Protocol

FOR THE

Preparation of Cocoa Liquor for Sensory Analysis

Contents

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Why Do We Need a Protocol?

The objective of this protocol is to guide users in the preparation of a uniform cocoa bean sample and to produce comparable cocoa liquor samples using different laboratories and equipment. We recognize that it is not possible for two laboratories with different equipment and environmental factors to produce identical cocoa liquor samples. We also recognize that comprehensive calibration among laboratories is a continuous and rigorous process. These instructions and suggestions should serve as a starting point in the production of a liquor that is ideal for sensory evaluation of cocoa attributes.

LABORATORIES USED

CONACADAO Agroindustrial
DOMINICAN REPUBLIC

TCHO Chocolate | **UNITED STATES**

Cafetalera Amazónica | **PERU**

A portable laboratory | **PERU**

PROTOCOLS CONSULTED

This protocol was developed by consulting protocols already in existence, among them:

- CAOBISCO/Cocoa of Excellence
- FCCI
- Internal protocols of the laboratories participating in the trials

Procedure for Developing this Protocol

This protocol for sample preparation is the result of a testing and research process that was part of the USAID-Equal Exchange-TCHO Cooperative Development Program (CDP) between 2010 and 2018.

During the program, our team conducted several evaluation trials and used degree of difference sensory analysis testing to determine the range of values or parameters that would allow us to develop a standard protocol. Although it is impossible to produce identical samples, this protocol produces samples sufficiently alike to allow for tasting and the evaluation of the same primary sample attributes.

The laboratories used for these trials indicate a minimal degree of difference in the end result.

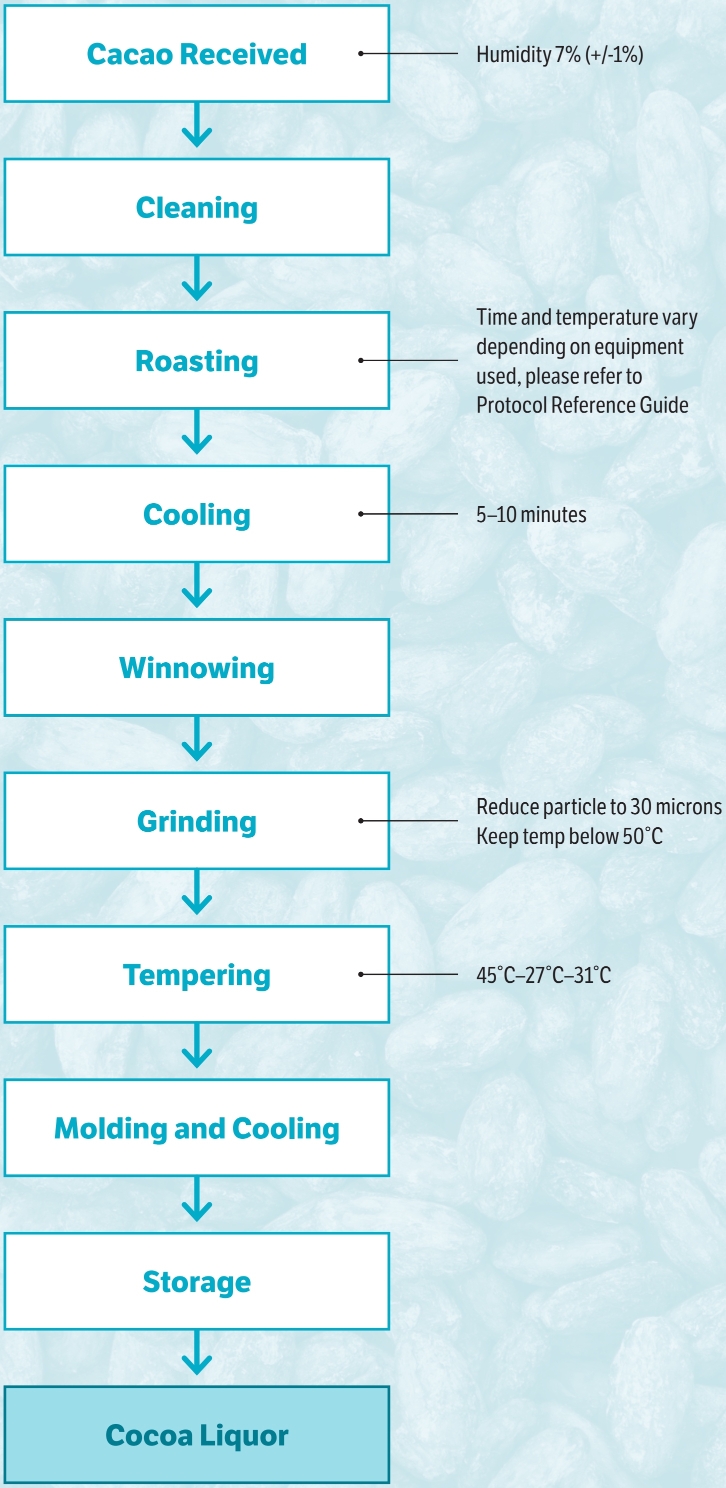
Importance of Following a Protocol for the Preparation of Cocoa Liquor

