How Long Should Coffee Rest Before Industry Professionals Assess Quality?

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I. Abstract:

A 24 hour post roast resting period may not be sufficient to determine a coffee's optimal flavor, and peak quality score. We conducted a study on 21 coffees, in order to collect data about the peaks and subsequent plateaus of a coffee's quality score, and optimal flavor profile, as it ages from the day of roast up until 22 days after roast. Our data was collected through double-blind cuppings, with a minimum of three experienced professionals per cupping, and always involving at least one licensed Q grader. These double-blindcuppings were conducted with coffee that was all roasted to the exact same specifications, using specific temperature and time profiles, on an Ikawa Pro 50 gram roaster. During all experiments, a control was blindly present through one of each coffee, roasted to the same specifications as the others, which had aged for only the one standard day (24 hours) recommended by both CQI (Coffee Quality Institute) and SCA (Specialty Coffee Association). (Citation 5. & 6.) The results of this study have shown, that 94.73% of the coffees studied, reached their peak cupping score after 72 hours of post roast rest, and from this we concluded that while some washed coffees in the study did peak near 24 hours of post roast rest , most coffees evaluated required additional resting time to achieve maximum quality potential. Using an 8-24 hour resting time might not allow for full exploration of a coffee's quality, nor the actual clarity of its true flavor profile. This research challenges the current international standard used for post roast resting time, and encourages further study of resting times needed before making quality assessments, profiling, or conducting purchasing decisions.

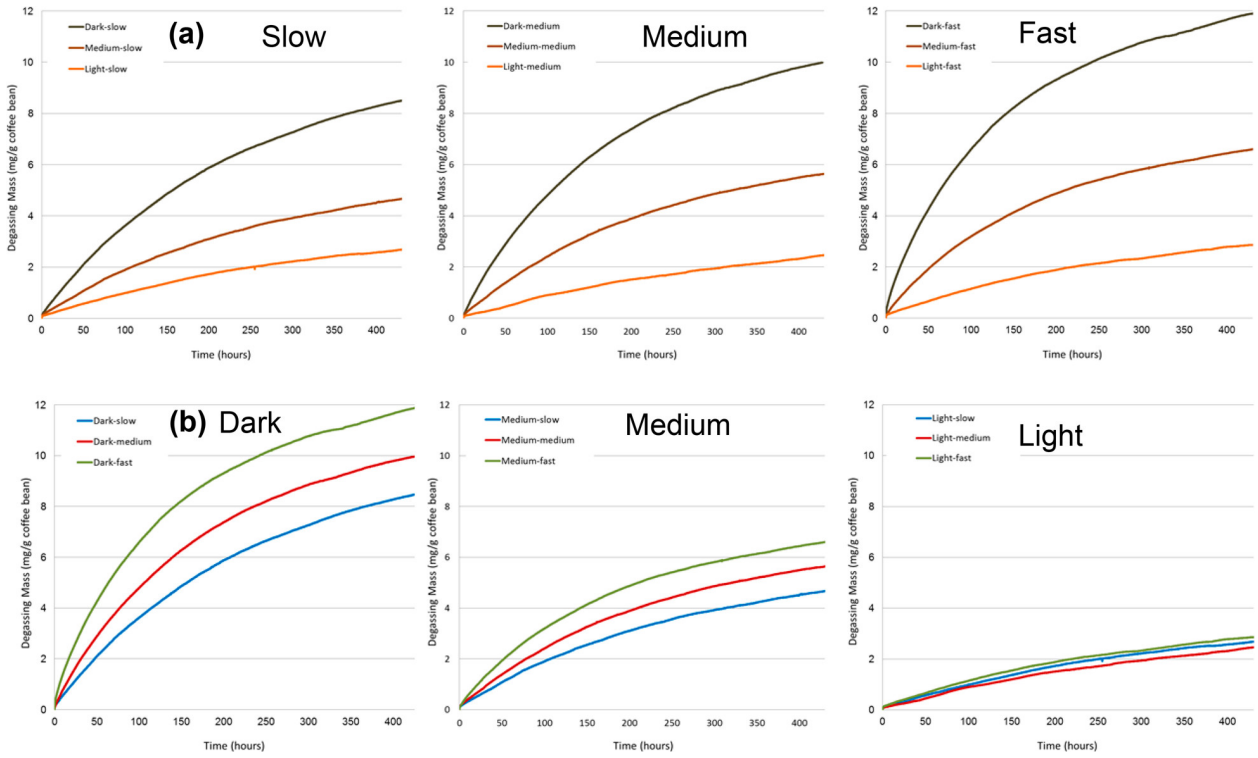
II. Introduction:

This study is significant because anyone using the CQI and SCA recommended protocol when profiling coffee, cupping for purchasing, cupping type samples/ preship samples,

experimenting with new processing methods, or even applying a score to a product, may not be allowing the coffee to reach its potential in the recommended 8-24 hour window.

