



TOOLS FOR Sensory Evaluation



Tools for sensory evaluation

To ensure comparability of results, it is essential to have a common vocabulary and a set of tools that guide the sensory evaluation and recording process. These tools play a crucial role in providing valuable insights into the sensory attributes of a product. Manufacturers, marketers, and researchers can then utilise these insights to enhance the quality and appeal of the product to consumers. This chapter delves into the various tools employed in sensory evaluation. The tools are as follows:

- **Flavour Wheel:** This tool provides a quick and comprehensive overview of a shared vocabulary for flavour attributes and their sub-attributes. It assists in standardising the terminology used during evaluations.
- **Glossary of terms:** A collection of terms with definitions of flavour attributes and sub-attributes. This resource aids in understanding and assessing the intensity of flavours and the global quality of the product.
- **Sensory Evaluation Form:** This form is designed to record the flavour attributes and their intensity scores, global quality assessments, and any additional comments that may be useful for communication with the producers of the cacao bean samples and any users of the product.
- **Tools for Analysis and Visualisation:** These tools enable the analysis and visualisation of flavour evaluations, helping to create a flavour profile for the product.
- **Additional Documentation Guidelines:** This section provides further guidance on documentation practices, ensuring that evaluations are thorough, consistent, and properly documented.

By utilising these tools, sensory evaluations can be conducted in a standardised and systematic manner, allowing for meaningful comparisons and facilitating communication among stakeholders.

Flavour wheel

A flavour wheel serves as a standardised tool for describing and evaluating flavours, and it exists for various food commodities, including coffee, wine, and olive oil. Its purpose is to facilitate consistent and objective communication and comparison of sensory attributes. By utilising a flavour wheel, consumers, producers, and researchers can effectively identify and describe specific attributes such as acidity, bitterness, fruitiness, spiciness, and other subtle nuances that contribute to the overall sensory experience. This shared vocabulary enhances the understanding and evaluation of flavours in a coherent and structured manner.

The Cacao of Excellence programme developed a flavour wheel (Figure 1) based on its 12 years of experience evaluating cacao samples from around the world for its Awards competition. Its development involved the collective input of experts in sensory evaluation and in the processing of finished products.

The flavour attributes are divided into three groups:

Core attributes: Flavour characteristics expected to be present in every cacao. They include cacao, acidity, bitterness, astringency, and roast degree.

Complementary attributes: Flavour characteristics that may or may not be perceived in cacao samples. These complementary attributes are described as fresh fruit or browned fruit, vegetal, floral, woody, spice, nutty, and caramel/panela. In the case of dark chocolate, sweetness is also included.

Off-flavours: Characteristics that result from defects and may or may not be perceived in the cacao samples.

