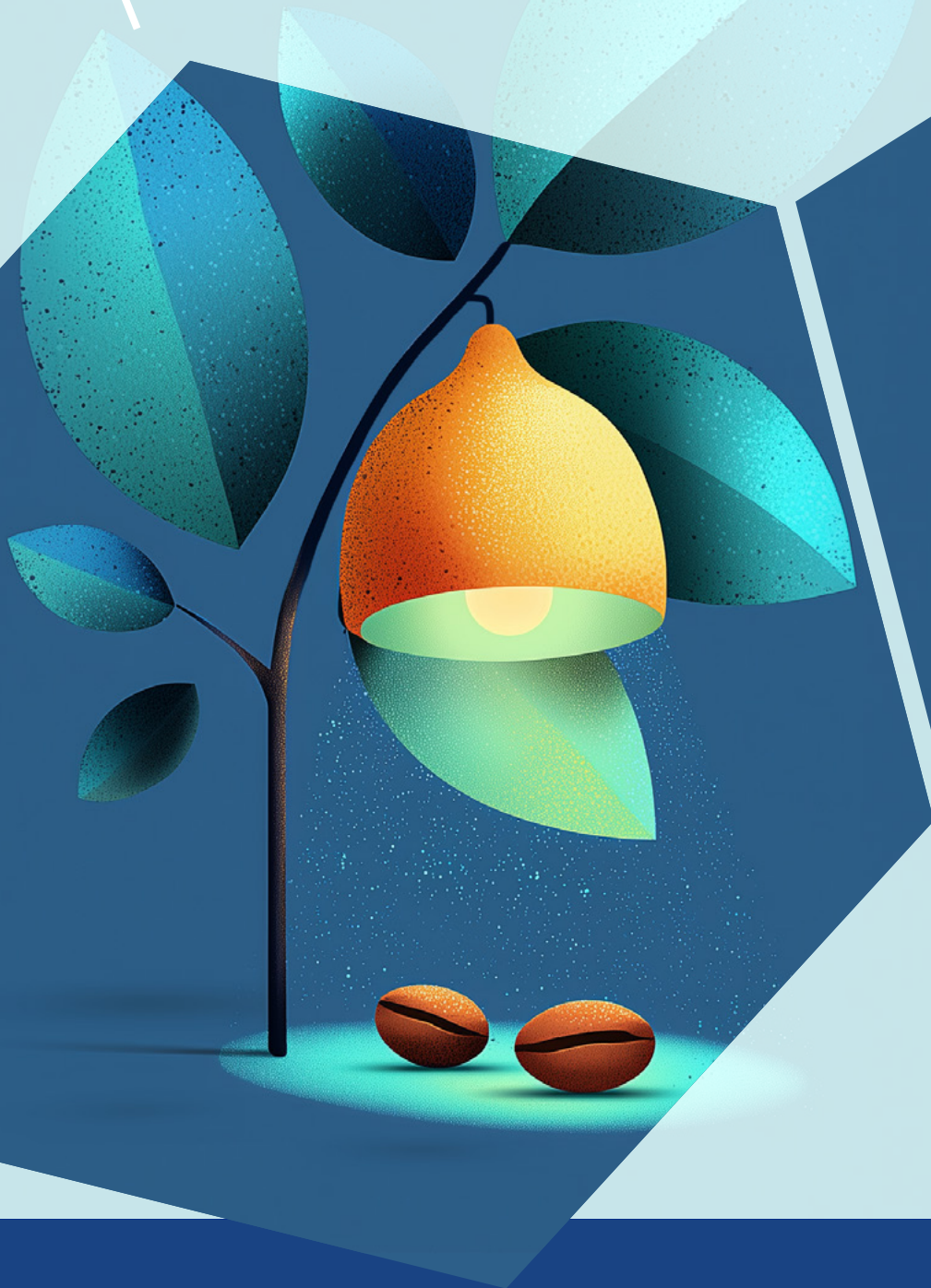


Beyond The Cup

Is Acidity really the problem?

Why coffee's brightest character may also be its most misunderstood.



