Processing Coffee for Quality

Hawaii Coffee Association

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Hula Daddy Kona Coffee

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“Never waver from quality, even when you don’t see how you can afford to keep it up. When you compromise, you become a commodity and then you die.” *Gary Hirshberg, CEO, Stonyfield Farm*

I. Why Care About Quality?

II. Improving Coffee Quality

1. Soil
2. Tree selection
3. Husbandry
4. Picking
5. **Processing**
   1. **Picking Basket to Roaster**
6. Roasting
7. Storage

III. How Do We Know When Quality has Improved?



IV. First Establish a Baseline

1. Need Ratable Characteristics

b. Need Rater

* + - Self-rating
    - Coffee Review
    - Roast Ratings
    - Coffeecuppers.com
    - Local Resources
      * Miguel Meza
      * Andrew Hetzel
      * Shawn Steiman

c. Create a Rating Scoresheet

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Aroma** | **Acidity** | **Flavor** | **Sweetness** | **Body** | **Aftertaste** |
|  |  |  |  |  |  |

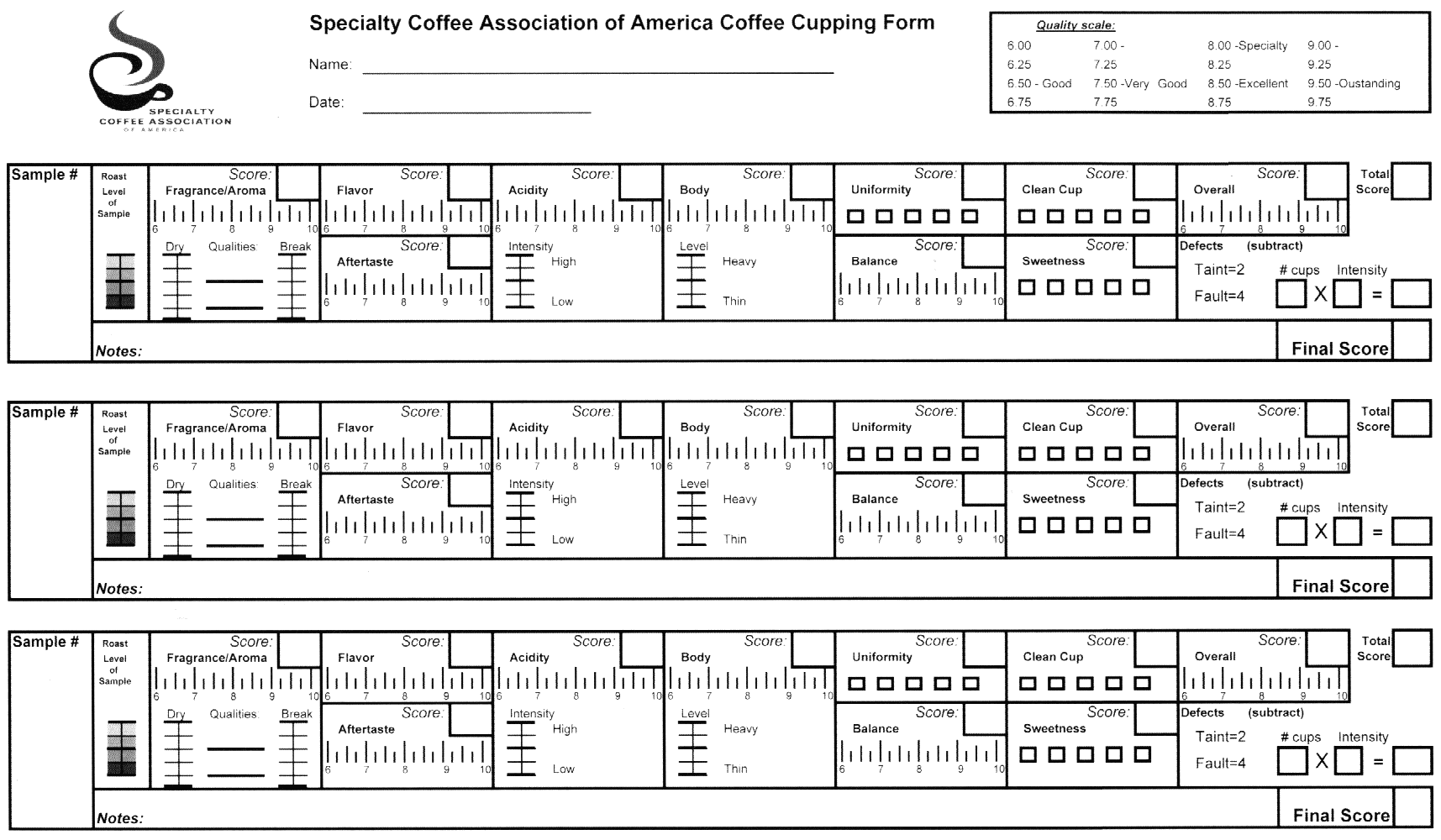
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10 = Outstanding

