Project Title: Producing Premium Grinds with Brisket Trimmings

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Background

Ground beef that is naturally enriched with oleic acid (18:1 n-9) may reduce risk factors for cardiovascular disease, and higher concentrations of oleic acid are positively correlated with overall palatability and beef/brothy (r = 0.37) and beef fat (r = 0.44) flavors. Increasing oleic acid in beef also increases the fat softness and thereby improves palatability of beef and beef products. We previously demonstrated that fatty acid composition varies considerably across carcass depots: adipose tissue overlying the brisket is unusually high in oleic acid, whereas the flank is low in oleic acid and high in stearic acid. The plate, which typically is used as raw materials for ground beef production, is intermediate in oleic acid content. For this reason, brisket lean and fat trim can be used to formulate a ground beef product with a consistently high oleic acid composition.

The objectives of this study were to determine the fatty acid composition, flavor profile and sensory characteristics of ground beef with three levels of fat (10, 20 and 30%) generated from a 50/50 lean/fat trimmings taken from beef brisket, flank and plate; and to establish regression equations from oleic acid concentrations and flavor profile and sensory characteristics of ground beef formulate from brisket, flank and plate trimmings.

Methodology

Sample preparation. Four carcasses were selected and graded at random from Sam Kane Beef Processors Inc. at Corpus Christi, TX. The carcasses graded USDA Select and represented a variety of Bos taurus breed types and backgrounds. Primals were collected from three carcass locations: brisket, plate, and flank. Primals were collected from both sides of the carcass and transported to Texas A&M University on ice were they were frozen at -20°C.

The day before separation of lean and fat trim, the primals tempered at 4°C. After separation, lean and fat trims were separated by dissection, and the fat content of each fat and lean trim from all primals for each carcass were measured for 5 gram, homogenized samples as described below. Lean and fat trim from each primal were formulated to contain 10, 20, or 30% total fat. Once formulated, lean and fat trim were combined, coarse ground, and vacuum packaged and stored at -20°C. A final grind was performed and patties were vacuum packaged and stored at -20°C until further testing, typically less than 14 d after sample collection. The ground beef production was divided into five production days.

Total lipid extraction and fatty acid composition. Total lipid was extracted and fatty acid methyl esters were prepared from the lipid extracts were prepared by standard procedures, and fatty acid methyl esters were analyzed using a Varian gas chromatograph (model CP-3800 fixed with a CP-8200 auto-sampler, Varian Inc., Walnut Creek, CA) (Chung et al., 2006).

Consumer sensory. A trained, 4-member consumer panel evaluated each sample using 15 point hedonic scale with a score of 1 being slightly detectable and a score of 15 was strongly detectable. The samples were evaluated on based on 32 different levels of flavor.

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Gas chromatography with mass spectrometry. Samples were prepared the same day as consumer sensory. Once samples were cooked, they were placed in a glass jar (473 mL) with a Teflon piece under the metal lid and then placed in a water bath for 60°C, where the headspace was collected for 2 hours with a solid-phase micro-extraction (SPME) Portable field sampler. AromaTrax software (MicroAnalytics-Aromatrax, Round Rock, TX) is used for determining flavor and aroma.

Findings

Consumer sensory evaluation. Fat level (10, 20, and 30%) significantly affected the Fat flavor value and the Green Hay flavor value, which increased as fat level increased (Table 1). The brisket and the plate had higher Fat values than the flank, and the brisket had a significantly higher Bloody value than the flank. Although the levels were very low, the brisket had a higher Green Hay value than the flank or plate.

Fatty acid composition of ground beef patties. Fat level significantly affected only the percentage of arachidonic acid (20:4) in ground beef, but had no effect on any other fatty acid (Table 2). This indicates that the fatty acid composition of ground beef containing these levels of fat is determined almost solely by the added fat trim. We previously demonstrated that fat trim from the brisket contained a higher percentage of monounsaturated fatty acids than fat trim from the flank and plate, and these results were confirmed in this study. The brisket contained higher proportions of palmitoleic acid (16:1n-7), and oleic acid (18:1n-9) and less stearic acid (18:0) than ground beef formulated from the other primals (Table 2).

Volatile chemical compounds that influence flavor. Volatile compounds were collected from the headspace above ground beef patties immediately following cooking and at the same time as those used for sensory analysis. Across all 29 samples collected, a total of 543 unique volatile chemical compounds were detected with the vast majority (n =4 88) of chemicals occurring in fewer than 10 samples and 328 chemical volatiles being unique (found in only 1 sample) and each sample containing an average of 68 ± 5.9 volatiles compounds. It is important to note that the units of measure expressed in all of the figures is a unitless, total ion count (TIC) measured with the mass spectrometer from the area under each respective peak and is shown as log transformed least squares means to more easily visualize treatment differences with orders of magnitude in variance. Wherever possible, published observed aroma descriptors associated with each aromatic compound are given.

