The Quest for Freshness

A Scientific Approach to Coffee Freshness

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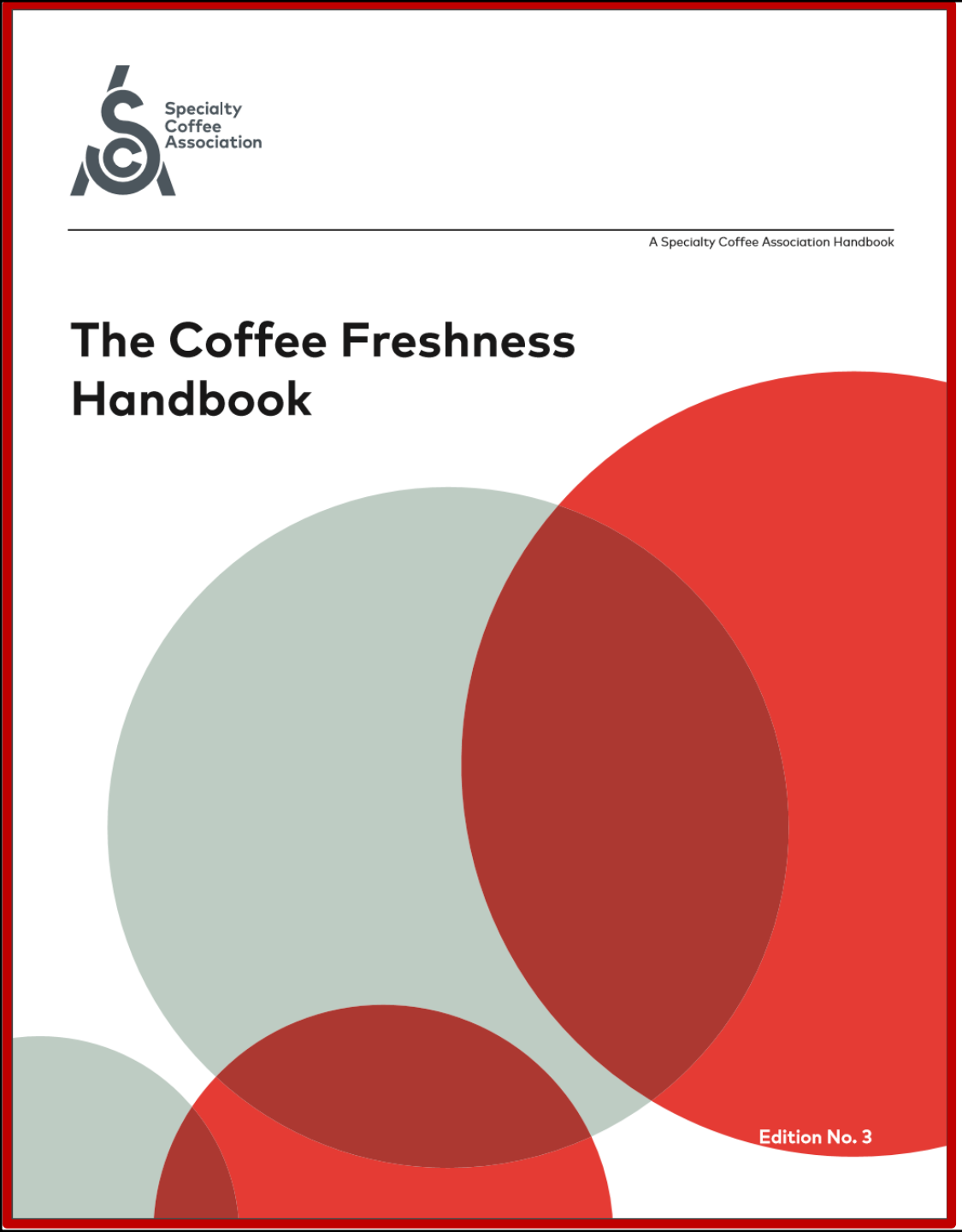
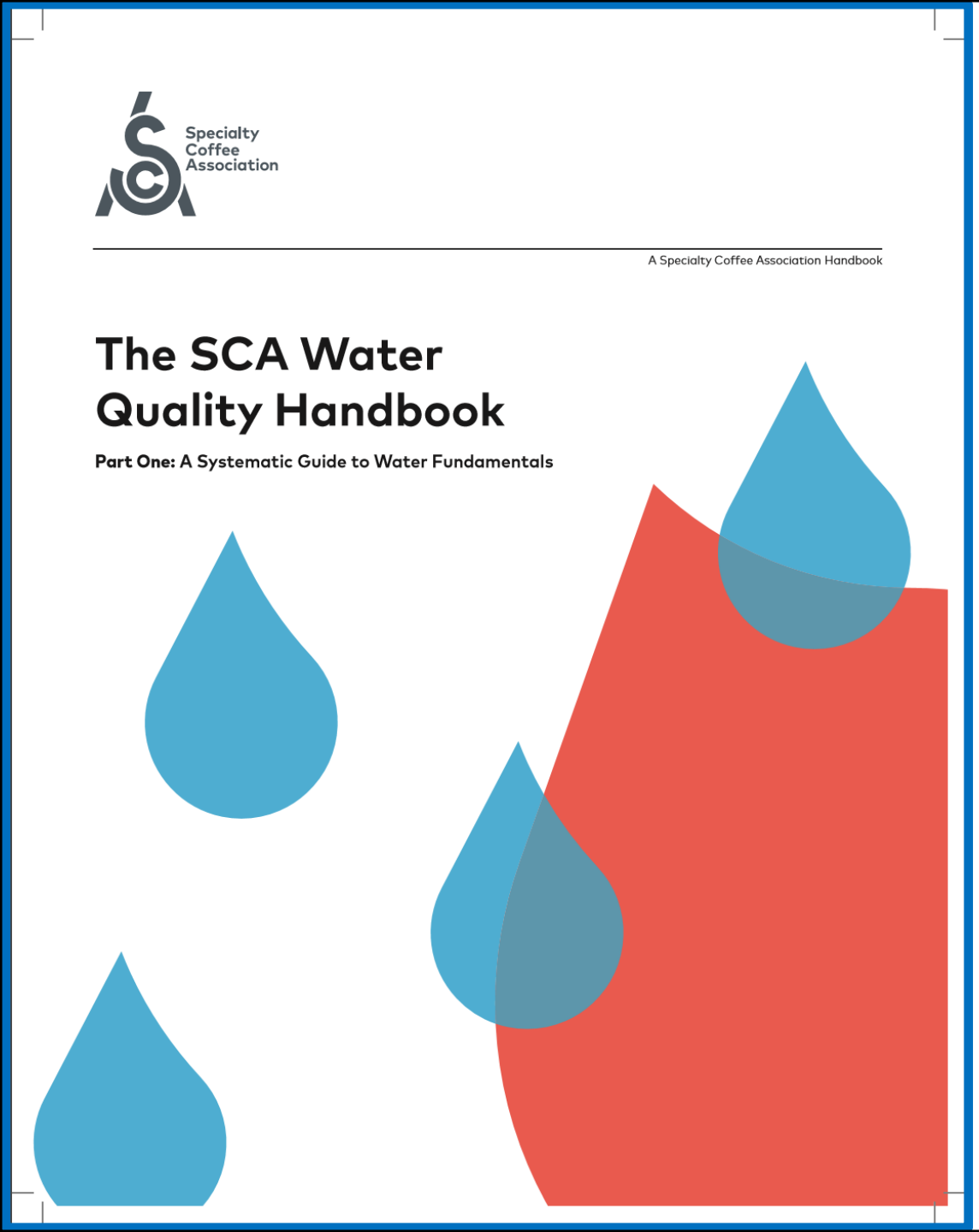
Specialty Coffee Association



Dr. Samo Smrke
Emma Sage
Dr. Marco Wellinger
Prof. Dr. Chahan Yeretzian



Dr. Marco Wellinger
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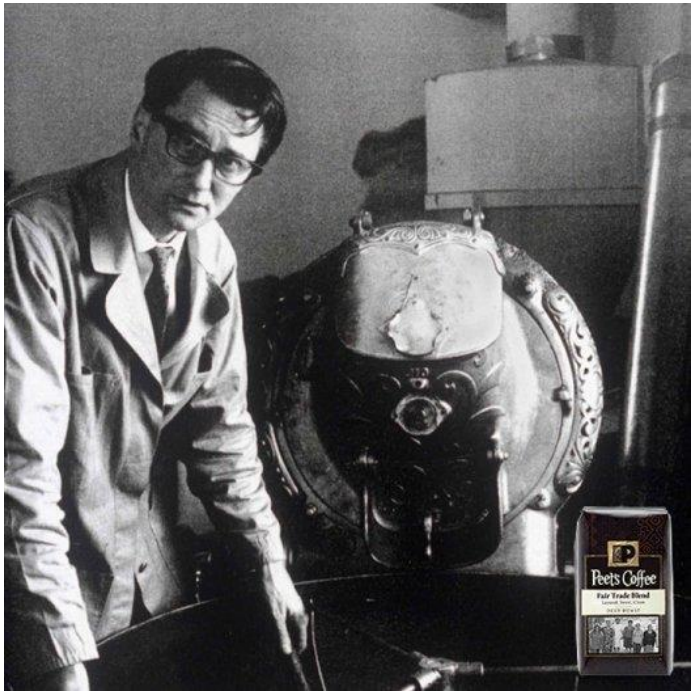
The secret to great coffee is the people who make it



It All Began … when *Alfred Peet* opened Peet's Coffee & Tea in Berkeley, 1966
His coffee was unlike anything Americans had ever tasted before – small batches, fresh beans, …

His philosophy: to have the shortest distance between roaster and customer

Peet taught roasting to Jerry Baldwin, Zev Siegl and Gordon Bowker ⇒ Founded 1971 Starbucks in Seattle

… selling fresh-roasted whole beans to local customers

Why do we care about freshness?

- Is the at the origin of the specialty coffee movement
- Is a highly sought-after quality for coffee
- Has become a competitive advantage

How do we define freshness?

Freshness is often defined by the <u>process</u>:

How can one measure freshness of coffee?

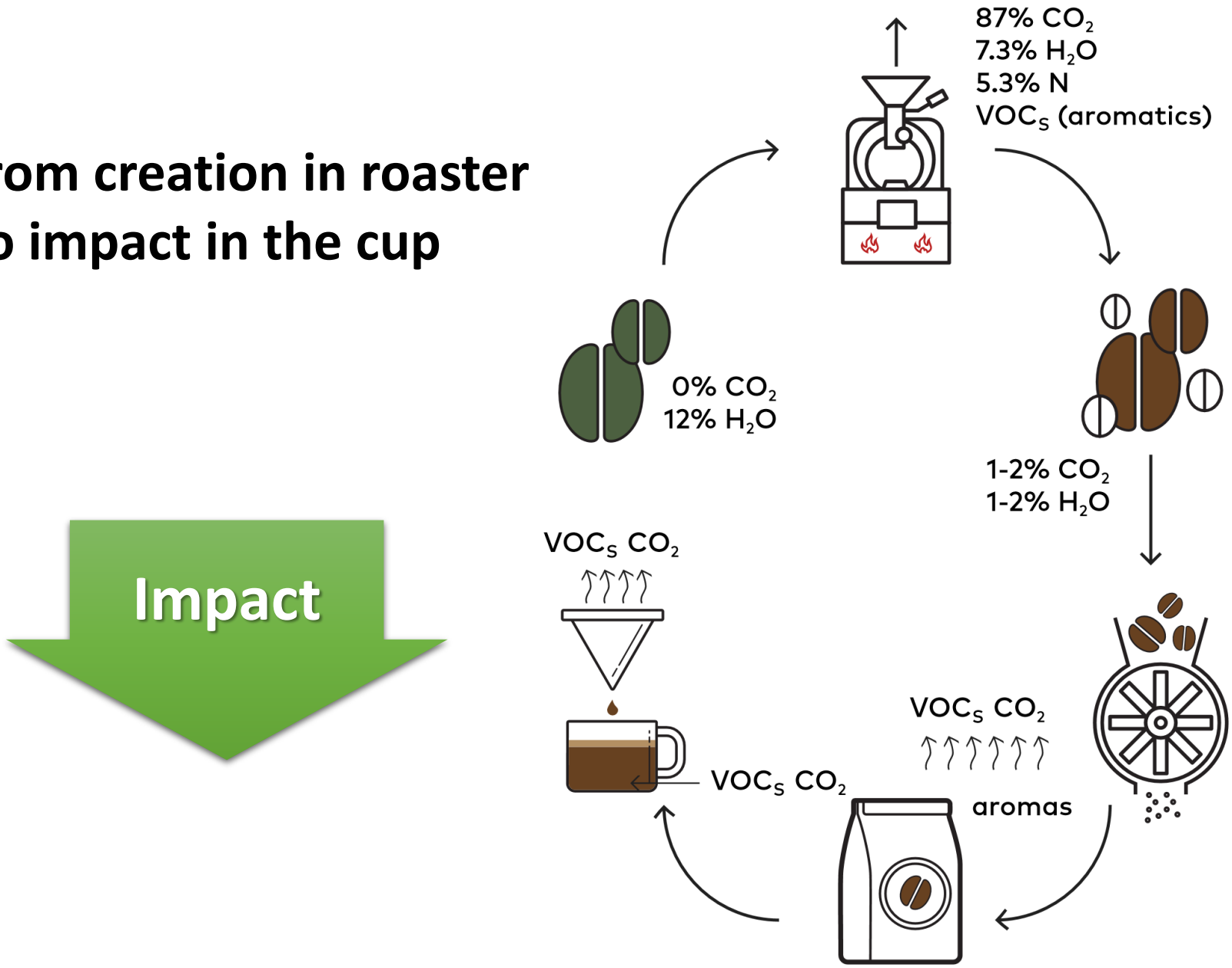
Markers of Freshness: CO_2 and Aroma

Freshness is best defined

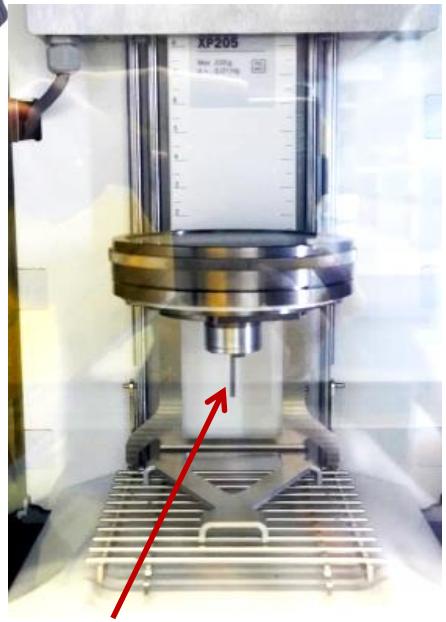
- as having original unimpaired qualities
- by the level of closeness to the original product

