DESCRIPTIVE AROMA AND FLAVOR ATTRIBUTES OF FOUR COMMERCIAL COFFEES PREPARED USING FOUR BREW METHODS

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Introduction

- Cupping is the current quality assessment system for coffee
- Cupping does not quantify flavor and aroma (Donfrancesco et al., 2014).
- World Coffee Research (WCR) partnered with Kansas State University and Texas A&M University to develop the coffee Sensory Lexicon as a new tool for flavor and aroma evaluation
- Four commercial coffees varying in roast level were brewed using four methods and evaluated for flavor, amplitude, and aroma utilizing the new WCR Coffee Lexicon using an expert trained coffee descriptive panel

Objective

To understand how brewing method affects the flavors and aromas in coffee from four commercial coffees varying in roast level

Methods

- **Coffees:** Folgers® Breakfast Blend, Folgers® Classic Roast, Folgers® Colombia, and Folgers® Black Silk (representing Mild, Medium, Medium-Dark, and Dark respectively)
- **Brew Methods**: Pour Over, Drip, French Press, and Cold Brew
- **Flavor:** Main aroma (n=25) and flavor attributes (n=35) were evaluated by a trained descriptive attribute sensory panel (n=5). The intensity scale used by the panelists ranged from 0-15, where 0=none and 15=extremely intense
- **Testing:**
  - Five randomized, three-digit coded coffees were sampled each day for a total of 31 days
  - Coffee was brewed and held for no longer than 20 minutes prior to evaluation and was transferred into an insulated carafe at a temperature of 150-155 °F for evaluation
  - Coffee was served and evaluated in double-walled, insulated glass cups and covered with a watch glass
  - Apples, bagels, and double distilled deionized water were provided as palate cleansers between samples
  - Coffees were evaluated by panelists individually, and final scores were determined using consensus
- **Chemical:** Extractable solids, pH, and volatile aroma compounds

Results

- Columbia coffee was higher in berry/fruit aroma (P=0.04) and had the highest mouth drying (P<0.001).
- Breakfast Blend had more blended (P=0.002) and less bitter (P=0.02), sour (P=0.007) and burnt (P=0.004) attributes.
- Black Silk coffee was higher in roasted (P=0.001) and acrid (P=0.01) flavor aromatics and bitter aftertastes (P=0.01).
- Cold brew coffee was lower in roasted (P<0.001) and burnt (P<0.001) aromas; and higher in sweet (P<0.001) flavor aromatics, and berry/fruit aromas (P<0.0001).
- Coffee prepared using the French press and pour over methods were similar in aroma and flavor attributes.
- Drip coffee was higher in mouth drying (P<0.0001), bitter basic taste (P<0.001), burnt (P<0.0001) and acrid (P<0.0001) flavor aromatic, and bitter aftertaste (P<0.0001)

Table 1. Least squares means for aroma and flavor descriptive sensory attributes for four commercial coffee blends.

Attributes	P value[c]	Commercial Coffee Blends[d]				RMSE
		Breakfast[e]	Classic[e]	Colombia[e]	Black[e]	
Aroma						
Roasted	0.21	6.4	6.3	6.5	6.7	0.92
Burnt	0.07	1.4	1.6	1.6	1.8	0.68
Sweet	0.008	0.6^{ab}	0.5^{b}	0.8^{a}	0.4^{b}	0.51
Sour	0.54	1.0	1.1	1.1	1.1	0.41
Ashy	0.82	0.9	0.8	0.8	0.9	0.43
Acrid	0.08	0.1	0.0	0.1	0.2	0.30
Musty/earthy	0.80	0.1	0.1	0.1	0.2	0.37
Grain	0.40	0.2	0.2	0.1	0.1	0.38
Dark Chocolate	0.28	0.5	0.5	0.4	0.3	0.52
Fruity, Berry	0.04	0.1^{b}	0.1^{b}	0.4^{a}	0.1^{b}	0.50
Cardboard	0.10	0.4	0.2	0.1	0.3	0.45
Musty/dusty	0.06	0.4	0.2	0.3	0.1	0.44
Flavor						
Overall Impact	0.001	8.2^{b}	8.2^{b}	8.8^{a}	9.1^{a}	1.1
Blended	0.002	7.8^{a}	7.4^{ab}	6.9^{b}	7.1^{b}	1.1
Body/Fullness	0.23	7.2	7.0	7.1	7.4	0.78
Mouth drying/ Astringent	<.0001	1.9^{b}	1.9^{b}	2.3^{a}	2.0^{b}	0.44
Thickness	0.07	1.8	1.8	1.9	2.0	0.29
Roasted	0.001	6.7^{b}	6.6^{b}	6.7^{b}	7.3^{a}	0.83
Bitter	0.02	6.2^{b}	6.5^{ab}	7.1^{a}	7.0^{a}	1.3
Burnt	0.004	1.8^{b}	2.1^{ab}	2.3^{a}	2.4^{a}	0.69
Overall Sweet	0.009	0.5^{c}	0.4^{dc}	0.6^{a}	0.3^{d}	0.45
Sweet	0.006	0.6^{ab}	0.4^{b}	0.7^{a}	0.3^{b}	0.46
Sour	0.0007	2.0^{c}	2.3^{bc}	2.5^{ab}	2.6^{a}	0.61
Ashy	0.24	1.3	1.3	1.4	1.6	0.61
Acrid	0.01	0.1^{b}	0.2^{b}	0.3^{ab}	0.4^{a}	0.46
Musty/earthy	0.74	0.3	0.2	0.2	0.3	0.44
Dark Chocolate	0.74	0.6	0.8	0.7	0.6	0.74
Cocoa	0.59	0.3	0.1	0.2	0.1	0.45
Cardboard	0.27	0.3	0.2	0.1	0.3	0.41
Musty/dusty	0.60	0.2	0.2	0.2	0.1	0.40
Bitter Aftertaste	0.01	3.0^{b}	3.0^{b}	3.3^{ab}	3.4^{a}	0.72
Sour Aftertaste	0.0003	2.0^{b}	2.0^{b}	2.5^{a}	2.4^{a}	0.60
Astringent Aftertaste	0.006	1.7^{b}	1.7^{b}	2.1^{a}	2.0^{ab}	0.56