A cocoa bean sample can exhibit vastly different attributes during cocoa liquor tasting depending on the preparation. It is important to consider the parameters and methodologies used in preparing a sample for tasting since, if not prepared properly, we might evaluate the sample incorrectly or deliver an inaccurate result.

We hope this document is of great use and serves as a guide in preparing samples for laboratory comparison.

Cocoa Liquor Processing

FLOWCHART



Preparation of Cocoa Liquor

Step 1: Before Roasting

Once the sample has been received, several considerations for proper storage must be taken into account before cocoa liquor preparation. The sample must be stored in an environment that is free from foreign odors and without humidity. Beans should be contained in appropriate bags or containers that do not alter the sample.

Before preparing the cacao beans for sensory analysis, it is important to complete a physical analysis that includes **counting 100 beans** and a **cut test**.

HUMIDITY PRIOR TO ROASTING

The initial humidity content of the beans must be **7% (+/- 1%)** before roasting. If the humidity is above 8%, we recommend pre-drying the sample. If the humidity is less than 6%, we recommend decreasing roasting time and temperature.

AMOUNT OF COCOA SAMPLE FOR ROASTING

A minimum 1 kg sample is recommended so that the physical evaluation can be performed in addition to preparing the liquor sample.

For roasting, the sample weight will vary according to the equipment used. We recommend a sample **between 200 and 700 grams** to achieve a representative profile. This weight will vary depending on the roasting equipment used. (See Appendix 2).

A cut test or physical analysis is an important accompaniment to a sensory analysis.

The sample of beans to be processed should be weighed after proper humidity levels are achieved, and just prior to roasting.

Step 2: Roasting

Roasting is an important step in cacao processing as it develops aromatic compounds and flavor. Therefore, time and temperature variables must be meticulously controlled. After inserting the beans in the roaster, the start time for roasting should commence once the temperature returns to 118˚C.

Roasting process variables—such as temperature, time, roaster type, and amount of cacao beans roasted—have a significant impact on the liquor flavors encountered during sensory analysis. Proper roasting of the beans is necessary to evaluate the sample attributes adequately. Likewise, if the beans are over roasted or burnt, the level of bitterness will increase, and it will not be possible to evaluate the attributes or quality of the sample. This process also allows the shell to detach more easily from the bean.

For this protocol, we conducted trials with different types of roasters:

MECHANICAL CONVECTION OVEN

500 grams » 120˚C x 20 min
In the trials conducted for this protocol, we used a Binder 56 with two trays. The roasting trays used were made following CAOBISCO recommendations (built with a wide stainless steel mesh, 0.6 cm/0.25 in deep, with a rigid enough wire that could be built into a tray and mounted on the screen).

LARGE ROTARY ROASTER

700 grams » 120˚C x 20 min
We used a rotary roaster with light heating. In addition to a temperature sensor that controls the roasting, the rotary drum also allows for a uniform roasting of the cacao beans.

SMALL ROTARY ROASTER

300 grams » 120˚C x 16 min
In the trials conducted for this protocol, we used an Alpenrost brand machine. This machine has an average 300-gram capacity and is generally used to roast coffee. It has controls for temperature, time, and cooling.

LARGE TOASTER OVEN

200 grams » 120˚C x 25 min
The oven we used has time, temperature, and air controls. A stainless steel screen in the shape of a tray is used to place the cocoa sample in the oven so that hot air is distributed uniformly. Please note that this is not a convection oven.

