

# Profiling Coffee / The Hidden Formula

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# Espresso



# Profiles

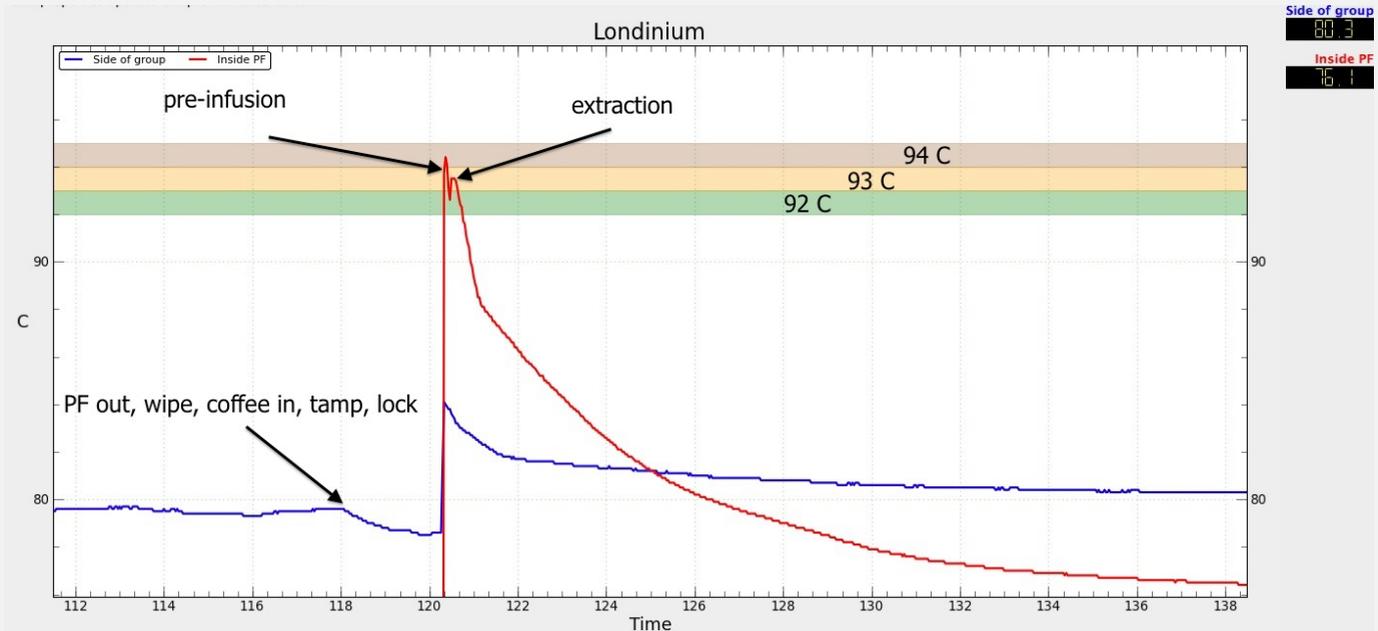
- Roasting: temp over time
- Burrs: coarse grabbing teeth to fine cutting edges
- Grinds: bell shaped size distribution
- Resting: declining CO<sub>2</sub> pressure, improving, then declining taste
- Extraction temperature: declining
- Extraction pressure: declining
- Flow: increasing
- Temp in the cup: declining



