

# Effect of Variety, Leaf Type & Processing Conditions on Sensory & Antioxidant content of Coffee Leaf Black Tea

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## Introduction

Coffee leaf has been historically consumed in countries as Ethiopia, South Sudan, Indonesia, Jamaica, India, Java, and Sumatra as a tea beverage (Campa & Petitvallet, 2017; Ross, 2005; Chen et al., 2018).

In the last 10 years, coffee leaf tea has come into prominence as a potential beverage due to the phytochemical composition. Coffee leaf tea can also add additional revenue from the biological asset of the coffee tree to a farmer and the coffee value chain.

Coffee leaf black tea was processed through CTC method using coffee leaves obtained from different varieties and leaf type including Juvenile, Young and Mature leaves in pilot plant setting. The tea was evaluated for various quality parameters and characterized for various phytochemicals. 3-CQA was common across all coffee leaf tea samples and with the highest concentration. The black tea CTC process was able to produce a coffee leaf black tea which is comparable in quality to standard black tea in color, aroma, flavor and percent extractives. The extracts were evaluated for antioxidant capacities using ORAC and ABTS assays. Results indicate that good correlation with the phenolic content of the coffee leaf tea samples. The antioxidant capacities are highest with younger leaves.

## Materials/Methods

Juvenile, young, and mature coffee leaves from TN01, Typica, S133, and Geisha varieties were investigated. Black tea was produced from each of the coffee varieties, 3 different leaf types Juvenile (JUV), Young (YOU) and Mature (MAT). Black tea from the coffee leaves was prepared using the standard black tea process of Withering, CTC, Fermentation for 12-24 hours and finally drying of the tea samples in a hot air dryer. Coffee leaf tea samples were ground to a homogeneous powder using a pestle and mortar before extraction was initiated.

The ABTS assay, ORAC assay, and HPLC quantification of phytochemicals were performed as described by Chen, Ma, and Kitts (2018).

Percent moisture and percent extractives were quantitatively measured for each of the coffee leaf types.

For the cupping, 2.5 g of coffee tea was steeped with 130 mL of 205° F DI water for 5 minutes and tea liquor was evaluated for aroma, strength, flavor and astringency.

## Results/Discussion

Caffeine and phenolic compounds present are summarized in Tables 1 and 2. In general, for within the same leaf variety, the JUV leaf contained the highest amount of both caffeine and phenolic compounds, respectively. The YOU leaves had the second highest amount, followed by MAT, which contained the lowest content of both caffeine and polyphenols. Results from ORAC and ABTS assays provide a good correlation to the polyphenol content. Tea quality and sensory evaluation shows that black tea made with JUV and YOU leaves have better appearance, higher extractives and better sensory quality.