[a][b] Mean values within a column and effect followed y the same letter are not significantly different (P>0.05).
[d] Breakfast = Folgers® Breakfast blend, Classic = Folgers® classic roast, Colombia= Folgers® 100% Colombia, Black= Folgers® Black silk
[c] P value from Analysis of Variance table
[e] RMSE= Root Mean Square Error

Table 2. Least squares means for aroma and flavor descriptive sensory attributes for four brew methods.

Attributes	P value[f]	Brew method[g]				RMSE
		Cold[g]	Drip[g]	French[g]	Pour[g]	
Aroma						
Roasted	<.0001	5.4^{c}	7.0^{a}	7.1^{a}	6.5^{b}	0.92
Burnt	<.0001	0.9^{c}	2.0^{a}	2.0^{a}	1.4^{b}	0.68
Sweet	<.0001	1.1^{a}	0.3^{c}	0.4^{bc}	0.5^{b}	0.51
Sour	0.002	0.9^{b}	1.2^{a}	1.2^{a}	1.0^{b}	0.41
Ashy	<.0001	0.6^{b}	1.1^{a}	1.0^{a}	0.6^{a}	0.43
Acrid	0.28	0.1	0.1	0.2	0.1	0.30
Musty/earthy	0.05	0.0	0.2	0.2	0.2	0.37
Grain	0.08	0.3	0.1	0.1	0.1	0.38
Dark Chocolate	0.24	0.4	0.3	0.5	0.5	0.52
Fruity, Berry	<.0001	0.5^{a}	0.0^{b}	0.1^{b}	0.0^{b}	0.50
Cardboard	0.84	0.2	0.3	0.3	0.3	0.45
Musty/dusty	0.02	0.1^{b}	0.2^{b}	0.3^{ab}	0.4^{a}	0.44
Flavor						
Overall Impact	<.0001	6.5^{c}	9.8^{a}	9.5^{a}	8.4^{b}	1.10
Blended	<.0001	8.1^{a}	6.4^{b}	6.9^{b}	7.8^{a}	1.10
Body/Fullness	<.0001	5.8^{b}	7.6^{a}	7.7^{a}	7.4^{a}	0.78
Mouth drying/Astringent	<.0001	1.5^{d}	2.5^{a}	2.2^{b}	1.9^{c}	0.44
Thickness	<.0001	1.3^{b}	2.0^{a}	2.2^{a}	2.1^{a}	0.29
Roasted	<.0001	5.1^{c}	7.7^{a}	7.6^{a}	6.9^{b}	0.83
Bitter	<.0001	5.3^{d}	8.0^{a}	7.3^{b}	6.2^{c}	1.30
Burnt	<.0001	1.2^{d}	2.9^{a}	2.5^{b}	2.1^{c}	0.69
Overall Sweet	<.0001	0.9^{a}	0.2^{b}	0.3^{b}	0.4^{b}	0.45
Sweet	<.0001	1.0^{a}	0.2^{b}	0.3^{b}	0.5^{b}	0.46
Sour	<.0001	1.7^{c}	2.8^{a}	2.6^{a}	2.2^{b}	0.61
Ashy	<.0001	0.9^{c}	1.8^{a}	1.5^{ab}	1.4^{b}	0.61
Acrid	<.0001	0.0^{c}	0.5^{a}	0.3^{b}	0.2^{bc}	0.46
Musty/earthy	0.02	0.1^{b}	0.3^{a}	0.3^{ab}	0.4^{a}	0.44
Dark Chocolate	0.14	0.5	0.8	0.7	0.6	0.74
Cocoa	0.84	0.2	0.1	0.2	0.2	0.45
Cardboard	0.40	0.3	0.2	0.3	0.1	0.41
Musty/dusty	0.46	0.1	0.1	0.3	0.1	0.40
Bitter Aftertaste	<.0001	2.4^{d}	3.9^{a}	3.6^{b}	2.8^{c}	0.72
Sour Aftertaste	<.0001	1.7^{c}	2.7^{a}	2.4^{a}	2.1^{b}	0.60
Astringent Aftertaste	<.0001	1.4^{b}	2.3^{a}	2.1^{a}	1.7^{b}	0.56