Figure 1 shows the impact of primal source on lipid-derived aromatic compounds. Patties from the brisket were significantly lower in 2-heptenal, decane, nonane, 2-octanone, dodecane, nonenal, heptanal, pentanal, octane, and octanal, but higher in butanoic (butyric) acid and 2-nonenal. In general, patties from the plate generated higher amounts of lipid-derived volatiles compared to those from the brisket or flank. Trimethyl pyrazine (an important nutty, roasted, smokey, burnt aroma), butyl-cyclopentane, and 1-butylpentyl-trifluoromethanesulfonate were absent in samples from the brisket and thiobis-methane was not present in samples from the flank while each was present in the other treatments. Brisket patties generally had higher amounts of meaty, caramel and buttery volatiles than ground beef from the flank or plate.

Implications

Each of the primal ground beef formulations had unique characteristics. Certainly, the plate and flank are best used for the production of ground beef, due to their high fat content and limited utility for other products. Ground beef formulated from brisket lean and fat trims was unique in in flavor and headspace volatiles and was especially high in oleic acid. Based on

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these findings, we recommended that brisket fat trim, and perhaps portions of the lean trim, be separated from other fat trims for the production of a premium ground beef product.

Table 1. Main effects of primal and fat percentage on flavor descriptors and off-flavors in cooked ground beef patties formulated from the brisket, flank, and plate

	Primal			Fat level				*P*-values	
	Brisket	Flank	Plate	10	20	30	SEM	Primal	Fat level
Beef	7.14	7.44	7.44	3.71	3.59	3.55	0.57	0.47	0.43
Brown	0.72	0.82	0.78	0.82	0.56	0.62	0.83	0.37	0.70
Bloody	**1.84^{a}**	**1.33^{b}**	**1.55^{ab}**	1.65	1.58	1.49	0.35	**0.02**	0.72
Fat	**3.53^{a}**	**2.97^{b}**	**3.64^{a}**	**3.01^{b}**	**3.37^{b}**	**3.77^{a}**	**0.38**	**0.006**	**0.008**
Metallic	2.06	1.85	2.02	1.99	1.95	1.99	0.33	0.40	0.94
GreenHay	**0.07^{a}**	**0.01^{b}**	**-0.01^{bc}**	**-0.02^{c}**	**0.04^{b}**	**0.05^{ab}**	**0.04**	**0.004**	**0.01**
Umani	0.02	0.11	0.08	0.08	0.08	0.04	0.19	0.60	0.90
Osweet	0.38	0.64	0.51	0.46	0.54	0.53	0.26	0.13	0.80
Sweet	0.40	0.67	0.39	0.40	0.47	0.60	0.25	0.07	0.35
Bitter	1.59	1.36	1.47	1.44	1.28	1.71	0.39	0.47	0.11
Sour	2.06	1.49	2.06	1.96	1.69	1.96	0.52	0.06	0.45
Salty	1.29	1.38	1.42	1.33	1.43	1.34	0.24	0.56	0.60
Sour A	0.09	0.04	0.22	0.12	0.15	0.08	0.17	0.16	0.75
Heated Oil	0.12	0.20	0.11	0.07	0.23	0.14	0.23	0.70	0.36
WOF	0.11	0.04	-0.01	0.09	0.03	0.03	0.13	0.20	0.55
Refri_Stale	0.15	0.25	0.03	0.19	0.09	0.16	0.21	0.20	0.60
Medicinal	0.10	0.21	0.02	0.04	0.19	0.11	0.15	0.09	0.12
Burnt	0.18	-0.01	0.37	0.06	0.07	0.41	0.66	0.57	0.53

Table 2. Main effects of primal and fat percentage on fatty acid composition of raw ground beef patties formulated from the brisket, flank, and plate

	Brisket			Plate			Flank				*P*-values		
Fatty acid	10	20	30	10	20	30	10	20	30	SEM	Primal	Fat %	P x F
14:0	3.34	3.35	3.59	3.52	3.71	3.59	3.55	3.61	3.71	0.07	0.52	0.72	0.94
14:1	0.72	0.82	0.78	0.66	0.82	0.56	0.62	0.60	0.45	0.04	0.13	0.32	0.78
16:0	**23.26**	**23.61**	**23.77**	**24.46**	**24.36**	**24.79**	**24.84**	**25.23**	**24.86**	0.23	**0.04**	0.86	0.98
16:1	**3.24**	**3.09**	**3.67**	**2.73**	**3.44**	**3.67**	**2.80**	**2.41**	**2.32**	0.10	**0.0001**	0.85	0.04
18:0	**14.10**	**15.09**	**13.35**	**16.97**	**14.77**	**17.24**	**17.95**	**19.55**	**20.00**	0.45	**0.0001**	0.69	0.46
18:1t10	4.00	2.94	2.76	3.20	3.04	2.77	2.83	2.16	2.25	0.25	0.43	0.46	0.98
18:1t11	0.56	1.71	1.01	2.20	1.71	1.01	1.09	2.31	2.14	0.19	0.98	0.74	0.83
18:1n-9	**39.47**	**38.66**	**40.17**	**36.32**	**38.43**	**36.44**	**35.86**	**34.61**	**33.95**	**0.50**	**0.0002**	0.90	0.46
18:1n-7	0.28	0.18	0.15	0.13	0.15	0.09	0.08	0.17	0.24	0.05	0.53	0.27	0.16
18:2n-6	3.91	3.37	3.14	3.06	2.55	2.89	3.78	3.25	3.17	0.16	0.28	0.38	0.98
18:3n-3	0.16	0.16	1.16	0.16	0.15	0.15	0.16	0.15	0.15	0.01	0.72	0.79	0.99
20:4n-6	**0.31**	**0.16**	**0.11**	**0.24**	**0.14**	**0.11**	**0.12**	**0.11**	**0.09**	0.02	0.31	**0.0001**	0.93