Coffee Leaf - Type	Caffeine	Epicatechin	Protocatechuic acid	Mangiferin	Gallic acid	Rutin	Transerutin	Isonangiferin
TN01 - JUV	11888.4 ± 38.0*	12133.3 ± 86.4*	673.5 ± 12.2*	327.4 ± 257.7*	867.4 ± 641.1*	255.6 ± 21.0*	ND	ND
TN01 - YOU	9668 ± 11.4*	2541.4 ± 21.0*	624.5 ± 5.7*	259.3 ± 4.7*	1058.5 ± 15.4*	109.2 ± 21.2*	ND	ND
TN01 - MAT	5379.6 ± 10.5*	1543.5 ± 39.6*	328.6 ± 5.0*	103.6 ± 1.1*	495.1 ± 4.1*	94.7 ± 5.3*	ND	ND
Typica - JUV	10376.8 ± 22.1*	8996.4 ± 36.8*	558.5 ± 3.2*	431.7 ± 2.9*	880.7 ± 123.7*	332.2 ± 7.0*	80.7 ± 2.1*	ND
Typica - YOU	6950.7 ± 27.4*	5894.5 ± 369.1*	205.3 ± 0.4*	197.1 ± 1.6*	254.6 ± 3.2*	219.9 ± 20.5*	79.8 ± 2.5*	ND
Typica - MAT	4720.5 ± 4.0*	9076.3 ± 171.7*	103.8 ± 2.6*	83.9 ± 0.7*	ND	173.4 ± 47.9*	ND	ND
S133 - JUV	6134.2 ± 53.9*	3872.4 ± 589.8*	388.9 ± 5.0*	24.3 ± 0.9*	319.4 ± 4.8*	177.3 ± 4.7*	ND	ND
S133 - YOU	4571.4 ± 9.1*	3550.7 ± 5.4*	143.9 ± 0.7*	23.8 ± 0.8*	102.1 ± 1.1*	120.9 ± 10.1*	ND	ND
S133 - MAT	2753.9 ± 2.0*	1082.5 ± 6.2*	64.9 ± 0.3*	ND	1.8 ± 0.6*	29.5 ± 2.4*	ND	ND
Geisha - JUV	13336.8 ± 13.4*	8830.6 ± 7.8*	727.7 ± 6.9*	63.4 ± 1.3*	1154.0 ± 2.3*	301.1 ± 5.6*	291.9 ± 46.2*	40.4 ± 1.7*
Geisha - YOU	8480.6 ± 17.4*	6686.7 ± 8.1*	290.1 ± 0.2*	57.3 ± 0.1*	581.1 ± 0.6*	241.0 ± 7.1*	353.5 ± 9.2*	36.70 ± 0.6*
Geisha - MAT	5712.1 ± 4.1*	2853.7 ± 10.2*	176.8 ± 0.5*	32.8 ± 0.8*	536.1 ± 1.8*	210.7 ± 4.6*	178.7 ± 5.0*	25.580.9*

**Table 1. Caffeine and Phenolic Compounds Present in Coffee Leaf Tea 1.**

Coffee Leaf - Type	3-CQA	5-CQA	3,4-CQA	3,5-CQA	4,5-CQA
TN01 - JUV	4852.1 ± 18.7*	273.1 ± 3.9*	339.1 ± 16.7*	1643.9 ± 56.8*	701.0 ± 12.3*
TN01 - YOU	814.6 ± 2.8*	71.3 ± 5.0*	110.7 ± 11.2*	101.1 ± 5.3*	251.7 ± 31.9**
TN01 - MAT	337.2 ± 4.5*	ND	95.4 ± 1.6*	ND	ND
Typica - JUV	3570.4 ± 3.9*	229.8 ± 1.9*	284.2 ± 29.9*	798.0 ± 22.7*	386.1 ± 36.4*
Typica - YOU	2195.1 ± 74.5*	41.4 ± 16.5*	125.4 ± 3.1*	320.8 ± 15.2*	236.3 ± 20.8*
Typica - MAT	3491.5 ± 44.4*	ND	147.3 ± 3.4*	ND	ND
S133 - JUV	1582.7 ± 1.5*	83.9 ± 0.8*	114.7 ± 6.2*	290.1 ± 7.5*	216.2 ± 27.2*
S133 - YOU	1294.1 ± 5.5*	14.2 ± 2.1*	110.6 ± 26.2*	183.3 ± 14.6*	ND
S133 - MAT	240.8 ± 0.7*	ND	60.9 ± 4.0*	ND	ND
Geisha - JUV	3688.6 ± 3.7*	311.6 ± 1.8*	369.0 ± 76.8*	1365.8 ± 112**	297.4 ± 32.5*
Geisha - YOU	2727.3 ± 2.5*	129.1 ± 1.4*	298.0 ± 40.3*	352.0 ± 27.1*	124.7 ± 3.3*
Geisha - MAT	1048.1 ± 2.4*	23.9 ± 0.4*	149.8 ± 8.7*	144.2 ± 20.1*	ND

**Table 2. CQA Isomers in Water Extracted Coffee Leaf Tea 1.**

<sup>1</sup> Values are presented as µg compound/g sample. Data represents Mean ± SD (n = 3). ND: not detected. Different letters denote significant (p < 0.05) differences in antioxidant activity (measured within the same assay) by using one-way ANOVA followed by LSD tests among different samples.

