Annex 15

Cocoa Bean Manual Puratos Belcolade
BU Real Chocolate

Cocoa bean manual Belcolade

Nele Van Herewegen
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Goal of Cocoa bean manual

The goal of the Cocoa bean manual is:

- to collect the right information
- to explain evaluation methods
- to set up a system for grading or classifying cocoa beans
- to standardize
- to compare production coming from different cocoa bean farms
- to set up methods to evaluate tastes of chocolates and cocoa mass

This manual is a guideline in the different steps of evaluating the quality and processing of the cocoa beans. All results of measurements during the cocoa bean evaluation and processing are collected in an Excel file “Overview & Reports Beans”. This is the link on the server: \blcvm019\BelcoladeShared\SBU_Chocolate\R&D\Cocoa\Tests cocoa beans\Reports & overviews or ask it to your R&D contact.
Step 0: Sampling

For evaluating the quality and for processing the cocoa beans into chocolate a 5kg sample is needed. This laboratory sample or bulk sample should be taken from all the bags in each lot by taking several primary samples from different bags and mix them carefully. They should be taken using a collector (Figure 5), approximately the same quantity/ bag, at random, from the top part, the centre and the bottom part of bags in good condition. The sample is then sealed and labeled in the area where the samples have been taken. The sampling person should be a trained person. Sampling happens mainly in the warehouse or at the cooperative.

Figure 3: Example of sampling

Definitions:
- Consign: a quantity of beans dispatched or transported at one time and covered by a particular contract or shipping document.
- Lot: A quantity of merchandise assumed to be of uniform characteristics, taken from the consignment and permitting the quality of the merchandise to be assessed. For example: each lot has 200 bags and each bag has 60 kg.
- Primary sample: A small quantity of cocoa beans taken from a single position in the lot.
- Bulk sample: a quantity of cocoa beans formed by combining and mixing the primary samples from the different positions in the lot.
- Adulteration: covers alteration of the composition of graded cacao by any means so that the resulting mixture or combination is either not of the grade prescribed, or its quality or flavour is injuriously affected or its bulk or mass is altered.

Step 1: Information on incoming beans

A minimum amount of 5kg of cocoa beans is needed in order to do an evaluation of the quality of the beans and to process the beans in chocolate.

Following information has to be collected:
- Cocoa beans or cocoa mass
- Date of reception
- Received amount
- Lot number
Pilot processing can happen in the following cases:

- Develop a new origin or replace an existing one
- Evaluate the taste of the cocoa mass
- Evaluate the bean quality
- Process them into chocolate

Depending on the goal of the trial, we choose to use a standard chocolate recipe or a specific one to evaluate the cocoa beans. For fermentation trials, usually the standard recipe is used (45.9% cocoa mass, 43.7% sugar, 10% cocoa butter and 0.5% lecithin), for developing a new origin for example, a specific existing or new recipe can be used (depending on the project).

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**Step 2: Moisture determination**

**Fast method with the Mini Gac**

The Mini Gac is a simple device (based on infrared technology) to measure the humidity of the cocoa beans in a very fast way.

![Mini Gac device](image)

**Figure 1: Mini Gac device**

The procedure is the following:

- Press the On/Off/Home button to start the device (1).
Select a product (cocoa beans) using the up or down arrow button (2) and press enter (3). "Cocoa" will appear at the top of the display.

Before starting the actual measurement, the device must be put on zero. Make sure the cell is empty and hold the machine upright and still to perform an empty cell test. When the empty cell menu displays, press the enter button. Ensure the loader is removed from the top of the unit.

After the empty cell test is completed, press "enter" and fill the unit with cocoa beans, press again "enter" to start the test.
Repeat the measurement two times and calculate the average and the standard deviation.

**Classic method**
Mill 100g of peeled beans into small pieces. Preheat 2 little glass bowls for 1h at 105°C. Cool them down in a desiccator for 1h. Fill each glass bowl with 5g of milled cocoa beans on an analytical scale. Put the bowls in the heating cabinet for 3h at 105°C. After heating, cool them down for 1h in the desiccators and weigh them on an analytical scale. Calculate the average loss of water and the standard deviation.

If we compare the classic method to the mini Gac, we found both standard deviations are acceptable at normal moisture contents; however, the mini Gac will always give higher moisture content especially at low moisture values. So a profound validation is needed.

If the moisture content measured with the mini Gac reaches 8% or more, please confirm with the classic method.

The moisture content of beans has to be between 5 and 8%. The risk of developing molds is too high above 8% of moisture. Important to take into account is the fact that moisture content can increase during transport. If the beans already have high moisture content before they are stored and shipped, molds can develop during transport.

When the moisture content is too low the nibs can break. This can correspond in too much waste and a low yield. Too small nibs are more sensitive to heat so they will burn more easily during nib roasting. This will affect the taste of the cocoa mass. For bean roasting, too low moisture content has not really an influence on the roasting process and taste of the cocoa mass, as the beans are not so sensitive to the heat during roasting.

NIK
Step 3: Physical appearance

For the physical appearance and the cut test there is a 500g sample needed (according to the official method a 1kg batch is needed). This 500g sample is taken by splitting the original 5kg sample several times by using a suitable dividing apparatus after carefully being mixed. For this we use a bag and is illustrated on figure 5.

By physical appearances of cocoa beans is understood the different characteristics of the beans that can be observed by looking at the sample of beans. The characteristics with their explanations are listed below. Beans (500g) which are grouped in one of the characteristics are weighed and the results are expressed as the percentage on the total sample weight.

At the end of the physical appearance, the waste is calculated. The waste is the sum of the siblings, the flats, the broken beans, the shells, the impurities and the foreign bodies.

Throw the waste away and use the cleaned sample for the bean cut test, so leave the fraction of the molded and the infested beans by insects.

Characteristics:

- **Living insects**: When the dried cocoa beans are exposed to beetles or moths, they attack the beans and destroy the cotyledon. The presence of wires coming from the moths are also an indication.