[a][b][c] Mean values within a column and effect followed y the same letter are not significantly different (P>0.05).
[g] Cold=Cold brew, Drip=Drip brew, Pour= Pour-over, French= French press
[f] P value from Analysis of Variance table
[e] RMSE= Root Mean Square Error

Table 3. Least squares means for flavor descriptive sensory attributes for brew method and coffee type interactions

Treatment	Overall Impact	Mouth drying/ Astringent	Thickness	Roasted
P value[i]	0.0556	0.0008	0.048	0.022
Breakfast*Cold[h]	6.3	1.6^{ef}	1.3^{c}	4.8^{d}
Breakfast*Drip[h]	9.1	2.0^{cd}	2.0^{cd}	7.4^{b}
Breakfast*French[h]	8.4	1.9^{cde}	1.9^{cd}	7.2^{b}
Breakfast*Pour[h]	8.9	2.1^{c}	1.9^{cd}	7.3^{b}
Classic*Cold[h]	6.2	1.6^{ef}	1.2^{e}	5.2^{d}
Classic*Drip[h]	9.2	2.2^{bc}	1.9^{cd}	7.2^{b}
Classic*French[h]	9.7	2.0^{cd}	2.4^{a}	7.6^{ab}
Classic*Pour[h]	7.8	1.7^{def}	1.9^{d}	6.2^{c}
Colombia*Cold[h]	6.4	1.7^{def}	1.3^{c}	5.1^{d}
Colombia*Drip[h]	10.4	3.1^{a}	2.0^{cd}	7.8^{ab}
Colombia*French[h]	10.0	2.6^{b}	2.1^{bcd}	7.8^{ab}
Colombia*Pour[h]	8.2	1.9^{cde}	2.2^{abc}	6.2^{c}
Black*Cold[h]	7.0	1.3^{f}	1.3^{c}	5.3^{d}
Black*Drip[h]	10.4	2.6^{b}	2.2^{abc}	8.2^{a}
Black*French[h]	9.9	2.1^{c}	2.2^{abc}	7.9^{ab}
Black*Pour[h]	8.9	2.0^{cd}	2.3^{ab}	7.8^{ab}

[abcdefg] Mean values within a column and effect followed y the same letter are not significantly different (P>0.05).
[h] Breakfast = Folgers® Breakfast blend, Classic = Folgers® Classic roast, Colombia= Folgers® 100% Colombia, Black= Folgers® Black silk, Cold=Cold brew, Drip=Drip brew, Pour= Pour-over, French= French press
[i] P value from Analysis of Variance table

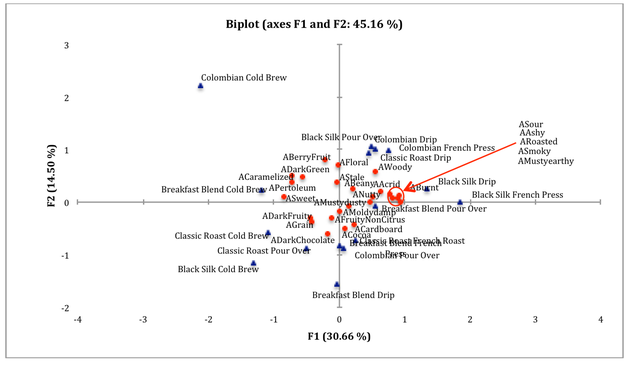

Figure 1. Principal Components Analysis Bioplot of descriptive sensory aroma attributes. Sensory attributes (●) and coffee samples (▲)

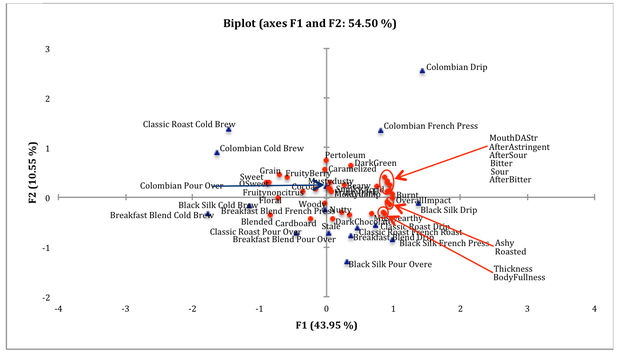

Figure 2. Principal Components Analysis Bioplot of descriptive sensory flavor, texture and aftertaste attributes. Sensory attributes (●) and coffee samples (▲)

Conclusions

- Coffee source and brew methods impacted aroma and flavor attributes
- Coffee aroma and flavor attributes can be determined using the WCR Sensory Lexicon

References

- Donfrancesco, B. D., Guzman, N. G., & Chambers, E. (2014). Comparison of Results from Cupping and Descriptive Sensory Analysis of Colombia Brewed Coffee. J Sens Stud Journal of Sensory Studies, 29(4): 302.311.