Coffee Leaf - Type	ORAC	ABTS
TN01 - JUV	21282 ± 2606*	2197.4 ± 242.7*
TN01 - YOU	12391 ± 1466.6*	1466.6 ± 222*
TN01 - MAT	10669 ± 3021**	1396.7 ± 109*
Typica - JUV	13932 ± 489*	2246.4 ± 385*
Typica - YOU	14609 ± 870**	1677.2 ± 194*
Typica - MAT	15152 ± 756*	1900.1 ± 352*
S133 - JUV	13213 ± 1095**	1769.4 ± 252*
S133 - YOU	9831 ± 1298*	1206.8 ± 151*
S133 - MAT	7906 ± 469**	696.0 ± 141*
Geisha - JUV	14163 ± 1139**	2111.8 ± 286*
Geisha - YOU	12272 ± 1372**	1528.8 ± 243*
Geisha - MAT	6797 ± 641*	922.8 ± 104*

**Table 3. Antioxidant Capacity in Coffee Leaf Tea Water Extracts<sup>2</sup>.**

<sup>2</sup> Values are presented as µmol Trolox/100g sample for ORAC and ABTS. Data represents Mean ± SD (n = 3). ND: not detected. Different letters denote significant (p < 0.05) differences in antioxidant activity (measured within the same assay) by using one-way ANOVA followed by LSD tests among different samples.

Coffee Leaf - Type	% Moisture	% Extractives	Dry Tea Visual Observation	Tea liquor Sensory Evaluation
TN01 - JUV	2.69	48.3	Uniform granules and homogeneous. Looks like black tea.	Darker color, higher body, mild astringency, smooth and no green notes.
TN01 - YOU	2.50	39.5	Uniform granules and homogeneous. Looks like black tea.	Lighter in color, floral, no astringency, and smooth taste.
TN01 - MAT	2.89	39.5	Non-uniform particle size. Larger leaf particles. Brownish and lots of veins.	Lighter in color, floral, no astringency, and smooth taste.
Typica - JUV	3.88	51.5	Uniform granules and homogeneous. Looks like black tea.	Darker color, higher body, mild astringency, smooth, and no green notes.
Typica - YOU	3.28	45.2	Uniform granules and homogeneous. Looks like black tea.	Lighter in color, not as strong as Typica-JUV, no bitterness, astringency, and milder.
Typica - MAT	3.01	45.2	Brownish and lots of veins. Not very good looking.	Low in color, no bitterness or astringency, smooth, and slight green notes.
S133 - JUV	4.68	41.5	Uniform granules and homogeneous. Looks like black tea. Visible leaf veins.	Dark color, excellent taste, tea like, strong cup, not bitter, not astringent, and smooth.
S133 - YOU	3.01	40.0	Uniform granules and homogeneous. Looks like black tea. Visible leaf veins.	Lighter in color, tea like, lighter cup, not astringent, not bitter, and smooth.
S133 - MAT	4.59	32.7	Brownish and lots of veins. Not very good looking.	Off flavor, musty, odor, and not clean.
Geisha - JUV	2.88	45.2	Uniform granules and homogeneous. Looks like black tea.	Darker color, higher body, mild astringency, smooth, and no green notes.
Geisha - YOU	2.32	41.07	Uniform granules and homogeneous. Looks like black tea. Visible leaf veins.	Lighter color compared to Geisha-JUV, milder body, mild astringency, smooth, and no green notes.
Geisha - MAT	3.84	37.38	Brownish and lots of veins. Not very good looking.	Lighter body, tea-like floral aroma, smooth taste, and no bitterness or astringency.

**Table 4. Coffee Leaf Moisture Content, % Extractives, Visual, and Sensory.**



## Conclusion/Perspectives

Phytochemical analysis of 4 varieties X 3 leaf types is presented. Caffeine, Epicatechin, Gallic acid, Protocatechuic acid, Chlorogenic acids, Mangiferin and Rutin were identified as key phytochemicals and varied with variety & leaf type. Antioxidant assays, ORAC and ABTS results demonstrate a good correlation to polyphenol content. Significant variation in polyphenols observed between varieties. Organoleptically, coffee leaf teas produced from JUV and YOU provided more uniform particle granulation, better visual color, and produced darker cups of teas. Black team using JUV and YOU leaves have higher extractives. Not much difference observed in organoleptic quality between varieties. This study shows the potential for coffee leaf black tea as an antioxidant beverage.

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