Measuring CO_2 and aroma along their journey

- from creation in roaster
- to impact in the cup



Measuring freshness by weighing - A gravimetric method

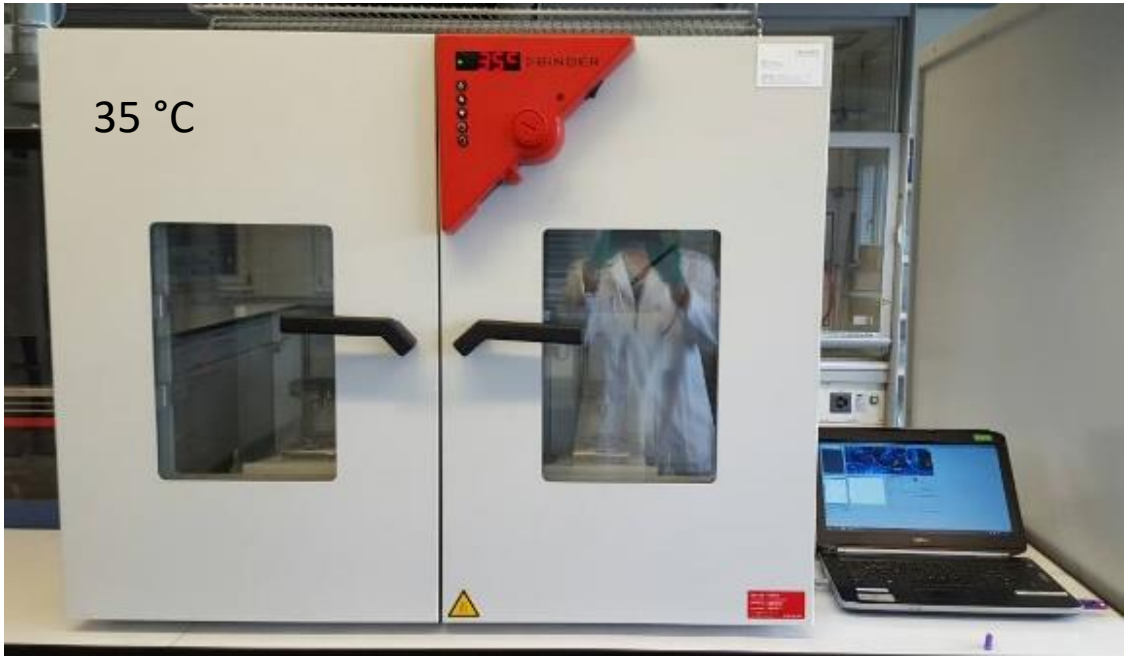


Mimics degassing from pack with a release valve

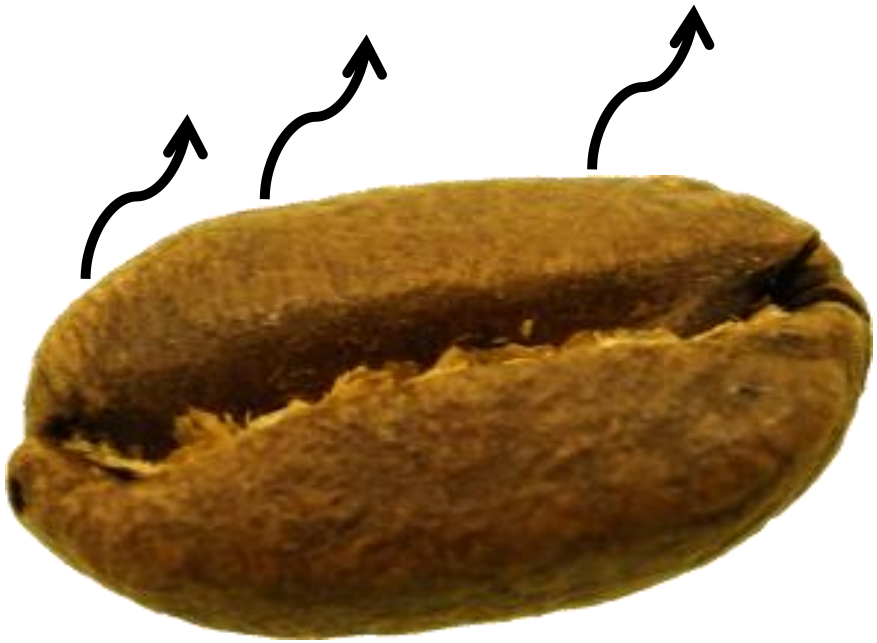
Capillary to release degassed CO_2

Probatino drum roaster (1kg-batch)

Measuring freshness by weighing - A gravimetric method



CO_2

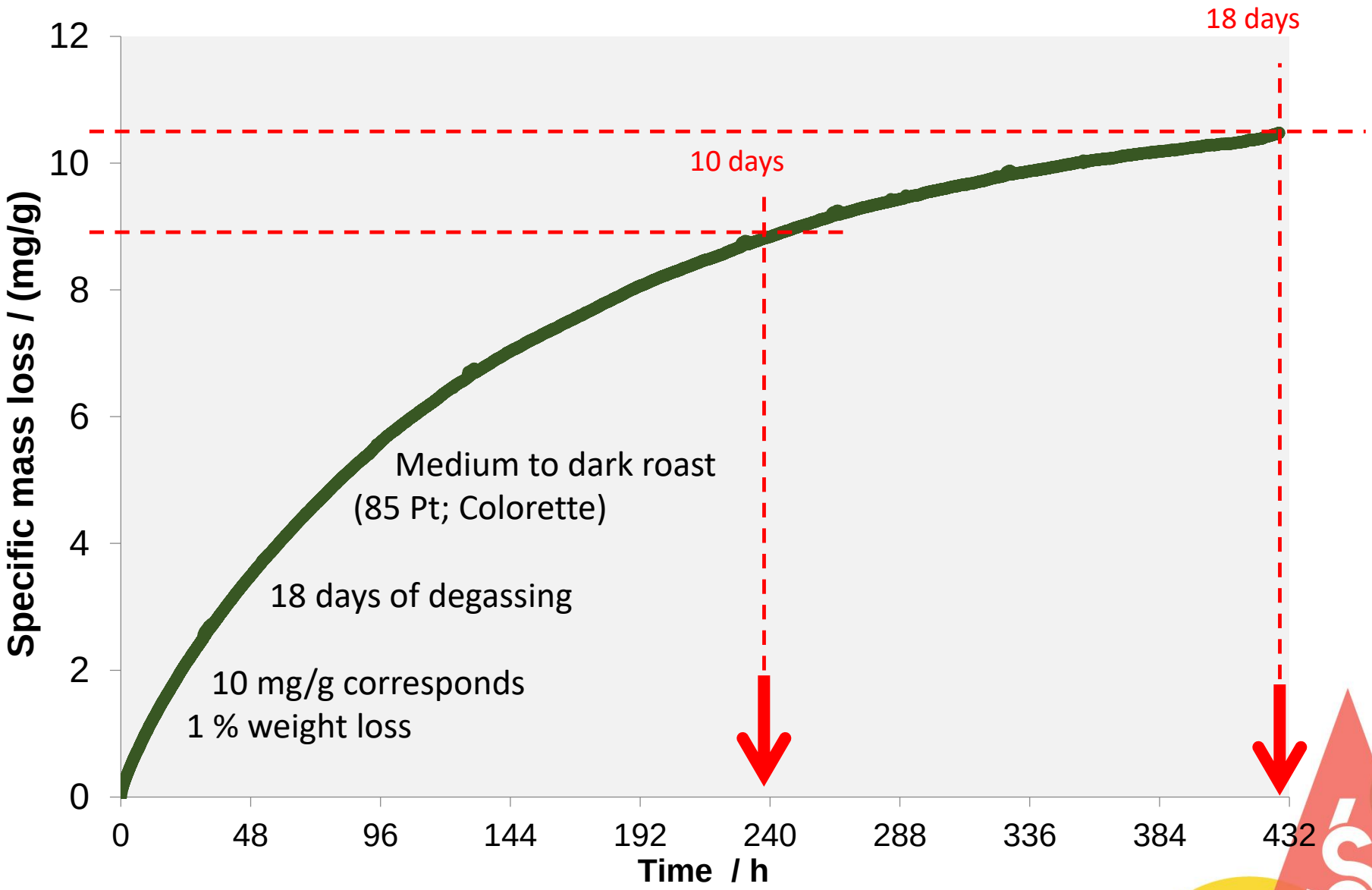


Whole Beans

Experimental plan – whole beans (Arabica, El Salvador)

	Fast 5 - 6 min 300 – 360 s	**Medium** 9 - 10 min 540 – 600 s	**Slow** 11 - 13 min 660 – 780 s
Light Roast (CT 130Pt)			
Medium Roast (CT 100Pt)			
Dark Roast (CT 80Pt)			

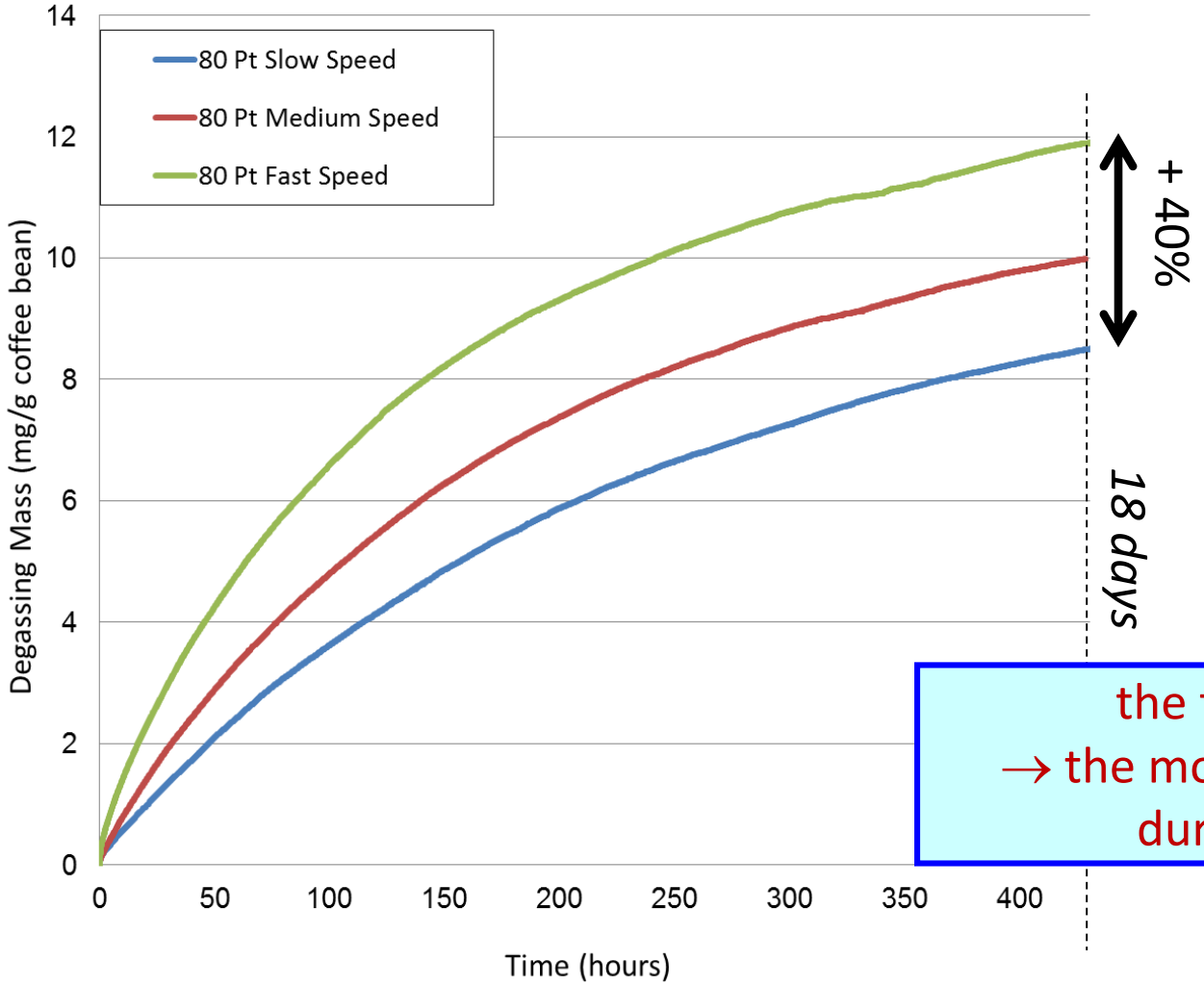
Weight loss of Arabica whole beans



Dark Roast Degree

Degassing of whole beans

Arabica – impact of roast profile (speed)



6 min roast time

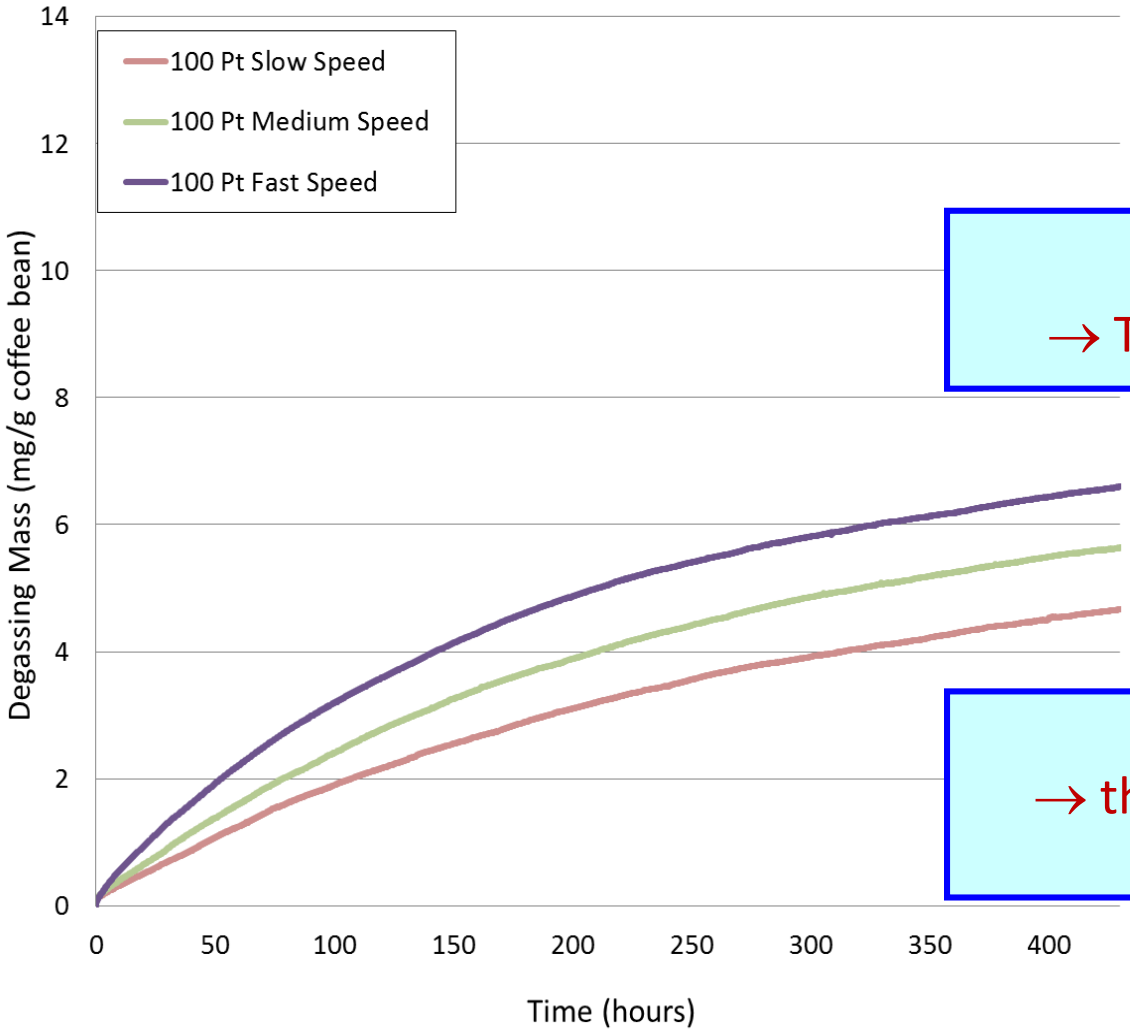
10 min roast time

15 min roast time

the faster the roast
→ the more CO_2 is released during storage

Degassing of whole beans

Medium Roast Degree



the lighter the roast
→ The less CO_2 is released

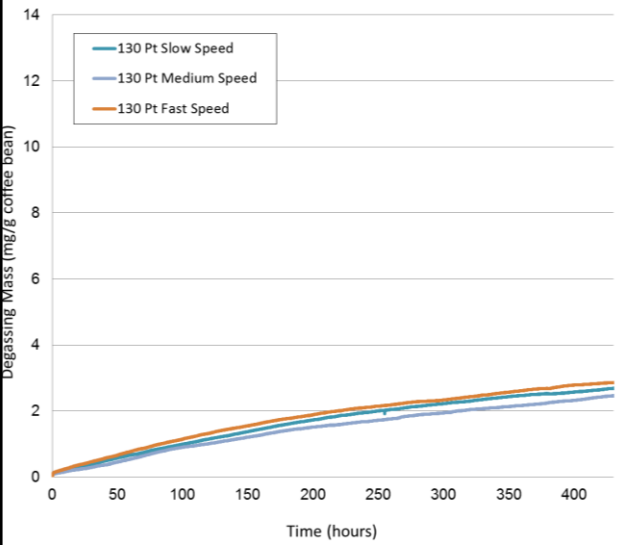
the faster the roast
→ the more CO_2 is released during storage