RESEARCH &
INNOVATION
COFFEE HUB

A COFFEE CHEMISTRY SERIES BY
SIMONELLI | GROUP

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ABSTRACT

Coffee acidity is one of the most distinctive yet often misunderstood attributes of coffee flavor. It results from the interaction of organic acids, chlorogenic acids and other compounds that evolve from green beans through roasting and brewing. Their balance is influenced by origin, processing, roasting and extraction conditions. Rather than being linked to a single molecule, acidity perception emerges from the complex chemical matrix of coffee, helping explain the remarkable diversity of acidity profiles across coffees and brewing methods.

PART 1

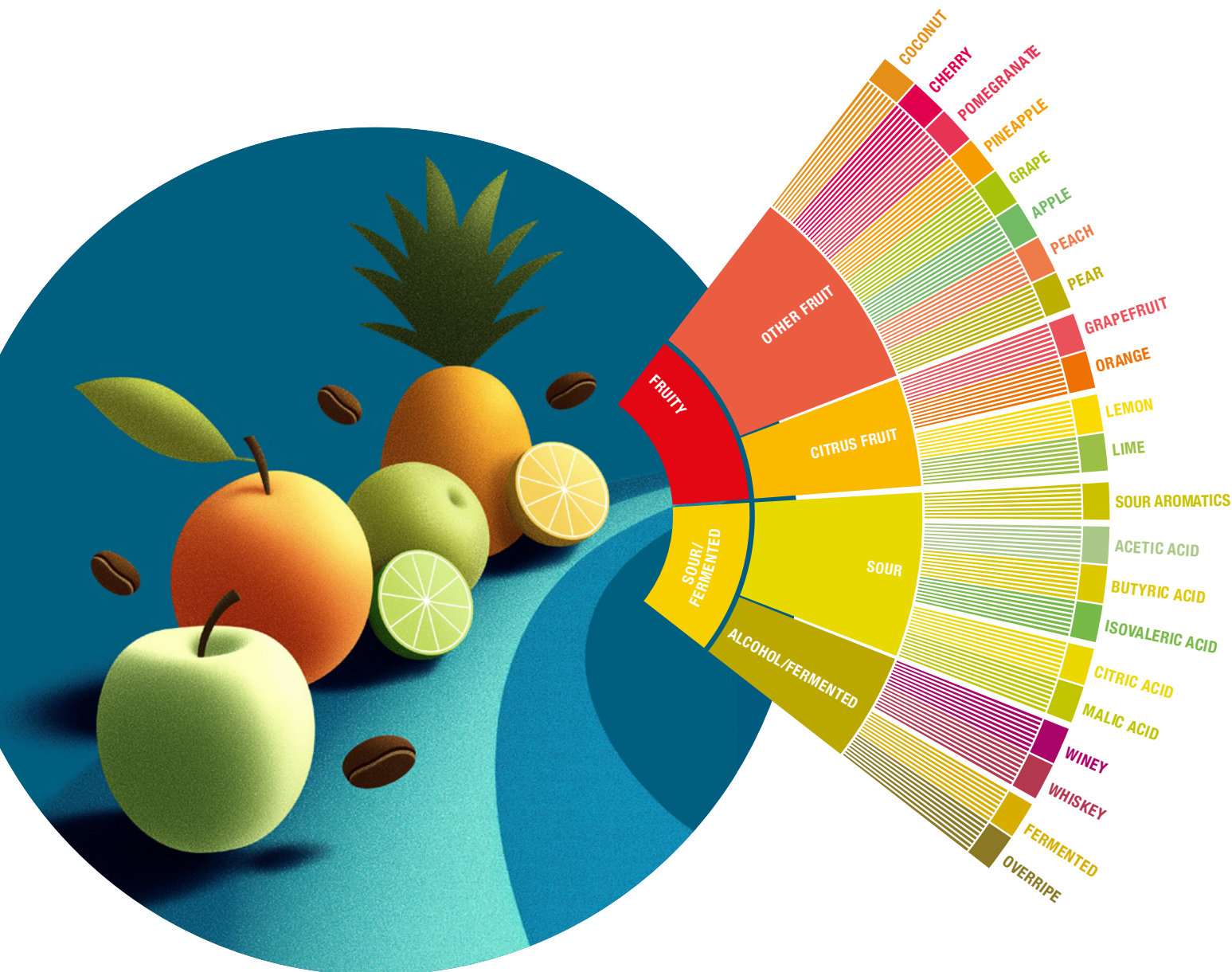
The bright paradox: understanding acidity in coffee



From sour to sparkling: why acidity divides us but defines great coffee.

