Every step matters to obtain a good cup of coffee

Why focus on freshness?

- Serving temperature
- Cup size and shape
- Black, with milk, sugar or other ingredients
- Water temperature, pressure, mineral content
- Extraction technique (espresso, filter, ...)
- The Barista
- Particle size distribution
- Temperature of burs
- Orientation, diameter, material of burs
- Technology (drum, tangential, fluidized bed ...)
- Roast degree / weight loss
- Time temperature profile
- Stripping, picking, mechanical harvesting
- Dry, semi-dry, wet processing
- Special PH treatments (Monsooned, Kopi Luvak)
- Propagation & irrigation
- Input of chemicals (fertilizers, ...)
- Farm management
- Species (C. arabica, C. canephora)
- Varieties (Bourbon, Typica, ...)

Consumption
Brewing
Grinding
Roasting
Harvesting, Post-Harvest Treatment
Agronomy
Genetics
The secret to great coffee is the people who make it

It All Began ... when Alfred Peet opened a coffee store in Berkeley, April 1, 1966

Few noticed but a revolution was brewing. His coffee was unlike anything Americans had ever tasted before – small batches, fresh beans, ...

His philosophy: there should be the shortest distance possible between the roaster and the customer

Alfred Peet’s inspired and guided founders of Starbucks.

In 1971, Jerry Baldwin, Gordon Bowker and Zev Siegl founded Starbucks in Seattle, selling fresh-roasted whole beans to local customers
The phrase « Speciality Coffee » was first used by Erna Knutsen, a small Roaster, in 1974 in an article of the Tea & Coffee Trade Journal. The concept: special geographic microclimates produce beans with unique flavor profiles, which she referred to as 'specialty coffees.' Underlying this idea of coffee appellations was the fundamental premise that specialty coffee beans would always be well prepared, freshly roasted, and properly brewed.

- 1982: Specialty Coffee Association of America
- 1998: Speciality Coffee Association of Europe

Freshness of the coffee that a roaster or retailer sells and serves is a direct reflection of the standards and abilities of that operation. It will determine one's competitiveness in the marketplace and the ability of the consumer to experience a product that is unique and worth seeking out. The bottom line is flavor. For specialty coffee, flavor means freshness.
How to ensure freshness with every cup.

Here are some tips on how to make sure your coffee always remains fresh and tasting its very best. No one wants to drink a bad coffee, right?
Freshness is at the heart of Specialty Coffee

Make freshness measurable!

During roasting:
- Formation of coffee aroma compounds
- Formation of CO₂ (Carbon dioxide)
  → Barely created they already start to evaporate and degrade

During roasting:
Aroma is generated ... and already starts degrading
CO₂ is generated ... and already starts being lost

Once roasting is completed:
Aroma starts degrading
- Evaporation
- Oxidation / chem. reactions
- Temp., humidity, light
Loss of CO₂

Measure freshness
during storage:
“freshness indices”

Measure degasing during storage:
loss of CO₂ and CO

(Loss of) Freshness  → Make freshness visible
  → Make freshness measurable
Coffee aroma formation during roasting

The aroma of coffee

~ 1000 volatile compounds
~ 5 % have odour
~ 25 are important coffee aroma compounds
Some important coffee aroma compounds

Chemical markers: “Freshness indices” related to coffee aroma

Ratio 1: Dimethyl disulfide / Methanethiol

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Odor</th>
<th>Volatility</th>
<th>Reactivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,3-Butanediione</td>
<td>buttery, creamy, fatty, oily, sweet, vanilla, caramel</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Dimethyl disulfide</td>
<td>sulphurous, onion, garlic, burnt rubber</td>
<td>medium</td>
<td>high (ox.)</td>
</tr>
<tr>
<td>Methanethiol</td>
<td>sulphurous, rotten eggs, fish, cabbage, garlic, cheesy</td>
<td>high</td>
<td>very high (ox.)</td>
</tr>
<tr>
<td>2-Methylfuran</td>
<td>burnt, ethereal, gasoline, acetone, chocolate</td>
<td>very high</td>
<td>very low</td>
</tr>
</tbody>
</table>