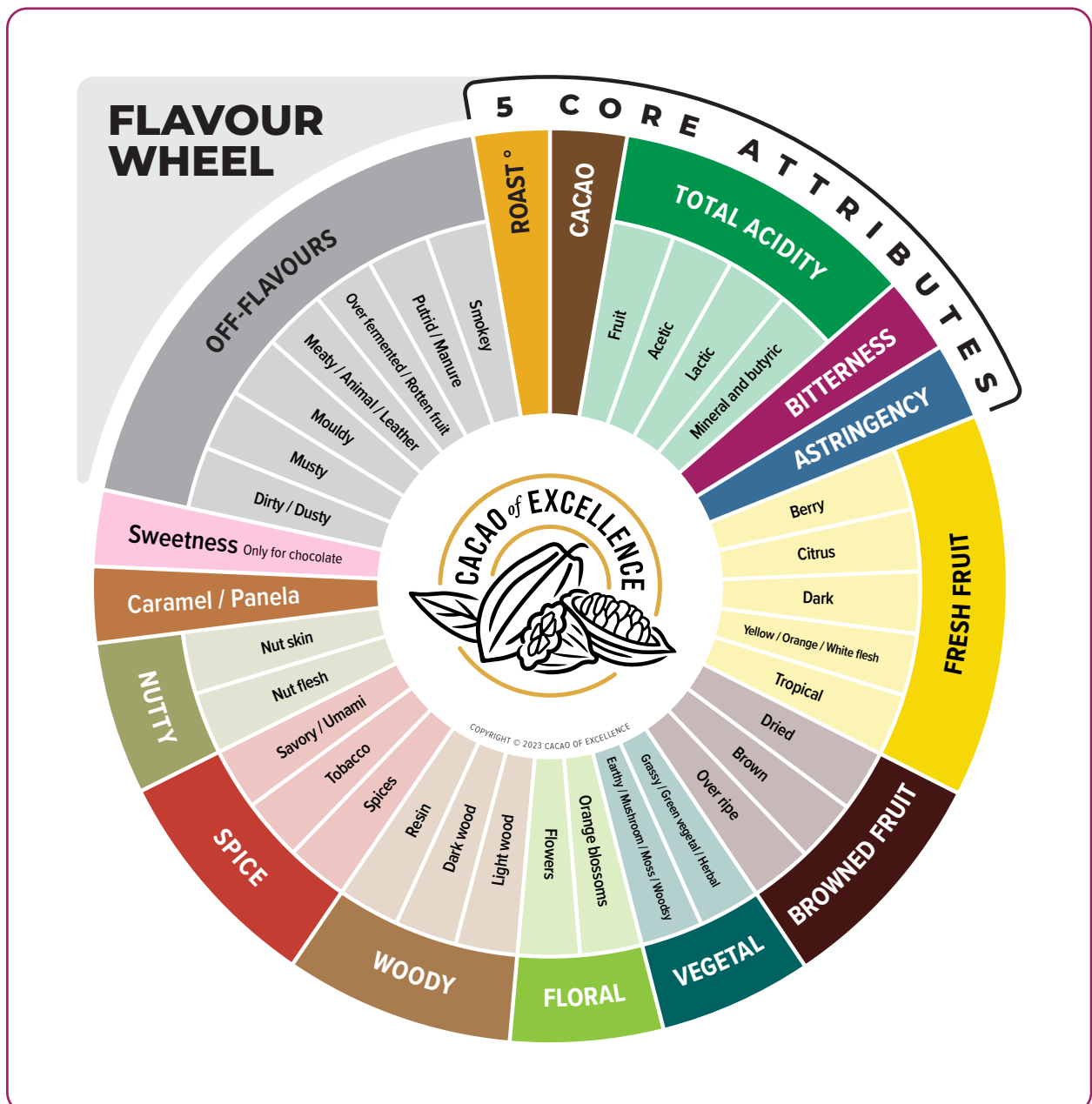


Figure 1. Cacao of Excellence Flavour Wheel (2023).

Glossary of terms for sensory evaluation

A glossary of terms is a valuable resource that provides a list of flavour attributes along with their definitions.

These flavour attributes and sub-attributes are categorized into core attributes, complementary attributes, and off-flavours. Each of these attributes is assessed using an intensity scale ranging from 0 to 10. The glossary also includes examples of intensity scores (references) to assist evaluators in understanding and applying the scale accurately.

Furthermore, a global quality score is defined, providing a comprehensive assessment of the overall quality of the sample. Table 2 presents a description of each score ranging from 0 to 10, aiding in the interpretation and communication of the sample's evaluation.

Table 1. Cacao of Excellence Glossary of terms for sensory evaluation of cacao beans processed into mass and dark chocolate (Cacao of Excellence 2023).

Attribute intensity scale and meanings:

Intensity Meaning

0	Absent.
1	Just a trace and may not be found if tasted again.
2	Present in the sample but at low intensity.
3 to 5	Clearly characterising the sample.
6 to 8	Dominant characterisation of the sample.
9 to 10	Maximum. Strong intensity. Overpowers some other flavour notes in the sample.