Roasting coffee results in significant chemical changes that contribute to quality. One of these chemical reactions include the emission of high levels of carbon dioxide(CO_2). Most of the CO_2 escapes during the roasting process itself, however a significant amount of CO_2 continues to escape the bean after the roasting process is completed. The amount of CO_2 is reportedly different across roast levels. For example, dark roasted coffee (defined as hitting the second crack or combustion of the coffee seed) is far more porous which makes it easier for gasses to escape quickly. (Geiger and others, 2005) Light roasted coffee, being far denser, has been observed to cause gasses to escape more slowly, resulting in a longer release of CO_2 , thus potentially requiring a longer post roast resting time. According to the Journal of Agricultural and Food Chemistry, a light roast was recorded as degassing at a rate almost three times slower than a dark roast with the same roasting speed. (Yeretzian, 2018)

Figure 1. For the coffee sample roasted to a light roast at a medium speed, the degassing measurements were extended for up to 800 h, allowing assessment of the performance of a fit on the first 400 h to extrapolate all the way to 800 h degassing. The resulting parameters (λ = 715 h, k = 0.842, M_∞ = 5.07 mg/g) show that using less data (only 0–400 h) led to underestimation of the total amount of degassing at infinite time as well as to an underestimation of the time constant. (Yeretzian, 2018)



This shows us that over the period of 400 hours, coffee continued to degas to a degree that was trackable during their study, and it is noted that while the Weibull model would not be adequate for displaying the degassing through and past their 800 hour study, the coffee does indeed continue to degas at noticeable rates.

Furthermore, several studies correlate the speed of roasting (coffee), with the speed of CO_2 degassing from the coffee. They Concluded that a faster roasted coffee could release more CO_2 immediately, while a slower roasted coffee might take longer to degas. (Geiger and others, 2005) (Wang and Lim, 2015) This would subsequently mean that the longer roast may be preserved for longer, or potentially need a longer resting period, both of which directly impact the quality (or assessment of quality) of the coffee.

The industry depends on assessing quality for various reasons. While previous studies have provided significant contributions to identifying the rates and amount of CO_2 gas released post roasting, there have been no studies correlating this to quality impact. If the industry-wide standard does not allow for full exploration of a coffee's quality due to the role of increased CO_2 influencing quality perception, then it holds that an adjustment to the standard is needed. There

are several areas where extending resting times would have a significant impact. A few examples of this are:

A roaster who is profiling their coffee, might seek to determine the best combination of times and temperatures as they apply a specific rate of temperature rise to their roasting profile.

A green buyer who is preparing to purchase a coffee, may request either a type sample (a sample of what the upcoming available coffee might be like) or a preshipment sample (a sample of a specific coffee on contract before it ships), and would likely be basing their purchasing decision on how that coffee cups.

A producer (or post harvest process technician) who is experimenting with different types of processing methods, or different times, temperatures, and pH levels during the fermentation period, needs to taste coffee to determine which of their experiments would create an optimal flavor for their buyer or consumer.

A barista or cafe owner, who is sampling various coffees in order to create a successful coffee program and specific intended experience for their customer base.

In all of these circumstances, ensuring one is evaluating quality at the maximum potential is a critical component in accomplishing the specific goal the industry professional has in mind. If it is possible that a coffee's characteristics are not accurately represented after 8 to 24 hours of resting, as they would be beyond the 24 hour maximum that is recommended by SCA, then the individual(s) evaluating, buying, selling, or studying the coffee could be at a disadvantage, and the resulting sensory evaluation would be incomplete. The roaster who is profiling a coffee might create a graph with specifications which are not applicable for the time frame that their customer will actually be consuming the product. The green buyer may evaluate green coffee samples based on attributes that will settle and/ or become more clear at a later time. If the price paid to the producer is based on a cupping score that is not based on its peak flavor (that might settle after a longer rest period), then it is both an unfair disadvantage to the producer and potentially not in the green buyers favor as they will not have a clear picture of the coffee and the value of the coffee, which they will be buying, roasting, and selling. A barista who dials in a coffee, or samples that coffee for purchasing, which has not fully rested might not be able to experience what their customers will experience for weeks to follow if that coffee's

attributes were to dramatically change. When a coffee producer or a post harvest process technician conducts an experiment regarding adjustments in their processing techniques, without allowing adequate resting time before evaluations, they might not be able to clearly evaluate their experiment to accomplish their goal to the optimal ability.