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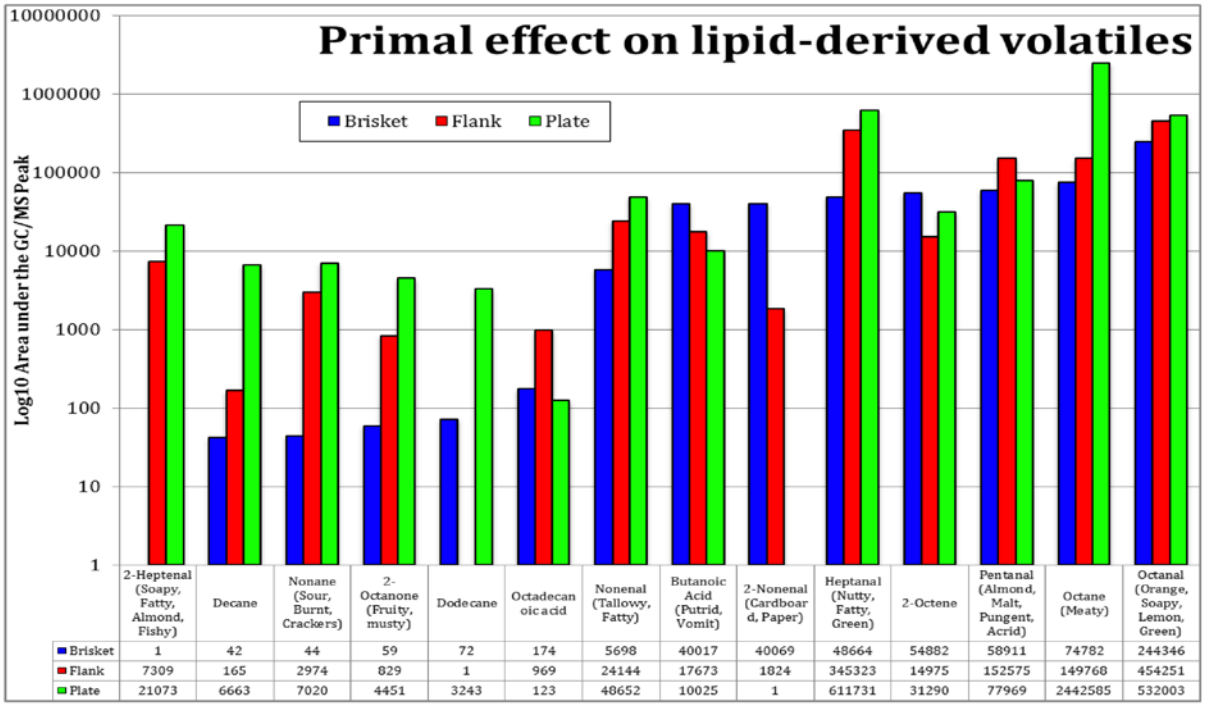

	2-Heptenal (Soapy, Fatty, Almond, Fishy)	Decane	Nonane (Sour, Burnt, Crackers)	2-Octanone (Fruity, musty)	Dodecane	Octadecanoic acid	Nonenal (Tallowy, Fatty)	Butanoic Acid (Putrid, Vomit)	2-Nonenal (Cardboard, Paper)	Heptanal (Nutty, Fatty, Green)	2-Octene	Pentanal (Almond, Malt, Pungent, Acrid)	Octane (Meaty)	Octanal (Orange, Soapy, Lemon, Green)
Brisket	1	42	44	59	72	174	5698	40017	40069	48664	54882	58911	74782	244346
Flank	7309	165	2974	829	1	969	24144	17673	1824	345323	14975	152575	149768	454251
Plate	21073	6663	7020	4451	3243	123	48652	10025	1	611731	31290	77969	2442585	532003

Figure 1.

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