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Masking Off-Flavors in Ground Beef

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Summary

Ground beef derived from fed (high energy diet for at least 60 days) and non-fed cows was combined with one of five commercial bitter blockers to determine if off-flavors could be masked. Off-flavor scores were generally low; no significant treatment effects were observed. Trained panelists more frequently noted sour, fatty, rancid and liver-like off-flavors in nonfed cow beef (and metallic flavors in fed cow beef). Consumers found no differences in flavor notes. Bitter blockers did not affect flavor perception. The greatest differences were between fed and non-fed cow beef.

Introduction

Off-flavors are often reported in cow beef. Some cows are fed a supplemental ration prior to slaughter in an effort to improve the carcass and meat quality. This research was conducted to determine if commercial bitter blocking compounds could mask off-flavors in ground beef. The study also provided the opportunity to compare ground beef from fed and non-fed cows for off-flavor notes.

Procedure

Five boxes of 90/10 nonfed cow trim, and five inside rounds from fed cows were obtained from Skylark Meats (Omaha, Neb.) and delivered to the UNL Loeffel Meat Laboratory. The "fed" inside rounds originated from the Gibbon Packing Inc. (Gibbon, Neb.) Prairie Premium program, which were fabricated from cows 30 months of age or older that have been fed a high energy diet for at least 60 days, possess white fat, grade commercial or higher, and possess a lean score of 1-4 on a 10 point scale with 1=cherry red and 10=extremely dark. The "nonfed" trim was taken from Gibbon's commodity program, which is comprised of cows that do not fall into the branded program. Trim and inside rounds were assigned to either a trained or consumer panel. Six treatments were applied within each replication (n=5), which consisted of a single, ground, inside round (fed) or a box of ground trim (nonfed).

Sample Preparation

Five inside rounds from fed cows and five boxes of nonfed cow trim were obtained and randomly assigned to one of five replications. Replications were trimmed, weighed out to 90% lean and 10% fat, and course ground through a kidney plate and a second grind through a 1/16 in plate. Six samples (1/3 lb) 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. A preliminary screening of 12 bitter blockers took place to identify the most promising compounds for this application *(2007 Nebraska Beef Report,* pp. 86-88). Five products were selected for use in ground beef at industry-recommended levels: Wixon #12006611 at 0.25%, International Fragrance and Flavor (IFF) #13559607 at 0.20%, IFF #13673888 at 0.20%, Givaudan #513409 at 0.05%, and Linguagen at 0.40%. All five treatments were represented in each replication. For distribution purposes, each treatment was mixed with water such that addition of 1% of sample weight would deliver the industry recommended level, 0.05%-0.25%, in the final product. Samples were manually mixed for 15 seconds with 1% water (control) or 1% solution with the appropriate bitter blocker. Samples were formed into approximately 1/3 lb patties using a 4 in x 4 in square patty mold, wrapped, frozen and stored at -20°C.

Trained Taste Panel

Patties were broiled on a tabletop broiler to a final internal temperature of 160°F. Immediately before serving the patties were cut into 0.5 in x 0.5 in portions. The panel was trained to evaluate juiciness and identify off-flavors, if present. The panelists received six samples per session. In a given taste panel session all samples were from the same replication of ground beef with all treatments being represented.

Consumer Taste Panel

Patties were cooked as described above and held no more than 10 minutes. Immediately before serving the patties were cut into 0.5 in x 0.5 in portions. The panel was asked to evaluate juiciness and overall like and was also asked to note any off-flavors, if present. The panelists received six samples per session. In a given taste panel session all samples were from the same replication of ground beef with all treatments being represented.

Statistical Analysis

Data were analyzed as a split-plot design, with the whole plot being feed level and the split plot being treatment by analysis of variance (ANOVA) using the GLIMMIX procedure of SAS with a predetermined significance level of $P \leq 0.05$. When significance was indicated by ANOVA, means separations were performed using the LSMEANS and PDIFF function of SAS.

Results

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 (Table 1).

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 nonfed cow beef (Table 2). 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, respectively), with livery approaching significance ($P=0.06$). Fed cow meat more frequently had metallic off-flavor notes ($P=0.008$) for trained panelists than meat from nonfed cows (Table 3).

Consumers found a treatment by feeding interaction for overall like and juiciness ($P=0.04$ and 0.02; Table 4). The IFF #13673888 showed significantly ($P=0.04$) higher overall like rating (0.79) for fed versus nonfed cows. The Wixon #12006611 and Givaudan #513409

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Table 1. Least squares means for main effects for hamburger trained and consumer panel evaluation for off-flavor.