Degassing of whole beans

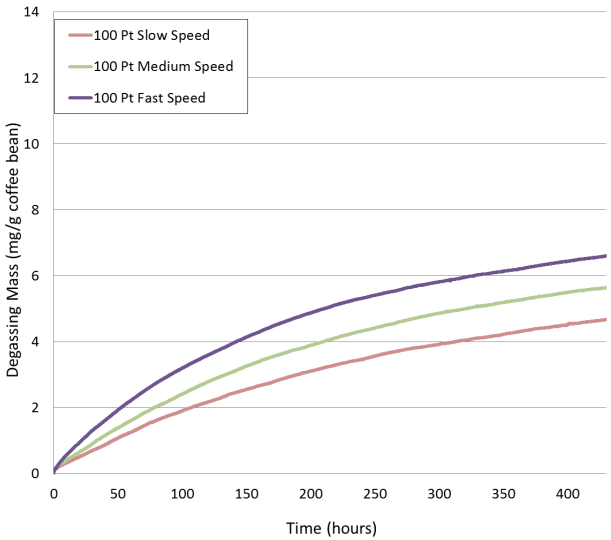
Arabica – impact of roast profile (variable speed – same roast colour)

Roast degree

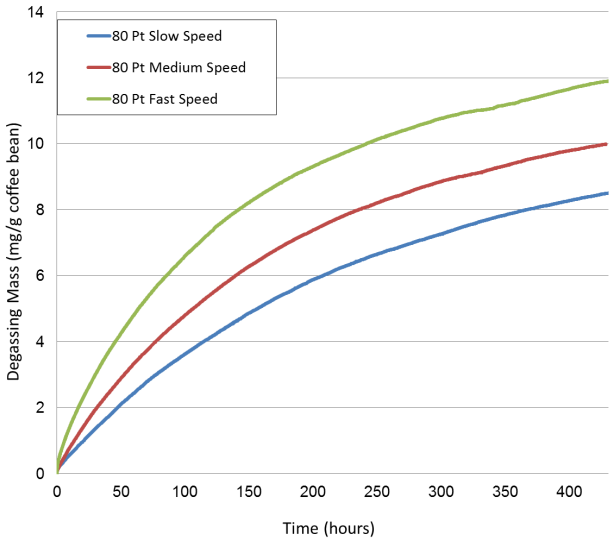
Light roast



Medium roast



Dark roast



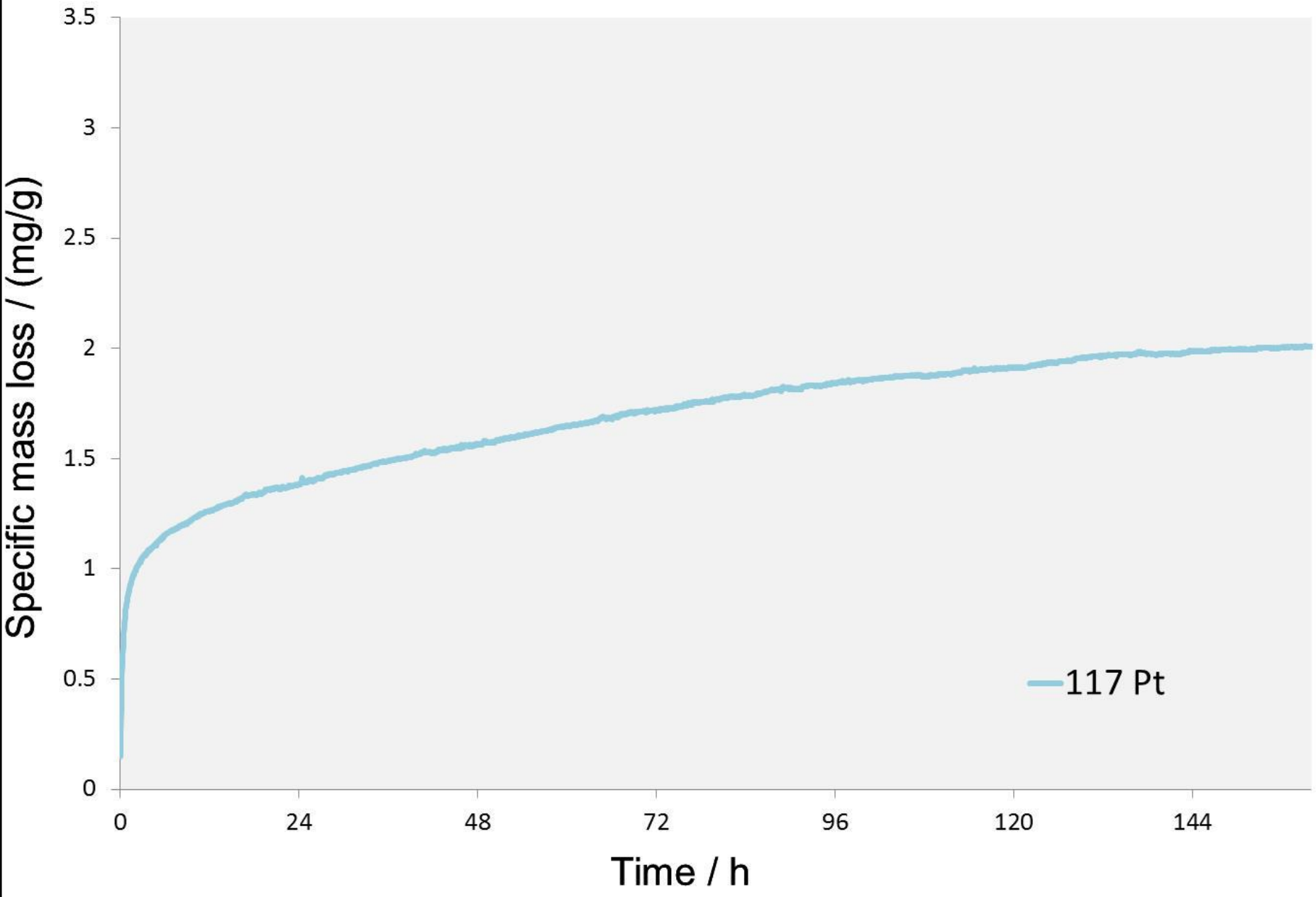
Degassing measured up to 20 days – still further degassing occurring after this period

- Strong impact of roast degree on degassing
  - 8-12 mg/g dark roast (1 %)
  - 5-7 mg/g medium roast (0.5 %)
  - 2-3 mg/g light roast (0.25 %)
- Impact of roasting speed on degassing: the faster the roast the more degassing

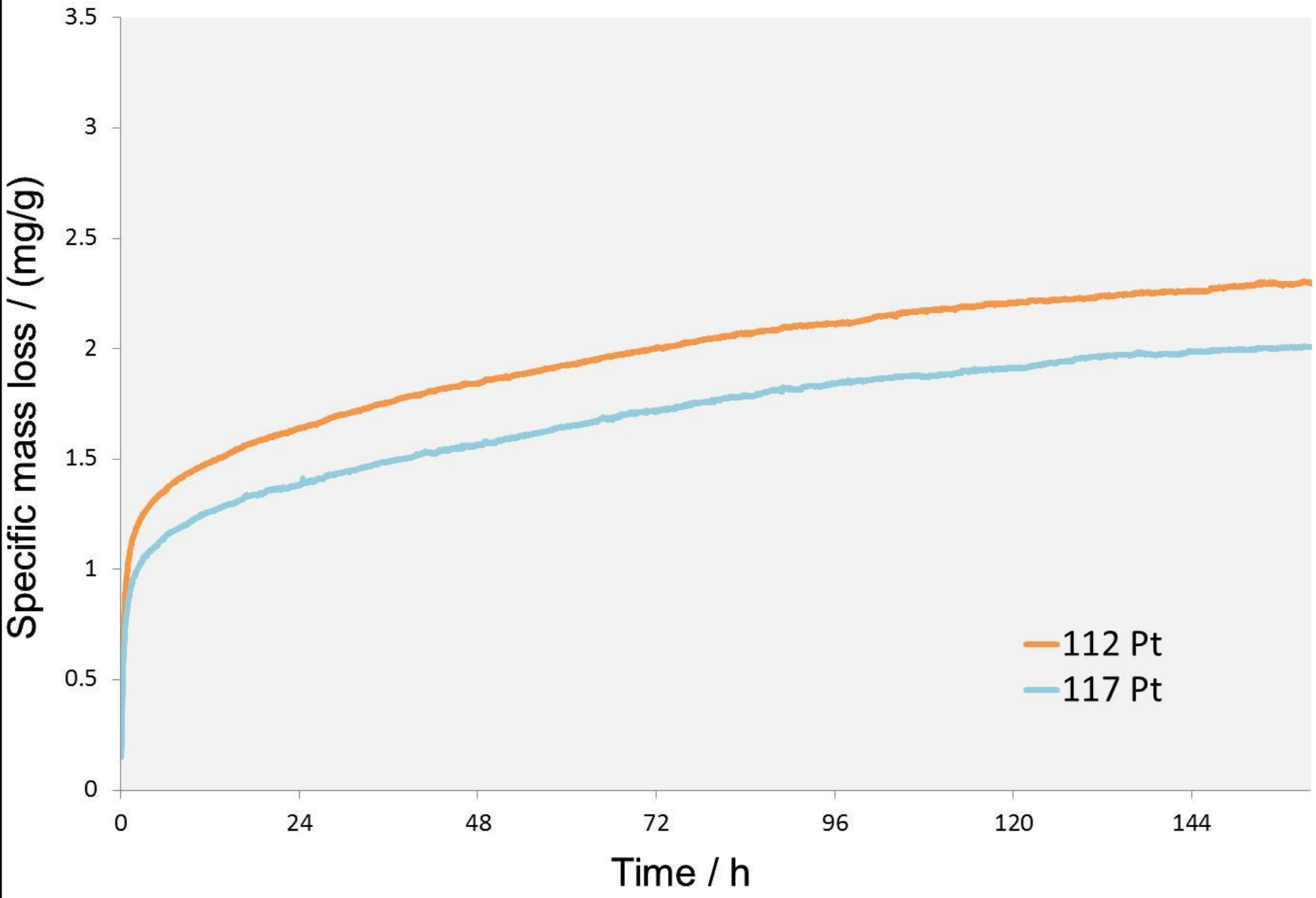
CO_2

Roast & Ground Beans

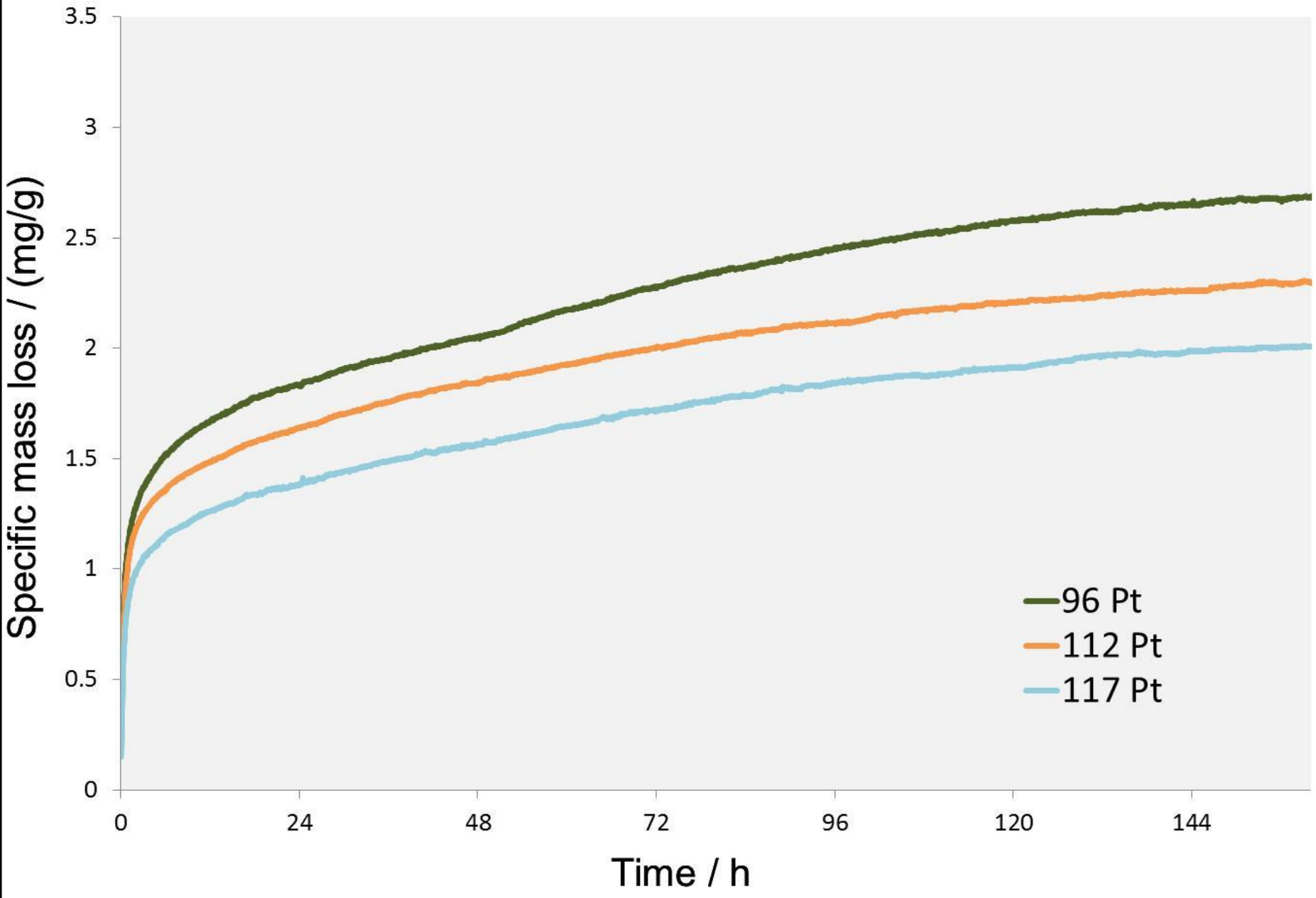
Degassing of ground coffee → gravimetric measurement of loss of freshness - Arabica



