

A Comprehensive Guide to Coffee Roasting: Mastering Consistency and First Crack

Author: Kaawa Co

Introduction

Coffee roasting is a craft that blends science and art, transforming green coffee beans into the aromatic, flavorful beans we brew. While the journey to becoming a master roaster is long, understanding a few key principles can dramatically improve the quality and consistency of your roasts. This guide is designed to provide a comprehensive framework for roasters of all levels, with a particular focus on the critical role of consistency in sample roasting and the pivotal decisions made around the first crack.

As one expert notes, "Consistency matters most when roasting samples, even though first crack timing often varies. This guide helps you decide exactly when to stop the roast depending on how long it took to reach that first crack." [1] We will delve into this concept, providing you with the tools and knowledge to make informed decisions and achieve repeatable, high-quality results.

Chapter 1: The Fundamentals of Sample Roasting

Sample roasting is the process of roasting small batches of coffee (typically 50-200g) to evaluate green coffee quality, select ideal roast profiles, and prepare for cuppings. [2] It is arguably more critical to final product quality than production roasting itself. [1] The primary goal of sample roasting is not to create the "perfect" roast, but to roast with **consistency**. This allows for a fair and objective comparison between different coffees, ensuring that you are tasting the inherent qualities of the bean, not the roast. [2]

Equipment

Sample roasters come in various forms, with the two main types being drum roasters and air roasters. Historically, open-faced drum roasters were common, but they often lack the consistency needed for professional evaluation. Modern sample roasting relies on more controlled machines:

| Roaster Type | Description | Advantages | Disadvantages |
|----------------------|---|---|--|
| Drum Roasters | Small, enclosed drum roasters (e.g., 500g capacity) offer good data quality and consistent results. [1] | Provides insight into how coffee may behave in a larger production roaster. | Can have issues with conduction, leading to roasty flavors. |
| Air Roasters | Machines like the Ikawa, Kaffelogic, and Roest use convection to roast the beans. [1] | Generally produces superior roast quality, making it easier to develop coffee and avoid roasty flavors. | May not perfectly replicate the conditions of a larger drum roaster. |

Regardless of the equipment, the key is to control variables such as batch size, charge temperature (the temperature of the roaster when the beans are added), and airflow to ensure consistency from one roast to the next.

Chapter 2: The Roasting Process: A Step-by-Step Journey

The coffee roasting process is a series of chemical reactions that can be broken down into several key stages. Understanding these stages is essential for controlling the roast and achieving the desired flavor profile.

| Stage | Typical Timing | Temperature Range (approx.) | Visual & Auditory Cues |
|--------------------------|-------------------|-------------------------------|--|
| Drying | 0:00 - 4:00 | Ambient to 150°C (302°F) | Beans turn from green to yellow. |
| Maillard Reaction | 4:00 - 6:00 | 150°C - 190°C (302°F - 374°F) | Beans turn from yellow to brown, aromas of bread and toast develop. |
| First Crack | 6:00 - 8:00 | 196°C - 205°C (385°F - 401°F) | Beans crack audibly, like popcorn popping. [3] |
| Development | After First Crack | 205°C+ (401°F+) | The period where the final flavor profile is shaped. |
| Second Crack | 9:00+ | 225°C - 230°C (437°F - 446°F) | A quieter, more rapid cracking sound as oils migrate to the surface. |

Chapter 3: First Crack: The Critical Decision Point

First crack is an exothermic reaction where the buildup of pressure from water vapor inside the bean causes it to crack open, releasing energy, steam, and carbon dioxide. [3] It is a pivotal moment in the roast, marking the beginning of the development phase. The timing of

the first crack can vary depending on the coffee's origin, processing method, density, and the roaster being used.

This brings us to the core question: **how do you decide when to stop the roast when the first crack timing varies?** The answer lies in the **Development Time Ratio (DTR)**.

Development Time Ratio (DTR)

Popularized by roasting expert Scott Rao, the DTR is the percentage of the total roast time that occurs after the first crack begins. [4] It is calculated as follows:

$$DTR = (Development\ Time / Total\ Roast\ Time) \times 100\%$$

For most specialty coffee roasts, a DTR of **20-25%** is recommended. [4] This range has been found to produce well-developed roasts with balanced flavors. By targeting a consistent DTR, you can achieve consistent results even when the first crack timing varies.

Here's how to apply the DTR in practice:

| If First Crack Occurs at: | Target Total Roast Time (for 20-25% DTR) | Target Development Time |
|---------------------------|--|-------------------------|
| 7:00 | 8:45 - 9:20 | 1:45 - 2:20 |
| 8:00 | 10:00 - 10:40 | 2:00 - 2:40 |
| 9:00 | 11:15 - 12:00 | 2:15 - 3:00 |

It's important to note that the 20-25% DTR is a guideline, not a rigid rule. For example, roasters with a high ratio of burner capacity to batch size may be able to achieve good development with a lower DTR (e.g., 15%). [4]

Chapter 4: Beyond First Crack: Roast Levels and Flavor Development

The development time after first crack determines the final roast level and flavor profile of the coffee. Roast levels are often categorized as light, medium, and dark, and can be objectively measured using an Agtron spectrophotometer.

| Roast Level | Agtron Score (Whole Bean) | Characteristics | Flavor Profile |
|-------------|---------------------------|--|--|
| Light | 61+ | Light brown, no oil on the surface. | Bright, acidic, with prominent origin characteristics. |
| Medium | 45-60 | Medium brown, some oil may be visible. | Balanced acidity and body, with a mix of origin and roast flavors. |
| Dark | 25-44 | Dark brown to black, oily surface. | Low acidity, full body, with dominant roast flavors (chocolate, caramel, smoke). |

For sample roasting, the SCAA recommends a light roast with an Agtron score of 58 for whole beans and 63 for ground coffee. [5] This ensures that the evaluation is focused on the coffee's inherent qualities rather than the roast itself.

Chapter 5: Avoiding Common Roasting Defects

Even with careful control, roasting defects can occur. Understanding how to identify and avoid these defects is crucial for producing high-quality coffee.

| Defect | Cause | Characteristics | How to Avoid |
|----------------|---|---|---|
| Baked | Stalled roast or a crash in the Rate of Rise (RoR). [6] | Flat, papery, and lifeless taste. | Maintain a steadily declining RoR throughout the roast. |
| Scorching | Excessive heat, causing the bean surface to burn. [7] | Burnt, smoky, and astringent flavors. | Use a lower charge temperature and avoid excessive heat application. |
| Tipping | The tips of the beans are burnt. [7] | Similar to scorching, but more localized. | Reduce initial heat and ensure even heat distribution. |
| Underdeveloped | Insufficient development time. | Grassy, vegetal, and sour flavors. | Ensure an adequate DTR (typically 20-25%). |
| Overdeveloped | Excessive development time. | Burnt, bitter, and ashy flavors. | Carefully monitor the roast after first crack and drop the beans at the target roast level. |

Conclusion

Mastering coffee roasting is a journey of continuous learning and refinement. By focusing on consistency, understanding the stages of the roast, and using tools like the Development Time Ratio, you can take control of your roasting and produce exceptional coffee. Remember that

this guide provides a framework, but the best way to learn is to roast, cup, and repeat. Embrace the process, and enjoy the delicious rewards of your craft.

References

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