  *Puratos grading*: when a batch of beans show living insects the batch is unacceptable.

- **Smoky**: cocoa beans which have a smoky smell or taste, which show signs of contamination by smoke.

  *Puratos grading*: smoky bean should be absent; this is unacceptable.

- **Moldy**: white moldy spots on the external parts of the bean visible to the naked eye and/or moldy smell (earthy, humus, ...)

Cocoa bean manual

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Puratos grading: less than 50% moldy beans are acceptable, more is unacceptable.

![Moldy beans](image)

**Figure 6: Moldy beans**

- **Siblings/twins/doubles**: Two or more cocoa beans fused together which cannot be separated by hand. A sibling contain two normal developed beans, when one of the two beans are flat, you consider this bean as normal. Multiple beans occur when the beans dry up together. These beans are very difficult if not impossible to roast and de-shell. This parameter is included in the waste.

Puratos grading: less than 2% of siblings are classified as type 1, a maximum of 2.5% siblings are classified as type 2 and type 3, more than 2.5% is unacceptable.

![Examples of siblings](image)

**Figure 7 and 8: Examples of siblings**

- **Flats**: A cocoa bean of which the cotyledons is so thin that it is not possible to obtain a cotyledon surface by cutting. These beans contain a very extensive portion of shell and a quite small portion of nibs. These beans are collected from immature pods. They will be calculated to the waste.

Puratos grading: a batch with less than 5% flat beans are classified as a type 1 bean, 6% is a type 2 bean, 7% is a type 3 bean. More than 7% flat beans are unacceptable.

![Flat beans](image)

**Figure 10: Flat beans**
- **Broken**: A cocoa bean of which a fragment of the nib is missing. However, when the shell is missing and the cotyledon is complete, the bean is not broken. Broken beans are indicated as waste.

  **Puratos grading**: more than 5% broken beans is unacceptable, less is counted as type 1, 2 or 3.

  ![Figure 11: Nibs to be found between the beans](image)

- **Shells**: Part of the shell without any of the cotyledon. The percentage of shells is part of the waste when processing the beans.

  **Puratos grading**: when the batch contains more than 4% of shells, the batch is unacceptable, less than 4% the batch is type 1, 2 or 3.

  ![Figure 12: Example of shells](image)

- **Impurities**: Material that is intrinsic to the processed product and includes fragments of the pod wall, residual pulp, placenta ... Also a waste parameter.

  **Puratos grading**: a percentage of more than 1 is unacceptable, less is classified as type 1, 2 or 3.

- **Foreign bodies**: any substance other than cocoa beans (broken beans, fragments and pieces of the shells): rope, metal, sand ... This substance belongs to the waste.

  **Puratos grading**: less than 0.3% is acceptable and classified as type 1, 2 or 3. More than 0.3% is unacceptable.

- **Black beans**: beans which were rotten before starting up the fermentation. These beans are coming from rotten cocoa pods. If you cut them, you will encounter a rancid smell.

  **Puratos grading**: TBD

---

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Calculation of the waste:
The waste of a batch of cocoa beans is counted as the sum of the flats, the broken, the shells, the foreign bodies and the impurities.
If the percentage is less than 1%, we have a type 1 bean. Till 5% of waste type 2, till 6% type 3. Above 6% of waste, the batch of cocoa beans is unacceptable.

Step 4: Bean Count

Total number of cocoa beans required to make a weight of 100 grams. The bean count is performed on the cleaned fraction obtained after the ‘physical appearance’ determination. The bean count shall be expressed as the number of beans per 100 g.

Bean count = \[\frac{\text{Number of whole beans}}{\text{Weight of whole beans (g)}}\times 100\]

We associate the weight of the cocoa beans with their size; this is correct if the dryness is on the low side. However, it is possible to obtain about the same weight with smaller beans and with the moisture in the 9% or even 8% area. The advice is to evaluate all those characteristics (bean count, moisture content) together.
Step 5: Bean cut test*

After the physical appearance test, next step is the evaluation of the interior of the bean. Therefore, a cocoa bean cutter is used to be able to see the inside of the bean (Figure 13 and 14). The bean cut test has to be done on 300 cleaned beans from the physical appearance, irrespective of size, shape and condition. Open or cut these 300 beans lengthwise through the middle, so the maximum cut surface of the cotyledons is exposed. Visually examine both halves of each bean in full daylight or equivalent artificial light. Use always the same light on the same distance. Count only one side of the bean cutter. The results for each kind of defect shall be expressed as percentage by the number of beans examined. When a bean is defective in more than one respect, count only the defect which appears first in the Puratos grading (table 1). The defects are expressed in order of importance: germinated, moldy, smelly, damaged by insects, violet (partly or fully) and over-fermented. Every defect will be discussed hereunder and the authorized percentage following the Puratos grading will be mentioned. At the end of this chapter an explanation of well fermented cocoa beans will also be explained.

Figure 14 and 15: a bean cut test

*Germinated cocoa beans
Before cutting the cocoa beans look for germinated beans; the shells of these beans were pierced, slit or broken by the growth of the seed germ. Only count them when the germ already fell out of the cotyledon. The failed germ creates a hole in the cotyledon, this is the reason why germinated beans are often affected by molds coming from the exterior.

This characteristic is caused by fermenting the beans in holes in the ground. This way the beans are not turned during the fermentation. Also, leaving ripe pods on the trees for several weeks and not harvesting them can cause germinated beans.

Puratos grading: a batch of beans with a maximum of 2% germinated beans are classified as type 1, maximum 5% as type 2, max 6% as type 3 and the batch is unacceptable as the amount of germinated beans is higher than 6%.

Figure 16: an example of germinated beans
Moldy cocoa beans

Molds that are present on the cotyledon are usually visible as white/green/yellow spots. In case of doubt, a check under a microscope can be enlightening, if this is available. Molds can develop when moisture content exceeds 8%. Moldy occurs often in combination with germinated beans.