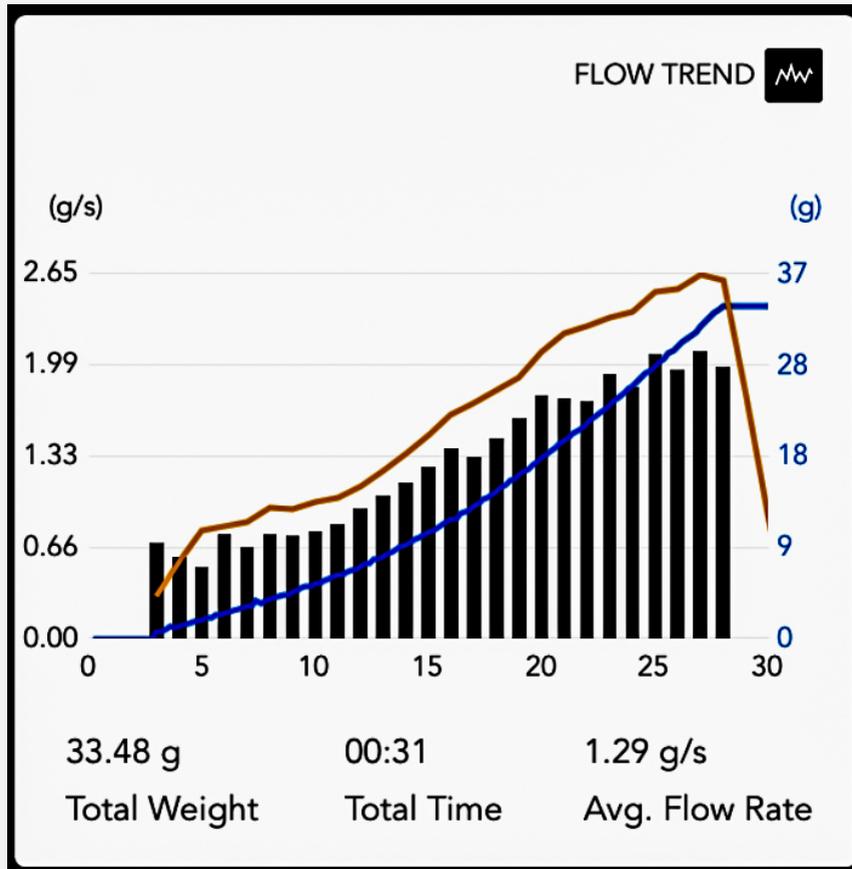
# LONDINIUM



# Extraction temperature profile



# Extraction flow profile



## Recipe example

- Grind 14g beans rather fine and even
- Tamp flat and firm
- Water around 93°C raining down inside brew head
- Pre-infusion, soaking the puck 3–7 seconds
- Extraction of 20g espresso



