

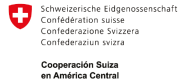
# **Steps towards a harmonized international standard for cocoa flavour assessment – a review of current protocols and practices**

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Cocoa of Excellence Programme



Cocoa Research Centre of the University of the West Indies, St Augustine Campus

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## Summary

This report forms one of the first activities outputs of the Working Group on International Standards for Cacao Quality which identified an initial work plan activity to carry out an inventory of all the standards and protocols that exists beyond those developed for the CoEx Programme to determine what different groups and/or individuals were doing in this area and in related commodities (such as coffee, wine and olive oil) to develop a first proposal for international standards and protocols to be discussed within this Working Group, revised, and then discussed in a broader consultation with finalisation based on feedback received before publishing and dissemination. The draft protocol produced from this consultation is to go to the next level of discussion. This activity is being supported by Lutheran World Relief, under Cacao Movil, funded by the US Department of State and Swiss Development Cooperation, and in partnership with CoEx.

Fourteen different entities who are part of the thrust forward in pursuing systematic assessments of quality and flavour in cocoa were contacted and interviews conducted with 17 individuals revealed that the sometimes disparate efforts of these entities are really towards common needs, objectives and challenges that fine quality, niche marketed cocoa currently faces. Different roads towards a common destination – creating an understanding of cocoa flavour quality that can be easily and systematically communicated across the diverse stakeholder network in a structured way for the benefit of all players. Some roads were more developed than others but with broad brush strokes, were covering farmers to consumers with the realisation and appreciation of the fully expressed genetic flavour potential of well-prepared cocoa and cocoa, cocoa powder, liquor and chocolate in a systematic manner.

The review of relevant published literature on standards and quality for cocoa, coffee, wine and olive oil revealed that each commodity was governed by an international body responsible for that commodity that is recognised by more than 80% of the global market for that commodity. One of the main functions that these international bodies performed, apart from marketing and other stakeholder interests, were to produce technical standards relative to product definitions and to provide detailed physical and chemical quality and monitoring protocols for the commodity. With the exception of wine, flavour and organoleptic assessment formed a key component of the quality monitoring protocols produced with tasting and aroma wheels and defined sensory descriptors with a lexicon (as is the case for coffee).

Although cocoa still has some way to go, it is evolving along the right path, closely following the evolutionary path taken by coffee in terms of the realization faced by and activities of key players in the sector. This includes developments about raw product quality and quality definitions, as well as, the niche marketing opportunities in the sector and the need for standards and protocols, including having an overarching international body to oversee this. The impression shared in the interviews and garnered from the literature was that with the experiences and learnings from coffee, hopefully cocoa will be able to “leap frog” a few steps forward at a faster rate along this evolutionary path towards a harmonised international standard for cocoa flavour assessment.

Six Sigma ( $6\sigma$ )<sup>1</sup> is a disciplined, data-driven approach and methodology for eliminating defects (driving toward six standard deviations between the mean and the nearest specification limit) in any process. The vision is to see cocoa eventually evolve towards this level and having a harmonised international standard for cocoa flavour assessment is a critical step towards this ideal.

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<sup>1</sup> [https://en.wikipedia.org/wiki/Six\\_Sigma](https://en.wikipedia.org/wiki/Six_Sigma)

## 1.0 Introduction

In the history of mankind there are examples of discoveries made whose significance to man was never at the time fully appreciated. The cocoa bean is such a discovery. Now at the source of a wide range of foods and delicacies, the cocoa bean enriches the lives of us all. High quality cocoa beans offer chocolate and confectionary manufacturers a cornucopia of delight in the products that can be made from it. Chocolate captures the hearts and imaginations of peoples all over the world. Its unique flavour, textural characteristics and more recently documented health and nutritional benefits combine and together make the secret of its success. Chocolate has the power to gladden mortal hearts.

### 1.1 Cocoa and Cacao

*Theobroma cacao* L. is the botanical name for 'cacao' and refers to the tree, the pods and the unfermented beans from the pods. 'Cocoa' refers to the manufactured product - the powder sold for drinking or food manufacturing purposes, but recently it has also been frequently used to describe the fermented cocoa beans in bulk. Cacao (*Theobroma cacao* L.) belongs to the family Malvaceae<sup>2</sup> and originated as an under-storey tree species in the tropical rainforests of the upper Amazonian region of South America<sup>3,4</sup>. The genus *Theobroma* contains some twenty-two species and *T. cacao* is the only species that is cultivated on a large scale<sup>5</sup>.

### 1.2 Bulk and Fine or Flavour Cocoa

The world cocoa market classifies traded cocoa into two broad categories: 'fine or flavour' cocoa beans and 'bulk' or 'ordinary' cocoa beans. Fine or flavour cocoa, originating largely from Criollo and Trinitario cacao-tree varieties, contains intrinsic and sought after ancillary flavours such as "fruity", "floral" or "nutty" that are essential in the preparation of premium quality chocolates.

The market for fine or flavour cocoa is small (only 5% - 6% of total world production), highly specialized, globalized, selective with its own supply and demand characteristics, but lucrative, with an annual value of over US\$4 billion. The increasing interest in dark and specialty chocolates and now 'origin specific' dark chocolates adds a new dimension to the premium chocolate market in which Latin America and the Caribbean are the world's largest producers of fine or flavour cocoa. Additionally, the emerging medicinal and nutraceutical value of cocoa has added further interest in fine or flavour cocoa and contributed to an upward movement of prices paid per tonne and created new opportunities for employment, niche marketing and potential for economic diversification of economies particularly in the Latin America and the Caribbean region.

