothesis that the incorporation of commercially available flavor mitigation systems would improve acceptability of off-flavored beef was not supported. The greatest differences for both consumer and trained panel were in regards to comparison of fed versus non-fed cow beef rather than between the treatments within a feeding regime.

Implications

The objective of this study was to explore new ways of managing off-flavor in fed and non-fed cow steaks and ground beef by blocking bitter perception. Strip loins from fed and non-fed cows were utilized to create steak samples. For ground beef, inside rounds from fed cow beef and non-fed cow beef trim were utilized to create 90% lean and 10% fat ground samples. Overall off-flavor scores for steaks and ground beef were generally low; therefore there were no significant treatment effects for reducing off-flavor. Regarding the steak trial: trained and consumer panelists showed that commercial bitter blockers did not contribute to off-flavor ratings. The trained panel found non-fed cow steaks more frequently had bloody and fatty off-flavor notes than steaks from fed cows. Regarding the ground beef trial: consumer and trained panelists showed no differences in regards to off-flavor ratings. In conclusion, the greatest differences for both consumer and trained panel were in regards to comparison of fed versus non-fed cow beef rather than between the treatments within a feeding regime. It appears that bitter blockers do not deteriorate nor improve sample flavor. However, samples that possess a greater amount of initial off-flavor are needed to truly evaluate the mitigation properties for bitter blockers.

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