Most people love a squeeze of lemon in their tea. But in coffee? Sourness is far more controversial.

I remember a washed Ethiopian brewed on a V60 during a cupping. The first sip was electrifying - clean, sharp and citrus - bright. I loved it. The woman next to me winced: "too sour", she said. Two tasters, same cup, opposite reactions. And that's the paradox of acidity in coffee.



What are we talking about?

In coffee, “acidity” doesn’t always mean what it sounds like. Chemically, it refers to the presence of acids in solution. Sensorially, it refers to the perception of sourness on the tongue. But in coffee language, acidity is often used as a positive descriptor - “bright”, “crisp”, “lively” - even though most people associate “sour” with unpleasantness.

Coffee professionals love acidity. It gives clarity and complexity. Without it, coffee can taste flat, bitter, hollow.

But consumers often recoil from the term “sour”. We crave balance, but we disagree on where that balance lies.

The science of sour

Coffee is a naturally acidic beverage, with a pH around 4.8 to 5.2 - less acidic than orange juice or soda, but more acidic than milk. However, pH alone doesn't tell the whole story.

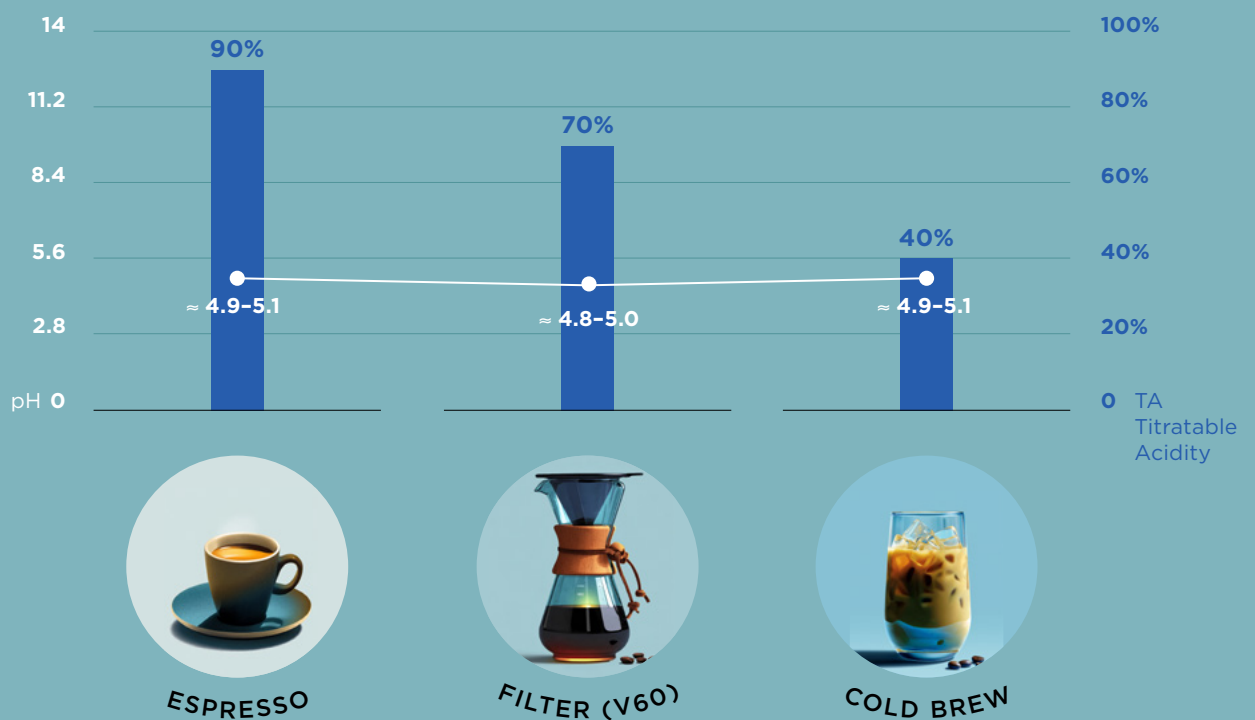
A better predictor of how “bright” or “sour” a coffee tastes is **titratable acidity (TA)**: a measure of how many acid molecules are present and how strongly they react.

TA correlates better than pH with perceived sourness, especially in filtered brews.

