

Fruit Maturation in *Coffea arabica*:

Relationship with Physical Bean Quality, Sensory Attributes of the Beverage, and Productive Yield

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Introduction

The optimal harvest point is crucial in coffee crop management as it directly affects the chemical composition, bean development, beverage sensory profile, and overall yield. Understanding the maturation stages of *Coffea arabica* can improve management practices like selective harvesting and the creation of higher-value lots. This study aimed to assess how different fruit maturation stages impact productive losses, physical bean quality, and the sensory profile of the coffee beverage.

Materials/Methods

Eight maturation stages were evaluated: green, light green, post-light green, pre-ripe, ripe (cherry), post-ripe, overripe, and dry (Figure 1). Productive losses were estimated based on the percentage difference from the post-ripe stage, which had the highest bean mass. Bean size distribution was measured by the percentage of flat beans on screen 16 or larger. Physical defects were quantified in 300 g samples according to Brazilian standards and sensory analysis followed the cupping protocol outlined by Brasil (2003).

Results/Discussion

The post-ripe stage yielded the highest productive output, with a greater proportion of larger beans, a lower incidence of physical defects, and superior sensory quality (Table 1). The ripe (cherry) stage showed similar results in terms of beverage quality and defect occurrence, though with an estimated productivity loss of 3.7%. The pre-ripe stage exhibited a 5.26% loss and a beverage with lower perceived sweetness. Fruits harvested at the green stage resulted in significant losses (18.43%), smaller bean size, a higher incidence of defects, and low sensory quality with pronounced astringency and low sweetness. The dry stage showed the highest productivity loss (22.03%), smaller bean size, and inferior beverage quality with strong astringency. These findings underscore the importance of maturation in defining the ideal harvest point, highlighting the ripe and post-ripe stages as the most suitable for achieving higher yield and superior coffee quality.

Figure 1. Maturation stages evaluated: green, light green, post-light green, pre-ripe, ripe (cherry), post-ripe, overripe, and dry.



Table 1. Yield loss relative to the post-cherry stage, incidence of defective beans, bean size distribution, and cup quality of *Coffea arabica* at eight maturation stages.

Maturation Stage	Yield Loss (%) ¹	Defective Beans ²⁴	Screen Size ≥16 (%) ³⁴	Cup Quality ⁴
Green	18.43	b 2084	55.01	High astringency
Light Green	7.12	c 354	71.69	High astringency
Post-Light Green	7.2	c 81	74.24	High astringency
Pre-Ripe	5.26	d 42	77.03	Medium astringency
Ripe (Cherry)	3.7	e 40	78.70	Low astringency / Medium sweetness
Post-Ripe	0	- 44	83.54	Low astringency / Medium sweetness
Over-Ripe	6.45	c 76	74.80	Medium astringency
Dry	22.03	a 156	44.84	High astringency
CV (%)	7.48	-	-	-

¹Means followed by the same letter do not differ according to the Scott-Knott test (P ≤ 0.05).
²Number of defective beans per 300 g sample. ³Bans with screen size 16 or above. ⁴Brazil (2003).

Conclusion/Perspectives

The maturation stage of *C. arabica* fruits directly affects bean quality, beverage sensory characteristics, and overall yield. Selective harvesting, focusing on ripe and post-ripe stages, results in coffee with better sensory attributes, fewer defects, larger beans, reduced mass loss, and higher added value.

References:

- Brasil. Ministério da Agricultura, Pecuária e Abastecimento. Instrução Normativa Nº 8 de 11 junho de 2003. Aprova O Regulamento Técnico de Identidade e de Qualidade para a Classificação do Café Beneficiado Grão Cru. Brasília, DF: Ministério da Agricultura, 2003.
- Specialty Coffee Association – SCA. Cupping Protocols, 2024.