If an industry processional is using the recommended 8-24 hours of resting time to assess the quality and attributes of a coffee, then they might not be allowing that coffee to reach it's optimal flavor and peak cupping score.

III. Methods:

This experiment tested how a coffee's cupping score is affected by the duration of its rest time after roasting. The standard industry rest period (according to Coffee Quality Institute, and Specialty Coffee Association) is between 8 to 24 hours after roasting, which was used as our control in this experiment. In order to see if the coffee's origin or processing styles were variables, the experiment was conducted on 21 different coffees harvested in 2021 from four different regions, across five countries, and eight processing methods. (Table 1) Each coffee was roasted in 50g (+/-0.2g) increments on a programmable air roaster (Ikawa Pro 50) using the same graph. (Citation 4.) While resting, the coffee was stored in 12oz side gusset coffee bags from North Atlantic Specialty Bag (3.5 mil - 48ga PET/48ga MET PET/.0025 LLDPE), with an inner lining of foil and a one way gas valve. This is a common bag type used in the coffee industry to keep the product safe from oxygenation while still allowing it to offgas. Each bag was filled and sealed for each coffee and only opened for each experimental resting time of 4, 8, 11, 17, and 22 days. A total of 105 experimental samples were prepared and evaluated. A set of control samples of each coffee were roasted the day before each rest period was sampled, to be used as controls and tasted alongside the experimental samples. Additionally a set of control samples was roasted for calibration purposes which was cupped separately from the experimental coffee. A total of 126 control samples were prepared and evaluated.

Table 1. Listing all coffees by assigned reference number, region they were grown, and process method used during production.

#	Region	Process	#	Region	Process
1	Caribbean	Washed	12	Latin America	Anaerobic
2	Caribbean	Honey	13	Latin America	Anaerobic

#	Region	Process	#	Region	Process
1	Caribbean	Washed	12	Latin America	Anaerobic
3	Caribbean	Natural	14	Africa	Washed
4	Caribbean	Aged Natural	15	Africa	Natural
5	Latin America	Washed	16	Africa	Natural
6	Latin America	Honey	17	Africa	Natural
7	Latin America	Natural	18	Africa	Natural
8	Latin America	Anaerobic	19	Latin America	Honey
9	Latin America	Washed	20	Latin America	Natural
10	Latin America	Natural	21	Latin America	Double Fermented
11	Latin America	Anaerobic			

Each of the five evaluation days were broken up into five sets over the course of approximately three hours. Each cupping consisted of at least three experienced cuppers, one of which was always a licensed Q-Grader, filling out standard SCA cupping forms. (Citation 7.) Each set consisted of double-blind cupping the experimental and control cups from single origin coffees next to each other. Double-blind cupping ensured that grading was not swayed by preconceived notions. A cupping consisting solely of the 24 hour post roast control coffee was used as a calibration round to ensure that all cuppers were grading relatively close to one another to reduce variability in results. The average variability in control cupping was 0.425 points.

To ensure consistency, the following standardized cupping methods were used across the entire experiment. Into each identical ceramic 8oz cup was deposited 13g (+/- 0.2g) of freshly ground (Auto-Drip Setting on Bunn G3 HD Burr Grinder) coffee and then filled to the brim with 200F (+/- 5F) tap water. After four minutes of steeping, the grounds were cleared from the cups. An additional four minutes of cooling time elapsed before the evaluators began silently tasting and scoring the coffee. Aromatic notes and scoring were performed before and after the addition of water to the coffee. No more than ten cups were prepared at a time to ensure ample time, space, and consideration were provided for each cupping set.