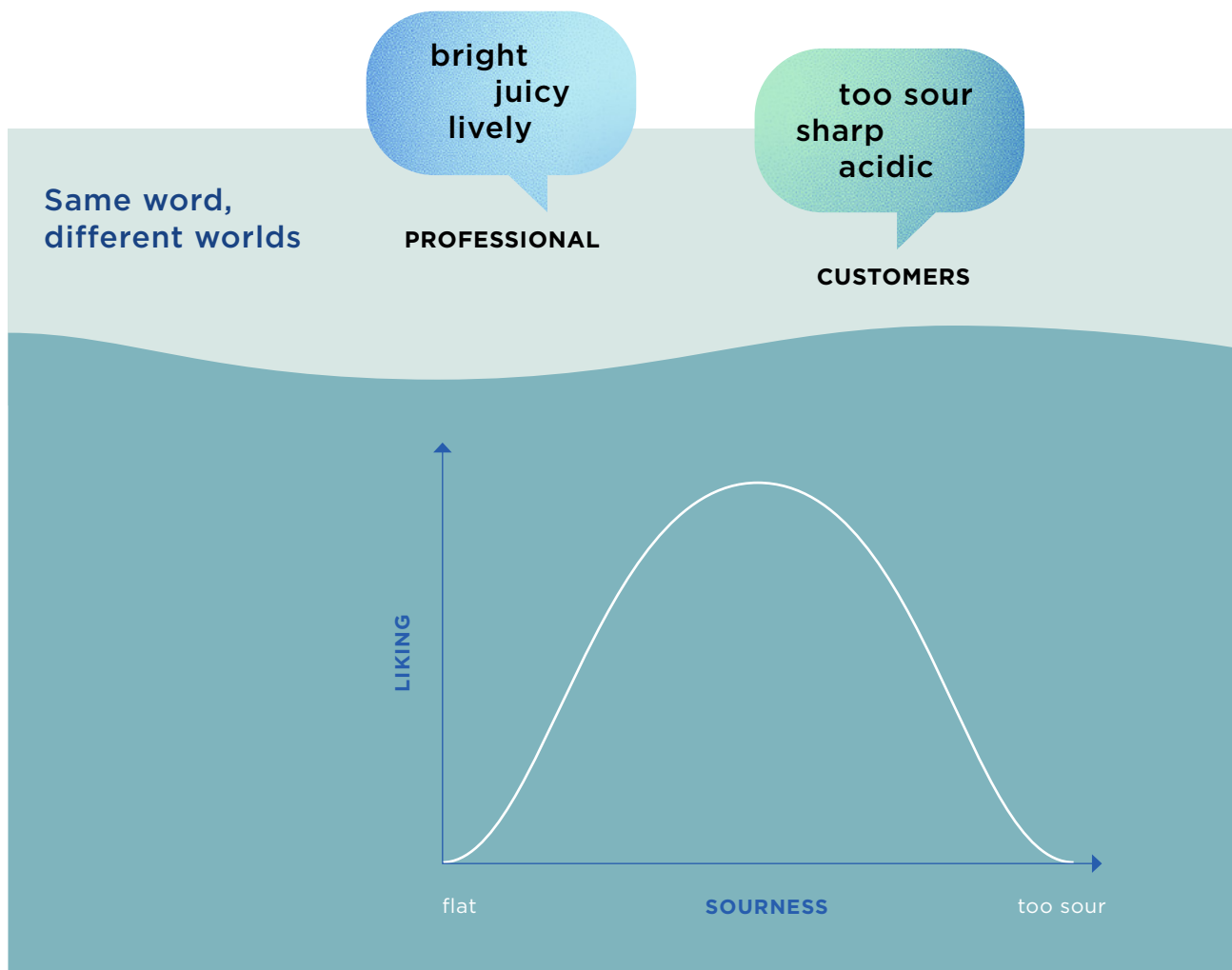
But even TA can't account for everything. Aroma compounds, sweetness and even texture influence how we experience acidity.

Fruity volatiles can *enhance* sourness perception, while body and sweetness can *suppress* it.

pH vs Titratable Acidity: What influences flavor perception?



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.



The U-shaped curve of enjoyment

Sensory scientists talk about the **“inverse U-shaped hedonic curve”**: we like a bit of sourness more than none, but too much is off putting.