9 = Very Good

8 = Good

7 = Poor



d. Need to be Consistent

* Same Brew Method
* Same Rater
* Same Rating System

V. Sorting Is the Best Processing Method to Improve Quality

1. Cherry sorting
   * + Green/yellow/overripe fruit
       - Mechanical
       - Manual
     + Floating

* **You cannot make great coffee from bad beans**

2. Sorting Parchment

* Wet Parchment sorting
* Manual sorting
* Floating

3. Dry Parchment sorting

* Manual

4 Green Bean Sorting

* Density table
* Grading screens
* Color sorter
* Manual

VI. Colored Defects

a. Stinker - Light-brown, brownish, or grayish coloring and dull appearance. Fermented/rotted fruit, foul, rotten fish flavor

b Sour - Full or partial yellow or yellow brown to red brown coloring. Sour, vinegar-like flavor

c. Black Bean – Black or partially black bean due to age or mold

d. Moldy – Mold growing on surface of bean

e. Fungus - Full or partial black opaque coloring

VII. Processing Defects

a. Ferment -Winey, sour, rotted fruit. Over fermented parchment

b. Baggy - Taste of burlap. Storage in burlap in humid conditions

c. Over-dry - Burn/scorch flavor. Drying parchment below 9% moisture

VIII. Choosing a Processing Method

 It has been pointed out that beverages from coffee drying processed by different methods have significant difference (Selmar et al., 2006; Leloup et al., 2008). Coffee produced by the wet method has less body and higher acidity; it is also more aromatic than coffee produced by the dry method, resulting in a higher acceptance by consumers. It is currently accepted that the metabolic reactions in the coffee fruits that occur during different types of processing can affect the chemical composition of beans and thereby affect beverage quality (Bytofet et al., 2005, 2007). *Processing and Drying of Coffee – A Review International Journal of Engineering Research & Technology* Vol. 3 Issue 12, December-2014

IX. Wet Fermentation

“I think we tend to lump what we call washed coffees too much together as if it were only one process. **In reality there are dozens of variations all of which make for a slightly differing cup.** When using fermentation for fruit removal how long and how much water is added or not added certainly makes for differences in the cup. Not using water tends to make for a brighter fruitier/wineyer cup though often with a thinner mouthfeel. And even many who use demucilaging machines may often not remove all the mucilage with these machines but only partially and then ferment away the rest for varying amounts of time. Fermentation may also be done multiple times with rinsing in between. All these coffees could be 'washed' or rinsed after the fruit removal stage and clumped as washed coffees. And **I suspect many coffees that are only semi-fermented/demucilaged (some mucilage still left on the parchment during drying) are being lumped with washed coffee as well.”** *Miguel Meza*, Paradise Coffee

a. The Wet Method.