Main Effect	Trained Off-flavor[a]	Consumer Off-flavor[b]
Treatment		
Control	4.95	2.04
Wixon 12006611	5.11	2.18
IFF 13559607	5.14	1.99
IFF 13673888	5.31	2.18
Givaudan 513409	5.12	2.24
SEM[d]	0.13	0.14
P-value[e]	0.26	0.45
Feeding		
Fed	5.20	1.96
Non-Fed	5.06	2.30
SEM[d]	0.11	0.15
P-value[e]	0.36	0.15

[a]Off-flavor intensity trained panel: 0= no off-flavor; 15= extreme amount.
[b]Off-flavor intensity consumer panel: 1= slight amount; 8= extreme amount.
[d]Standard error of the mean.
[e]*P*-value for the main effects.

treatments showed a significantly (*P*=0.001 and 0.03) higher consumer juiciness ratings (0.94 and 0.55) for nonfed versus fed cow beef. Within nonfed 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 (Table 5) for salty (*P*=0.01) flavor notes, and juiciness was approaching significance (*P*=0.06). The control, Wixon #12006611 and IFF #13559607 showed a significantly (*P*=0.001, 0.007 and 0.002) higher incidence for salty in fed versus nonfed cow beef. Within fed cow meat, control, Wixon #12006611 and IFF #13559607 showed significantly (*P* <0.05) higher percentages for incidence of salty off-flavor notes.

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.

Table 2. Percentage incidence of off-flavor notes by the hamburger consumer panel.

Off-flavor note	Fed[a]	Nonfed[b]	SEM[c]	*P*-value
Metallic	13.9	14.3	0.02	0.87
Sour	4.8	5.6	0.02	0.77
Rancid	5.4	14.9	0.03	0.10
Bloody	10.1	10.6	0.01	0.81
Bitter	5.4	8.4	0.02	0.24
Livery	16.9	18.8	0.04	0.72
Salty	7.1	4.0	0.01	0.07
Sweet	5.1	3.1	0.01	0.22

[a]Fed cow beef.
[b]Nonfed cow beef.
[c]Standard error of the mean.

Table 3. Percentage incidence of off-flavor notes by the hamburger trained panel.

Off-flavor note	Fed[a]	Nonfed[b]	SEM[c]	*P*-value
Metallic	26.5[x]	13.3[y]	0.03	0.01
Sour	18.7[x]	31.4[y]	0.02	<0.01
Rancid	51.7[x]	72.3[y]	0.03	<0.01
Bloody	3.2	1.1	0.01	0.18
Bitter	20.0	21.2	0.03	0.75
Livery	1.1	15.8	0.05	0.06
Fatty	0.6[x]	3.1[y]	0.01	0.05
Sweet	3.3	3.8	0.03	0.78

[a]Fed cow beef.
[b]Nonfed cow beef.
[c]Standard error of the mean.
[x,y]Means with different superscripts within the same row differ significantly (*P*<0.05).

Table 4. Interaction effects from consumer taste panel evaluation for overall-like and juiciness[a].

	Overall like[b]			Juiciness[c]		
Treatment	Fed	Nonfed	Fed vs. Non-fed *P*-value[d]	Fed	Nonfed	Fed vs. Non-fed *P*-value[d]
Control	5.79	5.45	0.34	4.23	4.37[x]	0.58
Wixon 12006611	5.80	5.95	0.67	4.19	5.13[y]	<0.01
IFF 13559607	6.02	5.46	0.13	4.53	4.50[x]	0.88
IFF 13673888	6.09	5.30	0.04	4.51	4.32[x]	0.46
Givaudan 513409	5.66	5.47	0.58	4.09	4.65[x]	0.03
Linguagen-AMP	6.06	5.45	0.11	4.50	4.65[x]	0.97
SEM[e]	0.24	0.24		0.18	0.18	

[a]Overall like *P*–value for treatment by feed interaction= 0.04; juiciness *P*-value for treatment by feed interaction= 0.02.
[b]Overall like: 1= extremely dislike; 9= extremely like.
[c]Juiciness: 1= extremely dry; 8= extremely juicy.
[d]*P*-value for the simple effects.
[e]Standard error of the mean.
[x,y]Means with different superscripts within the same column differ significantly (*P*<0.05).

Table 5. Interaction effects from trained taste panel evaluation for juiciness and salty[a].

	Juiciness [b]			Salty[c]		
Treatment	Fed	Nonfed	Fed vs. Non-fed *P*-value[d]	Fed	Nonfed	Fed vs. Non-fed *P*-value[d]
Control	3.95	4.67	0.07	16.2[y]	<0.01	<0.01
Wixon 12006611	3.97	4.96	0.02	12.9[y]	<0.01	0.01
IFF 13559607	4.11	4.60	0.21	14.8[y]	<0.01	<0.01
IFF 13673888	4.61	4.17	0.25	3.3[x]	0.00	0.46
Givaudan 513409	3.84	4.67	0.04	0.0[x]	<0.01	1.00
Linguagen-AMP	4.60	4.81	0.58	<0.01[x]	6.7	0.15
SEM[e]	0.33	0.33		0.03	0.03	

[a]Juiciness *P*–value for treatment by feed interaction= 0.06; salty *P*-value for treatment by feed interaction= 0.01.
[b]Juiciness: 1= extremely dry; 8= extremely juicy.
[c]Salty: Percentage incidence of salty off-flavor note.
[d]*P*-value for the simple effects.
[e]Standard error of the mean.
[x,y]Means with different superscripts within the same column differ significantly (*P*<0.05)

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