A touch of acidity balances sweetness and bitterness. But when acidity dominates, the experience becomes sharp, aggressive, even metallic.

This is why some of the most beloved high acid coffees (like Kenyan or Colombian washed Arabicas) are best appreciated when brewed well, with controlled extraction and temperature.

The same beans, poorly roasted or under-extracted, can cross the line into unpleasant territory.

Cultural taste, roasting choices and naming games

In specialty coffee, we often mask the term “sour” with euphemisms: **“juicy”, “tangy”, “vibrant”**.

The goal is to describe acidity without triggering negative associations. This is especially relevant when marketing to broader audiences.

Roasters also control acidity by roast degree. Light roasts preserve organic acids and highlight acidity. Medium roasts balance brightness and sweetness. Dark roasts mute acidity but increase bitterness and body.

This is why many dark-roast lovers prefer Brazilian or Indonesian coffees: lower in acidity, richer in body.

Why does it matter

Understanding acidity helps us appreciate coffee more deeply. It tells us about the coffee's origin, process, roast profile and brew. It also helps us describe flavor more precisely, whether we're cupping, training a team, or just savoring a morning pour-over.

The next time someone says a coffee is "too sour", try reframing it. Is it *unbalanced*, or just unexpected? Is there sweetness to round it out? Acidity is not the enemy. It's the spark that brings coffee to life.

Key Takeaway:

The perception of acidity in coffee depends not only on pH, but more strongly on titratable acidity (TA) and complex interactions with sweetness, bitterness and aroma. A moderate, balanced acidity enhances flavor clarity, while excess acidity can overwhelm. This is why high acid coffees shine when roasted and brewed with care.

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

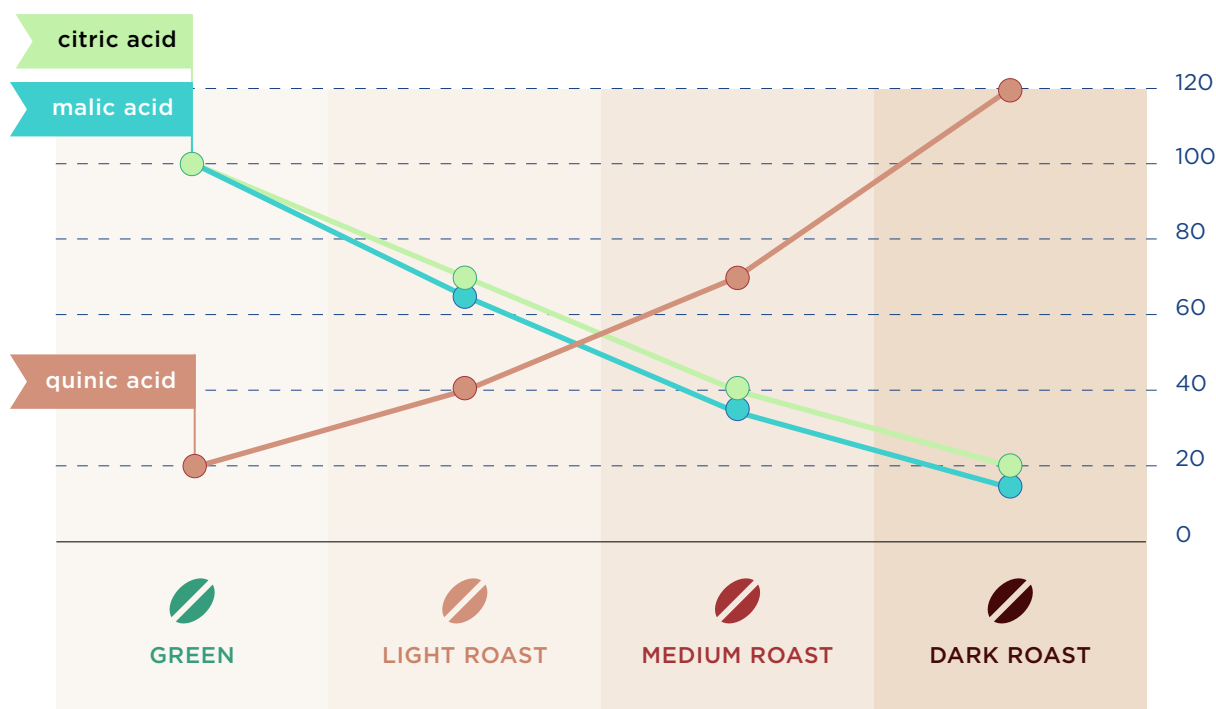
The **concentration and ratio** of organic acids depend heavily on:

- **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



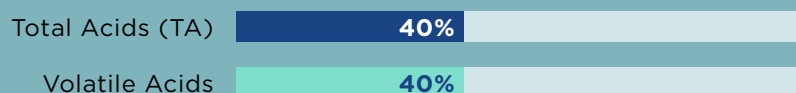
ESPRESSO



FILTER (V60)



COLD BREW



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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.