# Espresso

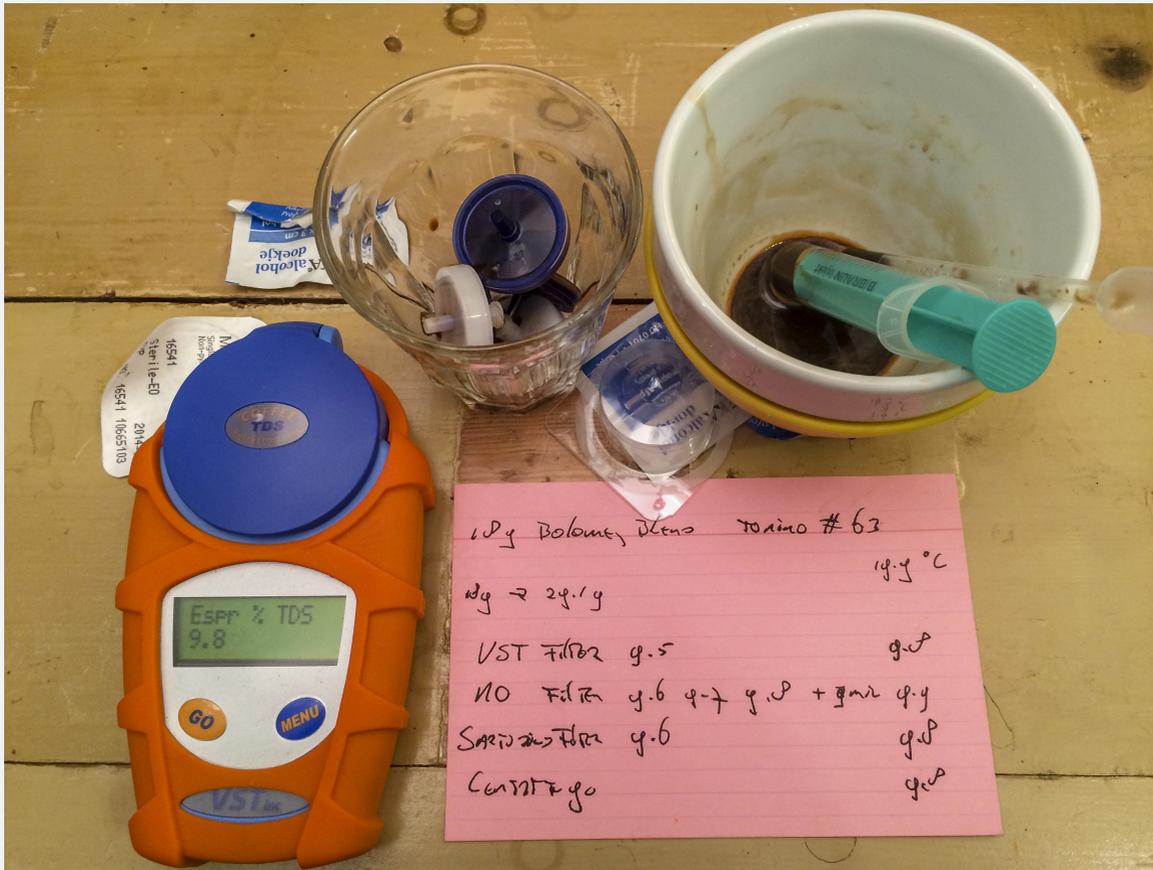


# Refractometer

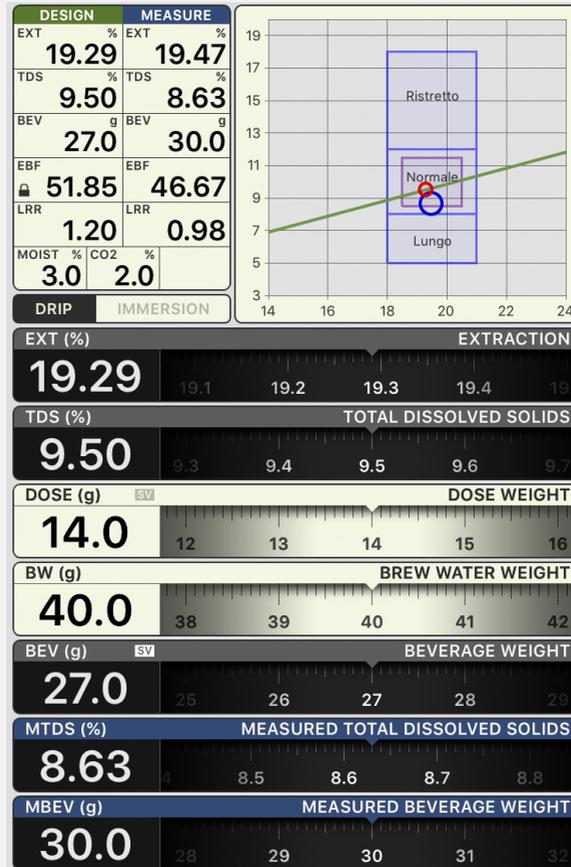
- Stir espresso
- Take sample in syringe
- Screw on medical grade filter
- Push out a few ml
- Wait to cool down
- Droplets on refractometer, start measurement
- Read TDS = Total Dissolved Solids percentage
- Calculate extraction rate of the puck



# Coffee refractometer



# Coffee refractometer app



# Green coffee bean

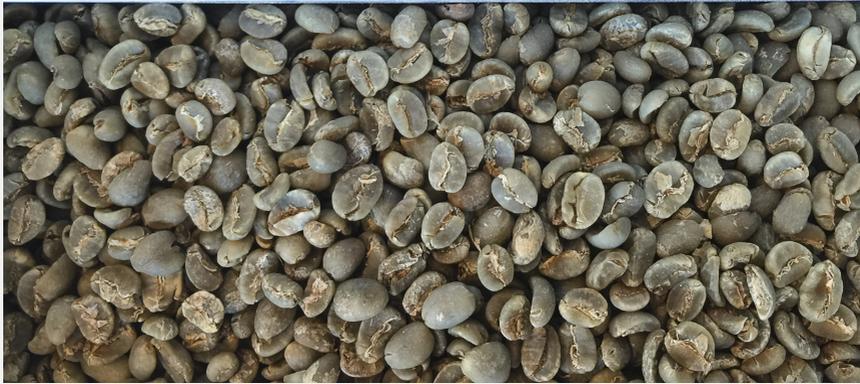


# Origin

- Ethiopia
- (Sub)tropics
- Best on high altitude
- Harvest berries 1–2 a year
- Picking, selecting: hard work
- Washing, drying, selecting and sorting
- Sample roast, cupping, trading, shipping



