

The Costa Rican samples ground and ready to brew

A STUDY IN

Comparing and Contrasting Two Coffees Roasted to Five Different Levels

Story and Photos by Coffee Analysts' Staff

OAST PROFILE DEVELOPMENT is both an **K** art and a science. Determining what is best for each coffee is a difficult challenge—best blend, best roast level, best brewing method, and so on. Knowing what attributes you prefer is easy; however, when developing products to sell, predicting what customers will like is more difficult. While marketing managers and consumer insight professionals have protocols for determining consumer preferences and purchase intent, coffee roasters and product developers must conduct their own technical analysis when developing new products and optimizing existing ones.



The first step is to identify success criteria: What is good, what is not good, how will the coffee be evaluated, and, perhaps most importantly, to what will the coffee be compared? Product development has two important functions: creating a product that meets the quality and profile expectations of the company, and developing a product that will be purchased and enjoyed by consumers. Ultimately, the true measure of any coffee program is beverage quality—how does it taste? Branding, promotion and merchandising will capture the first sale, but only consistent quality will keep your customers returning time after time.

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Both sample coffees roasted to five different levels

We often hear, "The lighter the roast, the greater the acidity; the darker the roast, the fuller the body," so we decided to study the effects of roast development on physical, chemical and sensory attributes.

The Project

We elected to evaluate two arabica coffees (one Central American and one East African) at five different roast levels for physical, chemical and sensory attributes. We set out to utilize two sensory protocols: cupping, as the standard professional analysis; and tasting, or evaluating brewed beverages from the consumer perspective. For consistency, we used the standard Specialty Coffee Association of America (SCAA) cupping form as the scoring method. Following SCAA protocols whenever possible, origins were sample roasted, then rested overnight and cupped by our sensory panel. To obtain tasting scores, origins were brewed on commercial Bunn Axiom brewers using a standard brewing formula and evaluated,

again using the SCAA scoring method for consistency.

The Coffee **Selection Process**

La Minita provided the two green coffee lots for this project. For sample purposes, our only request was fresh green coffee from Central America and East Africa so we could study the differences between these two popular growing regions. As with any scientific study, having two data sets is important to help explain any anomalies or unexpected results. However, instead of using two similar coffees for this research project, we decided that two green coffees from different parts of the world would be more interesting. We selected a fully washed arabica from Costa Rica and a naturally fermented arabica from Kenya.

The Central American coffee was grown at Hacienda La Minita in the Tarrazú region of Costa Rica, on a farm founded by William McAlpin in 1978, with a total size of 1,200 acres.

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The Kenyan coffee ready to cup

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A STUDY IN ROAST LEVELS (CONTINUED

This Rainforest Alliance-certified farm harvested by hand and processed the coffee in its wet mill and dry mill facilities. The coffee tested was harvested between 1,300 and 1,800 meters above sea level (MASL) and was made up of the following cultivars: caturra, catuai red, catuai yellow, and tipica hibrido.

The East African coffee was grown by the Mkumbune Farmer Coop Society in the Meru region of Kenya, in volcanic loam on the eastern slopes of Mount Kenya. The coffee tested was harvested at 1,550 MASL and was made up of traditional SL28 and SL34 varieties. The Mkumbune Farmers Coop Society is made up of approximately 400 small-holder farmers with an average of 200 trees each. These farmers also harvest by hand and deliver the fruit to the wet mill. The fully washed coffees are sun-dried on elevated tables at the Regeju Factory.

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CHART SECTION A: ROAST PROFILES







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A STUDY IN ROAST LEVELS (CONTINUED)

Physical analysis was completed on 350 grams of each coffee with the following results:

The Costa Rica Tarrazú coffee had zero primary defects and one secondary defect. The total moisture upon receipt was 7.53 percent with a density of 0.713 g/ml³.

The Kenya AA coffee had zero primary defects and two secondary defects. The total moisture was 7.27 percent with a density of 0.733 g/ml³, suggesting a greater concentration of cells per volume than the Costa Rica Tarrazú.

