Lexicon Development for Beef Flavor across Different Muscles and Quality Grades

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INTRODUCTION

Currently, the beef industry does not have a complete library of terms that describe flavor attributes in beef. Beef flavor has generally been evaluated as overall flavor intensity. If off-flavors were detected, the sensory panel would rate them subjectively, producing a result that could not be replicated by another panel because the flavor attributes were not defined or referenced. Although some flavor attributes arising from specific processing methods or certain diets were determined in order to detect flavor defects, but those were only from a fraction of the beef products available in the market (3,4,5,6). Other research involving the flavor of beef products have been conducted in the past decade. However, the references were not anchored, and therefore not standardized or no additional flavor descriptor was identified (1,2,7,8)

As more value-added cuts of beef and new beef products are developed, it is imperative that the industry has a standardized flavor lexicon to characterize and evaluate the flavor attributes among different beef products.

OBJECTIVE

To develop a universal lexicon for flavor of beef by determining a comprehensive list of flavor attributes present in commercially available retail cuts, varieties, and grades across different cooking methods and degrees of doneness.

MATERIALS & METHODS

Samples:

Beef samples evaluated varied in

- Age – young versus mature
- Gender – cow versus bull
- Cut – strip loin, top butt, top round, tenderloin
- Grade – prime, top choice, choice, select, standard
- Feeding regimen – wagyu, grass-fed
- Storage type – dry-aged, wet-aged, frozen
- Aging time – long-frozen, wet-aged for 24 or 70 days
- Packaging type – vacuum, MAP, PVC overwrap

Sample Preparation:

Samples were cooked to five level of doneness (57.2, 62.8, 68.3, 73.9, and 79.4°C) by oven-roasting, oven-broiling, grilling using electric grill or countertop electric charbroiler, and stewing. Outside-grill characteristics, warmed-over-flavor (WOF), and spoilage aromas were also examined.

Lexicon Development:

- 6 highly trained panelists examined 180 samples.
- 4 orientation sessions determined the base terminologies, using 16 different cuts, grades, and cooking methods, including the grass-fed and WOF samples.
- Aroma and flavor attributes were identified, defined, and referenced. Methods of preparation for each reference were also established.
- A consensus approach was utilized, using a 0 to 15-point scale from 0 = none to 15 = extreme.

Table 1. The definitions and references for the major beef aroma and flavors

Major Attribute	Definition	Reference
Beef ID	Amount of beef flavor identity in the sample	Grilled Beef Brisket = 4.0 (a,f) Warm Swanson's Beef Broth = 5.0 (a,f) Cooked 80% Lean Ground Beef = 7.0 (a,f)
Brown/Roasted	A round, full aromatic generally associated with beef suet that has been broiled	Seared Beef Suet = 8.0 (a, f) Cooked 80% Lean Ground Beef = 10.0 (a,f)
Bloody/Serumy	The aromatics associated with blood on cooked meat products. Closely related to metallic aromatic	Grilled USDA choice strip steak = 5.5 (a,f) Grilled Beef Brisket = 6.0 (a,f)
Fat-liked	The aromatics associated with cooked animal fat	Cooked Hillshire Farms Lit'l Beef Smokies = 7.0 (a,f) Seared Beef Suet = 12.0 (a, f)
Metallic	The impression of slightly oxidized metal, such as iron, copper, and silver spoons	0.10% Potassium Chloride Solution = 1.5 (f) Grilled USDA choice strip steak = 4.0 (a,f) Dole Canned Pineapple Juice = 6.0 (a,f))
Liver-like	The aromatics associated with cooked organ meat/liver	Seared Beef Liver = 7.5 (a, f) Brauschweiger Liver Sausage = 10.0 (a,f)
Green (hay-like)	Brown/green dusty aromatics associated with dry grasses, hay, dry parsley and tea leaves	Dry parsley in medium snifter = 5.0 (a) Dry parsley in 1 oz cup = 6.0 (f)
Umami	Flat, salty, somewhat brothy. The taste of glutamate, salts of amino acids and other molecules called nucleotides.	0.035% Accent Flavor Enhancer Solution = 7.5 (f)
Overall sweet	A combination of sweet taste and sweet aromatics. The aromatics associated with the impression of sweet	Post Shredded Wheat Spoon Size = 1.5 (f) Cooked Hillshire Farms Lit'l Beef Smokies = 3.0 (f) SAFC Ethyl Maltol 99% = 4.5 (a)
Sweet	The fundamental taste factor associated with sucrose.	2.0% Sucrose Solution = 2.0 (f)
Sour aromatics	The aromatics associated with sour substances.	Dillon's Buttermilk = 5.0 (f)
Sour	The fundamental taste factor associated with citric acid.	0.015% Citric Acid Solution = 1.5 (f) 0.050% Citric Acid Solution = 3.5 (f)
Salty	The fundamental taste factor of which sodium chloride is typical	0.15% Sodium Chloride Solution = 1.5 (f) 0.25% Sodium Chloride Solution = 3.5 (f)
Bitter	The fundamental taste factor associated with a caffeine solution	0.01% Caffeine Solution = 2.0 (f) 0.02% Caffeine Solution = 3.5 (f)

**Preparation methods for the references are not show in this table.*

RESULTS

- A total of 36 aroma, 31 flavor attributes, and 5 fundamental tastes (sweet, sour, salty, bitter, and umami) were identified.
- Attributes were categorized as 'major attributes' and 'other notes'.
- 'Major attributes' (Table 1) – present in all beef samples, except for *liver-like* and *green (hay-like)* that were present in majority of the samples.
- 'Other notes' – present in certain samples and included the following: *animal hair, barnyard, burnt, rancid, heated oil, chemical, old leather, apricot, green, asparagus, musty/earthy, cumin, floral, beet, cocoa, medicinal, petroleum-like, smokey (charcoal), smokey (wood), spoiled/putrid, dairy, buttery, cooked milk, sour milk/sour dairy, refrigerator stale, soapy,* and *warmed-over*.

The lexicon was checked via principle component analysis (Figures 1 & 2). Some key inferences were:

- Cooking method is the main factor impacting the beef flavor profiles.
- Grilling (by electric grill and charbroiler) brought out desirable attributes (e.g., beef ID, brown/roasted, umami)
- As the beef grade lowered, negative attributes appeared, especially in the broiled or stewed top butt samples.

CONCLUSION

This lexicon provides a complete list of accurate definitions and references that can be utilized universally by any trained sensory panel as a standardized flavor assessment tool. This will allow the beef industry to effectively characterize and differentiate flavors among beef samples.

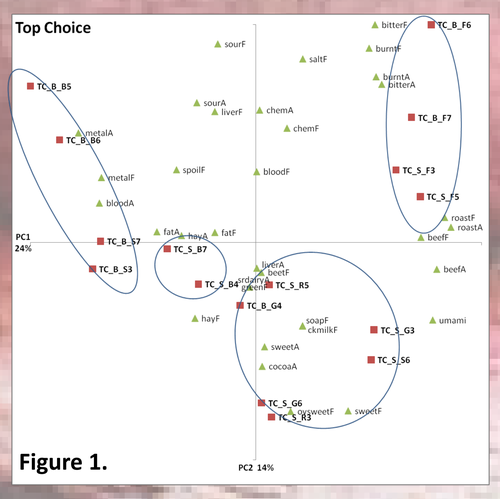

Figure 1.



Figure 2.

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