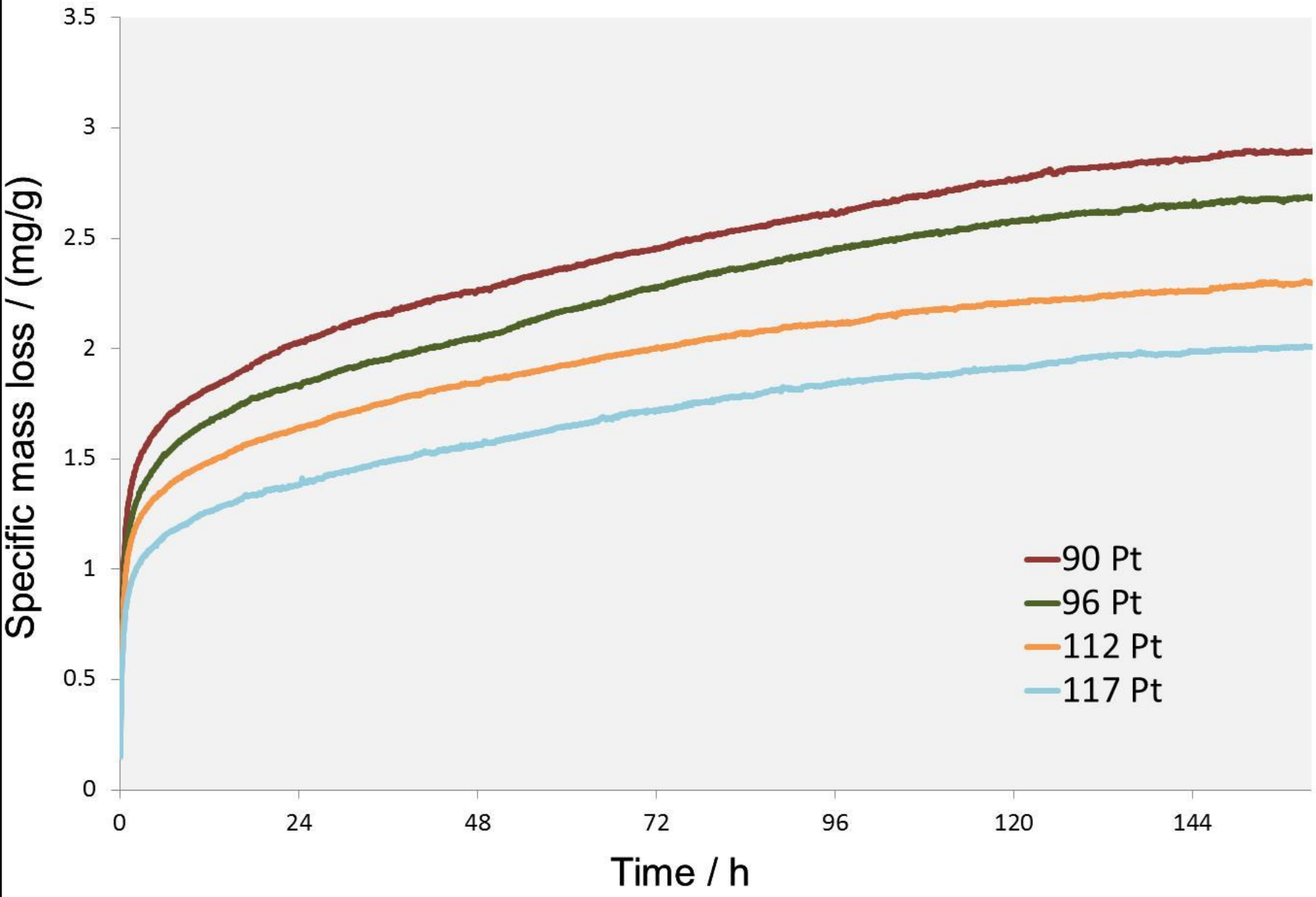
Degassing of ground coffee → gravimetric measurement of loss of freshness - Arabica



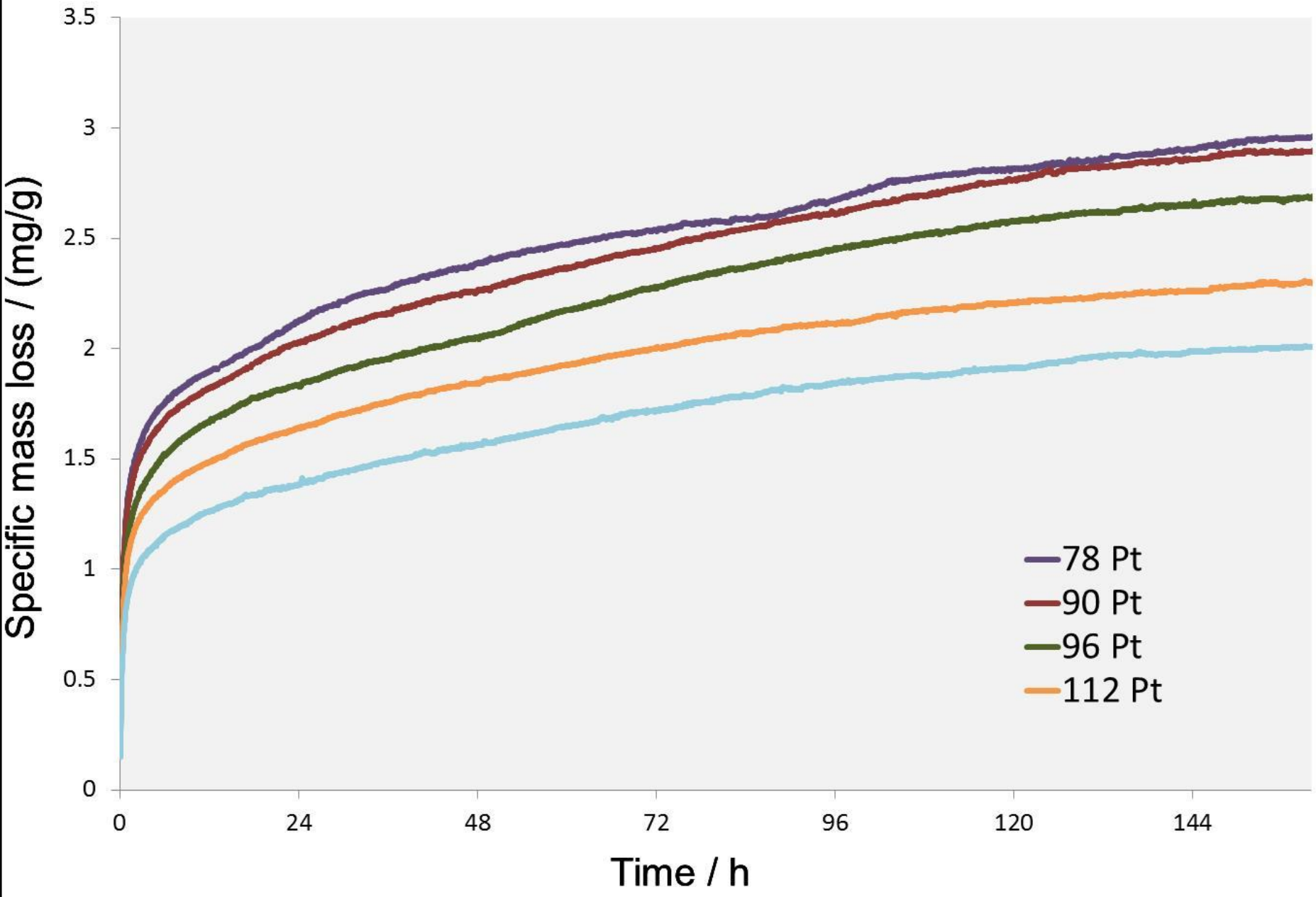
Degassing of ground coffee → gravimetric measurement of loss of freshness - Arabica

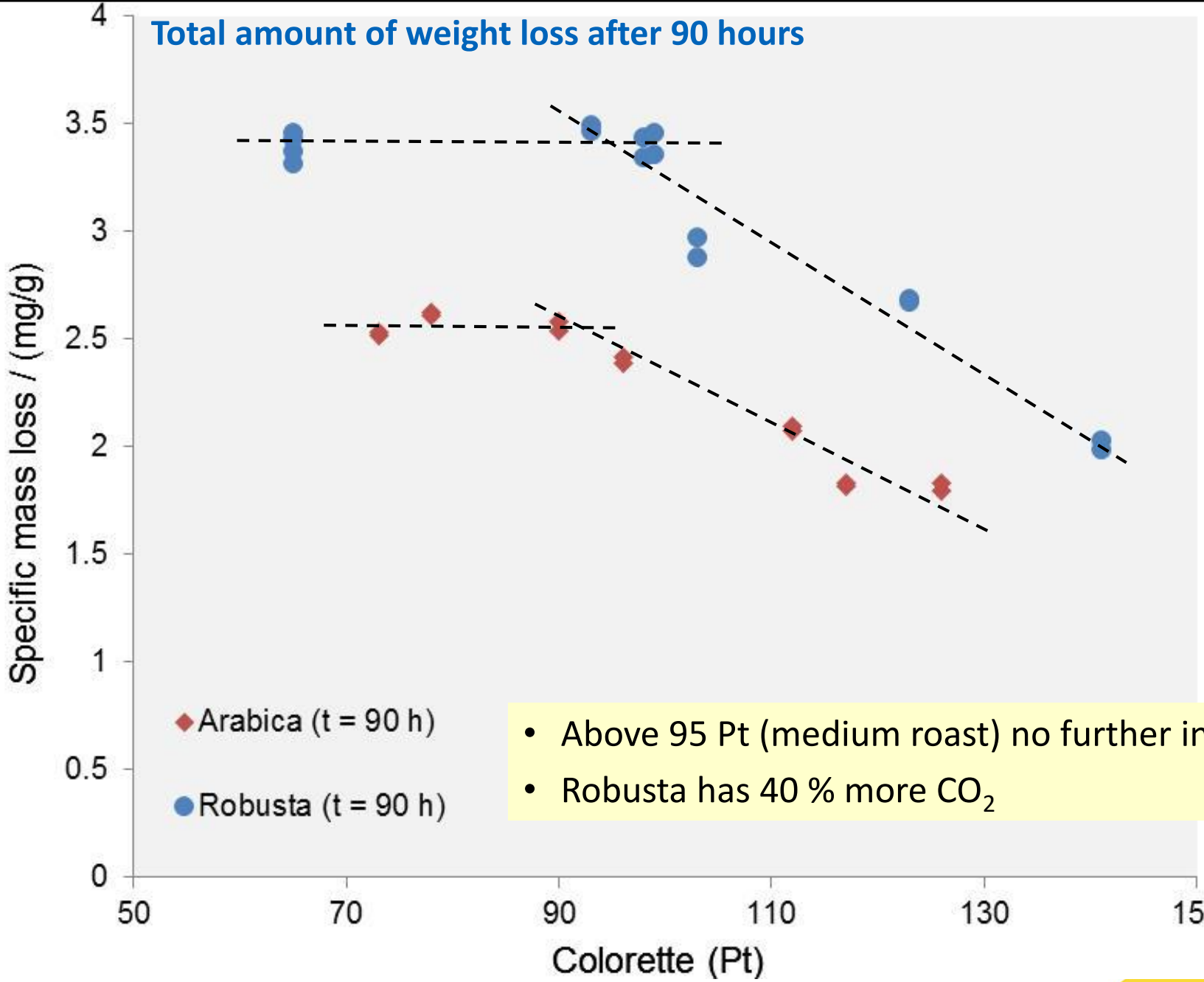


Degassing of ground coffee → gravimetric measurement of loss of freshness - Arabica

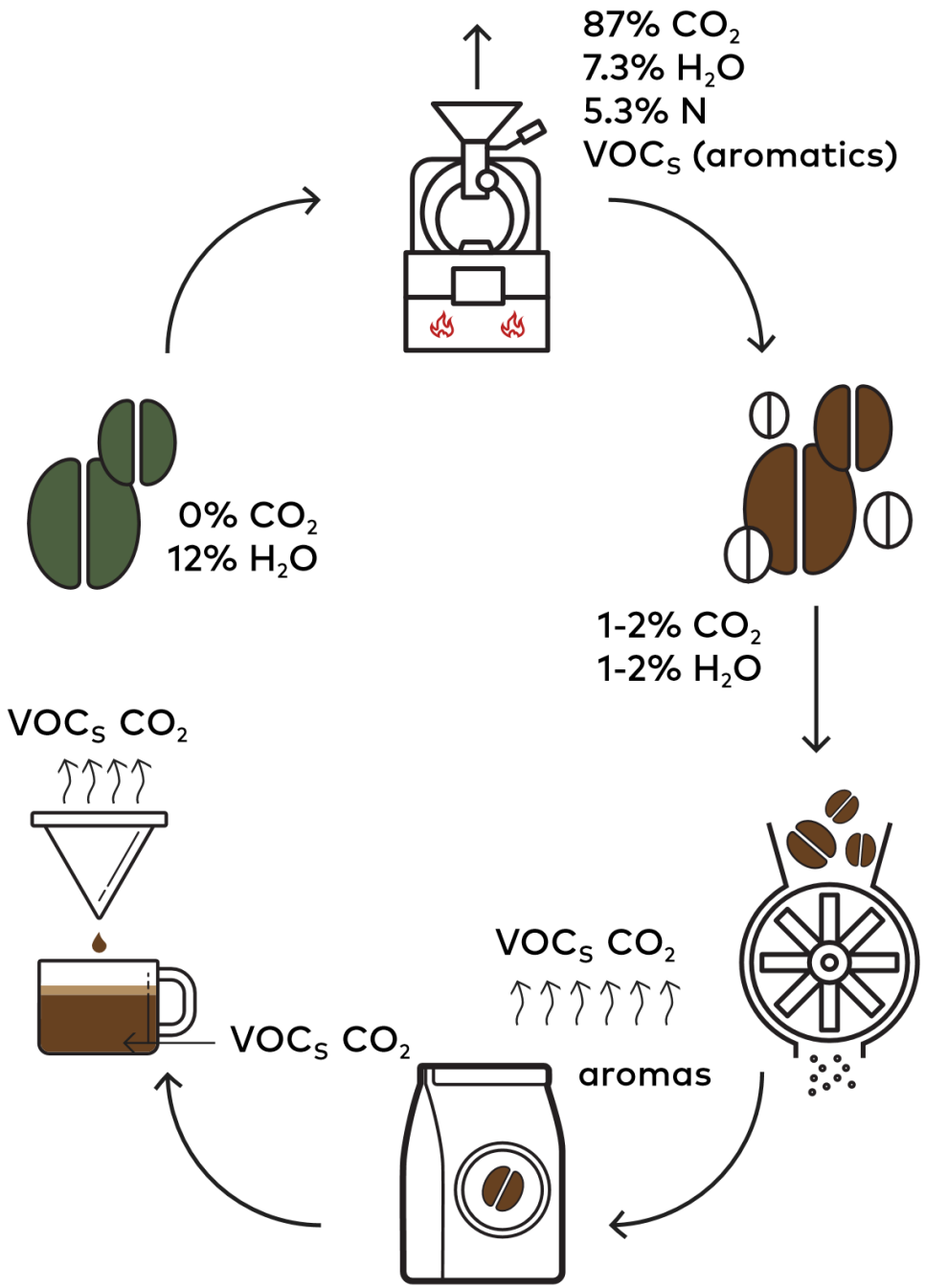


Degassing of ground coffee → gravimetric measurement of loss of freshness - Arabica