‘Here the fruit covering the seeds/beans is removed before they are dried. The wet method further subdivides into the classic ferment-and-wash method, and a newer procedure variously called aquapulping or mechanical demucilaging. Regardless of which of these procedures is used, coffee processed by the wet method is called wet processed or washed coffee”. *Coffee Review*

The coffee fermentation time depends on a number of factors including the amount of coffee fermenting, water temperature, and humidity.  The mucilage is made up of pectin materials including protopectin (33%), reducing sugars including glucose and fructose (30%), non-reducing sugars such as sucrose (20%), and cellulose and ash (17%) ([Wrigley, 455](http://www.coffeeresearch.org/bibliography.htm)).  Protopectin is not water soluble and will hydrolyze to pectinic acid in the fermentation tanks (Wrigley, 455). … If the coffee beans are fermented for 36-72 hours, stinker beans develop.  Lactic, acetic, and propionic acids are produced in this process and are believed to prevent the traditional fermentation taste by inhibiting mold growth that regularly occurs during drying on a patio in humid conditions (Wrigley).

<http://www.coffeeresearch.org/agriculture/processing.htm>

b. One-step Fermentation

“…Because the determination of completion of the fermentation process is typically a subjective one, it is common for coffee producers to inaccurately estimate the completion time of the fermentation process. This leads to over- and under-fermented coffee. **If the coffee is washed before the fermentation process is complete, the mucilage layer of the coffee will be incompletely removed. Incomplete removal of the mucilage layer typically results in coffee that may experience mold growth and a "clumping" together during drying. Further, the traces of remaining mucilage layer on the coffee promote spoilage of the coffee.** If fermentation is carried beyond the necessary fermentation time, the coffee will wash properly. However, studies indicate that over-fermentation results in degradation of coffee quality due to the presence of undesirable fermentation byproducts. Over-fermentation of coffee is associated with taste defects in roasted coffee such as alcoholic, fruity, flowery and sour tastes and is one of the most often cited problems affecting coffee quality. “ <http://goo.gl/D2FPxy>

c. Measuring Extent of Fermentation

* Using Broom Handle
* Using Feel
* Using pH

“…pH was initially in the range 5.5 to 5.7 and decreased sharply to about 4.6 as fermentation neared completion.” *Characterization of the Coffee Mucilage Fermentation Process Using Chemical Indicators: A Field Study in* Nicaragua Journal of Food Science August 2014

* Using Sample in Warm Water

d. Two Step Fermentation – After first fermentation, parchment is washed and replaced in fermentation tank

e. Machine Demucilage

Removing mucilage by machine is easier and more predictable than removing it by fermenting and washing. Unfortunately, machine demucilaging has been accused of limiting the taste palate of coffee by prematurely separating fruit and bean. By eliminating the fermentation step, the practice definitely robs mill operators of the most important expressive option they have at their disposal to influence coffee flavor... *Coffee Review*

f. Wet Process with Yeast Starters

“There is not (sic) conclusive evidence that fermentation adds much to coffee quality, and this experiment (though not about this question specifically) seems to support the position that activity in the fermentation tank- aside from the dramatic impact over-abundant acetic acid has on cup quality- plays a minor role in coffee flavor.” [A long overdue report on some coffee fermentation experiments.](http://petergiuliano.tumblr.com/post/29438469954/a-long-overdue-report-on-some-coffee-fermentation) http://petergiuliano.tumblr.com/post/29438469954/a-long-overdue-report-on-some-coffee-fermentation#disqus\_thread