A predetermined rule was made to remove any cups that showed taints or faults from consideration and data entry as they would be outliers to the experiment (Coffee #1, Day 4 Control). An additional rule was made to remove any averaged control scores that had a greater variance than one point, as they would be considered an inconsistent coffee (Coffee #3 & #14). The variance from the averaged control score for each coffee is being used as variance bars on each graph to denote a range that the score might be from the recorded amount.

IV. Results:

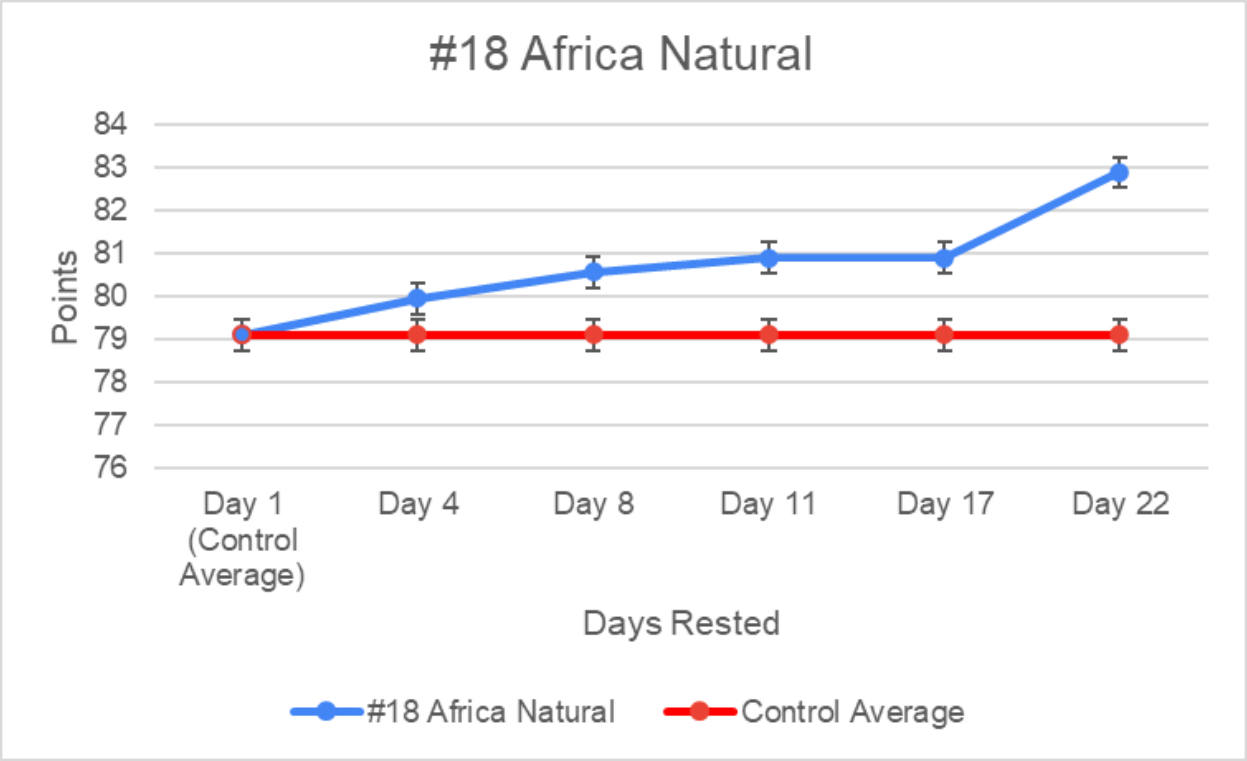
Table 2. Averaged cupping score results from controls as well as rest days 4, 8, 11, 17, and 22. Red cells are removed from consideration due to high variance (>1) in the control. Green cells are indicating peak cupping scores.	Day 1 (Control Average)	Day 4	Day 8	Day 11	Day 17	Day 22	Variance
#1 Caribbean Washed	N/A	83.06	84.38	83.13	84.44	83.13	0.51
#1 Control	84.05	Outlier, Note 1.	84.06	84.13	83.88	84.13	0.01
#2 Caribbean Honey	N/A	84.19	83.69	85.13	84.19	84.75	0.31
#2 Control	83.44	83.06	83.50	83.75	84.00	82.88	0.22
#3 Caribbean Natural	N/A	85.69	83.31	85.75	84.44	84.69	1.01
#3 Control (Disregarded, Note 2.)	84.54	84.19	86.63	84.38	83.06	84.44	1.67
#4 Caribbean Aged Natural	N/A	85.94	86.38	86.88	86.06	85.31	0.33
#4 Control	85.79	86.88	84.63	85.00	86.31	86.13	0.89
#5 Latin America Washed	N/A	85.56	84.31	83.69	84.38	84.88	0.49
#5 Control	84.11	84.63	83.44	84.13	83.75	84.63	0.28
#6 Latin America Honey	N/A	86.00	84.44	83.25	85.56	84.81	1.14
#6 Control	84.10	84.50	83.81	84.56	83.69	83.94	0.16
#7 Latin America Natural	N/A	84.69	84.88	84.44	85.38	85.50	0.20
#7 Control	84.94	85.19	84.75	84.88	85.75	84.13	0.36
#8 Latin America Anaerobic	N/A	84.94	84.94	83.56	83.69	83.94	0.46
#8 Control	83.91	83.50	84.25	82.75	84.31	84.75	0.62
#9 Latin America Washed	N/A	86.44	86.06	85.13	84.31	85.00	0.73
#9 Control	86.03	85.06	86.81	85.31	86.19	86.75	0.65
#10 Latin America Natural	N/A	84.63	86.13	87.25	85.50	86.06	0.92
#10 Control	85.31	85.69	85.38	85.13	86.00	84.38	0.38

