

## Coffee Roasting Phases (Biased Temperatures, Wrapped Cells, Landscape Format)

Phase	Temp (°C)	Biased Temp (°C)	Key Processes
Drying	100–150	80–130	Evaporation of moisture; no browning.
Maillard Reaction	150–170	130–150	Amino acids and sugars react; color changes; aroma precursors form.
Caramelization	170–190	150–170	Sugars break down; sweetness and complexity increase.
First Crack	195–205	175–185	Water vapor and CO <sub>2</sub> expand; audible cracking; bean structure opens.
Development / Post-First Crack	205–220	185–200	Flavor balance develops; acidity decreases; body increases.
Second Crack	225–230	205–210	Cell walls fracture again; oils migrate; smoky notes appear.
Dark Roast / Pyrolysis	230–245	210–225	Organic degradation; risk of carbonization above 245°C.