“The potential impact of these selected yeast strains to promote flavor development in coffee beverages was investigated for inoculating coffee beans during wet fermentation trials at laboratory scale. Inoculation of a single culture of P. fermentans YC5.2 and co-culture of P. fermentans YC5.2 and Saccharomyces sp. YC9.15 enhanced significantly the formation of volatile aroma compounds during the fermentation process compared to un-inoculated control. The sensory analysis indicated that the flavor of coffee beverages was influenced by the starter cultures, being rated as having the higher sensory scores for fruity, buttery and fermented aroma. This demonstrates a complementary role of yeasts associated with coffee quality through the synthesis of yeast-specific volatile constituents. **The yeast strains P. fermentans YC5.2 and Saccharomyces sp. YC9.15 have a great potential for use as starter cultures in wet processing of coffee and may possibly help to control and standardize the fermentation process and produce coffee beverages with novel and desirable flavor profiles.”** *Isolation, selection and evaluation of yeasts for use in fermentation of coffee beans by the wet process* [International Journal of Food Microbiology](http://www.sciencedirect.com/science/journal/01681605)[Volume 188](http://www.sciencedirect.com/science/journal/01681605/188/supp/C), 1 October 2014, Pages 60–66 [*http://www.sciencedirect.com/science/article/pii/S0168160514003389*](http://www.sciencedirect.com/science/article/pii/S0168160514003389)

“…the inoculated fermentations were shown to influence the volatile fraction of roasted coffee beans by increasing the concentration of yeast-derived metabolites compared to control. **Sensory analysis of coffee beverages demonstrated that the use of the YC5.2 strain was favorable for the production of high-quality coffees with distinctive characteristics, e.g., intense perception of ‘vanilla’ taste and ‘floral’ aromas**. In conclusion, the use of P. fermentans YC5.2 in coffee processing was shown to be a viable alternative to control the fermentation step and to ensure consistent quality of finished products.” [Food Research International](http://www.sciencedirect.com/science/journal/09639969)[Volume 75](http://www.sciencedirect.com/science/journal/09639969/75/supp/C), September 2015, Pages 348–356 http://www.sciencedirect.com/science/article/pii/S0963996915300697

X. Pulped Natural Processing

**Pulped natural**: Widely used term for coffee processed by removing the skin of the fruit only and leaving all of the fruit pulp adhering to the beans during drying. A term first coined in Brazil. Often used equivalently to “honey.”

**Red Honey**: Used among some producers in Central America. Essentially describes the same process as pulped natural; in both cases the coffee is processed by removing the skin of the fruit only and leaving all of the fruit pulp adhering to the beans during drying. The relatively thick coating of mucilage takes on a reddish cast as the beans dry, hence “red” honey.

**Semi-Washed**: Used mainly in Brazil to describe coffee in which a portion but not all of the fruit pulp is removed by demucilaging machines before the beans are dried. Typically produces a lighter, more delicate profile than produced by the full-on pulped natural/red honey technique.

**Yellow Honey**: Used among some producers in Central America to describe the same process as semi-washed, both in respect to technique and to typical cup profile. Allowing less mucilage to remain on the beans during drying means they develop a golden color, darker than “red” honey coffee but lighter than fully washed or parchment coffee.

**Black Honey**: At least one mill in Costa Rica uses this term to describe a coffee dried with all of the fruit pulp remaining on the beans (similar to pulped natural/red honey), but applied to very sweet fruit from the peak of the harvest, which dries even darker than “red” honey.” *Coffee Review* September 2012

XI. Dry Fermentation

In dry fermentation the mucilage is removed by putting the pulped beans in a tank without water for 12, 24, 36 or 48 hours and then washing the beans. Dry fermentation is followed by wet fermentation.