#11 Latin America Anaerobic	N/A	89.19	89.38	88.31	86.44	88.00	1.37
#11 Control	87.46	86.88	87.75	86.81	88.81	87.06	0.71
#12 Latin America Anaerobic	N/A	85.44	84.94	85.25	85.56	85.19	0.06
#12 Control	85.09	85.50	85.69	84.50	84.81	84.94	0.24
#13 Latin America Anaerobic	N/A	83.19	86.38	86.81	84.88	84.38	2.20
#13 Control	84.45	84.56	84.88	85.25	83.38	84.19	0.51
#14 Africa Washed	N/A	85.56	87.19	85.19	86.44	85.81	0.62
#14 Control (Disregarded, Note 2.)	85.35	87.31	85.06	85.69	84.75	83.94	1.60
#15 Africa Natural	N/A	85.00	85.56	85.19	84.63	85.13	0.11
#15 Control	85.08	86.00	86.06	84.19	84.38	84.75	0.80
#16 Africa Natural	N/A	84.63	84.31	83.44	83.81	84.00	0.21
#16 Control	85.02	85.25	84.31	85.94	85.13	84.45	0.43
#17 Africa Natural	N/A	84.81	85.69	84.25	84.38	82.94	0.10
#17 Control	83.71	83.19	84.06	84.13	82.94	84.25	0.36
#18 Africa Natural	N/A	79.94	80.56	80.88	80.88	82.88	1.22
#18 Control	79.09	78.19	79.31	79.25	78.88	79.81	0.36
#19 Latin America Honey	N/A	84.06	85.81	84.75	83.56	83.88	0.80
#19 Control	84.53	84.69	84.56	84.00	84.75	84.63	0.09
#20 Latin America Natural	N/A	84.44	86.06	83.75	83.63	84.81	0.97
#20 Control	84.38	83.63	85.06	83.88	84.81	84.50	0.33
#21 Latin America Double Fermented	N/A	85.44	86.13	85.38	85.63	87.00	0.66
#21 Control	85.64	84.81	86.25	86.25	86.13	84.75	0.61