PHENOMENON: when 1% of the cuted surfaces are molded, we deal with a type 1 bean, from 1% to 4%, a type 2, maximum 10% for a type 3 bean and unacceptable when the amount of molded beans are higher than 11%.

Figure 17: examples of molds in the interior of the bean

Figure 18: microscopic magnification of figure 15

Cocoa bean manual

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- **Slaty cocoa beans**
  A cocoa bean showing a grayish and/or greenish color. This indicates that the bean has not been fermented. Slaty beans have not developed the characteristics chocolate aromas and brown color and are very astringent.

  Puratos grading: when not more than 1% of the beans are slaty, the batch is a type 1 batch, when the amount of slaty beans refer between 1 and 5%, we deal with type 2 and type 3 beans. The batch is unacceptable above 5%.

- **Insect damage/infested**
  A cocoa bean of which the internal parts contain insects (including mites) at any stage of the development, or a bean that is been attacked (i.e. holes in the beans) by insects which have caused damage that is visible to the naked eye. Usually a crimson is still present.

  Puratos grading: a type 1 cocoa bean has less than 1% damaged beans, between 1 and 5% recorded as a type 2 and type 3. More than 5% is unacceptable.
• **Violet cocoa beans**

Cocoa beans of which the cotyledons are fully or partly violet, including a light or dark violet colour. In cases of doubt the bean can be manually broken in the width. When the whole surface of the transversely broken bean is violet, we count this bean as a violet bean. When the border of the beans has a brown colour and less than 10% of the bean is violet, the beans are counted as well fermented beans.

A batch of cocoa beans, with a lot of violet beans are characterized as under-fermented. On the other hand the cocoa mass of a batch with no violet beans can be very sour, because they were fermented too long. During the fermentation the lactic acid bacteria and the acetic acid bacteria can work longer and produce more acetic acid and lactic acid.

Batches of cocoa beans from the beginning of a crop will have more violet beans and the cocoa mass will be less sour. The farmers want to sell their merchandise faster. Beans from the end of the crop will be sourer, there is more time for fermentation.

**Puratos grading:** when 20% of the cutted beans are violet we deal with type 1 beans, between 20 and 40% violet beans type 2 beans, between 40 and 60% we will classify as type 3 beans. More than 60% violet beans are unacceptable.

![Example of violet beans](image)

• **Over-fermented cocoa beans**

Cocoa beans of which the color of the cotyledons is totally black. There will be no tint when making a cross-section in the width. Characteristically cotyledons have a burned flavor and a hammy taste.

**Puratos grading:** a type 1 cocoa bean has less than 2% over-fermented cocoa beans, a type 2 has maximum 4% over-fermented beans, and a type 3 has maximum 6% over-fermented beans. More than 6% over-fermented cocoa beans are unacceptable.

(a picture will be included)
**Well-fermented cocoa beans**

A cocoa bean of which the color of the cotyledons are fully brown (light or dark). It can be a bean with less than 10% purple, than there will be a brown border present. The bean can have a brown border and turning white towards the center, this is a white (pale) bean (figure 22).

![Figure 22: Example of a fully dark brown colored bean](image1)

![Figure 23: Example of fully light brown colored bean](image2)
Step 6: Classification of the results following the Puratos grading

Puratos has developed a grading tool for classification of cocoa bean quality. After doing the physical appearance test and the bean cut test, the evaluated beans fall into a certain class. The cocoa beans are evaluated as type 1 till type 3 or as unacceptable per characteristic. All the parameters are examined. The total bean is classified as the lowest score that occurs. If a bean is unacceptable for one characteristic, the whole batch is rejected. In this case the bean is usually not further processed into cocoa liquor or chocolate.

<table>
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<th>PURATOS GRADING</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
<th>Unacceptable</th>
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<tr>
<td>MOISTURE</td>
<td></td>
<td></td>
<td></td>
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<td>Moisture</td>
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<td>max 8%</td>
<td>max 9%</td>
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<tr>
<td>min 5%</td>
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<tr>
<td>PHYSICAL APPEARANCE</td>
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<td>Living insects</td>
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<td>absent</td>
<td>absent</td>
<td>present</td>
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<td>absent</td>
<td>absent</td>
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<td>&lt; 50%</td>
<td>&lt; 50%</td>
<td>&gt; 50%</td>
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<td>max 2.5%</td>
<td>max 2.5%</td>
<td>&gt; 2.5%</td>
</tr>
<tr>
<td>Plan</td>
<td>max 5%</td>
<td>max 6%</td>
<td>max 7%</td>
<td>&gt; 7%</td>
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<td>max 6%</td>
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<td>TBD</td>
<td>TBD</td>
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<td>Waste</td>
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<td>BEAN COUNT</td>
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<tr>
<td># beans/100 g</td>
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<td>max 100</td>
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<td>&gt; 100</td>
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<td>BEAN CUT TEST</td>
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<td>&gt; 6%</td>
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<td>Moldy</td>
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<td>max 4%</td>
<td>max 1%</td>
<td>&gt; 11%</td>
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<td>Slaty</td>
<td>max 1%</td>
<td>max 5%</td>
<td>max 5%</td>
<td>&gt; 5%</td>
</tr>
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<td>damaged by insects</td>
<td>max 1%</td>
<td>max 5%</td>
<td>max 5%</td>
<td>&gt; 5%</td>
</tr>
<tr>
<td>Violet (partly or fully)</td>
<td>max 20%</td>
<td>max 40%</td>
<td>max 60%</td>
<td>&gt; 60%</td>
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<tr>
<td>over-fermented</td>
<td>max 2%</td>
<td>max 4%</td>
<td>max 6%</td>
<td>&gt; 6%</td>
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Table 1: Puratos specifications for cocoa beans
Step 8: Additional tests on cocoa beans

- pH measurement on beans (AOAC 13.010)
The pH can vary rather significantly in different batches of cocoa beans. This can be depending on the origin of the bean, the type of bean and the type and batch size of fermentation. The pH fluctuates from 4.0 to 5.8.