Step 3: Cooling

Cooling the beans is important because the roasting process might continue for a few more minutes if the beans are not adequately cooled directly after the roasting process. Therefore, the beans should be removed and cooled once roasting time has been completed. In this step, the following methods can be used:

- Basket with cold air circulation.
- Cooling Unit within the Roaster.
- A vacuum (such as Shop-vac) attached to two buckets modified with a wire mesh screen in between them.

IMPORTANT!

- Bean cooling takes 5-10 minutes depending on equipment.
- It is not recommended that the beans be left to cool at room temperature.

Step 4: Winnowing

CRACKING

Before cracking and winnowing the sample, beans should be cooled to 30˚C so that friction does not separate the cocoa butter. The sample can be processed for up to one hour after cooling.

The shell, firmly attached to the bean in raw cacao, separates during the roasting process, easing the winnowing, shelling, or peeling of the beans.

WINNOWING

This step is carried out with equipment called **winnowers**. Some winnowers incorporate a prior grinding or "breaking" process, which further facilitates the process of removing the shell. The cacao and ground shells fall on a strainer formed by sieves of different calibers. Due to their shape and lesser specific weight, the shells are carried by an air current, thus separating the cacao from the shell. Now fragmented and without shells, the cacao beans become cocoa nibs.

Bean cracking machines may be manual or electric.

The following equipment or operational resources can be used for this process:

- Bean cracker and ventilation fan to separate the shell.
- Cacao bean winnowing equipment.
- Manual winnower.

Winnowing Machine

IMPORTANT!

It is important to remove at least 99.0% of the cacao shell because if the shell content of the cocoa liquor sample is high, it can increase the sensation of astringency and even cause some unwanted changes or characteristics in the sample.

The sample needs to be processed within 36 hours of roasting since contact with oxygen can cause changes in sample appearance as well as taste fluctuation, possibly causing rancidity in the cocoa butter.

Step 5: Grinding

The cocoa nibs are crushed until the friction of the grinding process transforms them into a liquid paste called cocoa liquor.

The following mills or melangeurs can be used to carry out this procedure:

- Disk mill.
- Stone mill.
- Ball mill.

Nibs should be added slowly to prevent clogging the machine.

Stone Melanger or Grinder

Ball mill refiner

IMPORTANT!

Grinding temperature should not reach above 50 ˚C, otherwise the sample could burn or release volatile compounds. By the end of the grinding process, cocoa liquor particles should have been reduced to 30 microns.

Step 6: Tempering

Tempering is the process by which the temperature of the cocoa liquor is lowered from approximately **50 ˚C to 29 ˚C** and then raised to **32 ˚C** with the goal of keeping the cocoa butter fatty acid chain stable and, consequently, the cocoa liquor.

This process can be achieved manually or with tempering machines. The tempering process presented in this manual begins at a temperature of **45 ˚C**, which is lowered to **27 ˚C** and then increased to **31 ˚C**, stabilizing the butter and resulting in a glossy shine and beautiful appearance.

Tempering can be done by hand or with a machine.

Step 7: Molding and Cooling

Once the cocoa liquor has been tempered, it is placed in cooling containers or molds. This process requires a controlled temperature of **10 to 15 ˚C** with a relative humidity no greater than **60%**. A cold chamber is recommended for this process.

Molding

Step 8: Storage

Finished samples may be placed in storage. Certain considerations must be taken into account, such as:

- maintaining the temperature at or below **12–18 ˚C**,
- keeping away foreign odors, and
- storing the sample for no longer than **12 months**.

Longer periods of storage may result in slight variations in the intensity of certain attributes.

Well tempered samples will release easily from the moulds.

APPENDIX 1: Sample Preparation Checklist

BEFORE ROASTING

☐ Receive the cacao sample, which must contain information about humidity content.

☐ Mix the sample and separate the amount of cacao to be processed through quartering (mix, separate into four parts, and keep only one part).

☐ Weigh the sample. The kind of roaster used determines the amount of cacao to be weighed. Turn on and zero the scale. Place an empty container upon the scale and tare it. Weigh the amount of cocoa to be processed in the container.

ROASTING AND COOLING

☐ Place the weighed cacao in the roaster, which should be preheated to the indicated roasting temperature.