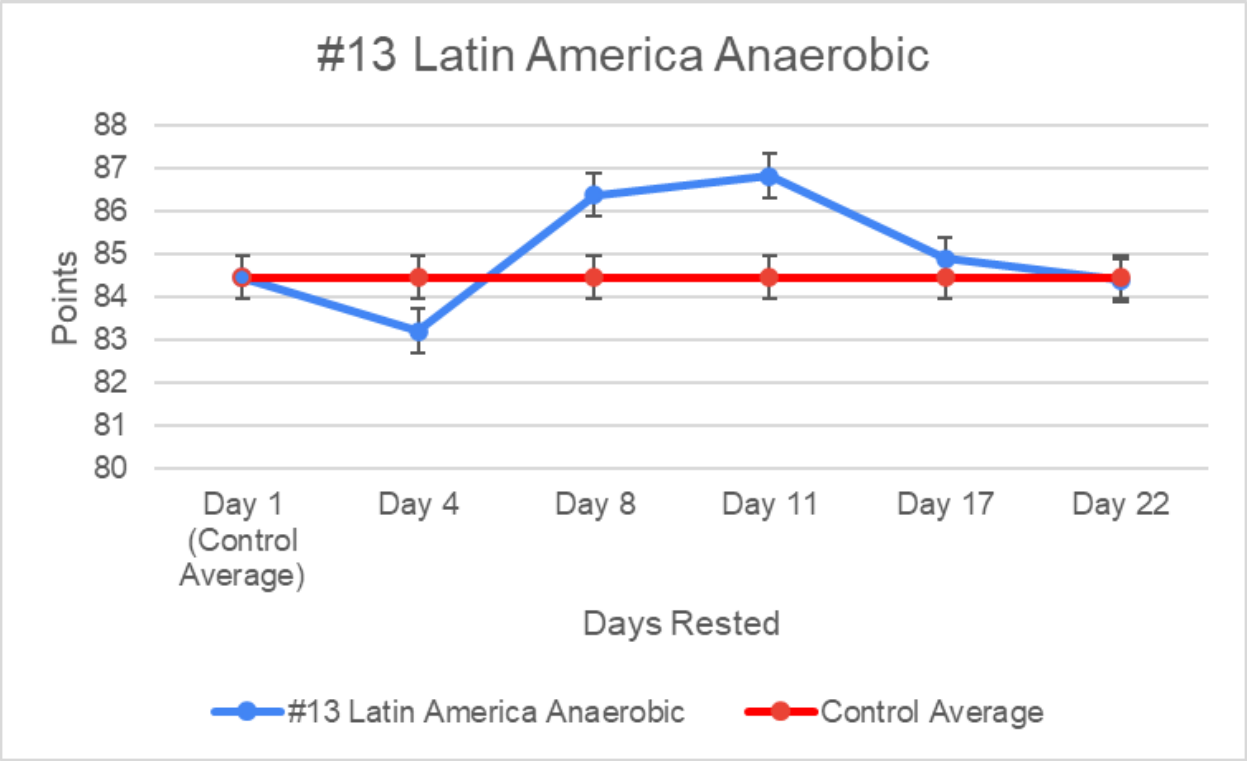
Table 3. Amount of coffees that peaked for each rest period.	Day 1 (Control Average)	Day 4	Day 8	Day 11	Day 17	Day 22
# of Coffee's that Peaked	1	4	5	4	2	3
% of Coffee's that Peaked	5%	21%	26%	21%	11%	16%

Table 4. Average Variance and Delta change of cupping score based on processing type.	Wash	Honey	Natural	Anaerobic and Double Fermentation
Average Experimental Variation	0.58	0.75	0.53	0.91
Average Experimental Change from Control to Peak Score	0.75	1.63	1.11	1.43