Method:
- Grind about 200g of cocoa beans in a mixer.
- Weigh 10g of the fine mix into a 150ml beaker and slowly add, while stirring, 90ml boiling H2O. The suspension must be free from lumps.
- Filter and cool down till 20-25°C.
- Measure the pH immediately.
- Don’t forget to calibrate the instrument.
- To obtain this pH measurement as a quality parameter, a validation is needed.

Step 8: Roasting

After the cocoa beans have been classified as type 1, 2 or 3, the preparing of cocoa liquor can start. For moment a bakery oven is used for roasting the beans. 1.5kg of beans is roasted for 40 minutes at 135°C. Make sure that the internal extraction of the oven is closed and no steam is injected. After the heating process, the roasted beans need to cool down for about 30 minutes (on a rack at room temperature).

Figure 24: Bakery oven Mawe

By measuring the weight of the beans, the percentage of water loss is calculated. All this data is collected in our cocoa bean Excel file. Link: \bcvm019\Belcolade\Shared\JBU_Chocolate\R&D\JBU Real Chocolate\JBU Projects\Cocoa Beans\Tests cocoa beans\Reports & overviews.

The roasting process will be further optimized by using a "real" cocoa bean roaster (figure 25) instead of a bakery oven. In this way we expect to have a better heat transfer and the possibility to program accurately a few parameters like temperature, time and moisture. This will result in higher taste stability. The possibility to set up a standard procedure for beans and the possibility to experiment on the roasting process is needed to grow in taste and knowledge.
Figure 25: Cocoa bean roaster

**Step 9: Pre-grinding with the cocoa bean breaker**

The dryness and harness of the beans have an influence on the amount of breaking steps, 1, or 2 times. Too much breaking can give too little nibs. Those nibs give more trash while winnowing.
As specified in the purchase specs of Belcolade; a maximum of 1.75% shells in the cocoa liquor is acceptable.

Figure 26: Cocoa bean breaker: Limprinita CPS 0803821

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Step 10: Winnowing

The goal of winnowing is to remove the shells from the nibs in order to obtain a good quality product.
- Shells are exposed to external factors and will have picked up undesirable contaminants.
- Shells can have a negative influence on the flavor of the final product and may even lead to off-flavors.
- It is a very fibrous and hard material; consequently it is difficult to grind what can lead to abrasion of the grinding equipment during cocoa and chocolate processing.
- An uncontrolled separation of nibs and shell can lead to the loss of small nib particles along with the shells.
This is a particularly important financial factor.
Remark: we don’t have a method to measure the amount of shells at the moment.

Figure 27: Cocoa bean winower Cetador CC1 CPS 0803621

Step 11: Grinding

Produce cocoa mass for making chocolate
The Thermomix, a fast and easy instrument, is used when making more than 500g of cocoa mass. The cocoa mass
doesn’t need to be very fine when further refining is needed for making chocolate.
Install the temperature on 60°C and grind at speed 5. Keep an eye on the temperature, if the temperature raises too
much, wait for further manipulation.

Figure 28: Thermomix
Cocoa mass for tasting and lab trials

For tasting and/or lab trials we need a sample fineness of around 30μm, also for adding the cocoa mass after conching. Therefore we use the Pulverisette from Fritsch.

Figure 29: Cocoa grinder: Pulverisette from Fritsch

How to use the method

The pot and 3 spheres are pre-heated till 45°C. Add around 200g nibs, close the pot with the cover. Don’t forget the white Teflon ring. When the ring is damaged, replacement is necessary. When closing the pot, the ring needs to be clean, also the contact surface with the pot and the cover need to be cleaned up. Fasten the pot with the “safe Lock Holder” in the apparatus like described here under, explained in figure 30.

Figure 30: method for closing the pot with the safe lock holder
Set up the counterweight. If we always use the same product (nibs) and the same amount of spheres, further adjustment is not needed. If another weight is chosen, adapt the counterweight. Close the hood of the unit and set up the apparatus.

Be careful! If material like mass or nibs comes between the seal in between different runs (by opening and closing the pot), the mass can leak out of the pot. This should certainly be avoided because cleaning the apparatus inside is not that easy.

If the mass is used to add it to the chocolate after conching, it is required to mix for 12 minutes instead at 500rpm. Control the fineness of the mass with the micrometer.

Clean the pots in between runs with a spatula. After using the machine, clean with water and with detergent. Put everything back in the warm cabinet.

Maintenance of the Fritsch Pulverisette is needed yearly or two-yearly depending on the frequency of use.

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**Step 12: Lab trials on cocoa mass and cocoa butter**

- **FFA**
  
  Measuring FFA is an important parameter for crystallization. A too high content can indicate problems with crystallization. By abundant rainfall it can occur that the drying is not sufficiently done; the beans are then stored wet and the fermentation continues. The FFA will increase. Too high amounts will refer in a soap taste.
  
  Not fermented beans have a low content FFA.
  
  Normally the FFA is measured on cocoa butter by pressing the butter out of the roasted cocoa beans with the aid of a press. The Belcolade purchase specs refers to a maximum of 1.75% in cocoa butter.

  Measuring FFA in cocoa mass is maybe also possible (at the moment no experience with this), therefore an extraction with diethyl ether is needed.

  **Method**
  
  - Weight 1g of fat in an Erlenmeyer flask. If necessary melt the fat.
  - Add 50ml diethylether/hiethyl. (Preparation of the reagens: 500ml diethylather and 500 ml halethyl in a flask of 1 l. Add a few drops of phenolphtalein. Titrate with NaOH (0,1M) until light pink (add ± 0,8 ml)).
  - Add a few drops phenolphtalein.
  - Titrate with NaOH 0,1M until soft pink. Note the volume of NaOH (0,1M).
  - Calculation of the result:

\[
\% FFA = \frac{V \times 56,1 \times M}{P} \times 2, \]

with:

- \(V\) = volume NaOH (ml)
- \(M = 0,1M\)
- \(P = \text{mass fat (g)}\)
- **pH measurement (AOAC 13.010)**

  PH measurements are useful for comparing the acidity of cocoa masses. It can give information about the fermentation.