The Roast Process and Selection Of Roasted Samples

See Chart Section A on page 28

Five green samples of 165 grams each were prepared from each origin. These greens were roasted with Coffee Analysts' Jabez Burns four-barrel sample roaster. The roasting followed SCAA protocol for roast development (length of roast). Roast temperatures were noted and logged during the process at

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CHART SECTION B: COSTA RICA









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www.handybrew.com Proudly Made in Taiwan 1-minute intervals. After the roasting was complete, five samples were selected from each origin, fairly representing the lightest to and 27.9 (lightest to darkest). darkest samples for this experiment.

For this research, our goal was to produce five samples for analysis at visually different levels of roast development. We measured the roast development using an Agtron E-20 CP Analyzer, using the commercial scale for recording. The Costa Rica samples were 63.3,

52.1, 46.0, 36.6, and 28.4 (lightest to darkest). The Kenyan samples were 56.9, 50.1, 40.8, 37.3

Yield from each roast was between 140 and 150 grams. This allowed for each sample to be used for cupping (60 grams + purge) and brewing (77.9 grams) from the same roasted batch.

Per SCAA protocol, 100 grams from each roast was evaluated for the presence of quakers;



there were no quakers present. (A quaker is an undeveloped coffee bean that doesn't roast to the same level as others. Specialtygrade coffee has zero quakers in a 100-gram roasted sample.)

The Cupping Process

For each origin, coffee from each of the five roast levels was scaled into five cups and hydrated using 1.63 grams per fluid ounce of water. The samples were ground and evaluated by panelists using the SCAA scoring method.

The Brewing Process

For each origin, 77.9 grams was scaled, then ground into a filter and brewed using Bunn Axiom commercial equipment. Samples were drawn to determine and test for pH, brew solids and extraction.

The brewed samples were poured into cupping bowls and arranged so that each panelist had a full set of all five roast levels to evaluate and note the sensory attributes. The SCAA scoring method was used for the brewed coffee samples to achieve uniformity in sensory evaluation.

Sensory Profile Tasting and Cupping: Costa Rica Tarrazú

See Chart Section B on page 30

Sensory attributes were observed as consistent with roast development from lightest to darkest.

Level 1 (lightest): Panelists noted lemon, apricot and peanut shells.

Level 2: The lemon character became more of a caramelized citrus combined with the introduction of caramel, honey sweetness and chocolate.

Level 3: Panelists noted the acidity beginning to diminish. The brightness of the citrus was tempered with plum and dried fruit.

Level 4: The introduction of tobacco, ash and molasses was noted along with chocolate notes becoming less sweet, more similar to cocoa and dark chocolate.

Level 5 (darkest): The coffee maintained the sweet, dried-fruit note along with the introduction of leather and smoke.

These characteristics were consistent with cupping and tasting.

Sensory Scores Tasting and Cupping: Costa Rica Tarrazú

See Chart Section B on page 30

Scores for the Costa Rica coffee followed different sensory score trends for cupping and tasting. Cupping scores peaked at roast level 3 with body at greatest intensity at level 4 and acidity highest at level 2 and level 3, but dropping almost 3 points at level 5. Level 4 of the Costa Rica coffee produced similar scores for cupping and tasting. Level 3 had the greatest sensory score difference. The scores intersected after level 1 and at level 4, illustrating a reversal of intensity and quality between cupping and tasting.

Sensory Profile Tasting and Cupping: Kenya AA

See Chart Section C on page 34

The progression of sensory attributes throughout the roasting process was observed as follows:

Level 1 (lightest): Panelists mentioned bright lemon, grass and floral notes. The sweetness came from honey, toasted almond and light caramel.

Level 2: As the roast progressed, lemon became peach and tangerine, honey turned to caramel, and toasted almond generalized to toasted nuts.

Level 3: Chocolate and bakery spices entered the profile of the coffee. What was once tangerine and peach moved into dried fruit (berry and plum).

Level 4: Dark chocolate was prominent. Tobacco, leather, molasses and slight smoky notes were apparent and the driedfruit notes held firm.

