PART 2

The acids that bring coffee to life

From bean to brew: what organic acids do and how they shape the cup

Some coffees taste like red currants. Others recall white grapes, oranges or green apples.
These vivid, sparkling notes owe their character not just to aromas, but to something more fundamental: **organic acids**.

When we talk about acidity in coffee, we often describe flavor. But that flavor starts with chemistry: specific molecules that survive from the plant, evolve during roasting and dissolve in the cup.

Organic acids are among the most influential.

A family of acids, each with a voice

Organic acids are naturally occurring compounds found in all plant tissues. In green coffee beans, organic acids are present in relevant amounts, while chlorogenic acids — the most abundant acidic compounds — can represent roughly **6–12% of the bean's dry weight**.

Their origin is **metabolic**: they are key intermediates in the citric acid (TCA) cycle, glycolysis and fermentation pathways.

The most abundant include:

- **Citric acid** – often associated with a bright, citrus-like acidity.
- **Malic acid** – typically linked to a smoother, apple-like perception of acidity.
- **Quinic acid** – perceived as more astringent or drying; partly formed during the degradation of chlorogenic acids.
- **Acetic acid** – sharp and volatile; often associated with fermentation processes.
- **Lactic acid** – softer and rounder in perception, frequently linked to anaerobic fermentation.

CITRIC ACID
Taste sensation
JUICY
Aromatic perception
ORANGE

MALIC ACID
Taste sensation
SMOOTH
Aromatic perception
APPLE

QUINIC ACID
Taste sensation
BITTER
Aromatic perception
DRY WOOD

ACETIC ACID
Taste sensation
SHARP
Aromatic perception
VINEGAR

LACTIC ACID
Taste sensation
CREAMY
Aromatic perception
YOGURT

Each acid contributes not only to taste but also to the structure of acidity, influencing mouthfeel and aftertaste.

Malic and lactic acids, for instance, are often associated with a softer, lingering acidity, while quinic or acetic acids may contribute to sharper or more drying sensations, depending on their relative concentration in coffee.

However, in coffee these sensations arise from the combined effect of multiple compounds within the matrix, rather than from individual acids alone.