  **Method**
  Weigh 10g sample into 150ml beaker and slowly add, with stirring, 90ml boiling H2O. Suspension must be free from lumps. Filter, cool filtrate till 20-25°C, detect the pH immediately.
  The pH range accepted in the Puratos specifications is from 5.3 till 5.8.

- **Measuring amount of shells in cocoa mass**

  As specified in the purchase specs of Belcolade, a maximum 1.75% of shells in the cocoa liquor is acceptable.
  Official method: AOAC 970.23.

- **Solid fat content = SFC**

  **Method**
  - First degreasing the cocoa mass with diethyl ether (extraction for 8h). When the fat is free from solvent, the actual measurement can start.
  - Melt for 15 minutes at 80°C.
  - Fill 5 tubes till 3cm.
  - Leave the tubes at 60°C during 5 minutes, than 60 minutes at 0°C. After this, put one tube in a warm water bath of 10-20-30-35-40°C during 30 minutes.

- **Cd determination**

  A lot of origins from volcanic areas are enriched with the heavy metal Cadmium. The concentration of this element is performed at an external accredited lab.

- **Microbiology on cocoa mass**

  Total plate count, the amount of Enterobacteriaceae, molds, salmonella and yeast can be analyzed at an external accredited lab.
Sources:
ISO 1114 - 1977 Cocoa beans – Cut test
ISO 2292 - 1973 Cocoa beans – Sampling
ISO 2451 – 1973 Cocoa beans – Specification
Cocoa cut test chart from Cocoa Research Unit, The University of the West Indies, St. Augustine, Trinidad, Rap. of Trinidad (http://sta.uwi.edu/cru/guides.asp)
The international Cocoa Trade – Robin Dand
REGULAMENTO TÉCNICO DA AMÊNDOA DE CACAU (Brazil) - INSTRUÇÃO NORMATIVA Nº 38, DE 23 DE JUNHO DE 2008
Crespo Silvio, Cocoa Beans Today
Annex 16

The evaluation form for cocoa mass used by Puratos Belcolade
Questionnaire taste sessions cocoa masses

Please find in front of you one or more cocoa masses. Evaluate all the cocoa masses on the descriptors hereunder. The descriptors are explained, read them before scaling.

Scale them from 0 to 5. The meaning of every number is explained hereunder. It is possible that two or more evaluated cocoa masses are scored the same on some descriptors.

- 0 = none present
- 1 = just a trace and may not be found if tasted again
- 2 = present in the sample
- 3 = clearly characterizing the sample
- 4 = dominant
- 5 = extremely dominant

At the end we want to have a clear taste mapping of the cocoa mass(es) you have tasted.

Cocoa: the typical flavour of cocoa beans that are well fermented, roasted and free of defects.

less cocoa

more cocoa

Bitter: Find in caffeine (coffee bitterness), beer, grapefruit and quinine.

less bitter

more bitter

Acid: four different tastes of acidity can be felt:
- citric acid: fresh sourness, find in fruit
- acetic acid: volatile acid, possible to smell, find in vinegar
- lactic acid: vomit like, like in sour milk or molasses

less acid

more acid

Astringency: a dry, puckering mouthfeel, which boosts the production of saliva, perceived between tongue and palate or at the back of the front teeth. Reflected in raw nut skins, banana skins, unripe fruits, some wines with a lot of tannins.

less astringent

more astringent
Questionnaire taste sessions cocoa masses

For the following descriptors it is indicated to note if you can retrieve the explained flavour notes. Feel free to add some more descriptors at the end.
“yes”: you find this flavour back  “No”: this flavour is not present

Fruity:
- Fresh fruit:
  - Fruit berry, currants, not fully ripe raspberry
  - Fruit citrus, essence of citrus
  - Tropical fruit, like banana, passion fruit or orange, almost always some citrus note involved
- Browning fruit:
  - Dark reddish fruit like plum, dark cherry.
  - Fruit dried like dried apricot, banana, raisins etc.: caramelization of fruit sugar, essence of a fruit that has undergone the drying process, sulphur and nutty notes also
  - Over ripe fruit: beginning of over fermentation
  - Brown fruit like prunes or dates

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

NUTTY:
- The meat of peanuts, hazel nuts, almonds and walnuts
- Skins of nuts, associated with some astringent sensation

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

Floral:
- Floral can come from natural environment you can get this by taking a walk in your garden, green earthy, herbal and woody.
- Grassy: fresh cut grass, very fresh grass or young leaves
- Green vegetative (dark green): old cocoa leaf crushed, dark green note, green beans, cooked bell peppers, dark green vegetables
- Woody: dried essential oil, going for walk in forest before winter, dried flowers
- Herbal: dried spices
- Flowers

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

Earthy: forest after the rain. Loam. Mushrooms.

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<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
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</tbody>
</table>

Hammy: carved meats like ham

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

Smoky: The flavor of burned vegetative matter like wood, grass, cocoa hulls, etc. Other off flavours like diesel fumes.

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

Roasted: The roasted smell and/or taste of a cocoa mass is due to the heat treatment process of the cocoa beans. This flavour is caused by caramelization and maillard reaction during the roasting process of the beans.

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

Others:
Annex 17

Aspects of the Fine Robusta Cupping Standards and Details of the Attributes Used on the SCAA Tasting Form
Environment

Lighting Standard

When grading green coffee, the light level on the table-top and grading mat shall be full spectrum and at least 4000 Kelvin (K) / 1200 Lux (lx) / 120 foot-candles (fc).