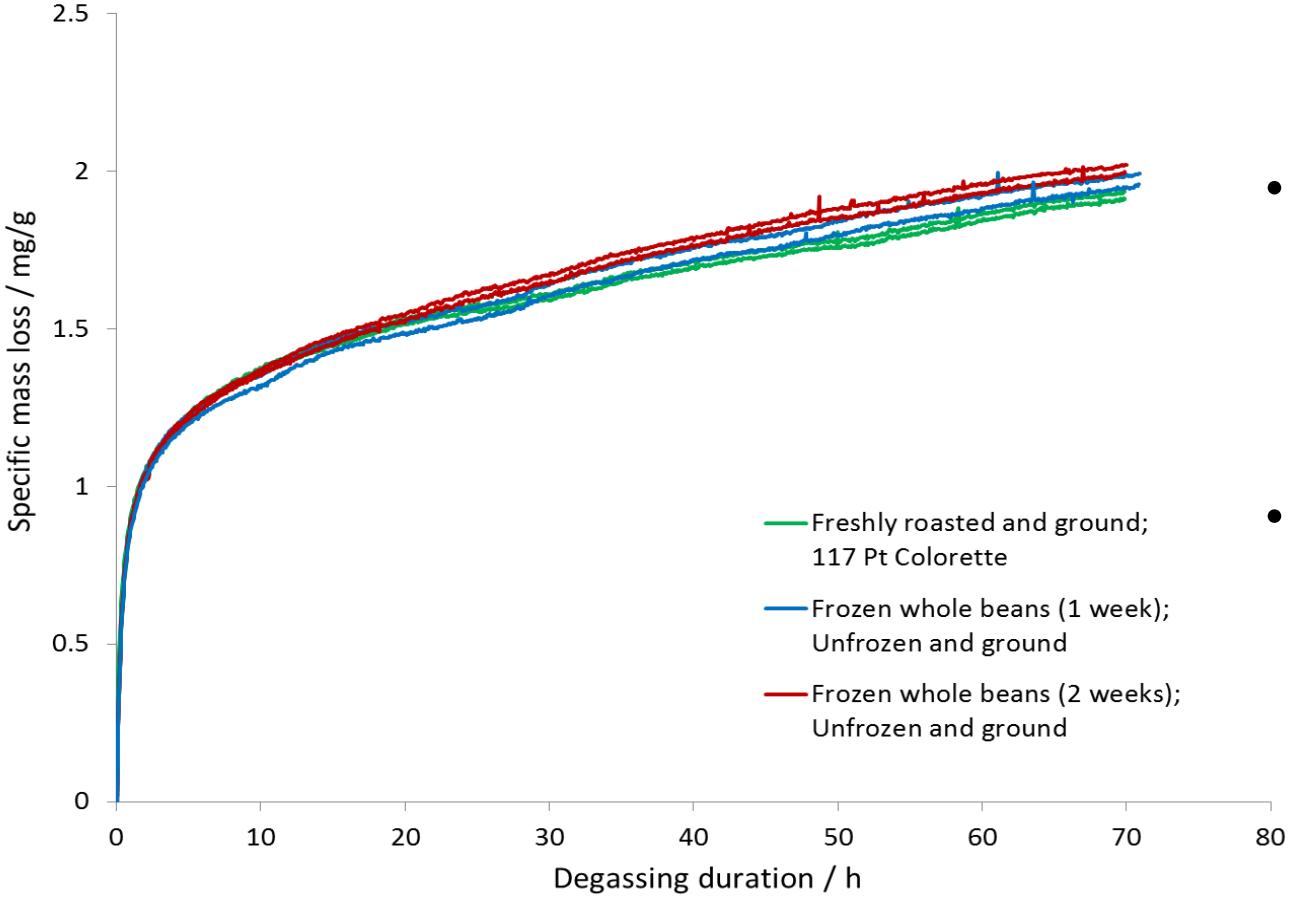
- Above 95 Pt (medium roast) no further increase
- Robusta has 40 % more CO_2



Implications on

- Processing
- Cup

Degassing of R&G from whole beans stored in freezer at -25 °C / -15 °F



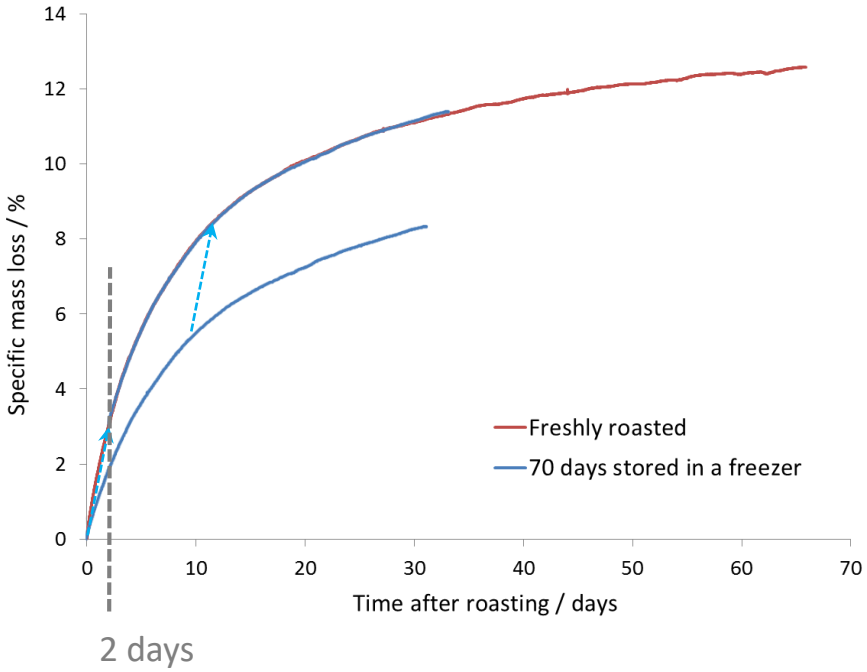
- Cooling (freezing?) roasted coffee beans greatly reduces the degassing rate
- The process does not appear to impact the amount and the kinetics of degassing from R&G coffee

Degassing of whole beans after stored in a freezer (-25 °C / -15 °F)

Coffee stored for 70 days at -25 °C

releases the same amount of gas as

freshly roasted coffee stored at 35 °C for 2 days



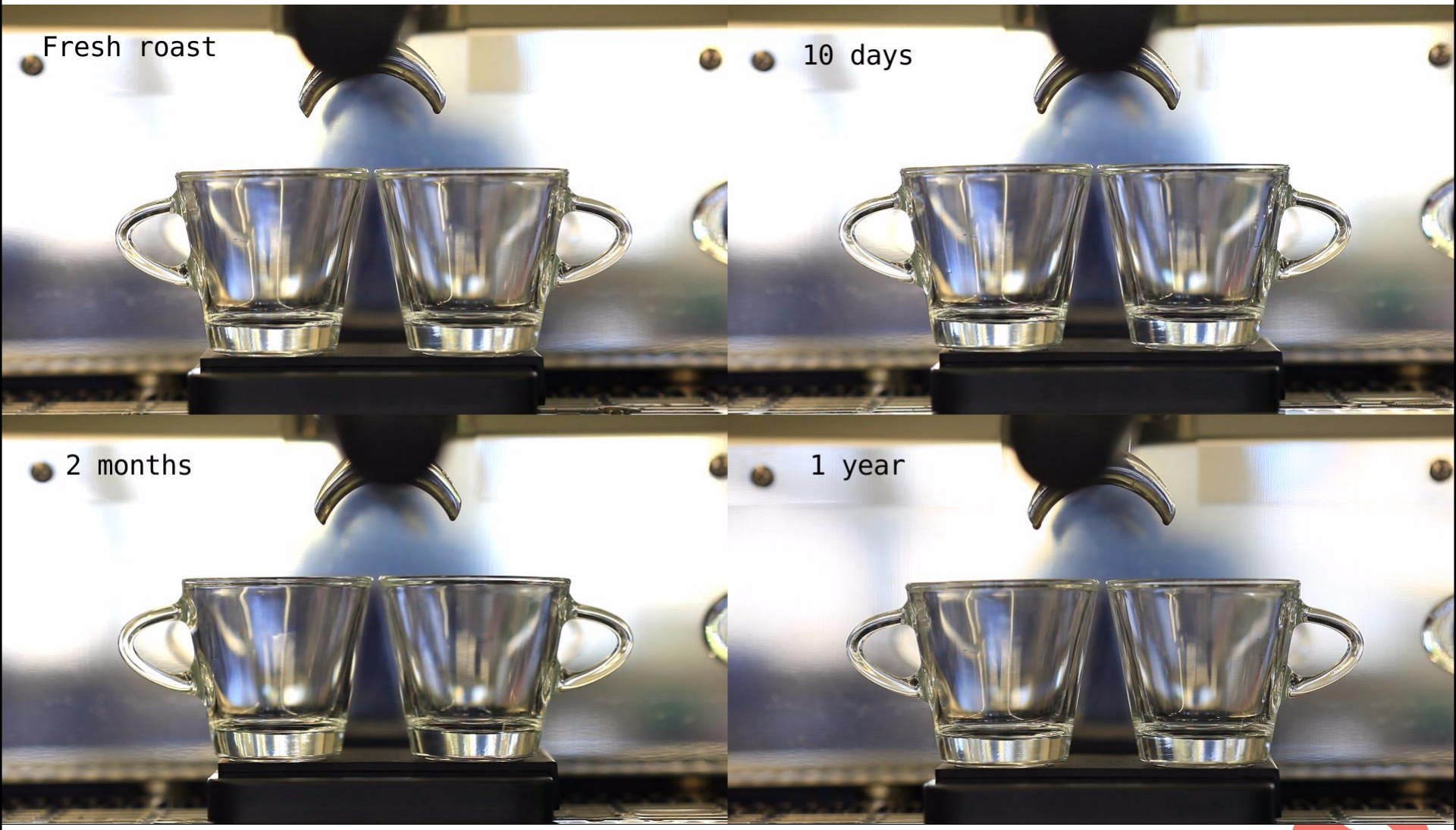
~2 faster per 10 °C increase

- **Freshly roasted whole beans**
- **Whole beans degassing at 35 °C**
- **Stored at –25 °C for 70 days**

Coffee stored at -25 °C still does degas
… but significantly slower than at 35 °C