The flavour attributes are divided into three groups:

- 1. Core attributes:** cacao, acidity, bitterness, astringency and roast degree expected to be present in every sample and scored.
- 2. Complementary attributes:** characteristics that may or may not be perceived in cacao samples.
- 3. Off-flavours:** resulting from defects that may or may not be perceived in cacao samples.

Descriptor

Description

Intensity level / Reference notes

Cacao	Typical flavour of roasted cacao beans that are well fermented, dried, free of defects.	0–2	Under-fermented cacao, ancient Criollos.
		3–5	Appropriately fermented “Nacional” and Papua New Guinean lots.
		6–8	Appropriately fermented cacao, some West African and some Dominican Republic Hispaniolan lots.
		9–10	Some West African lots.
Acidity	<p>Total acidity is the sum of the following individual acidities:</p> <ul style="list-style-type: none"> • Fruit: citric or other fruit acids. • Acetic: vinegar (can be smelled in the sample). • Lactic: typically occurring in sour milk and yogurt. • Mineral and butyric: harsh metallic tasting (mineral) and rancid butter (butyric). <p>Perception of acidity intensity is particularly dependent on the amount of sample in the mouth.</p>	0–2	Some well-prepared West African lots.
		3–5	Some Ecuadorian, Peruvian and Central American lots.
		6–8	Some Dominican Republic Hispaniolan, Papua New Guinean and Malaysian lots.
Bitterness	<p>Basic taste, typically perceived in caffeine, coffee, kola nut, some beers and grapefruit.</p> <p>Perception of acidity intensity is particularly dependent on the amount of sample in the mouth.</p>	1–2	Some ancient Criollos.
		3–5	Well-prepared West African lots.
		6–8	Severely under- and un-fermented cacao.

Descriptor

Description

Intensity level / Reference notes

Astringency

Astringency could be perceived in two ways:

- **Sharp mouth-drying effect**, sharp, perceived between tongue and palate and /or at the back of the front teeth and inside lips and gums – typical of raw nut skins and green banana skins.
- **Velvety sensation** on the sides of mouth and tongue. Typical of tannins in some wines or beers.

Perception of astringency intensity is particularly dependent on the amount of sample in the mouth.

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1–2	Some ancient Criollos.
3–5	Normal intensity for most cacao.
6–8	-
9–10	-

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Sharp-mouth drying	Typical of under-fermented cacao.
Velvety	Typical of appropriately fermented “Nacional”.

Fresh fruit

Total fresh fruit is composed of the following sub-attributes:

- **Berry**: red or black currant, strawberry, raspberry, blackberry, acai berry.
- **Citrus**: orange, lemon, lime, grapefruit or generic sensation of citrus-like fruit.
- **Dark**: cherry, plum.
- **Yellow / orange / white flesh**: apricot, peach, pear, banana.
- **Tropical**: passion fruit, pineapple, mango or soursop.

0–2	Many West African lots.
3–5	Some Central and South American, well fermented Asia and Pacific country lots.
6–7	Madagascar, some Central and South American country lots, some Papua New Guinean lots.

Browned fruit

Total browned fruit is composed of the following sub-attributes:

- **Dried**: dried apricot, banana, yellow raisin, fig that has undergone an un sulphured drying process.
- **Browned**: dark raisin, dates, prune.
- **Over ripe**: No longer fresh and severely over-ripe fruit, turning brown inside and outside, as a step towards over-fermentation.

0–2	Many West African lots.
3–5	Fully fermented Indonesian and some Caribbean country lots.
6–8	Some Papua New Guinean and some Caribbean country lots.

Vegetal

Total vegetal is composed of the following sub-attributes:

- **Grassy / Green vegetal / herbal**:
 - » Grassy – freshly cut grass, young green leaves.
 - » Green vegetal – crushed mature leaves.
 - » Herbal – hay, straw or herbal / dried green, herbs like thyme and rosemary.
- **Earthy / mushroom / moss / woody**:
 - » Earthy – smell of dampness rising from soil after rain.
 - » Mushroom – smell of fresh mushrooms.
 - » Moss – damp moss often associated with earthiness.
 - » Woody – leaves and wood on a forest floor.