☐ Note the start time to control roasting. Start time should commence once the temperature returns to 118°C

☐ Once the roasting time has transpired, remove the sample from the roaster.

☐ Cool the sample for 5-10 minutes depending on your cooling equipment.

WINNOWING

☐ Crack the cacao beans once they have cooled to a temperature of 30° C.

☐ When the beans are cracked, begin winnowing. This can be done with a machine, a fan, or by hand.

☐ The percentage of remaining shell in the sample should not be above 1%.

GRINDING

☐ Begin the grinding process by slowly adding the cocoa nibs to the mill or melangeur (to prevent clogging).

☐ Once the entire sample is in the mill, it is only necessary to observe and ensure that the equipment is working properly.

☐ Grinding will be completed when the cocoa liquor has a micron level of 30 microns. A micrometer is needed to measure the fineness of the cocoa liquor. This measurement can also be done with a sieve or by hand (given the experience of the person processing the sample).

TEMPERING

☐ Begin the tempering process with cocoa liquor to lock together the fatty acid crystals in the cocoa liquor to avoid a grainy sample with surface white streaks. In the absence of a machine, tempering can be done with a granite, marble, or porcelain slab. A thermometer is needed for tempering. Cool cocoa liquor to 27 °C. Then, add uncooled cocoa liquor to raise the temperature to 31 °C.

MOLDING & COOLING

☐ Mold and cool the cocoa liquor (10 °C/20 minutes). If there is no cold storage, a refrigerator can be used.

STORING

☐ When the cocoa liquor is cold, the samples can be unmolded and/or packed.

☐ The samples are now ready for tasting, and they must be stored under the recommended conditions.

APPENDIX 2: Protocol Quick Reference Guide

Humidity before roasting	7% (+/- 1%)
Cocoa sample amount	The parameters by type of equipment are: Convection Oven: 500 g Small Rotary Roaster: 300 g Large Rotary Roaster: 700 g Large Toaster Oven: 200 g
Roasting	The parameters by type of equipment are: Convection Oven: 120 °C x 20 min Small Rotary Roaster: 120 °C x 16 min Large Rotary Roaster: 120 °C x 20 min Large Toaster Oven: 120 °C x 25 min
Cooling	5-10 min to 30°C
Humidity after roasting	1-2%
Bean cracking	1 hour maximum after sample cooling
Winnowing	1% shell maximum Cocoa nibs must be ground within 36 hours after roasting
Grinding	Particles will be reduced to 30 microns Liquor temperature during this process must be kept below 50 °C
Tempering	45 °C – 27 °C – 31 °C
Molding–Cooling	Chocolate bar mold preferred Cooling must achieve a temperature between 10 and 15 °C Relative humidity of 50 to 60%
Storage	12-18 °C Clean and sealed containers Free from foreign odors 1 year

Notes:

CACAO
SENSORY ANALYSIS
Tasting Form

SAMPLE ______________________

TASTER ______________________

DATE ______________________

CATEGORIES		INTENSITY	NOTES	QUALITY (0–10)	POINTS	
Aroma		0 1 2 3 4 5			**x 1 =**	
Acidity		0 1 2 3 4 5			**x 1 =**	
Bitterness	INTENSITY **0 to 2.5:** ≥ 5 in quality **2.5 to 5:** ≤ 5 in quality	0 1 2 3 4 5			**x 1 =**	
Astringency		0 1 2 3 4 5			**x 1 =**	
Defects		0 1 2 3 4 5			**x 2 =**	
Flavor	Cocoa/Cacao	0 1 2 3 4 5		☐	**x 2 =**	
	Sweet	0 1 2 3 4 5				
	Nutty	0 1 2 3 4 5				
	Dried Fruit	0 1 2 3 4 5				
	Fresh Fruit	0 1 2 3 4 5				
	Floral	0 1 2 3 4 5				
	Spices	0 1 2 3 4 5				
	Other					
Aftertaste		0 1 2 3 4 5			**x 1 =**	
COMMENTS:			TASTER'S POINTS		**x 1 =**	
			FINAL SCORE			

INTENSITY SCALE

0	1	2	3	4	5
None/Not Detectable	Faint	Clearly Present	Moderate	Dominant	Extreme

QUALITY SCALE

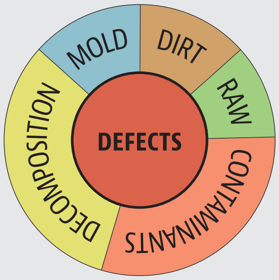
0	1	2	3	4	5	6	7	8	9	10

Terrible Bad Ordinary Good Excellent

TIPS TO SCORE QUALITY FOR DEFECTS

Name the defect:
A reduction in quality points should be defined in the notes.