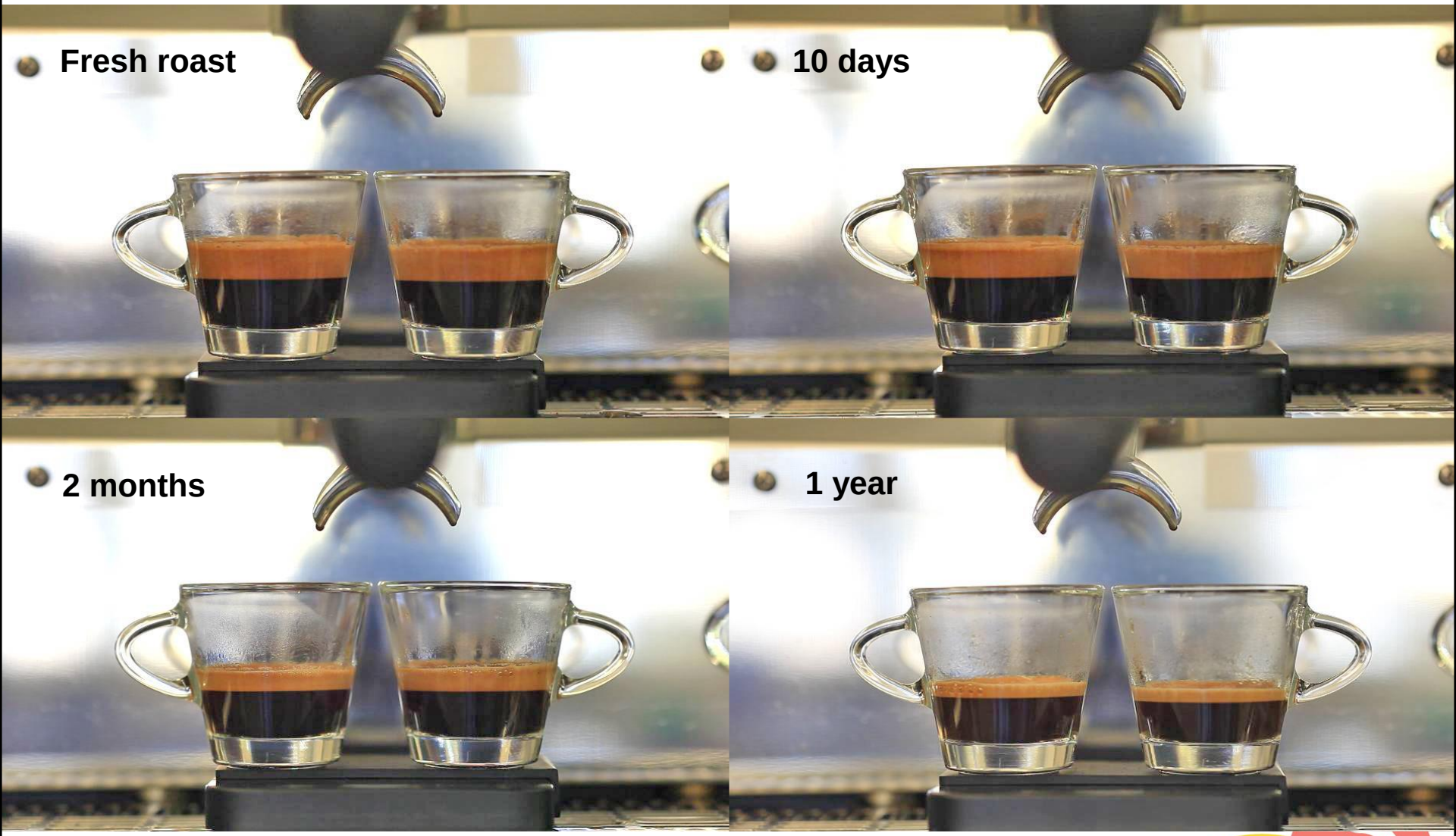
Freshness and espresso extraction

Impact of freshness on crema formation

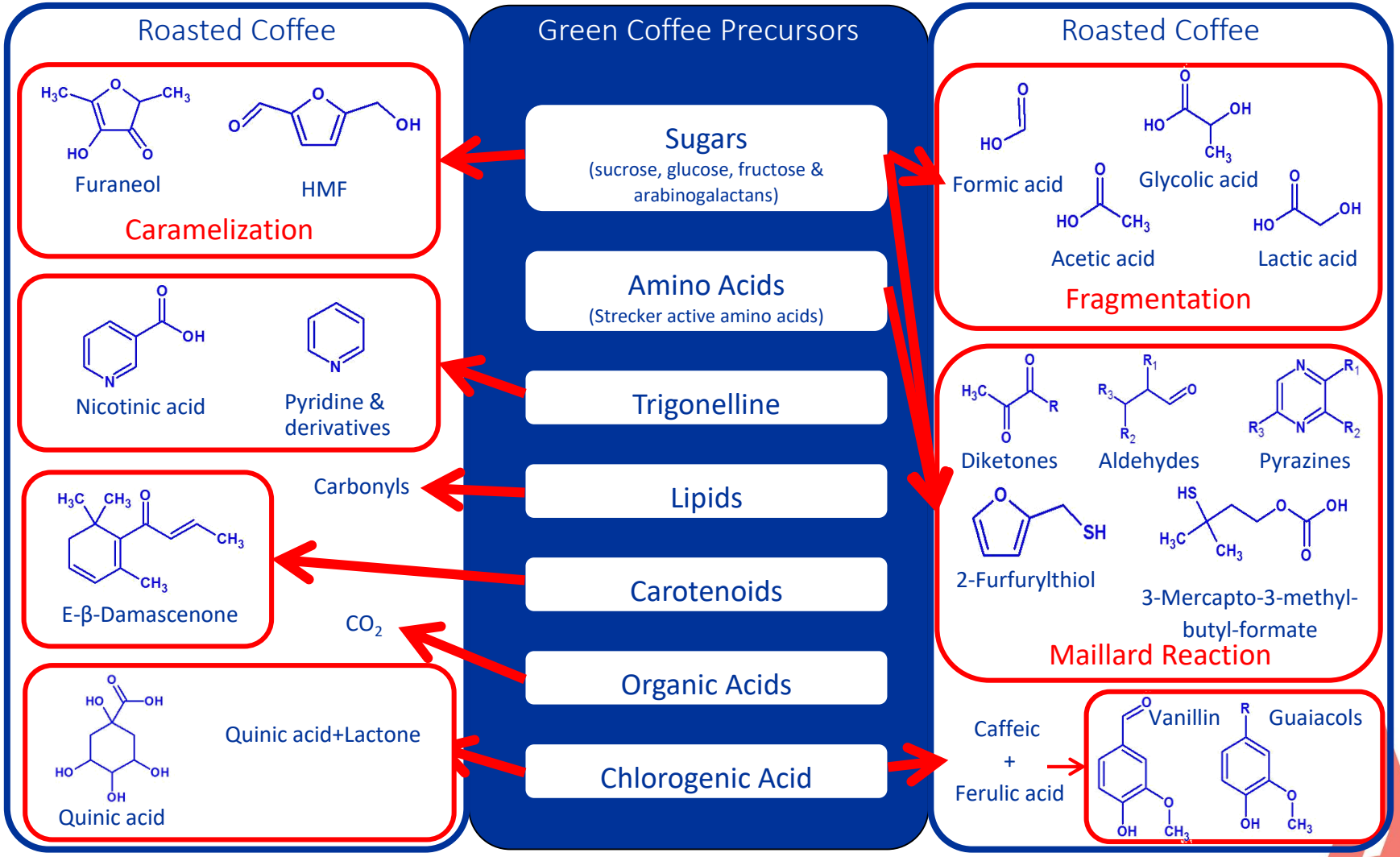


Freshness and espresso extraction

Impact of freshness on crema formation0



Aroma formation: from precursors to aroma compounds

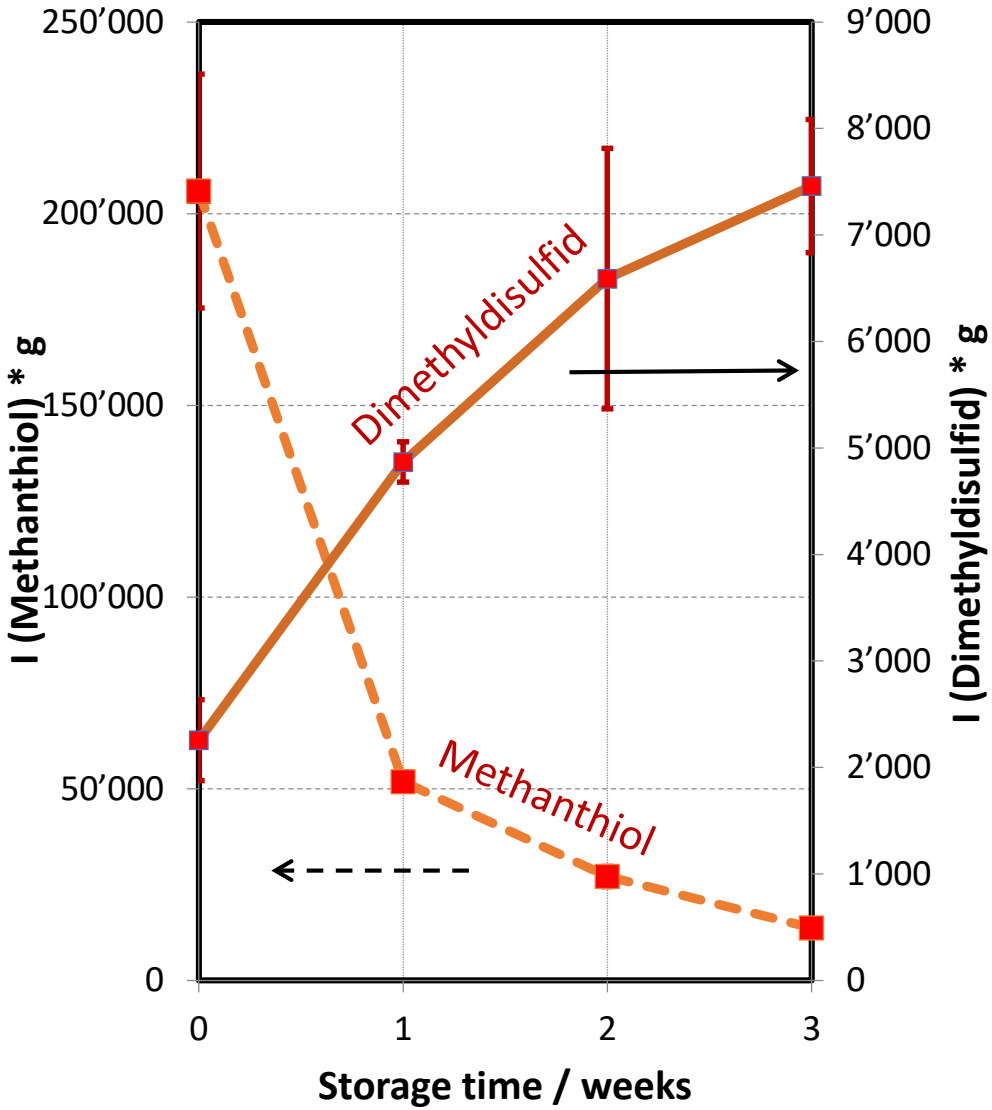


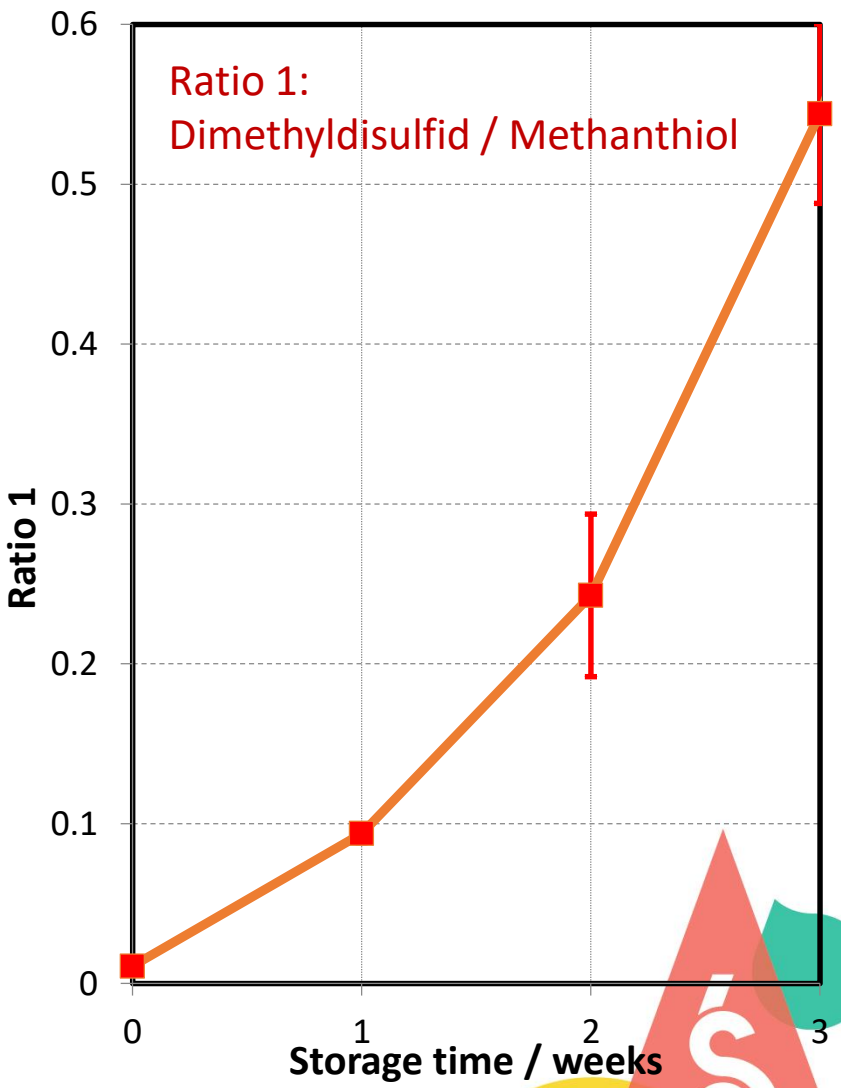
Chemical markers: “Freshness indices” related to coffee aroma

Ratio 1: Dimethyl disulfide / Methanethiol

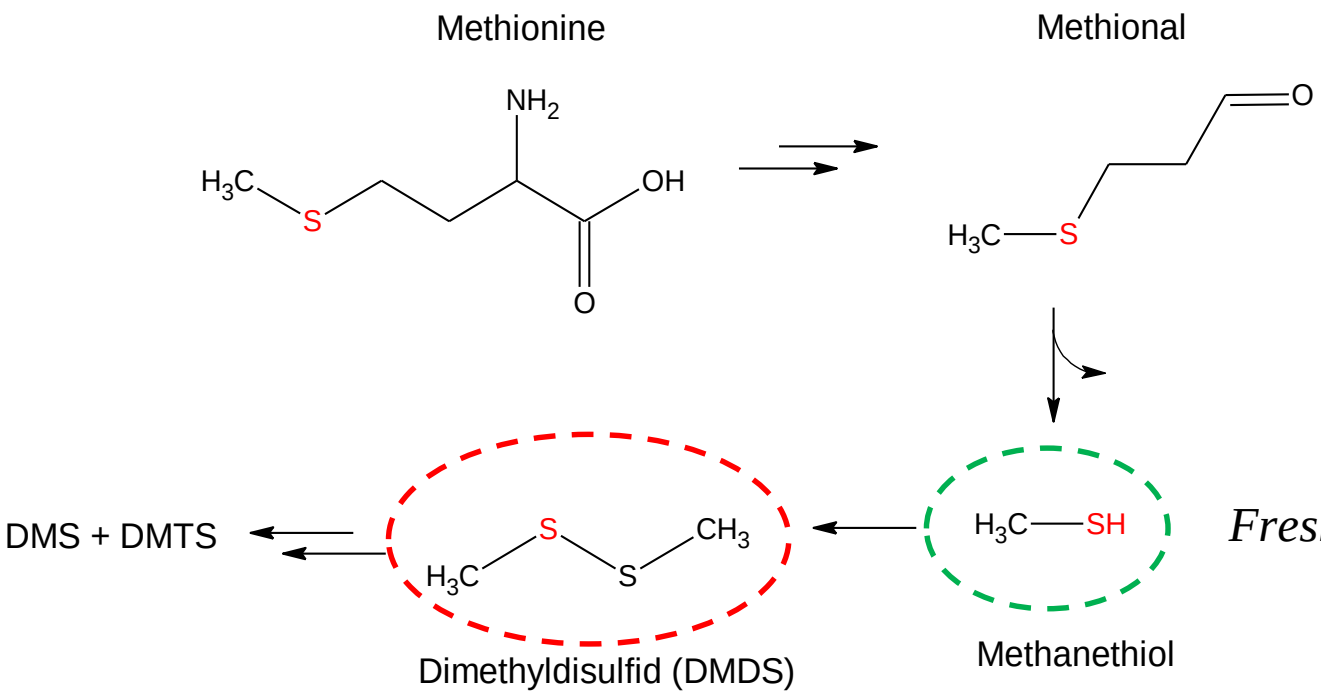
Compounds	Odor	Volatility	Reactivity
2,3-Butanedione	buttery, creamy, fatty, oily, sweet, vanilla, caramel	low	low
Dimethyl disulfide	sulphurous, onion, garlic, burnt rubber	medium	high (ox.)
Methanethiol	sulphurous, rotten eggs, fish, cabbage, garlic, cheesy	high	very high (ox.)
2-Methylfuran	burnt, ethereal, gasoline, acetone, chocolate	very high	very low

Dimethyldisulfid and Methanthiol (Medium roast degree: Pt 95)





Chemistry of freshness index - Dimethyl disulfide / Methanethiol



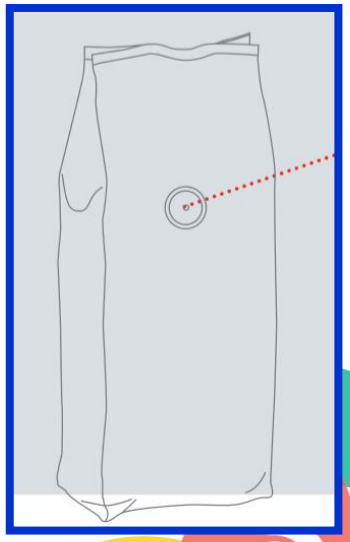
$$Freshness\ Index = \frac{DMDS}{MeSH}$$