PART 3

Acidity and the body: is coffee really a gut irritant?



Sorting science from myth in the debate on acids and digestion

"I love coffee, but it upsets my stomach. Must be the acid".

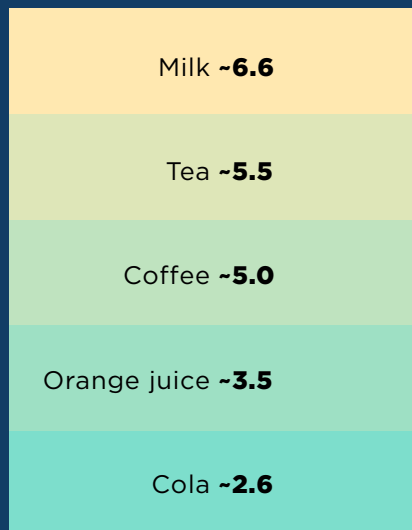
It's a phrase we've all heard - maybe even said. But what does science tell us about the relationship between coffee acidity and digestive health?

The truth is more complex than popular wisdom suggests.

Let's take a look.

Comparative pH of common beverages

LESS ACIDIC



↓
MORE ACIDIC

CHLOROGENIC ACIDS:
affect gastric motility

CAFFEINE:
gastric acid
secretion



Factors proposed
to influence
gastrointestinal
response to coffee

**ROASTING
BYPRODUCTS:**
sensitive mucosa
irritation

Is it really the acid?

As we have seen, coffee is mildly acidic, with a pH between **4.8 and 5.2**, depending on roast and brewing.

For comparison: orange juice is around 3.5, cola around 2.5. Yet many people tolerate those beverages better than coffee. Why?

Acidity perception and gastric response don't always correlate. What irritates the stomach isn't necessarily the acid content alone, but also:

- **Caffeine**, which can increase gastric acid secretion.
- **Chlorogenic acids**, especially caffeoylquinic acid, which may affect gastric motility.
- **Volatile compounds** and **roasting byproducts**, which can irritate sensitive mucosa.

So, while organic acids play a role, they are not the sole cause of discomfort.

What the studies say

A review published in Food & Function (2020) and later discussions summarized by Victor R. Preedy (2023) highlight that the relationship between coffee consumption and gastric discomfort is complex and not fully explained by acidity alone.

Several compounds present in coffee — including **chlorogenic acid** derivatives, **caffeine** and roasting products such as **N-methylpyridinium** — have been suggested to influence gastric acid secretion and gastrointestinal responses.

As a result, coffees described as “low-acid” are sometimes perceived as less irritating, although this effect does not necessarily depend on their pH.

Brewing method may also play a role. For instance, **cold brew extraction** often results in lower concentrations of certain compounds extracted at higher temperatures and many consumers report it as more stomach-friendly, even when its pH is comparable to that of hot-brewed coffee.

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Individual sensitivity matters

Just like lactose or gluten, **tolerance to coffee varies**. Some individuals are more sensitive to certain polyphenols or fermentation byproducts.

Others react more to unfiltered brews (e.g., French press), which carry more diterpenes and oils.

Because espresso is consumed in a much smaller serving size, the total intake of acids per serving may be lower than in larger coffee beverages such as filter coffee. However, espresso generally contains a higher concentration of dissolved compounds and the overall acid exposure ultimately depends on beverage volume, dilution and brewing parameters.