0–2	West African lots.
3–5	Appropriately fermented “Nacional” and some Caribbean country lots.
6–8	Some Caribbean country lots and some Peruvian lots.

Descriptor**Description****Intensity level / Reference notes**

Floral **Total floral** is composed of the following:

- **Orange blossom:** orange blossom flavour.
- **Flowers:** jasmine, honeysuckle, rose, lilac, lilies, etc.

0–2 West African lots.

3–5 Appropriately fermented “Nacional” and some Caribbean country lots.

6–8 Some Caribbean country lots and some Peruvian lots.

Woody **Total woody** is composed of the following sub-attributes:

- **Light wood:** freshly cut cacao wood, white pine wood, maple wood, ice-cream/popsicle wooden stick.
- **Dark wood:** oak, walnut, teak, mahogany.
- **Resin:** pitch of pine or other resinous wood.

0–2 -

3–5 Some “Nacional” and many West African lots.

Spice **Total spice** is composed of the following sub-attributes:

- **Spices:** dried coconut, nutmeg, cinnamon, cloves, cacao mass, tonka, vanilla, black pepper.
- **Tobacco:** dried tobacco leaves.
- **Savoury/Umami:** sodium glutamate, umami.

0–2 In most origins.

3–5 In some West African, Central and South American and Caribbean country lots.

Nutty **Total nutty** is composed of the following sub-attributes:

- **Nutty – nut flesh:** the edible kernel of a light roasted nut – hazelnut, macadamia, pecan, walnut, cashew, almond, brazil nut
- **Nutty – nut skins:** the flavour of lightly roasted nut skins – hazelnut, macadamia, pecan, walnut, cashew, almond, brazil nut

0–2 In most origins.

3–5 Some Central and South American and Caribbean countries’ lots and ancient Criollos.

Caramel / Panela Aromas reminiscent of caramel, brown sugar and panela (unrefined cane sugar)

0–2 In most origins

3–5 Some Central and South American and Caribbean countries’ lots and ancient Criollos

Sweetness (only for chocolate) Basic taste of white sugar solutions, typically perceived in foods like candies and desserts that contain sugar (or other sweeteners such as aspartame) and also naturally found in other foods like fruits.

Descriptor	Description	Intensity level / Reference notes
Roast degree	A measure of the extent of the roasting the beans. Significant under or over roasting alters many of the attribute values.	2–3: Low roast. 4–6: Medium roast. 7: High roast. 8–10: Levels of burnt/over-roasted.
Off-flavours	<p>Total Off-Flavours is composed of any unpleasant characters from the following:</p> <ul style="list-style-type: none"> • Dirty/dusty: not related to texture but to an off-flavour. • Musty: stale, damp, mildew, decaying. • Mouldy: characteristic of mould growth. • Meaty/animal/leather: <ul style="list-style-type: none"> » Meaty – cured meat, ham, rendered fat. » Animal – dirty animal / farmyard. » Leather – used old leather. • Over-fermented/rotten fruit: decomposing fruit. • Putrid/manure: <ul style="list-style-type: none"> » Putrid – wet decomposing vegetative matter. » Manure – farmyard animal manure. • Smoky: contamination from the smoke (any kind). • Other off-flavours: rancid, diesel, oil fumes, petroleum, tar, paint, tyres, chemicals, burnt, etc. 	0: Absent – clean, well fermented, dried and stored cacao beans. 1–2: Low intensity. 3+: Clearly characterizing the sample as a defect.
Global Quality	<p>The Global Quality score reflects the overall impression of the:</p> <ul style="list-style-type: none"> • expressed flavour potential • uniqueness of the sample • balance of flavour and cleanliness of the finish <p>It celebrates the expression of genetics and terroir diversity through the farmer's knowhow.</p>	Global Quality scores and meaning below



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Table 2. Meaning of the global quality scores for the sensory evaluation of cacao beans processed into mass and chocolate (Cacao of Excellence 2023).