Storage of whole beans: aluminium packaging with valve

- Ethiopian Limu, Washed, Grade 2, Arabica

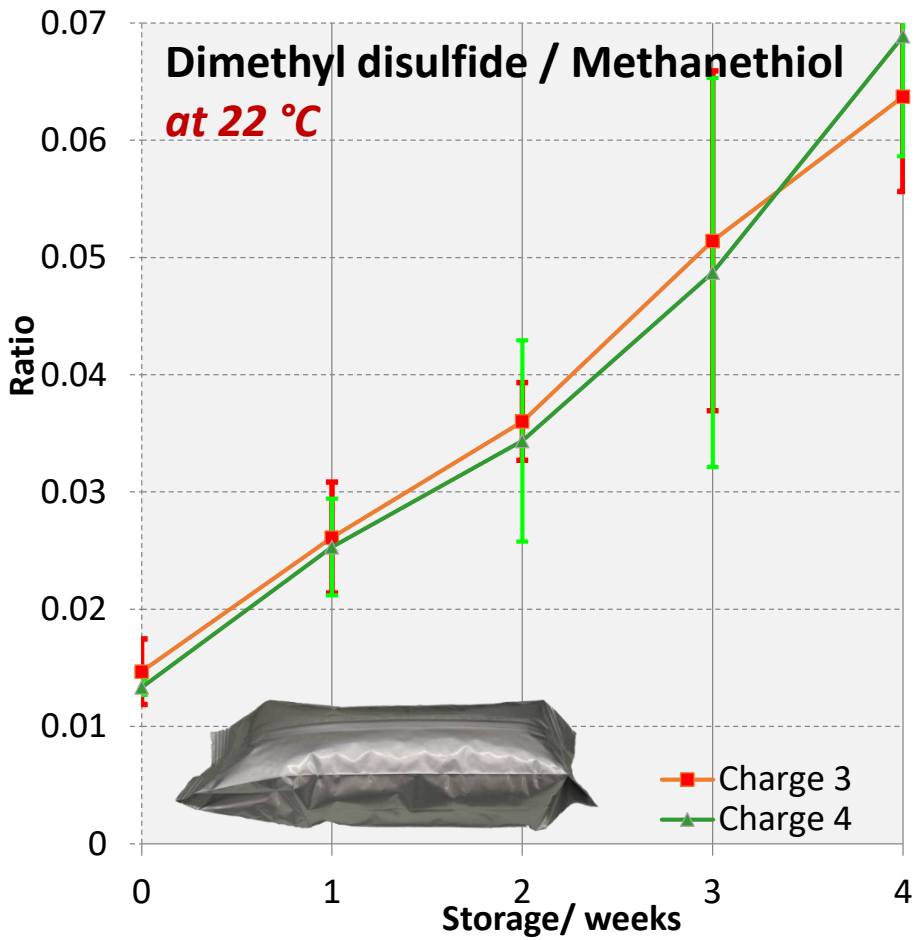
- Roasted on a 1-kg batch size Probatino
- Roast degree 93 Pt (Colorette), medium roast
- 65 g roasted whole beans in each pack

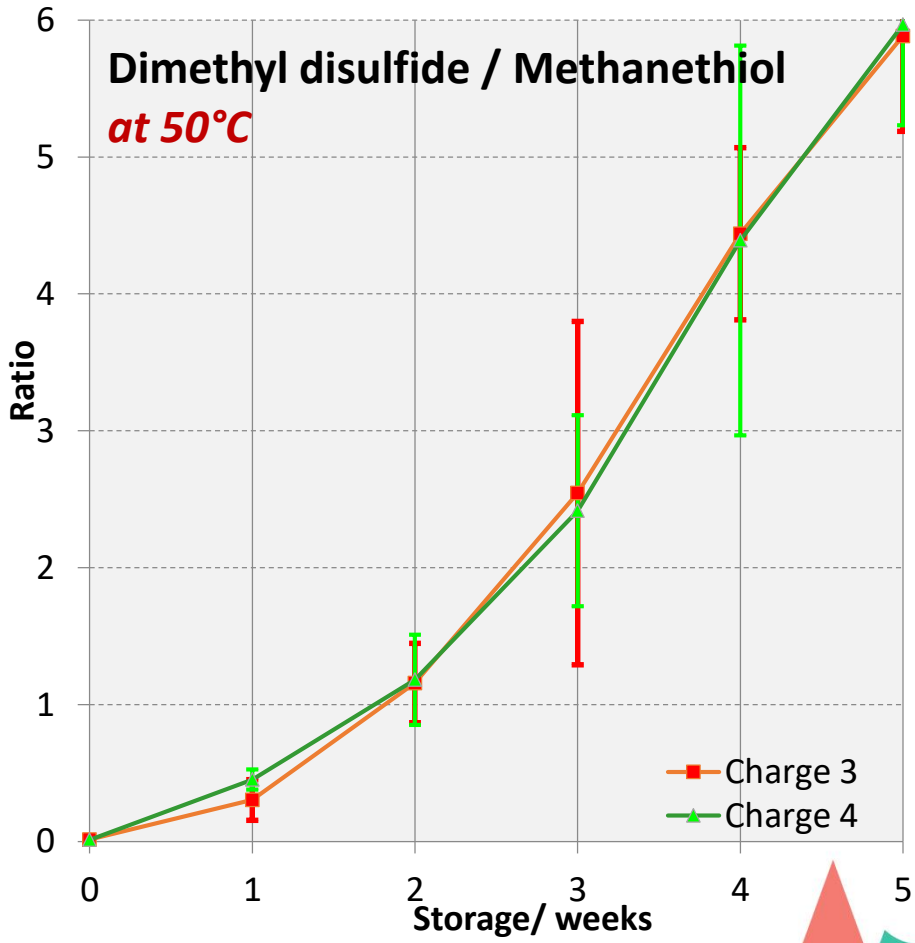
- Packaging: plastic composite film with thick aluminum layer
- Valve
- Heat sealed
- Stored at 22 °C and 50 °C



Evolution of ratio: Dimethyl disulfide / Methanethiol

stored 22 °C and 50 °C





- ~ 10-fold increase when going from 22 °C to 50 °C
- Sensitive freshness index : significant changes within 1 week (suited for specialty coffee)

Vertical Roasters, Switzerland
San Jerónimo, Guatemala
Catuaí, Espresso Roast

grinding

Ditting KR 805
grinding fineness: 5

sampling

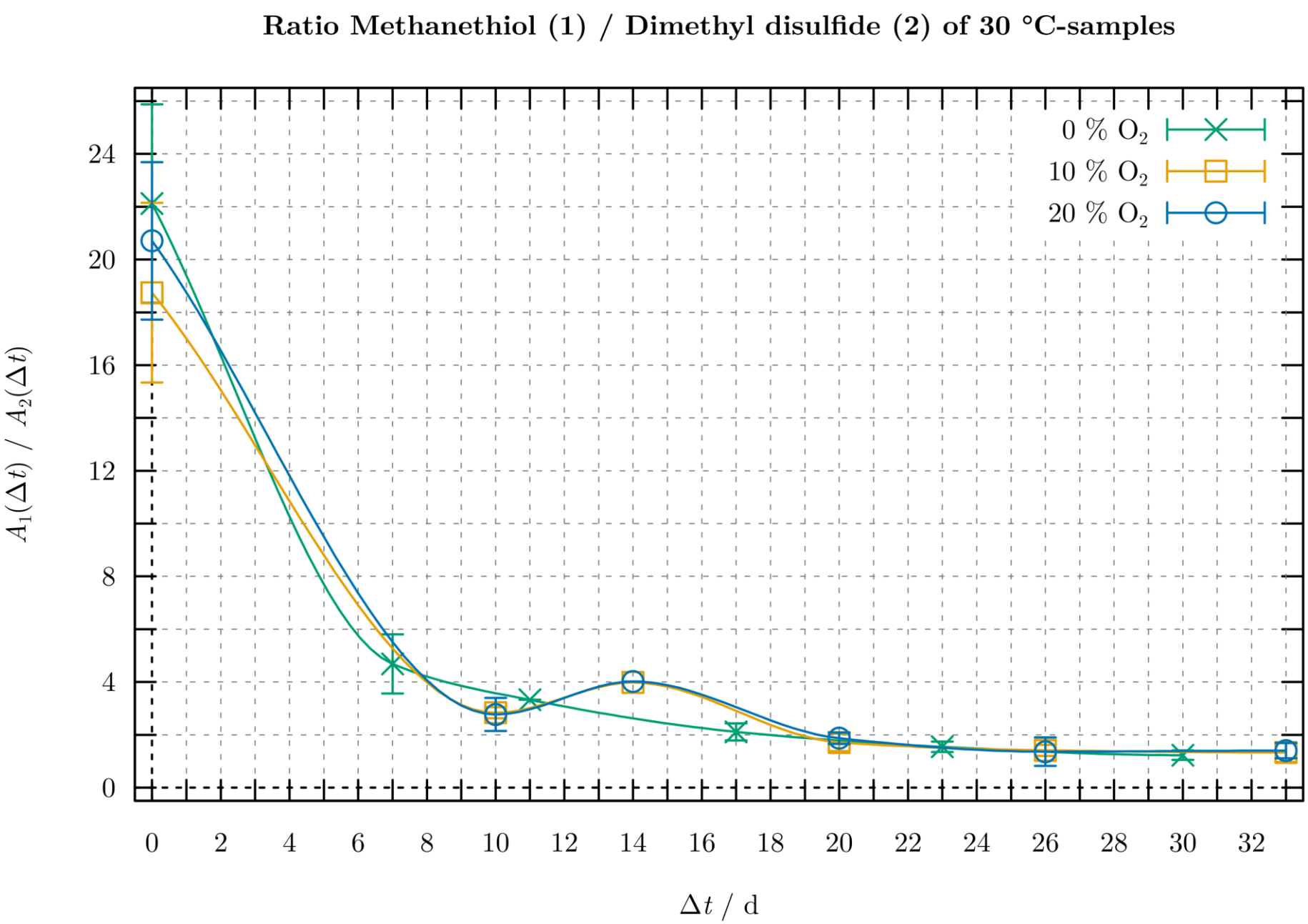
(4.00 ± 0.01) g samples

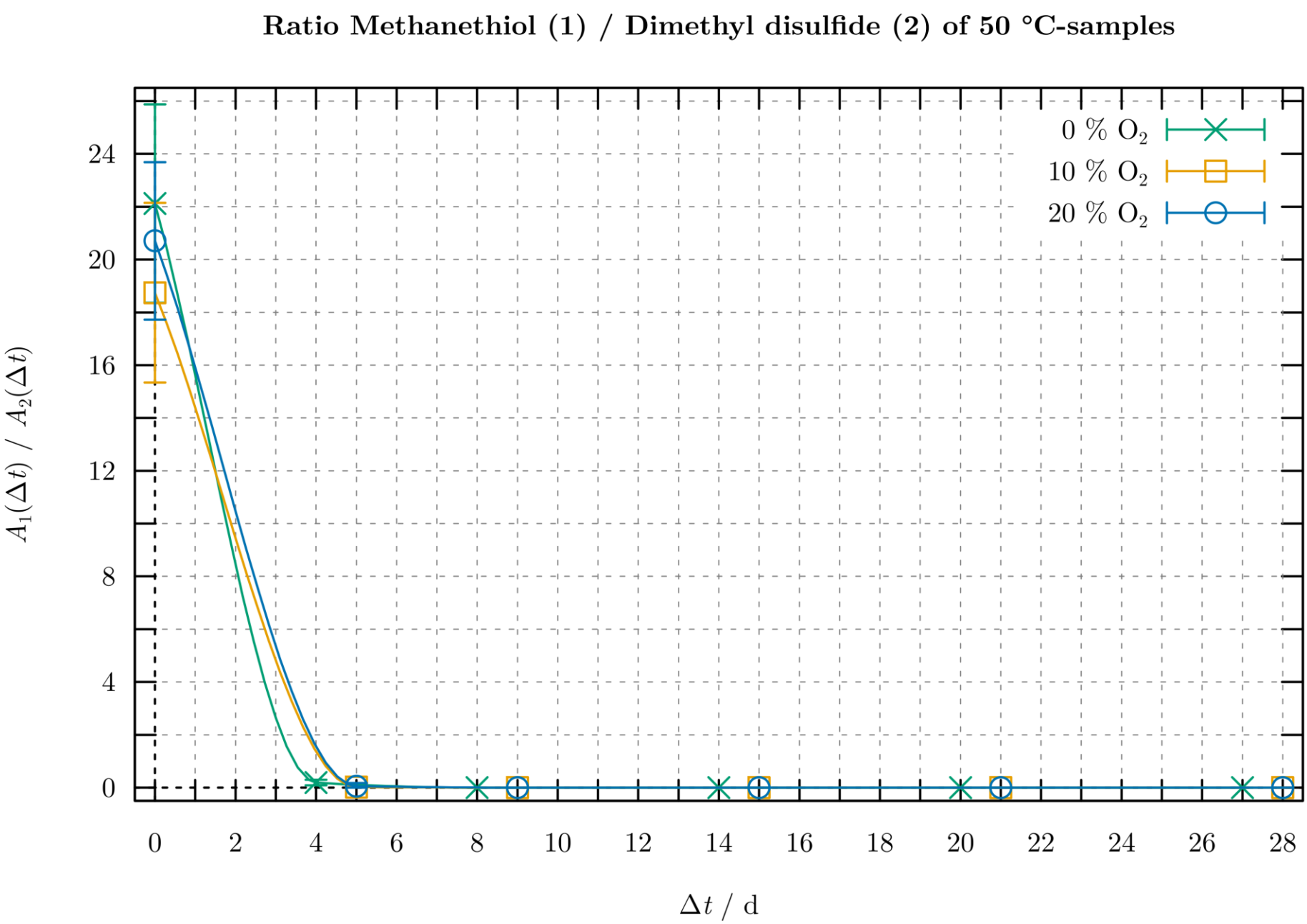
storage

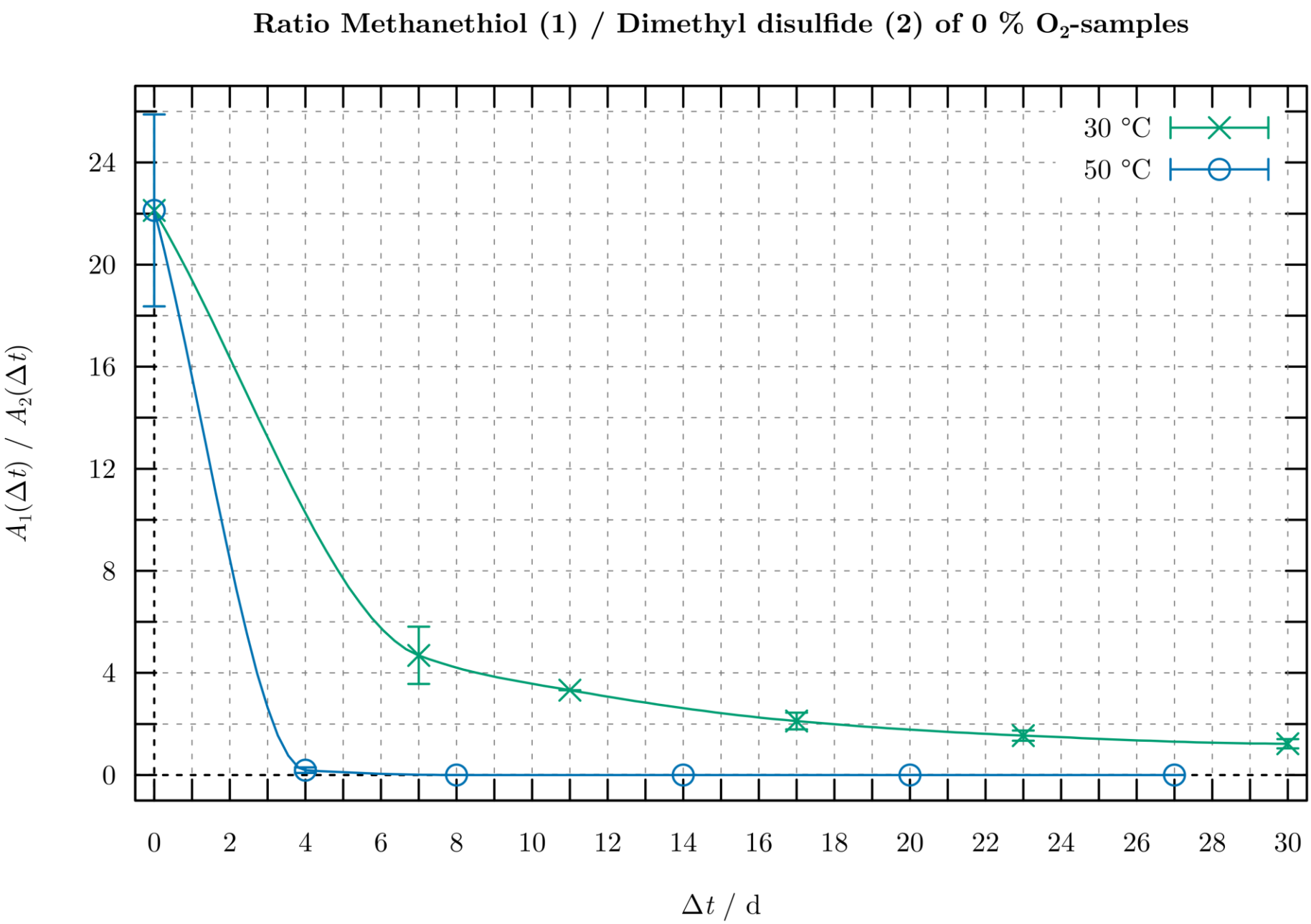
3 oxygen concentrations:
0 % (V/V), 10 % (V/V), 20 % (V/V)