Inverse relationship:
As the defect flavor(s) increase in intensity, the quality score decreases.



USAID-Equal Exchange-TCHO Cooperative Development Project, Version 2017.

CACAO
SENSORY ANALYSIS

Tasting Form Instructions

The goal of these instructions is to give users of the form a quick and basic guide to its use. For more in-depth information, please reference the *Guide to the Cacao Sensory Analysis Tasting Form* or contact us at **cacaoquality@gmail.com**

Filling in the Form

Aroma	Smell the sample. Mark the intensity of the aroma on the first scale, write any characteristics that you find in the notes section, and score the quality. Remember that a low intensity or even absence of aroma does not imply a lower quality.
Acidity	The relationship between intensity and quality varies depending on the perception and description of the acids that the taster finds during the evaluation. For example, if the taster perceives a citric or fruity acid, the score may be higher than if the acidity is more like vinegar (acetic acid).
Bitterness and Astringency	These are inherent characteristics of cacao, but the level of intensity can influence the quality, and there is often an inverse relationship. For example, a bitterness level that is 'Clearly Present' with an intensity of 2, might have a score between 'Good' and 'Excellent' in quality; while a higher intensity of bitterness may decrease the quality.

Example:

CATEGORIES	INTENSITY	NOTES	QUALITY (0–10)	POINTS	
Bitterness	0 1 2 3 4 5 ☐☐☒☐☐☐	mild bitterness	8	x 1 =	8

This example is consistent with the guideline provided on the form for bitterness and astringency, which indicates that an intensity score lower than or equal to 2.5 may result in a quality score of 5 or higher.

Defects	Increased intensity of defects means a lower score in quality. For example, if you find a strong flavor such as dirt that is 'Dominant' with an intensity of 4, your quality score will likely be between 'Terrible' and 'Bad'.

Example:

CATEGORIES	INTENSITY	NOTES	QUALITY (0–10)	POINTS	
Defects	0 1 2 3 4 5 ☐☐☐☐☒☐	dirt	1.5	x 2 =	3

If quality points are deducted, the taster should write the name of the specific defect in the notes section. If the sample is clean or free of defects, it should be scored as 'Excellent' in quality. To the right we offer some general categories of defects and some specific examples of common defects within those categories.

Flavor	The taster need only evaluate the characteristics that are perceived, as not all can be found in every sample. The quality score is based on a combination of factors including the harmony, clarity and complexity of the flavors.
Aftertaste	The residual flavor left in the mouth after the sample has dissolved completely.
Taster's Points	The taster's general impression and subjective quality score for the sample.
Comments	This space is for observations which are not noted elsewhere (for example: appearance, texture). The taster may also use Comments to prepare a summary of the evaluation and recommendations.
Final Score	A cumulative total of all quality points. The highest possible final score is 100 points.

Using the Scales

This form contains two types of scales. The purpose of the Intensity Scale is to develop a **flavor profile** of the samples, while the Quality Scale helps to identify the sample's **potential**. Remember that there is no direct relationship between intensity and quality, except in the case of Bitterness, Astringency and Defects. Half points are permitted when scoring on either scale.

INTENSITY SCALE

0	1	2	3	4	5
None/Not Detectable	Faint	Clearly Present	Moderate	Dominant	Extreme

QUALITY SCALE

0	1	2	3	4	5	6	7	8	9	10

Terrible Bad Ordinary Good Excellent

Examples of Defects

MOLD
musty, basement, mildew

DIRT
mud, wet earth, dust

RAW
vegetal, unripe, grassy, green

CONTAMINANTS
plastic, chemical, smoke, metal, petrol

DECOMPOSITION
hammy, meaty, rancid, putrid, compost

Note: Do not deduct points in defects for aroma, bitterness or astringency—these are evaluated in their respective categories.

TIP A maximum evaluation time of 10 minutes per sample is recommended.

11/02/17

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