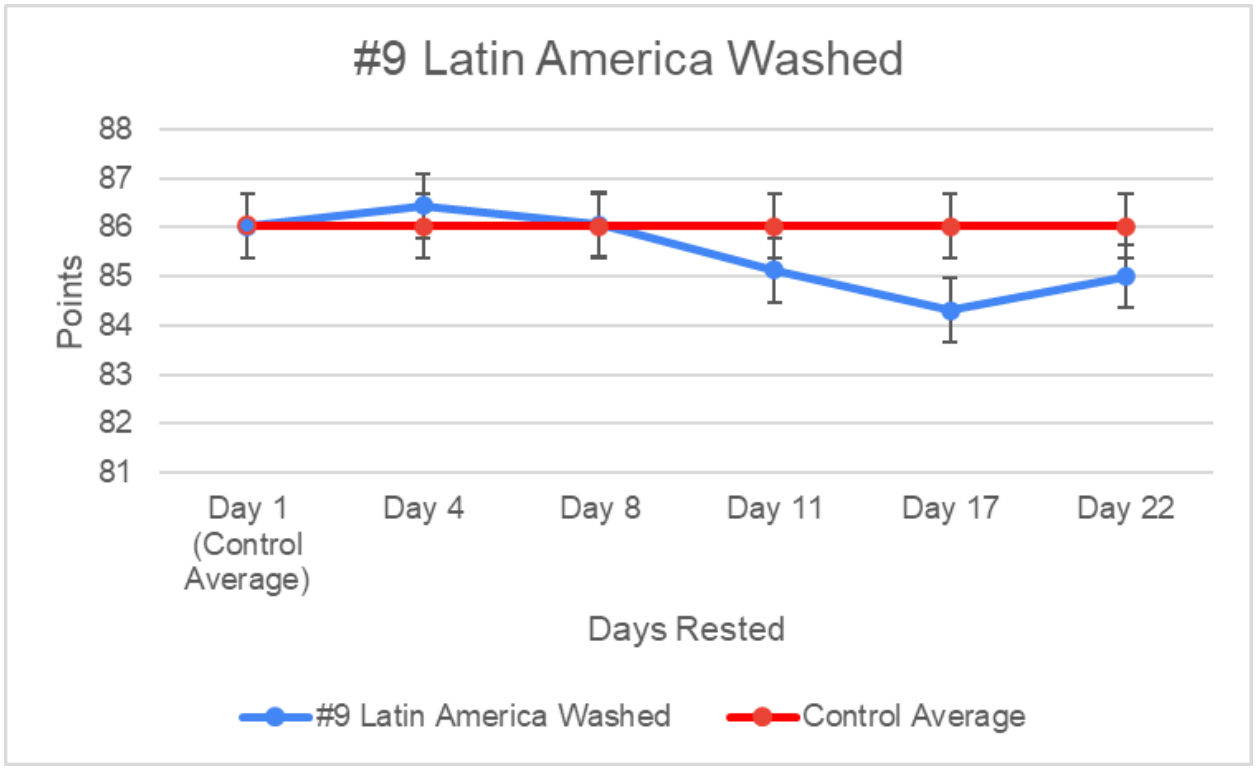
Graph 1. The effect of rest days on the cupping score for coffee #18 (Africa Natural). The average cupping score of the control for #18 (Africa Natural) is shown for comparison.



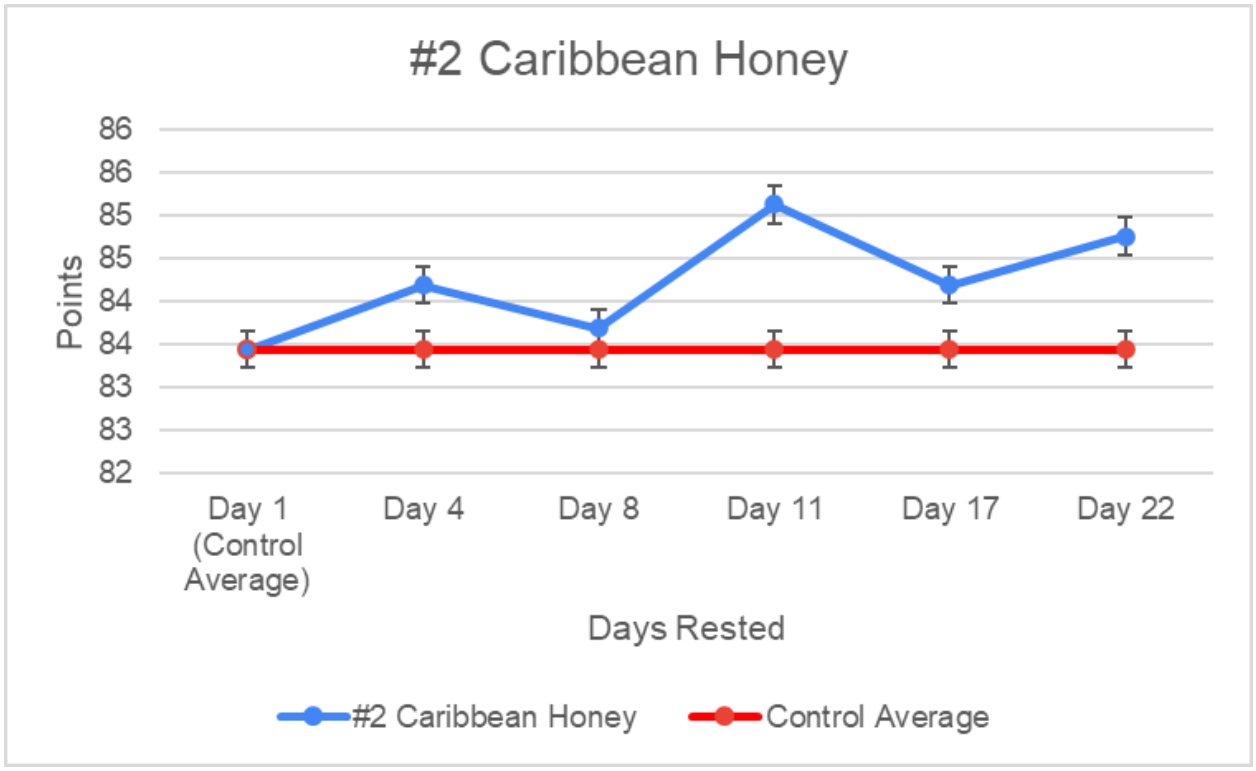
Graph 2. The effect of rest days on the cupping score for coffee #13 (Latin America Anaerobic). The average cupping score of the control for #13 (Latin America Anaerobic) is shown for comparison.