Surface

The green grading surface must be a black grading mat of no less than .18581m² (2 ft²).

Samples

Sample Size

Each green coffee sample shall be exactly 350g.

Moisture Content

Moisture content must be within 10-12% for fully washed coffee and 10-13% for natural processed coffee.

Bean Size

Bean size must not deviate more than 5% from contract specification, measured by retention on traditional round-holed grading screens.

Cupping Standards

Coffee to Water Ratio

When cupping, the ratio of 8.75 grams (whole bean) coffee (± 0.25 grams), to 150 ml (~5 fluid ounces) water shall be used. When adjusting due to vessel size, a ratio of 0.058 g coffee (whole bean) per 1 ml water or 1.73 grams per 1 fluid ounce of water shall be used.

Cupping Vessel

Cupping vessels shall be of tempered glass or ceramic material. They shall be between 210 ml and 265 ml, (7 and 9 fluid ounces), with a top diameter of between 75 – 90 mm, (3 and 3.5 inches). All cups used shall be of identical volume, dimensions and material of manufacture with lids.

Water Temperature

Cupping water temperature shall be 92 – 94.5°C (200°F ± 2°F) when poured on grounds.

Cupping Water

Cupping Water shall meet all the requirements listed in the SCAA Standard ‘Water for Brewing Specialty Coffee,’ as shown below:
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Target</th>
<th>Acceptable Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odour</td>
<td>Clean/fresh, odour free</td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>Clear colour</td>
<td></td>
</tr>
<tr>
<td>Total Chlorine</td>
<td>0 mg/L</td>
<td>75 – 250 mg/L</td>
</tr>
<tr>
<td>TDS</td>
<td>150 mg/L</td>
<td>75 – 250 mg/L</td>
</tr>
<tr>
<td>Calcium Hardness</td>
<td>4 grains (68 mg/L)</td>
<td>1-5 grains (17 mg/L – 85 mg/L)</td>
</tr>
<tr>
<td>Total Alkalinity</td>
<td>40 mg/L</td>
<td>At or near 40 mg/L</td>
</tr>
<tr>
<td>pH</td>
<td>7.0</td>
<td>6.5 – 7.5</td>
</tr>
<tr>
<td>Sodium</td>
<td>10 mg/L</td>
<td>At or near 10 mg/L</td>
</tr>
</tbody>
</table>

**Coffee Grind**

The coffee used for cupping shall be ground so that 70-75 percent of the grinds pass through the #20 mesh sieve.

**Roast for Cupping**

The roasting of coffee for cupping shall take between 9 and 14 minutes and shall be used for cupping within 8 and 24 hours after roasting.

**Roast Level**

The roast for cupping shall meet Agtron gourmet colour score of 48 for whole beans, 78 for ground coffee, ± 1 unit, or between the scores of 50 and 55 on the ‘standard’ Agtron scale. If an Agtron machine is not available, roasted whole bean coffee shall match Agtron roast tile #50.

**Cupping Room Size**

Cupping room minimum dimensions (for exactly one cupping table) shall be no smaller than 10 m² (~110 square feet).

**Cupping Spoons**

Cupping spoons shall hold 4-5 ml (0.135 – 0.169 fluid ounces) of coffee sample and should be of non-reactive metal.

**Cupping Tables**

Cupping tables (for 6 people) shall have a surface area of at least 1 square meter (~10 square feet), and be between 107 – 117 centimetres (42 and 46 inches) tall.
## Cupping Protocols

### Requirements

<table>
<thead>
<tr>
<th>Roasting Preparation</th>
<th>Environment</th>
<th>Cupping Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample roaster</td>
<td>Well lit</td>
<td>Balance (scale)</td>
</tr>
<tr>
<td>Agtron or similar colour reading device</td>
<td>Clean, no interfering aromas</td>
<td>Cupping glasses with lids</td>
</tr>
<tr>
<td>Grinder</td>
<td>Cupping tables</td>
<td>Cupping spoons</td>
</tr>
<tr>
<td></td>
<td>Quiet</td>
<td>Hot water equipment</td>
</tr>
<tr>
<td></td>
<td>Comfortable temperature</td>
<td>Forms and other paperwork</td>
</tr>
<tr>
<td></td>
<td>Limited distractions (no phones, etc.)</td>
<td>Pencils and clipboards</td>
</tr>
</tbody>
</table>

### Sample Preparation

**Roasting:**

The sample should be roasted within 24 hours of cupping and allowed to rest for at least 8 hours.

**Roast Profile:**

- Robusta beans are typically more dense than most Arabica beans and present greater resistance to heat. For this reason, the surface of Robusta whole beans must be roasted considerably darker than Arabica whole beans in order to achieve similar flavour development and internal roast colour (after grinding).

- Robusta whole bean roast colour should be *medium to medium-dark*, not *light to medium-light* as is common for Arabica cupping roasts. On the M-Basic (Gourmet) Agtron scale, a Robusta whole bean reading of approximately 48 is needed to produce a ground M-Basic (Gourmet) Agtron reading of approximately 78, +/- 1 point (Agtron/SCAA tile #45 for whole bean and Agtron/SCAA tile #75 for ground). Cupping panel testing has suggested this lighter roast profile is the optimal ground roast colour for Robusta cupping.

- Comparable color readings for ground Robusta would be approximately 54 on the Agtron E10/E20 commercial scale or approximately 110 on the Probat colourette scale, and approximately 115 on the Neotec-Neuhaus scale.

- Those accustomed to sample roasting Arabica should note that the first crack is not as pronounced or dramatic in Robusta as it is in Arabica. With Robusta, the first crack seldom reaches a crescendo and the second crack is also very subdued at its onset. Those who time their roast by the sound of the crack must wait until the first crack has completely concluded before considering terminating the roast. If the roast is terminated a few moments (10 seconds...
or so) before the second crack, the optimum roast development for Robusta as determined by panel cupping should be achieved.