	Off-flavours	Core attributes	Complementary attributes	Notes
0	Serious off-flavours clearly characterizing the sample as defective	Masked by off-flavours	Masked by off-flavours	Be as specific as possible on the type of off-flavours as this is valuable feedback to the producers Depending on the type, number and intensity of off-flavours, 0 would be the worst case and 3 the least but still bad
1				
2				
3				
4	In low intensity	Seriously unbalanced	Masked by off-flavours and unbalanced core attributes	
5	In low intensity	Unbalanced	Partially masked by unbalanced core attributes	
6	In low intensity or absent	Unbalanced	In low intensity, none outstanding, not in balance to core attributes	Overall plain flavour – mainly characterized by the core attributes and less by the complementary attributes
7	Absence of any	Balanced	One or more are outstanding but not in balance to core attributes	Overall plain flavour – mainly characterized by the core attributes and less by the complementary attributes
8	Absence of any	Well balanced with moderate base cacao flavour	One or more are outstanding, in balance to core attributes and to each other	Overall flavour presents some complexity
9	Absence of any	Well balanced, good base cacao flavour	Many outstanding, in balance to core attributes and to each other	Overall flavour presents a combination of complexity, uniqueness, harmony, brightness, clean finish
10	Absence of any	Well balanced, in low to moderate intensity, good base cacao flavour	Clearly recognizable, many outstanding, in balance to core attributes and to each other	Overall flavour presents a combination of complexity, uniqueness, harmony, brightness, clean finish The sample is of extraordinary quality, rarely seen

Forms for the sensory evaluation of cacao beans

Sensory data resulting from the evaluation of each sample can be recorded in various formats. The tables and figures below contain examples of forms used for evaluating cacao beans in the forms of unroasted coarse powder, cacao mass, and dark chocolate. For a detailed evaluation, a total score for the sub-attributes can be calculated using the indicated formula (a declining series). This ensures that the total score accurately represents the overall intensity of the flavour attribute and is not simply the sum of all sub-attributes, with the exception for the Total Acidity score, which is calculated as the sum of the sub-attributes. Experts have advised that for this specific core attribute (acidity being a basic taste and non-volatile), scoring the total perception first and then describing each component separately yields a more accurate Total Score.

Sensory evaluation data can be recorded using a Microsoft® Excel® form such as the Cacao of Excellence Sensory Evaluation Form, which provides a user-friendly interface (Figure 2). Additionally, Cacao of Excellence offers a printed version of the evaluation form (Figure 3). The form can be simplified by using the main core attributes only as shown in Table 4.

Table 3. Calculations of the total scores for the flavour attributes of the Cacao of Excellence Sensory Evaluation Form.