XII. Dry Natural Processing

a. “In this, the oldest of processing methods, the coffee fruit is simply picked and put out into the sun to dry, fruit and all. It is spread in a thin layer and raked regularly to maintain even temperatures from top to bottom of the layer. Drying takes anywhere from ten days to three weeks, and, on larger farms, occasionally may be accelerated by putting the coffee into mechanical driers. The hard, shriveled fruit husk is later stripped off the beans by machine. In the marketplace, coffee processed by the dry method is called dry processed, unwashed, or natural coffee.” *Coffee Review*

b. Dry Natural Process with Yeast Starters

“…The coffee inoculated with yeast showed sensations of flavors higher than the control coffee indicating increased sensory quality. The treatment with C. parapsilosis UFLA YCN448 showed dominance rate higher (near 1) for the sensation of caramel. In non-washed coffee those sensations were not pleasant in relation to the washed coffee, except when P. guilliermondii UFLA YCN731 was inoculated, suggesting that washing the fruit before the fermentation process positively influenced the final product quality. **A coffee with special aroma of caramel, herbs and fruits could be produced using the starter cultures C. parapsilosis UFLA YCN448 and S. cerevisiae UFLA YCN727 in coffee processed by the dry method.”** “Improvement of coffee beverage quality by using selected yeasts strains during the fermentation in dry process” *Food Research International* [Volume 61](http://www.sciencedirect.com/science/journal/09639969/61/supp/C), July 2014, Pages 183–195 [*http://www.sciencedirect.com/science/article/pii/S096399691300642X*](http://www.sciencedirect.com/science/article/pii/S096399691300642X)

XIII Drying Parchment

“The objective of the present study was to evaluate the physiological and sensory quality of coffee beans processed and dried in different manners. The experiment was conducted with two types of processing - dry and wet processing, and four drying methods - drying in a drying yard, and mechanical drying with heated air at three alternating temperatures (50/40°C, 60/40°C and 40/60°C) where the temperature was changed when the coffee beans reached moisture content of 30% ± 2% (w.b.), with supplementation of drying until achieving 11% ± 1% (w.b.). The mechanical drying system used consisted of three fixed bed dryers, which allows control of temperature and flow drying rate. After application of the treatments, the coffees were sampled according to the evaluation system proposed by the Specialty Coffee Association of America (SCAA). In addition to sensory analysis, analyses were made of the physical-chemical and physiological quality of the coffee beans. The physical-chemical and physiological analyses involved: fatty acid composition, leaching of potassium, electrical conductivity and germination. Interesting results were obtained. **Coffee dried in the drying yard showed better sensory, physiological and physical-chemical results when compared with that dried in a dryer. Pulped coffee was more tolerant to drying than natural coffee, regardless of the way it was dried, showing better final quality of the product. Moreover, it may be observed that the increase in drying temperature in the final phase of the drying process leads to grain damage, which notably reduces beverage quality, confirming existing research.”**

*Physiological aspects of coffee beans, processed and dried through different methods, associated with sensory quality* [Coffee Science](https://www.researchgate.net/journal/1809-6875_Coffee_Science) 8(2):211-220 · December 2012 *https://www.researchgate.net/publication/286985392\_Physiological\_aspects\_of\_coffee\_beans\_processed\_and\_dried\_through\_different\_methods\_associated\_with\_sensory\_quality*

XIV Parchment Sun Drying Methods

a. Concrete

b. Asphalt

c. Dirt

d. Rubber Bags

e. Raised Beds

XV Hybrid Drying Terraces

“This new method adds a non-solar thermal source to drying on a traditional terrace by pushing heated air through perforated ducting around which the coffee is heaped. The heaps can be spread during the day to take advantage of solar input and heaped under a plastic tarpaulin overnight where it continues to dry as the warm air is conducted through it. There is little experience of the system in the field, but experimental results have been promising.” International Coffee Association