The role of roasting

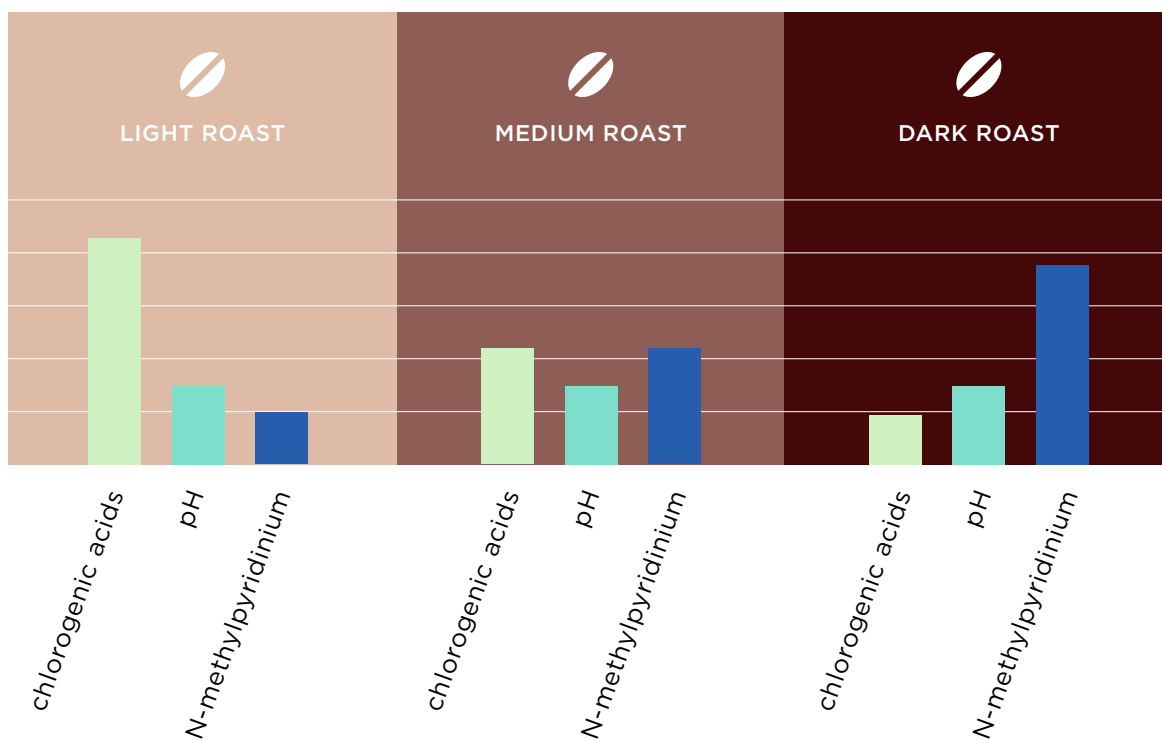
Dark roasts often feel “gentler” on the stomach not because they’re less acidic (pH can be similar), but because:

- They contain **less chlorogenic acids** (due to thermal degradation)
- They may increase **N-methylpyridinium**, a compound shown to **reduce gastric acid secretion in vitro**.

Thus, roast degree affects not just taste, but **physiological effects** too. Dark roasts often feel “gentler” not because they’re less acidic, but because they contain less chlorogenic acids and more compounds like N-methylpyridinium that may reduce gastric acid secretion.

Roast degree and compounds potentially involved in gastric response

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Marketing vs evidence

Many “low acid” coffees on the market are **marketed** based on pH values alone.

But as we’ve seen, **titratable acidity** and **compound profile** matter more than pH.

A coffee with pH 5.0 can be more irritating than one at 4.7 if it contains more caffeine and chlorogenic acids.

For sensitive drinkers, useful strategies include:

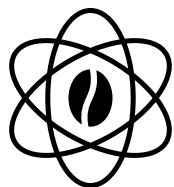
- **Choosing medium-to-dark roasted Arabicas**
- **Opting for washed coffees with balanced profiles**
- **Trying cold brew or espresso instead of large filter brews**
- **Watching brew strength and temperature.**

Why does it matter

Understanding the real role of acids helps us debunk myths and make informed choices. Coffee isn't inherently harmful to the gut. But its complex chemistry interacts uniquely with each body. Respecting that individuality is key.

Key Takeaway:

Stomach discomfort from coffee is not due to acidity alone. Compounds like caffeine, chlorogenic acids and certain roasting byproducts play a larger role. Roast degree, brew method, and individual sensitivity all influence how coffee is tolerated. Choosing darker roasts, milder origins, or cold brew can help sensitive drinkers enjoy coffee without discomfort.



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