# Sorting Indonesia Mandheling



# Cupping



# Monsooned Mabalar from India



# Roasting machines

- Keep the beans moving
- Add thermal energy
- Have probes ready to measure what's happening
  
- Drum roasters like PROBAT
- Fluid bed roasters like Sivetz
- Others, like Tije's *Roaster shaker*



# Roastilino, a little *fluid bed* roaster



## Tije's *Shake, Not Stir* roaster



# Roasting phases

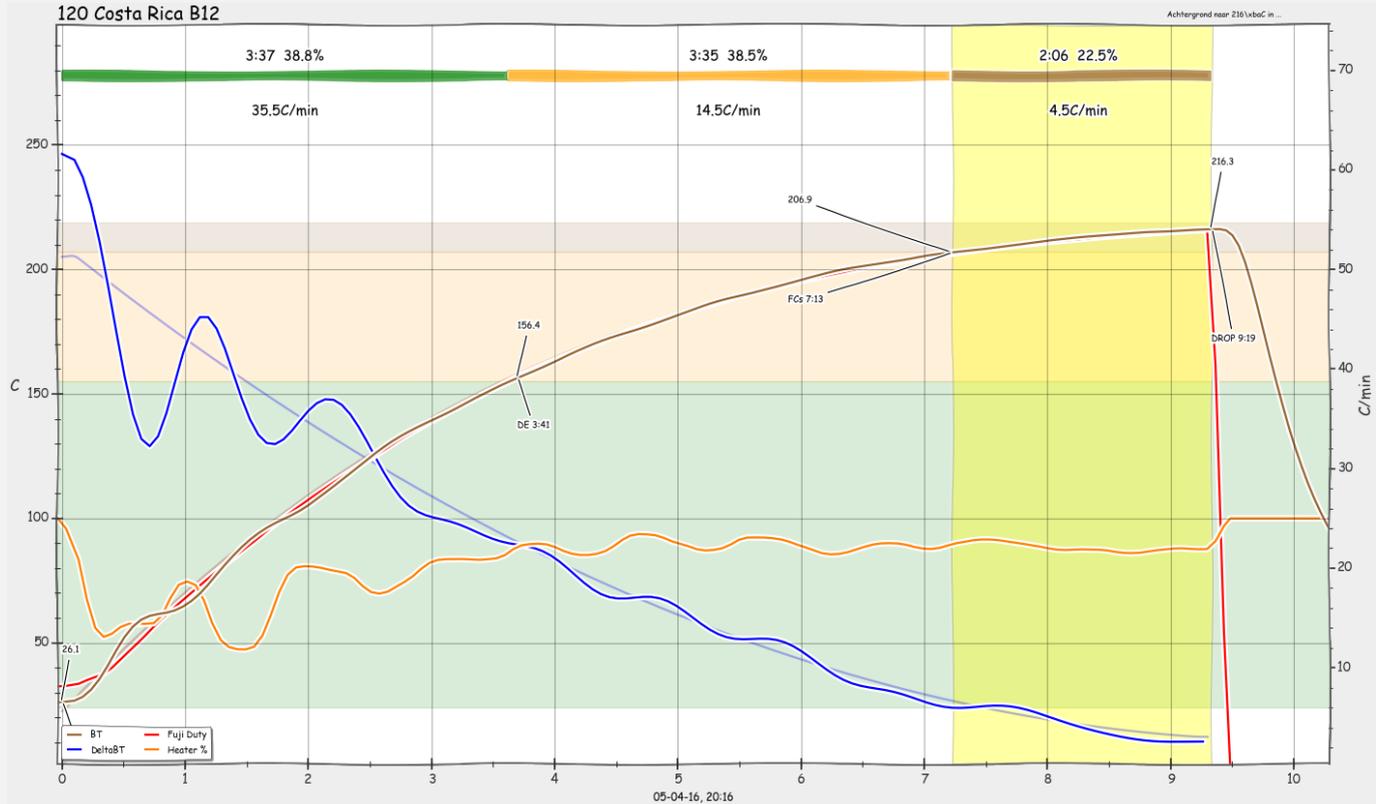
- Room temp to 150°C: drying
- 150°C to *First Crack*: Maillard
- *First Crack* (about 205°C) onwards: development