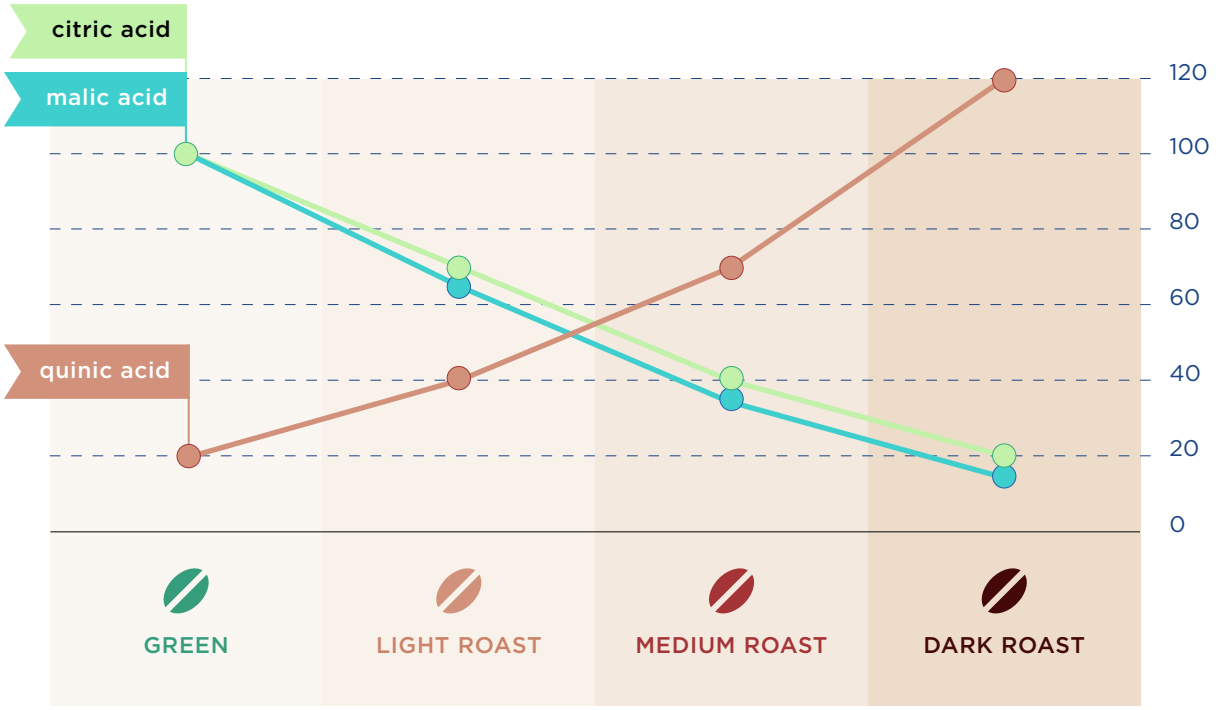
The influence of origin and processing

The **concentration and ratio** of organic acids depend heavily on:

- **Botanical variety**: Ethiopian landraces often have high malic and citric acid.
- **Altitude and ripeness**: higher altitude = slower maturation = higher organic acid retention.
- **Post-harvest processing**: washed coffees are often associated with higher **citric** and **malic** acidity, while fermentation-driven processes such as natural or anaerobic processing may promote **lactic** and **acetic** acid formation. However, these patterns depend strongly on cultivar, microbial activity and roasting.

These differences explain why Kenyan coffees are known for their vibrant tartness, while a Brazilian natural might feel mellower, even syrupy.

How roasting affects organic acids



Values are relative and represent schematic trends reported in the scientific literature.
Actual values may vary depending on coffee origin, roasting degree, brewing method and analytical conditions.

What roasting does

Roasting profoundly alters acid content. As the bean heats, organic acids degrade, transform, or react in **Maillard** and **Strecker** pathways.

- **Citric and malic acids** decrease with roast time and temperature.
- **Acetic acid** increases initially (from sugar and fermentation residue), then may volatilize.
- **Quinic acid** increases as **chlorogenic acids** break down.

Thus, **light roasts** preserve the fresh acidity of citric/malic acids, while **dark roasts** shift the balance toward quinic bitterness and lower perceived acidity.

A 2023 study from *Food Chemistry* showed that during roasting, the concentration of several organic acids — including citric and malic acid — generally decreases as thermal degradation occurs. At the same time, compounds such as quinic acid may increase due to the breakdown of chlorogenic acids. The extent of these changes varies considerably depending on coffee variety, roasting profile and analytical method.

The Maillard reaction is a chemical process during roasting where sugars and amino acids react to form brown pigments and complex flavors, while Strecker degradation breaks down amino acids into aroma compounds that contribute to coffee's distinctive smell.

Extraction matters too

Not all acids extract equally. Citric and malic acids are **highly water-soluble**, and tend to appear early in the brew.
Acetic acid, being volatile, may influence aroma more than taste.

Longer brew times (e.g., immersion) or finer grind can **increase acid content** in the cup.

Cold brew is often perceived as less acidic or less sour than hot-brewed coffee.

However, studies show that the pH of cold brew and hot coffee is often similar, while differences are more evident in titratable acidity and extraction of specific compounds, which are influenced by the lower brewing temperature.

Solubility and extraction of organic acids during brewing

ESPRESSO

Total Acids (TA) 90%

Volatile Acids 90%

FILTER (V60)

Total Acids (TA) 60%

Volatile Acids 60%

COLD BREW

Total Acids (TA) 40%

Volatile Acids 40%

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Why does it matter

Organic acids are more than numbers on a lab report. They define how “alive” a coffee feels on the palate. They bridge plant physiology, roast chemistry and sensory experience.

By understanding which acids are present, and how they behave, we can choose origins, processes and roast levels that match our taste goals. As professionals, it allows us to **calibrate flavor**. As consumers, it helps us **decode labels** and **trust our palates**.

Key Takeaway:

Organic acids like citric, malic, lactic, acetic and quinic play central roles in the flavor of coffee. Their levels depend on variety, altitude, processing and roasting. Light roasts preserve fruity acids like citric and malic, while darker roasts favor the development of quinic acid bitterness.

Understanding these molecules helps explain the brightness, softness or sharpness we perceive in different cups.