Processes that lead to changes in aroma compound:
- Evaporation
- Oxidation
- Other reaction / “intrinsic” reactivity
Storage of whole beans: Aluminium packaging with valve

- Ethiopian Limu, Washed, Grade 2, Arabica
- Roasted on a 1-kg batch size Probatino
- Roast degree 93 Pt (Colorette), medium roast
- 65 g roasted whole beans in each pack

- Packaging: plastic composite film with thick aluminum layer
- Valve
- Heat sealed
- Stored at 22 °C (room temperature) and at 50 °C
The evolution of the ratio dimethyl disulfide / methanethiol stored at room temperature and at 50 °C

- ~ 10-fold acceleration of degradation when going from 22 °C to 50 °C
- Very sensitive freshness index: significant changes within 1 week

The chemistry of freshness index Dimethyl disulfide / Methanethiol

\[
\text{Freshness Index} = \frac{\text{DMDS}}{\text{MeSH}}
\]
Freshness roasted whole beans

**Chemical markers**

![Graph showing the ratio of 2-butanone / 2-methylfuran over time for different packaging materials.]

- Freshly roasted *coffee arabica* from Guatemala, 250 g roasted whole beans, stored at room temperature
- Packed in four different packaging materials (with valves except for paper packaging)

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Freshness in single serve capsules (ground coffee / hermetically sealed)

**Chemical markers**

<table>
<thead>
<tr>
<th>Code</th>
<th>Capsule</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Delizio (Ø40x26)</td>
<td>Body: PP/EVOH/PP, Cover: PP/EVOH/PP; thickness: 0.1 mm, Barrier-properties integrated into capsule and cover</td>
</tr>
<tr>
<td>C2</td>
<td>Dolce Gusto (Ø53.5x39)</td>
<td>Body: PP/EVOH/PP, Cover: PP/EVOH/PP; thickness: 0.12 mm, Barrier-properties integrated into capsule and cover</td>
</tr>
<tr>
<td>C3</td>
<td>Denner (Ø37x31)</td>
<td>Body: PP (injection molding without barrier-properties), Cover: Paper with aluminum coating; thickness: 0.03 - 0.05 mm, Secondary packaging: aluminum; each capsule is individually packed; barrier-properties integrated into secondary packaging</td>
</tr>
<tr>
<td>C4</td>
<td>Nespresso (Ø37x31)</td>
<td>Body: 99% aluminum, with thin coating of food-grade shellac, Cover: Aluminum foil; thickness 0.03 - 0.05 mm, Barrier-properties integrated into capsule and cover</td>
</tr>
</tbody>
</table>

![Graph showing the ratio of dimethyl disulfide / methanethiol over time for different capsules.]

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Freshness Index = DMDS / MeSH for Nespresso Lungo Fortissio

During roasting:
- Drying
- Formation of CO₂ (a few percent are CO)

\[
\begin{align*}
\text{CO}_2: & \quad 0 \% \text{ weight, } 1-2 \\
\text{H}_2\text{O}: & \quad 12 \quad 1-2
\end{align*}
\]
Measuring Freshness by Weighing Coffee

*Physical freshness marker*

The story of CO₂ from green to old coffee (Arabica coffee)

- **Loss from roasting to grinding** (0.15 mg/g)
- **Loss during grinding** (7.6 mg/g)
- **Loss from grinding to first measurement** (0.20 mg/g)
- **CO₂ degassing in R&G** (2.7 mg/g)

<table>
<thead>
<tr>
<th>Time / h</th>
<th>Loss (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>60</td>
<td>4</td>
</tr>
<tr>
<td>80</td>
<td>2</td>
</tr>
<tr>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

Specific mass loss over time.
Weight Loss of Arabica Whole Beans

Specific mass loss / (mg/g)

0 48 96 144 192 240 288 336 384 432

Time / h

Medium to dark roast (85 Pt; Colorette)

18 days of degassing

10 mg/g corresponds 1 % weight loss

18 days

10 days