Calculations of the Total Scores for the Flavour Attributes

	SCORE (0-10)	Core attributes
	_____	CACAO
	_____	ROAST DEGREE
	_____	BITTERNESS
	_____	ASTRINGENCY
TOTAL OF ALL SUB-ATTRIBUTES	_____	TOTAL ACIDITY
	_____	Fruit
	_____	Acetic
	_____	Lactic
	_____	Mineral and Butyric
		Complementary attributes
CALCULATED FIELD:	_____	TOTAL FRESH FRUIT
100% OF HIGHEST SCORE	_____	Berry
+75% OF 2 ND HIGHEST	_____	Citrus
+33% OF 3 RD	_____	Dark
+33% OF 4 TH	_____	Yellow / Orange / White flesh
+33% OF 5 TH	_____	Tropical
CALCULATED FIELD:	_____	TOTAL BROWNE D FRUIT
100% OF HIGHEST SCORE	_____	Dried
+75% OF 2 ND HIGHEST	_____	Brown
+33% OF 3 RD	_____	Over ripe
CALCULATED FIELD:	_____	TOTAL VEGETAL
100% OF HIGHEST SCORE	_____	Grassy/green vegetal/herbal
+75% OF 2 ND HIGHEST	_____	Earthy/mushroom – moss / woody
CALCULATED FIELD:	_____	TOTAL FLORAL
100% OF HIGHEST SCORE	_____	Orange blossom
+75% OF 2 ND HIGHEST	_____	Flowers
CALCULATED FIELD:	_____	TOTAL WOODY
100% OF HIGHEST SCORE	_____	Light wood
+75% OF 2 ND HIGHEST	_____	Dark wood
+33% OF 3 RD	_____	Resin
CALCULATED FIELD:	_____	TOTAL SPICE
100% OF HIGHEST SCORE	_____	Spices
+75% OF 2 ND HIGHEST	_____	Tobacco (dried tobacco leaves)
+33% OF 3 RD	_____	Savoury/umami
CALCULATED FIELD:	_____	TOTAL NUTTY
100% OF HIGHEST SCORE	_____	Nut flesh
+75% OF 2 ND HIGHEST	_____	Nut skins
	_____	CARAMEL / PANELA
	_____	SWEETNESS (Only for chocolate)
CALCULATED FIELD:	_____	Total off-flavours
100% OF HIGHEST SCORE	_____	Dirty/dusty
+75% OF 2 ND HIGHEST	_____	Musty
+33% OF 3 RD	_____	Mouldy
+33% OF 4 TH	_____	Meaty/animal/leather
+33% OF 5 TH	_____	Over fermented/rotten fruit
+33% OF 6 TH	_____	Putrid/manure
+33% OF 7 TH	_____	Smoky
+33% OF 8 TH	_____	Other off-flavour description
IF THE RESULT IS >10 IT IS ROUNDED TO 10 AS THE MAXIMUM	_____	GLOBAL QUALITY
	_____	Comments on flavour

Table 4. Simplified list of flavour attributes for sensory evaluation of cacao beans processed into mass and chocolate (Cacao of Excellence 2023).

Cacao of Excellence - simplified list of flavour attributes for sensory evaluation of cacao beans processed into mass and chocolate 2023

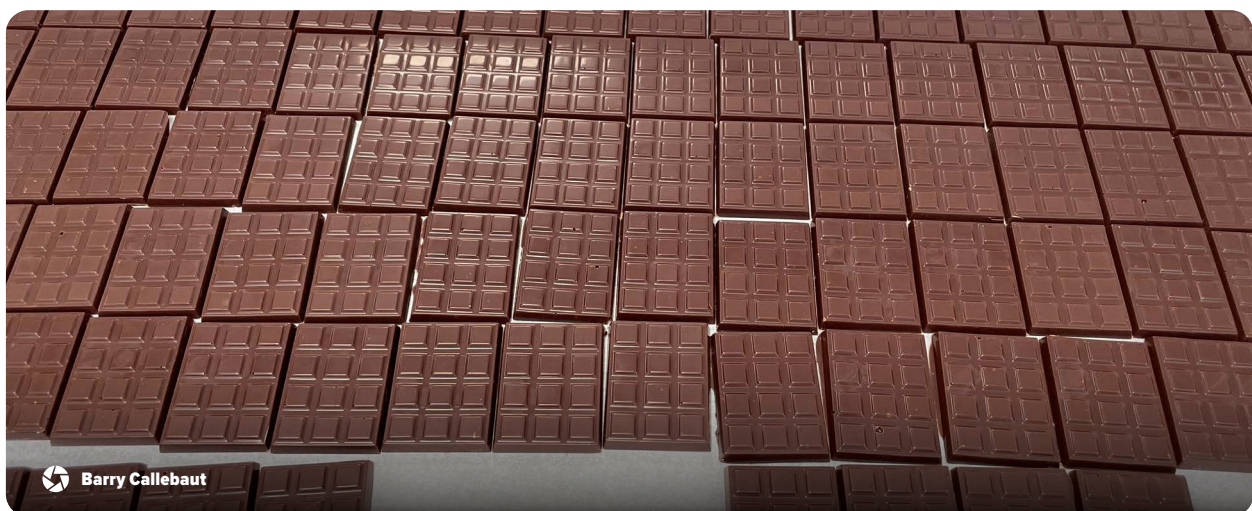
_____ Jane Doe _____ dd/mm/yy _____ hh:mm – pm/am _____ 000
 Assessor name Date of evaluation Time of evaluation Sample code