- The roast should be completed in no less than 9 minutes and no more than 14 minutes. Scorching or tipping should not be apparent.
- Sample should be immediately air-cooled (no water quenching).
- When the beans reach room temperature (approximately 75°F or 20°C), completed samples should then be stored in airtight containers or non-permeable bags until cupping to minimize exposure to air and prevent contamination.
- Samples should be stored in a cool dry place, but not refrigerated or frozen.
- The optimum ratio is 8.75 grams per 150 ml of water
- Determine the volume of water in the selected cupping glass and adjust weight of coffee to this ratio within +/- .25 grams
- Sample should be ground immediately prior to cupping, no more than 15 minutes before infusion with water. If this is not possible, samples should be covered and infused not more than 30 minutes after grinding.
- Samples should be weighed out AS WHOLE BEANS to the predetermined ratio (see above for ratio) for the appropriate cup fluid volume.
- Grind particle size should be slightly coarser than typically used for paper filter drip brewing, with 70% to 75% of the particles passing through a U.S. Standard size 20 mesh sieve.
- At least 5 cups from each sample should be prepared to evaluate sample uniformity.
- Each cup of sample should be ground by running a cleansing quantity of the sample through the grinder, and then grinding each cup’s batch individually into the cupping glasses, ensuring that the whole and consistent quantity of sample gets deposited into each cup. A lid should be placed on each cup immediately after grinding.
- Water used for cupping should be clean and odour free, but not distilled or softened. Ideal Total Dissolve Solids are 125-175 ppm, but should not be less than 100 ppm or more than 250 ppm pursuant to SCAA water quality standards for cupping.
- The water should be freshly drawn and brought to approximately 200°F (93°C) at the time it is poured onto the ground coffee.
- The hot water should be poured directly onto the measured grounds in the cup to the rim of the cup, making sure to wet all of the grounds.
- As the coffee degasses, the cap may sink below the rim of the cup. When this occurs immediately pour additional water into the cup so that the cap again rises to the rim of the glass.
- Allow the grinds to steep undisturbed for 4 minutes before evaluation.

**Measurement:**

- The optimum ratio is 8.75 grams per 150 ml of water
• Determine the volume of water in the selected cupping glass and adjust weight of coffee to this ratio within +/- .25 grams

Cupping Preparation:

• Sample should be ground immediately prior to cupping, no more than 15 minutes before infusion with water. If this is not possible, samples should be covered and infused not more than 30 minutes after grinding.
• Samples should be weighed out AS WHOLE BEANS to the predetermined ratio (see above for ratio) for the appropriate cup fluid volume.
• Grind particle size should be slightly coarser than typically used for paper filter drip brewing, with 70% to 75% of the particles passing through a U.S. Standard size 20 mesh sieve.
• At least 5 cups from each sample should be prepared to evaluate sample uniformity.
• Each cup of sample should be ground by running a cleansing quantity of the sample through the grinder, and then grinding each cup’s batch individually into the cupping glasses, ensuring that the whole and consistent quantity of sample gets deposited into each cup. A lid should be placed on each cup immediately after grinding.

Pouring:

• Water used for cupping should be clean and odour free, but not distilled or softened. Ideal Total Dissolve Solids are 125-175 ppm, but should not be less than 100 ppm or more than 250 ppm pursuant to SCAA water quality standards for cupping.
• The water should be freshly drawn and brought to approximately 200°F (93°C) at the time it is poured onto the ground coffee.
• The hot water should be poured directly onto the measured grounds in the cup to the rim of the cup, making sure to wet all of the grounds.
• As the coffee degasses, the cap may sink below the rim of the cup. When this occurs immediately pour additional water into the cup so that the cap again rises to the rim of the glass.
• Allow the grinds to steep undisturbed for 4 minutes before evaluation.

Details of the attributes assessed on the SCAA Tasting form:

Fragrance/Aroma: The aromatic aspects include Dry Fragrance (defined as the smell of the ground coffee when still dry) and Wet Aroma (the smell of the coffee when infused with hot water). One can evaluate this at three distinct steps in the cupping process: (1) sniffing the grounds placed into the cup before pouring water onto the coffee; (2) sniffing the aromas released while breaking the crust; and (3) sniffing the aromas released as the coffee steeps. Specific aromas can be noted under qualities and the intensity of the dry fragrance, break, and wet aroma aspects noted on the 6-point vertical scales. The score finally given is calculated by summing the vertical scales and should reflect the preference of all three aspects of a sample’s Fragrance/Aroma.
• Enzymatic notes commonly found in Fine Robusta coffees include: Tea Rose, Lemon, Coffee Blossom, and Honey; while those commonly found in commercial (off-grade) Robusta coffees include Potato and Garden Peas.
• Sugar Browning notes commonly found in Fine Robusta coffees include: Vanilla, Butter, Caramel, Cocoa and Walnuts; while those commonly found in off-grade Robusta coffees include Toasted Bread and Roasted Peanuts.

• Dry Distillation notes commonly found in Fine Robusta coffees include Malt; while those commonly found in off-grade Robusta coffees include Pepper, Cedar, and Pipe Tobacco.

• Aromatic Taints commonly found in Fine Robusta coffees include Coffee Pulp; while those commonly found in off-grade Robusta coffees include Earthy, Medicinal, Smoke, Rubber, and Straw.

**Flavour:** Flavour represents the coffee’s principal character, the mid-range elements, in between the first impressions given by the coffee’s first aroma and taste to its final aftertaste. It is a combined impression of all the gustatory (taste bud) sensations and retro nasal aromas that go from the mouth to nose. The score given for Flavour should account for the intensity, quality and complexity of its combined taste and aroma, experienced when the coffee is slurped into the mouth vigorously so as to involve the entire palate in the evaluation.