XVI Mechanical Drying

“Generically there are three common types of mechanical dryers used in coffee processing: Static bed or silo dryers where hot air is forced through a bed of coffee;  Contra-flow or vertical dryers where the coffee is cycled from bottom to top and allowed to flow downward through a stream of hot air; and Horizontal dryers where the hot air is introduced through a central shaft and forced outward through a rotating, perforated cylinder oriented horizontally which shares features of contra and concurrent flow. There are several new designs which promise higher drying efficiencies as measured by kJ/kg of coffee required to effect drying. Mechanical drying requires pre-drying so, with the exception of some arrangements of silo dryers, partial drying in the sun is also required where mechanical drying is applied. Heat exchangers are commonly employed to protect the coffee from acquiring a taint but where clean burning materials such as charcoal or propane are used, direct heating can be applied. In addition to these, wood (often from shade trees or coffee pruning), coffee husk, dried sugar cane, fuel oil and kerosene are used. Control parameters include loading, duration and operating temperature – normally air flow is fixed, though this may vary with back-pressure. Many mechanical dryers, horizontal designs in particular, only dry efficiently when fully loaded, others are more flexible. Typical drying times are from 12 to 24h depending on input moisture content, technology and operating temperature. If duration is insufficient the product will not be stable and if too great the producer loses money due to a loss both of quality and of weight. Uniformity of drying is an aspect that has received little attention but there is no reason to believe that rapid drying will result in a population of uniformly dried particles since the migration of water through the bean and fruit tissues is quite slow. The air temperature is usually controlled at the inlet and is critical since **temperatures in the grain above 45 C (113F) can damage coffee quality and a proportion of immature beans will become black and thereby lose much of their commercial value**“ International Coffee Association

a. Dehydrators

b. Microwave dryers

c. Solar Ovens

XVII. Parchment Drying Temperature

Coffee should be dried at or below 38C (100 F). Natural Coffee is more temperature sensitive than washed coffee. Beyond Wet and Dry: Breaking Paradigms in Coffee Processing, *Flavio Borem* https://www.youtube.com/watch?v=6QJRklaKEgY

XVIII. Green Bean Storage

* Temperature 65 - 75F
* Humidity 65%

XIX Resting

After coffee is harvested, pulped, washed, and dried, it is left in its parchment (a thin skin around the bean) for 30 days. During this period, the coffee is referred to as reposado, Spanish for “resting.” The reposo(“rest”) allows the coffee’s moisture levels to normalize and distribute more evenly throughout the beans. Many Latin American coffee producers insist this period is crucial to developing a pleasant, consistent flavor throughout the coffee.

|  |  |  |  |
| --- | --- | --- | --- |
| **Process** | **Positive Quality Effect** | **Methods** | **Detriment** |
| **Picking Red Ripe Fruit** | Aroma  Flavor  Sweetness  Acidity  Body  Aftertaste | Hand Pick | High cost |
| **Mechanical Demucilager** | None  (Lower labor cost)  (Less water usage) | Machine | Capital Expense  Incomplete mucilage removal  Loss of fermentation changes |
| **Wet Process** | Acidity  Flavor | Complete washing  -Soaking |  |
| **Pulped Natural** | Flavor  Body  Sweetness |  | Loss of acidity |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dry Ferment** | Sweetness  Body  Flavor |  | | Difficult to control  Not positive for some varieties |
| **Dry Natural** | Aroma  Sweetness  Body  Flavor | Patio Drying  Raised Bed Drying  Mechanical Drying | | Loss of acidity  Needs heat  Perception of fermented coffee |
| **Hybrid**  Dry ferment for 12, 24, 36 or 72 hours followed by wet process | Body  Flavor  Sweetness  Acidity |  | | Difficult to control |
| **Yeast starter** | Flavor | Can produce yeasty flavor | | Experimental |
| **Sorting Defects** | Aroma  Flavor  Sweetness  Acidity  Body  Aftertaste | Manual Sorting | | High Cost |
| **Parchment Drying** |  | -Sun Drying  -Mechanical Drying  -Hybrid Drying | | Difficult to control  Loss of chemical changes (mechanical)  Capitol Expense |
| **Parchment Resting** | Flavor | 30 – 90 days | | Expense |
| **Green Bean Storage** | Flavor | -Plastic lined paper bags  -Grain Pro  -Nitrogen Flushing | -Freezing  -Vacuum Pack  -Temp/  Humidity Control | Cost |