Graph 3. The effect of rest days on the cupping score for coffee #9 (Latin America Washed). The average cupping score of the control for #9 (Latin America Washed) is shown for comparison.



Graph 4. The effect of rest days on the cupping score for coffee #2 (Caribbean Honey). The average cupping score of the control for #2 (Caribbean Honey) is shown for comparison.



V. Discussion:

While further study is needed, we have found that the recommended 8 to 24 hours of post roast resting time to assess the quality and attributes of a coffee, can be insufficient for an industry professional that would like the coffee to reach its optimal flavor and peak cupping score, or from a sensory perspective be able to assess the actual flavor their customer or end user would be experiencing.

During our study, we found that only a single coffee (out of the 21 coffees studied) had its peak score at 24 hours post roast rest. (Table 2 & 3) Over 73% of the studied coffees reached a peak score after eight or more days of resting from the time of roast. (Table 3) One coffee in the study increased by over three points over the span of the 22 days of testing, and continued to improve with the peak score being on the final day. (Graph 1) This indicates that we may not know the peak score of that coffee, since this study concluded on day 22.

It is important to note, that if an industry professional does not want to reach an optimal flavor profile, a peak cupping score, or assess coffees that will potentially better reflect what a customer would be tasting, this might not apply to their situation. There are also practicality reasons that limit the ability to wait multiple days before evaluating a coffee sample post roast. However, the results from this study indicate that if a sensory evaluator desires to understand the full quality potential of a coffee, then the SCA and CQI industry-wide standard of evaluation within 24 hours post roast, should be reevaluated.

There are many reasons why an industry professional would want to allow a longer post roast resting time than the recommended 8 to 24 hours. One example would be a coffee roaster, who in order to find an ideal rate of rise for time and temperature, would undergo a coffee tasting at these different temperatures and times, known as profiling. That industry professional may want to do their profiling and quality assessment at a time that best reflect what their customer would be receiving and tasting. Another example worth noting, would be for any experiments while the fermentation of a coffee cherry takes place during or before the processing of that coffee cherry to prepare it for depulping, drying, and export. During such

experiments, it is important that the industry professional doing the experimentation, would be able to assess the coffee in a way that either reflects that coffee's peak cupping score, or is reflective of the actual flavor that coffee would have during a time when consumers would likely be consuming and experiencing the product.

Of the coffees studied, we saw strong evidence that washed coffees did not change as significantly from day one through the end of the study, especially in an overall positive direction. (Table 4) Coffees that were naturally processed (the process of leaving the seeds inside of the coffee fruit during the period of drying), and honey processed (the process of depulping the seeds from the fruit, and drying the seed with mucilage intact), appeared to have the largest and most consistent changes in coffee quality as the coffee was allowed a longer period of post roast resting time. (Table 4) Additional studies are needed to assess why this is as well as how consistent those types of processing methods are in benefiting from longer rest periods, but we do speculate that this potentially has to do with the additional bacteria and other microorganisms that would exist in those coffees from their processing, and that those microorganisms possibly cause more gas to be created and subsequently released during and after the roasting process of the coffee seed. This study provides a framework for future studies, and alerts the industry to this potential adjustment needed to post roast resting.

Citations:

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5. Coffee Quality Institute Recommended Rest Time: https://database.coffeeinstitute.org/api/s3proxy/get/coffee/files/f05qp1bqg3/Process%20for%20Evaluating%20Coffees%20in%20the%20Q%20Coffee%20System%20March%202022.pdf
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