• Flavour notes found in Fine Robusta coffees commonly include:
  - Fruit-like: cherry, black currant, raisin, raspberry, berry, dry fig, lemon, and prunes.
  - Nut-like: walnut, almond, and malt
  - Spice-like: clove, coriander and allspice
  - Sweet-like: molasses, syrupy, caramel, honey, dark chocolate, cocoa, and buttery
  - Overall: rounded, complex, complete, mellow, deep and delicate.

• Flavour notes found in off-grade Robusta coffees commonly include:
  - Vegetable-like: grassy, hay, grain-like, barley-like, legume, potato, pea-like, silage, jackfruit, popcorn, and biscuit-like
  - Phenol-like: medicinal, metallic, rubbery, smoky, burnt, woody
  - Astringent-like: uric, salty, briny, brackish
  - Overall: dull, lifeless, flat, uneven, neutral, harsh, soapy

**Aftertaste:** Aftertaste is defined as the length of positive flavour (combined taste and aroma) qualities emanating from the back of the palate and remaining after the coffee is expectorated or swallowed. When an aftertaste is short or unpleasant, a lower score is appropriate. In Robusta coffees, aftertaste is often underscored by the potassium level found in the coffee, with high levels resulting in *brackish* (high saltiness and displeasing aromas) aftertastes and with low levels resulting in *savoury* (low saltiness and pleasing aromas) aftertastes.

**Salt/Acid Aspect Ratio:** The Salt/Acid Aspect Ratio is responsible for the pleasing and delicate taste that is derived from distinguishable acidity and sweetness in Robusta coffees, stemming from the presence of fruit acids and sugars. It is also recognized because of lower levels of potassium and caffeine that make the Robusta coffee tastes coarse or harsh are absent from Fine Robusta coffees. This attribute is comparable to the strictly soft or strictly hard categorization of Brazilian coffees. The noticeable
perception of acidity is one of the striking taste differences between Fine Robusta and off-grade Robusta coffees.

**Bitter/Sweet Aspect Ratio:** Both bitter and sweet taste sensations are present in Robusta coffees. The bitter component stems principally from the caffeine and potassium levels present in the coffee, while the sweet component is derived from the fruit acids, chlorogenic acid, and sugars levels in the coffee. Fine Robusta coffees have a low bitter and high sweet aspect in their taste, while Commercial Robusta coffees have a high bitter and low sweet aspect in their taste. In determining the Bitter/Sweet Aspect Ratio Score, the cupper rates the relative bitterness on a scale of 1 to 6, giving the higher score to the lower perceived bitterness, while at the same the cupper rates the relative sweetness on a scale of 1 to 6, giving the higher score to the higher perceived sweetness. The two scores are then added to determine the Bitter/Sweet score.

**Mouthfeel:** The quality of Mouthfeel is based upon the tactile feeling of the liquid in the mouth, especially as perceived between the tongue and roof of the mouth. Most samples with heavy Mouthfeel may also receive a high score in terms of quality due to the presence of brew colloids. Brew colloids are formed as the oils extracted from the ground coffee coagulate around the micro-fine bean fibres suspend in the brew. Mouthfeel has two distinct aspects: weight and texture.

**Balance:** How all the various aspects of Flavour, Aftertaste, Salt/Acid Aspect Ratio, Bitter/Sweet Aspect Ratio, and Mouthfeel of the sample work together and complement or contrast to each other is “Balance.” As the intensity of each of these attributes increases, it is more difficult for all the attributes to remain in balance. If each attribute increases equally in intensity, then the Balance score is high. If the sample is lacking in one or more attributes or if some attributes are overpowering, the Balance score would be reduced.

**Uniform Cups:** Uniform Cups refers to consistency of flavour of the different cups of the sample tasted. If a single sour, ferment, phenolic or other off-tasting bean is present in any of the cups, one or more of the cups will exhibit a different taste. This inconsistency in the flavour of the coffee is a very negative attribute. This type of inconsistency should be so distinct that the cupper can easily identify the off-cup in a triangulation with the other cups in the sample set. The rating of this attribute is calculated on a cup-by-cup basis. 2 points are awarded for each cup in the sample that is uniform (tastes like the other cups), with a maximum of 10 points if all 5 cups are the same.

**Clean Cups:** Clean Cups refers to a lack of interfering negative impressions from first ingestion to final aftertaste, a “transparency” of cup. In evaluating this attribute, notice the total flavour experience from the time of the initial ingestion to final swallowing or expectoration. If a single mouldy, dirty, and baggy or other off-tasting bean is present in any of the cups, one or more of the cups will exhibit a non-coffee taste. Any non-coffee like tastes or aromas will disqualify an individual cup. 2 points are awarded for each cup in the sample that is free from a non-coffee like taste or aroma.

**Overall:** The “overall” score attribute is meant to reflect the holistically integrated rating of the sample as perceived by the individual cupper. A sample with many highly pleasant attributes, but not quite “measuring up” to the cupper’s expectation would receive a lower rating. A coffee that met expectations as to its character and reflected particular origin flavour qualities would receive a high score. An exemplary example of preferred characteristics not fully reflected in the individual score of the individual attributes might receive an even higher score. This is the step where the cuppers make their personal appraisal of the coffee. Good cuppers do not allow their personal preference for a coffee to interfere with the rating of the other flavour attributes of the sample.
Defects: Defects are negative or poor flavours that detract from the quality of the coffee. These are classified in 2 ways. A *taint* is an off-flavour that is noticeable, but not overwhelming, usually found in the aromatic aspects. A “taint” is given a “2” in intensity. A *fault* is an off-flavour, usually found in the taste aspects, that is either overwhelming or renders the sample unpalatable and is given an intensity rating of “4”. The defect must first be classified (as a taint or a fault), then described (“sour,” “rubbery,” “ferment,” “phenolic” for example) and the description written down. The number of cups in which the defect was found is then noted, and the intensity of the defect is recorded as either a 2 or 4. The defect score is multiplied by the number of cups in which it is found and subtracted from the total score in calculating the Final Score, following to directions on the cupping form.