2 temperatures:
30 °C, 50 °C

HS-GC-MS

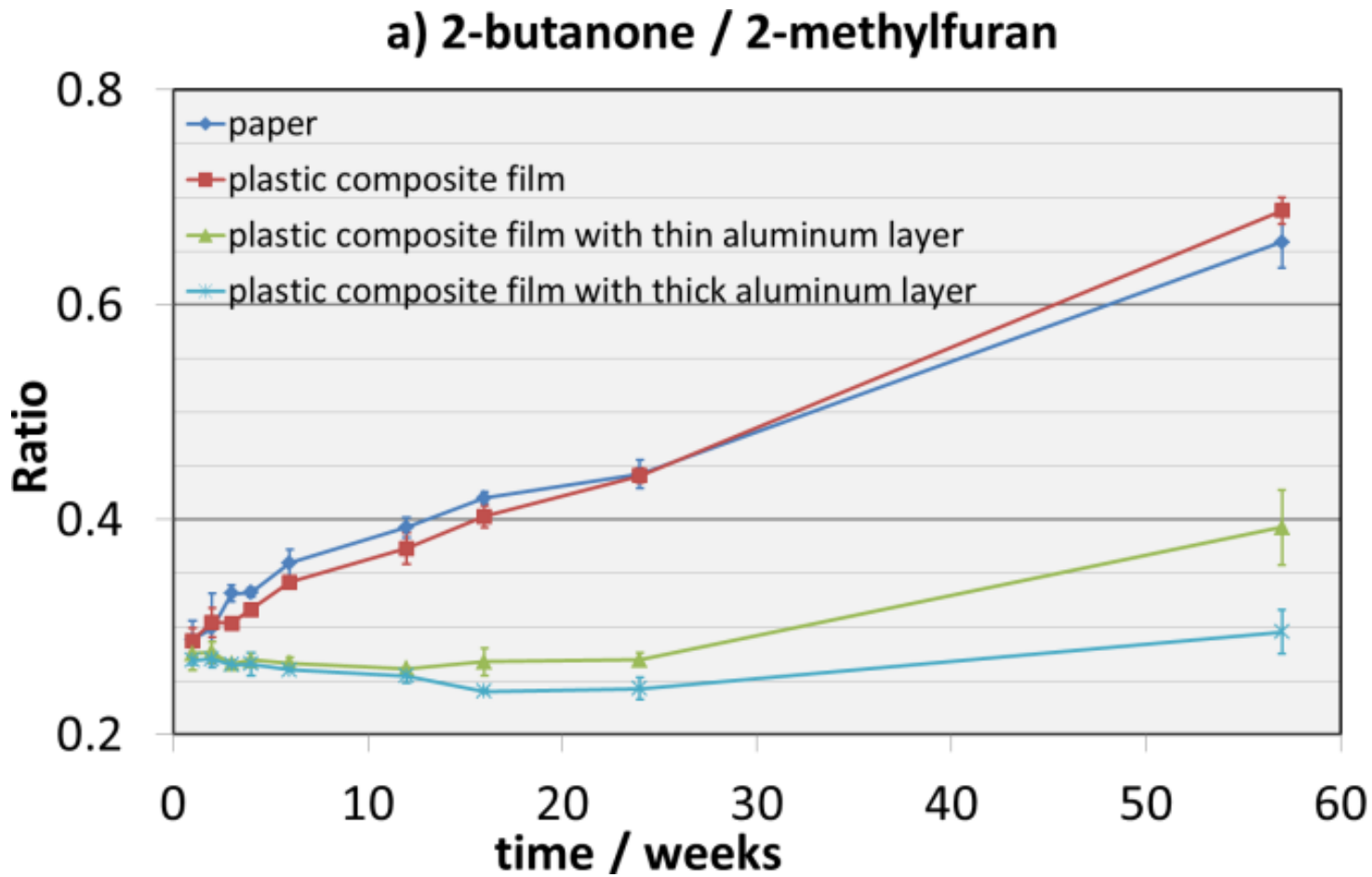

Ratio Methanethiol (1) / Dimethyl disulfide (2) of 30 °C-samples
0 % O2
10 % O2
20 % O2
A1(Δt) / A2(Δt)
Δt / d
0
4
8
12
16
20
24
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32


Ratio Methanethiol (1) / Dimethyl disulfide (2) of 50 °C-samples
0 % O2
10 % O2
20 % O2
A1(Δt) / A2(Δt)
0
4
8
12
16
20
24
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Δt / d


Ratio Methanethiol (1) / Dimethyl disulfide (2) of 0 % O2-samples
30 °C
50 °C
A1(Δt) / A2(Δt)
0
4
8
12
16
20
24
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Δt / d

Freshness roasted whole beans

Chemical markers

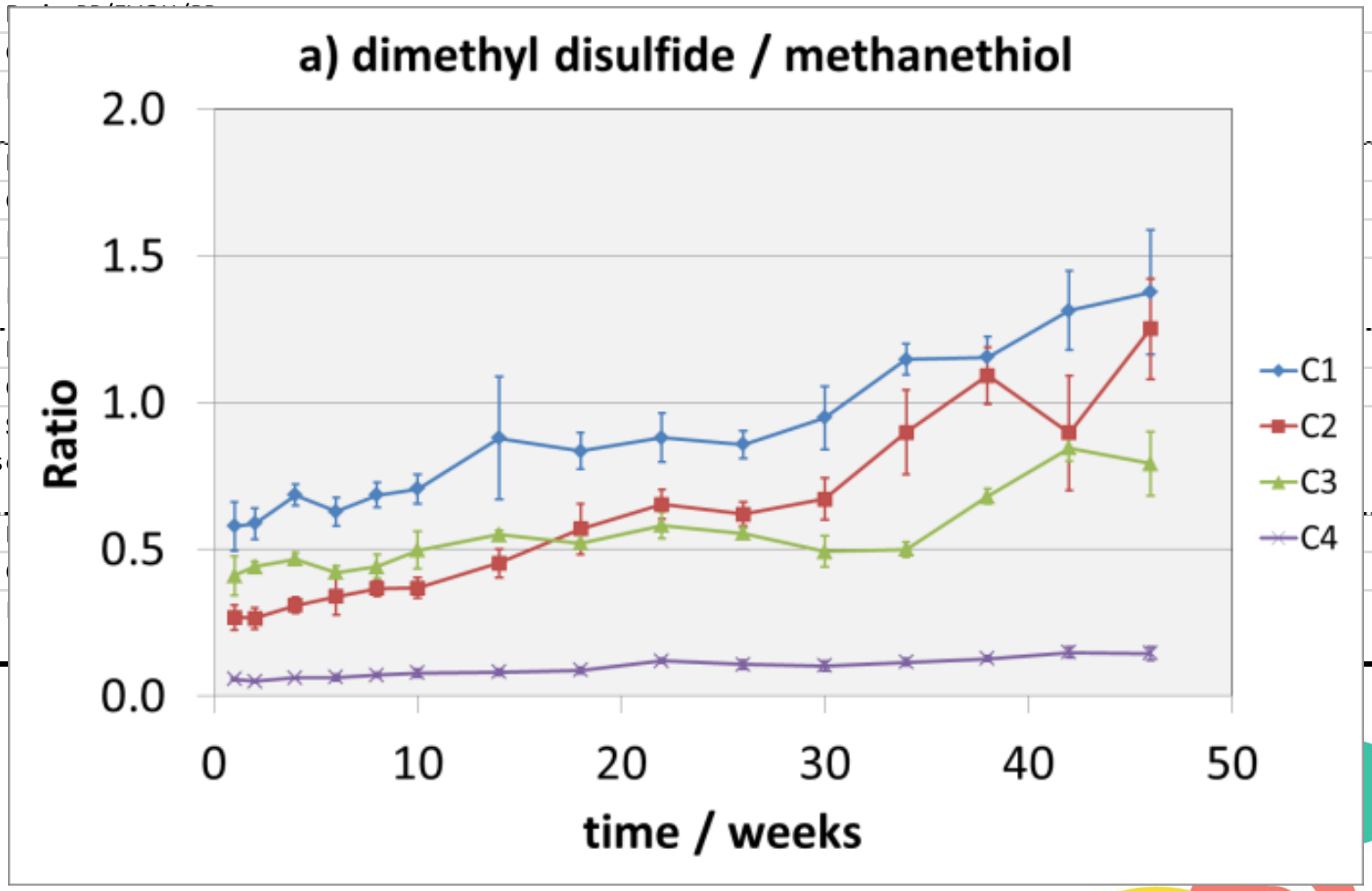


- Freshly roasted *coffea arabica* from Guatemala, 250 g roasted whole beans, stored at room temperature
- Packed in four different packaging materials (with valves except for paper packaging)

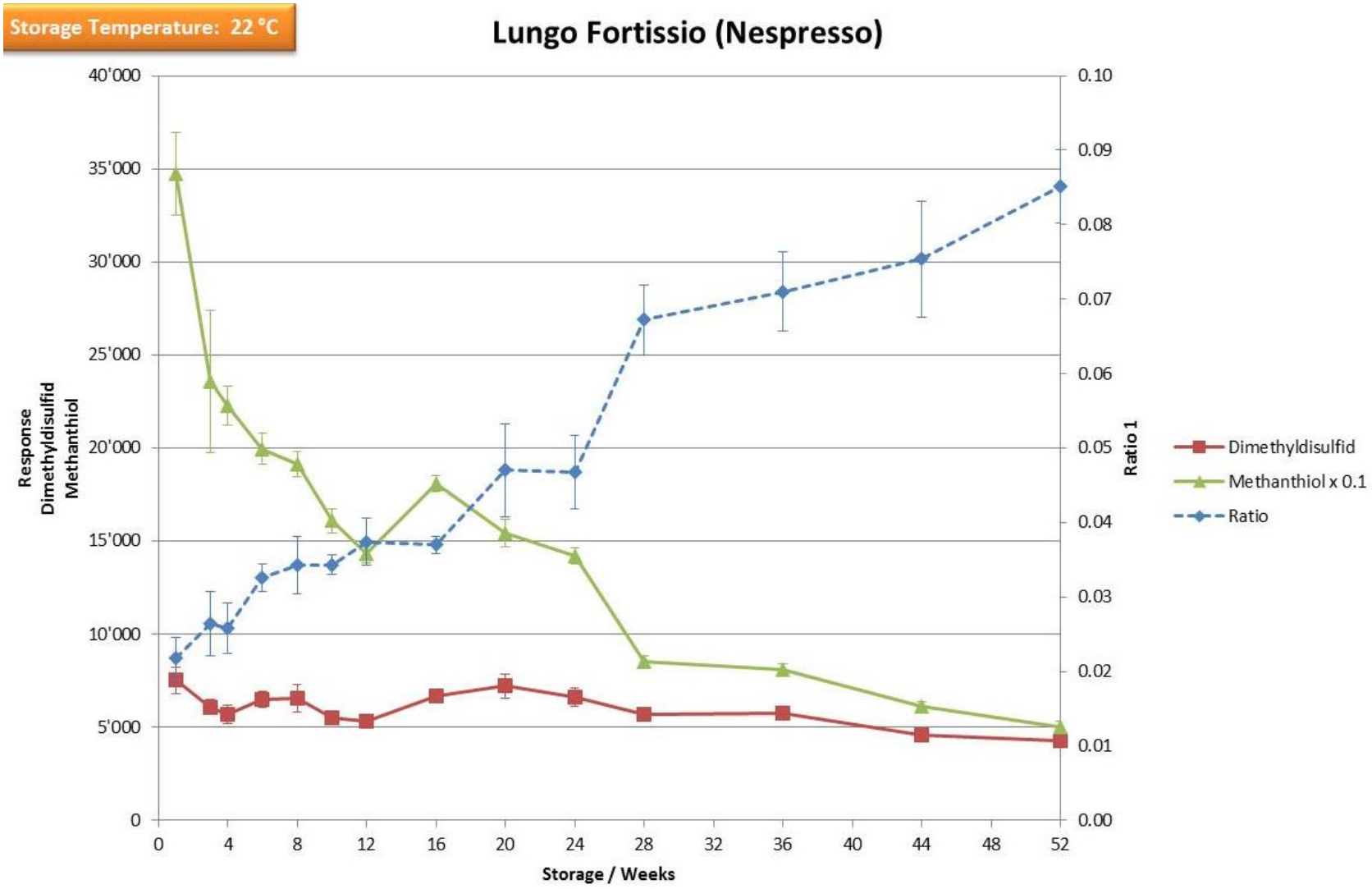
Freshness in single serve capsules (ground coffee)

Chemical markers

Code	Capsule	Material
C1 Delizio (Ø40x26)		
C2 Dolce Gusto (Ø53.5x39)		
C3 Denner (Ø37x31)		
C4 Nespresso (Ø37x31)		



Freshness Index = DMDS / MeSH for Nespresso Lungo Fortissio



Take-away messages

- Freshness gives a competitive advantage in the specialty coffee segment
  → for whole beans, for capsules
- By making freshness measurable & comparable it becomes an objective concept
  → it can be improved and communicated
- We introduced and applied two complementary dimensions of freshness:
  → Freshness Indices and loss of CO_2.
  → They are related but not identical
- Measuring both Freshness Indices and loss of CO_2 represent practical and effective means to assess the impact of process parameters, packaging and storage conditions on loss of freshness
- We are in the process of developing a tool (gravimetric method) to measure degassing

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Dr. Sebastian Opitz

Transformation

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Extraction

Dr. Marco Wellinger

Aroma

Dr. Anja Rahn

Continuing Education & Sustainability

MSc Sabine Stauffacher

Evaluation Forms

Please Complete An Evaluation Form After This Lecture

Coordinator: Room Host

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Questions, Discussions … ?

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