Score (0-10) Attributes

- _____ **Cacao**
- _____ **Acidity** (fruity, acetic, lactic, mineral, butyric)
- _____ **Bitterness**
- _____ **Astringency**
- _____ **Fresh fruit** (berry, citrus, dark, yellow / orange/white flesh, tropical)
- _____ **Browned fruit** (dried, brown, over ripe)
- _____ **Vegetal** (earthy, mushroom, moss, woody, green vegetal, herbal)
- _____ **Floral** (orange blossom, flowers)
- _____ **Woody** (light or dark wood, resin)
- _____ **Spice** (spices, tobacco (dried tobacco leaves), savoury/umami)
- _____ **Nutty** (nut flesh and nut skins)
- _____ **Sweetness (only for chocolate)**
- _____ **Caramel / Panela**
- _____ **Roast degree**
- _____ **Off-flavours** (dirty/dusty, musty, mouldy, meaty / animal / leather, over fermented / rotten fruit, putrid / manure, smoky, other)
- _____ **Off-flavours - others**
- _____ **GLOBAL QUALITY**

Comments on flavour _____



Cacao of Excellence Sensory Evaluation Form for Cacao Mass and Chocolate

Evaluator:

Sample ID:

Sample info:

Start Evaluation

Recall/Edit

Date:

Time:

Intensity Scale

Less Intense 0 1 2 3 4 5 6 7 8 9 10 More Intense

Click 'Start Evaluation' to enable input to sensory evaluation attributes

Cacao	Bitterness	Astringency	Roast Degree
0.0 Acidity (Total)	0 Fruit	0 Acetic	0 Lactic
0.0 Fresh Fruit (Total)	0 Berry	0 Citrus	0 Dark
	0 Yellow / Orange / White flesh	0 Tropical	0 Mineral / Butyric
0.0 Browned Fruit (Total)	0 Dried	0 Brown	0 Over ripe
0.0 Vegetal (Total)	0 Grassy / Green vegetal / Herbal	0 Earthy / Mushroom / Moss / Woodsy	
0.0 Floral (Total)	0 Orange blossom	0 Flowers	
0.0 Woody (Total)	0 Light	0 Dark	0 Resin
0.0 Spice (Total)	0 Spices	0 Tobacco	0 Savory / Umami
0.0 Nutty (Total)	0 Nut flesh	0 Nut skins	
0 Caramel / Panela			0 Sweetness (only for chocolate)
0.0 Off-flavours (Total)	0 Dirty / Dusty	0 Musty	0 Meaty / Animal / Leather
Calculated values	0 Over-fermented / Rotten fruit	0 Putrid / Manure	
	0 Smoky	0 Other	Description

Global Quality

0 1 2 3 4 5 6 7 8 9 10

Additional positive qualities

Add selected quality (for Global Quality >= 7)