Level 5 (darkest): Earth and smoke predominated. The dried-fruit note, though present, was diminished significantly and the coffee gave way to slight ashy and burnt characteristics.

These characteristics were mirrored in both cupping and tasting notes.





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Sensory Scores Tasting and Cupping: Kenya AA

See Chart Section C on page 34

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Sensory scores for the Kenya AA showed similar trends for cupping and tasting, both peaking at level 2 and scoring lower for dark roast levels. Cupping scores peaked at roast level 2 with continued on page 34

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body at greatest intensity at level 3 and acidity highest at level 1 and level 2, but dropping 1.5 points at level 5. Level 2 of the Kenya produced similar scores for cupping and tasting. Level 3 had the greatest sensory score difference. The scores did not intersect, but followed similar trends.

Brew Solids, Extraction and pH

See Chart Section D, this page

Prior to roasting, all green coffee has an abundance of amino acids and carbohydrates. The roasting process starts to convert and break down these components, eliminating some and creating new ones. In the green state, coffee has the highest amount of soluble material. As heat is applied, the amount of soluble material decreases until complete pyrolysis occurs. This general trend can be seen in the brew solids and extraction data charts.

An anomaly occurred at roast level 4, which demonstrated a large increase in both the extraction percent and, therefore,

CHART SECTION C: KENYA



Kenya | Tasting vs. Cupping 86 85 84 ш 82 FINAL SCOR 80 78 76 74 72 70 Level 1 Level 2 Level 3 Level 4 Level 5 ROAST LEVE

brew solid levels. Because the samples all were brewed at the same coffee-to-water ratio, in the same brewers, at the same temperature, and tested identically, one can only posit that

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CHART SECTION D: Brew Solids, Extraction and pH







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A STUDY IN ROAST LEVELS (CONTINUED)



The Costa Rican samples brewed and poured

something inherent to the roast level caused this change. The occurrence of second crack happened at roast level 4, causing thermal expansion of the beans, creating a more porous cell structure that allows for greater extraction, and thus increased yield. However, a more thorough physical and chemical investigation of this phenomenon would be required for a conclusive answer.

pH is the measure of the acidity or alkalinity of an aqueous (water-based) solution, not the presence of organic acids. As expected, pH increased as the roast development darkened, with almost a 1-point range overall. However, it was interesting to observe the reduction of acidity, with pH data increasing, as the roast development increased to darker levels.

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CHART SECTION E: Acidity and Body





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A STUDY IN ROAST LEVELS (CONTINUED)



The Costa Rican tasting samples, hot and cold.

Summary of Observations

See Chart Section E, page 36

This was a project of discovery, not an experiment to prove or disprove a theory. Our team was excited to collect the technical data for the various roasts of these two coffees and genuinely curious regarding the outcome of these evaluations. We reminded ourselves that quantifying the intensity of attributes as well as the quality of sensorial characteristics does not always equate to consumer preference. Our goal was to use scientific tests to understand the effects of different roast levels on physical, chemical and sensorial attributes.

Our research confirmed our expectations that sensory perceptions change as roast development darkens for these two coffees. For both the Costa Rican and the Kenyan coffees tested, lighter roasts were observed to have higher levels of intensity and quality for sensorial attributes than darker roasts.

Our data further supported the common industry understanding that "the lighter the roast, the greater the acidity; the darker the roast, the fuller the body." As the roasts developed darker, the perception of intensity and quality of acidity diminished while the mouthfeel became more viscous.

In addition to the specific attribute changes related to roast level, it is important to note the variations in final sensory scores between cupping and tasting—or brewing—the same coffees. This suggests that product development should not be isolated in the laboratory but should consider consumer brewing methods as well.

COFFEE ANALYSTS is an independent coffee testing laboratory certified by the Specialty Coffee Association of America. The company does not sell coffee; it tests coffee. The Coffee Analysts team specializes in the evaluation and improvement of coffee programs and supports quality programs throughout the global farm-to-cup coffee supply chain. Coffee Analysts staff includes Tobin Jordan, Peter Montane, Gwen Toohey, Vince Caloiero, David Morrill, Spencer Turer and Dan Cox.





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