Smells like...

- Room temp to 150°C: hay, stable
- 150°C to *First Crack*: toast
- *First Crack* (about 205°C) onwards: coffee!



# Roast profile



# Profiling for taste

## ■ Drying

- Fast: simple and bright or defective
- Slow: rich or dull

## ■ Maillard

- Fast: light, clear
- Slow: full bodied

## ■ Development

- Fast: sweet, possibly grassy
- Slow: complex and round or bitter and flat



# TEX in Artisan roast software

The screenshot displays the Artisan 0.9.9 interface. The main window, titled "ROASTER SCOPE", features a coordinate system with a vertical axis labeled "F" (ranging from 0 to 600) and a horizontal axis labeled "MIN" (ranging from 0 to 10). The plot area contains several mathematical annotations:

- $square-symbol = \sqrt[3]{x}$
- $integral-symbol = \int_{t=0}^{\infty} \frac{\log(t)}{dt}$
- $Sum-symbol = \sum_{i=0}^{\infty} \frac{z^{-1}}{3!} + \frac{z^{-2}}{4!}$
- $Greek-letters = \alpha \text{---} \beta \text{---} \gamma \text{---} \omega \text{---} \rho \text{---} \theta \text{---} \phi$
- $Fractions = \left(\frac{5-\frac{1}{2}}{-4}\right)$
- $fonts = \mathcal{CALIGRAPHY} \text{---} \text{ROMAN} \text{---} \text{ITALIC} \text{---} \text{TYPewriter} \text{---} \text{DEFAULT}$
- $ARROWS = 500 \leftarrow \text{your-value}$

The top of the window includes a toolbar with navigation icons, a "RESET" button, and two green buttons labeled "ON" and "START". A digital timer shows "00:00".

An "Extras" dialog box is open on the right, with the "Plotter" tab selected. It contains a list of nine items (P1-P9) for configuration:

- P1: `annotate($square-s)` Background Color
- P2: `annotate($Sum-sym` ET/BT Color
- P3: `annotate($Fractions=\left(\frac{5 - \frac{1}{2}}{-4}\right)` Color
- P4: `annotate($fonts = \mathcal{CALIGRAPHY}` Color
- P5: `annotate(arrow=500\Longleftarrow your-\` Color
- P6: `annotate($integral-symbol = \int_{t=0}^{\infty}` Color
- P7: `annotate($Greek-letters=\alpha\text{---}\beta\text{---}\gamma` Color
- P8: Color
- P9: Color

Buttons for "Plot", "Save Image", "Data", and "Help" are at the bottom of the dialog, along with "Cancel" and "OK" buttons.



# Controlling the roast

- The Artisan application gets a roast profile
- Artisan controls the PID
- The PID controls the heating element
- Temperature probe sends Bean Temp to the PID
- Artisan reads Bean Temp, looks 10 seconds ahead, sends latest target to the PID
- Artisan alerts the operator with voice reports



# Tonino roast color meter





- Small machines can be temperamental
- A PID can provide stability





## So now we know?

“After winning, I realized how little I knew”

Gwilym Davies, 2009 World Barista Champion

“Everyone is kind of bumbling along in the dark, looking for the light switch.”

Talor Browne, roastmaster and top barista

“I am lost, but others too.”

Marko Luther, coffee application and device innovator



The bean smiling back at us