←

Overall Flavour comment

Feedback to producer

End Evaluation

Print

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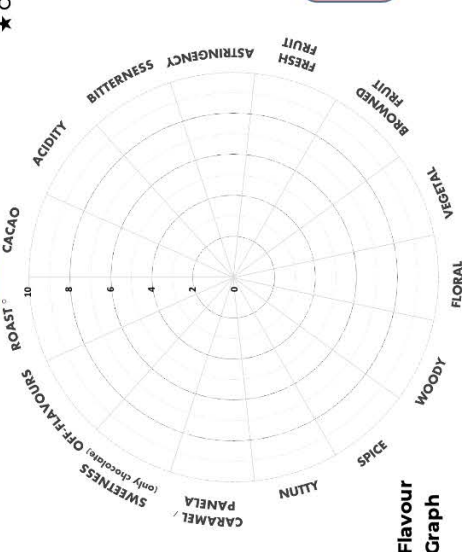
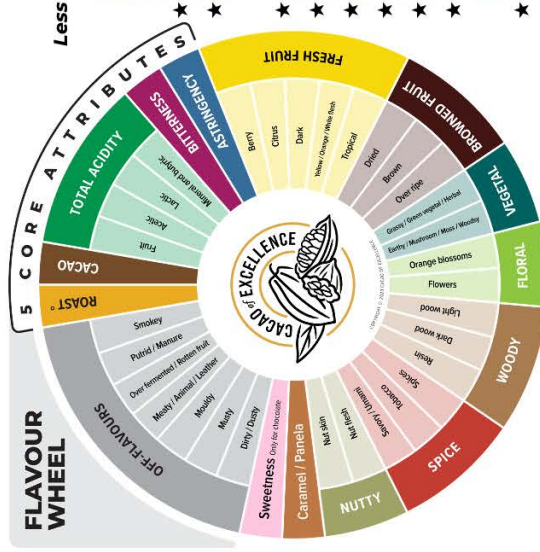


Figure 2. User interface of the Cacao of Excellence Sensory Evaluation Form with the total scores of flavour attributes calculated (Cacao of Excellence 2023).

Cacao of Excellence

Sensory Evaluation Form for Cacao Mass and Chocolate

Evaluator _____ Date _____
 Sample ID _____ Time _____
 Sample Info _____

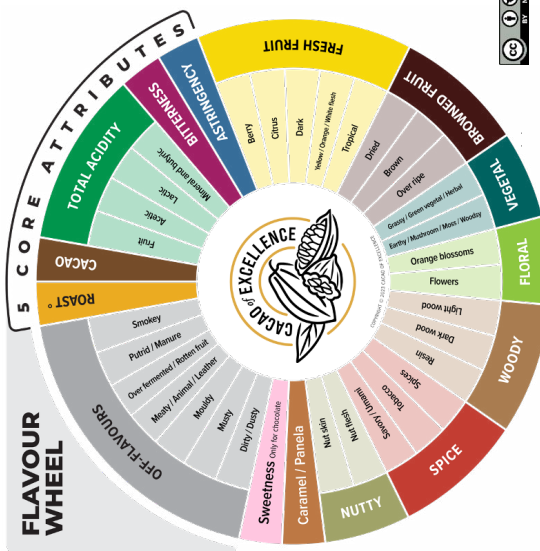
Cacao Mass **Chocolate**

Instructions: Insert the intensity values of each attribute in the and mark with a the perceived sub-attributes.

Intensity Scale

0 1 2 3 4 5 6 7 8 9 10

← Less Intense More Intense →



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Off-flavours

Dirty / Dusty Musty
 Mouldy Meaty / Animal / Leather
 Over-fermented / Rotten fruit
 Putrid / Manure Smoky
 Other Off-flavour _____
 Description _____

0 1 2 3 4 5 6 7 8 9 10

Global Quality

Flavour comments

Cacao

Acidity

Fruit Acetic Lactic
 Mineral / Butyric

Bitterness

Berry Citrus Dark
 Yellow / Orange / White flesh
 Tropical

Astringency

Fresh Fruit

Dried Brown Over ripe

Vegetal

Grassy / Green vegetal / Herbal
 Earthy / Mushroom / Moss / Woody

Floral

Orange blossom Flowers

Woody

Light Dark Resin

Spice

Spices Tobacco
 Savory / Umami

Nutty

Nut flesh Nut skins

Caramel / Panela

Sweetness (only for chocolate)

Roast Degree

Flavour Graph

Figure 3. Format for the printed version of the Cacao of Excellence Sensory Evaluation Form (Cacao of Excellence 2023).





Citation: Cacao of Excellence. 2023. Tools for Sensory Evaluation. Extract from the Guide for the Assessment of Cacao Quality and Flavour. Bioversity International. 14 Pages.