Apart from traditional bean markets such as the USA, the EU and Japan, increasingly, non-traditional commercial markets are emerging, such as Russia, Eastern European countries, Arab and Asian countries. These markets are looking for diverse and complementary attributes from the cocoa beans and/or cocoa products closely associated with the fine or flavour origin itself, genetics and particular

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<sup>2</sup> Bayer et al. 1999. Support for an expanded family concept of Malvaceae within a recircumscribed order Malvales: a combined analysis of plastid atpB and rcbL DNA sequences. *Botanical Journal of the Linnean Society* 129: 267-303.

<sup>3</sup> Mossu, G. 1992. Cocoa. *The Tropical Agriculturalist*. London: Mac Millan Press. pp. 10-22.

<sup>4</sup> Butler, D.R., and P. Umaharan. 2004. Working with cocoa germplasm. *Cocoa Futures. A source book of some important issues confronting the cocoa industry*, edited by J. Flood and R. Murphy, pp. 54-64. Chinchiná (Colombia): CABI-FEDERACAFÉ, USDA.

<sup>5</sup> Wood, G. A. R., and R.A. Lass eds. 1985. *Cocoa* 4<sup>th</sup> ed. London: Longman.

climatic conditions, unique varieties, sustainability and social responsibility, (such as fair trade and organic cocoa), as well as, traditional or innovative methods of processing.

### 1.3 International Initiatives Recognising Cocoa Quality

There are number of international initiatives recognising cocoa quality that have been launched within the last 8 – 10 years. These initiatives build on the trend of heightened consumer awareness for recognising bean origins and genetics used in various chocolates and essentially take the form of receiving bean samples, processing them according to some defined set of protocols followed by qualitative and/or quantitative assessment by a trained or experienced tasting panel. The modalities and execution between each initiative differ but all try to link flavour quality to either genetics, farm or region with the aim of recognising desirable quality attributes and/or facilitating niche marketing.

### 1.4 Working group on International Standards for Cacao Quality

According to past World Cocoa Foundation (WCF) President, Bill Guyton, in fine or flavour cocoa *“quality and genetics are important and interlinked (with) issues the cocoa and chocolate industry is facing”*.<sup>6</sup> Towards this end, the genesis of this study arose from the WCF hosted *“Second Annual Seminar on Cocoa in the Americas”* on the theme: *“Fine or Flavour Cocoa & Quality”* held in El Salvador between 7 – 8<sup>th</sup> September, 2015. This was the first in a series of cocoa-related meetings to raise Latin American awareness about issues related to fine or flavour cocoa, quality and plant genetics. The market outlook, opportunities for further developing this market segment, the latest research, and the role of capacity building including niche marketing were all covered at this meeting. An early morning meeting following a presentation on the Cocoa of Excellence Programme (CoEx) (see section 3.1.2.2) led to the informal constitution of a Working group on International Standards for Cacao Quality<sup>7</sup> in association with Asociación Mesoamericana de Cacao y Chocolate Finos (AMACACAO). This group is now being coordinated by Bioversity International with a focus on quality for all cocoas – not just targeting the fine or flavour market.

Initial members of the working group are:

1. Brigitte Laliberté (Bioversity International/CacaoNet/Cocoa of Excellence Programme) - coordinator
2. Daniel Domingo (ECOM)
3. Darin Sukha (Cocoa Research Centre - CRC)
4. Ed Seguire (Seguire Cacao and Chocolate/Guittard Chocolate)
5. Gilberto Amaya (Catholic Relief Services - CRS)
6. Jenny Wiegel (Lutheran World Relief - LWR)
7. John Kehoe (Guittard Chocolate)
8. Juan Francisco Molinedo (AMACACAO/CUNAkakaw)
9. Marie-Amelie Ormieres (Belcolade/Puratos)
10. Rick Peyser (Lutheran World Relief - LWR)

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<sup>6</sup> <http://www.worldcocoaoundation.org/wp-content/uploads/FINAL-Press-Release-El-Salvador-Seminar-Breeder-Group-Sept-2015.pdf>

<sup>7</sup> The name of this group is currently being formalized to give it more recognition and visibility.



## 11. Virginia Sopyla (World Cocoa Foundation - WCF)

### 1.5 The Consultancy

This consultancy forms one of the first activities of the Working Group on International Standards for Cacao Quality which identified an initial work plan activity to carry out an inventory of all the standards and protocols that exists beyond those developed for the CoEx Programme to determine what different groups and/or individuals were doing in this area and in related commodities (such as coffee, wine and olive oil) to develop a first proposal for international standards and protocols to be discussed within this Working Group, revised, and then discussed in a broader consultation with finalisation based on feedback received before publishing and dissemination.

Lutheran World Relief, under Cacao Movil, funded by the US Department of State and Swiss Development Cooperation, and in partnership with CoEx and the Working Group on Cocoa Quality Standards and Protocols is therefore supporting this consultancy for broad use within the sector, including cocoa cooperatives, to standardize how actors assess and communicate cocoa quality attributes, in an effort to improve transparency along the chain and help farmers better understand and meet quality standards demanded by buyers.

#### 1.5.1 Objectives of the Consultancy

Against the background presented above, the objectives of this consultancy therefore are:

- 1) To review existing flavour and quality standards in cocoa as well as other products (where appropriate) such as coffee, olive oil and wine;
- 2) Develop a first draft of international standards and procedures for measuring them, on behalf of the Working Group;
- 3) To share the draft with the working group and incorporate feedback into a second draft for broader consultation with standards bodies in the sector;
- 4) Propose a draft training course (can be several modules) for training farmer cooperatives on the proposed protocols.

#### 1.5.2 Activities to be carried out during the Consultancy

Activities carried out include but were not limited to:

- 1) Coordinating the compilation of existing flavour and quality standards in cocoa as well as other foods (where appropriate) such as coffee, olive oil and wine;
- 2) Analyzing how existing standards have been used and how successful have they been;
- 3) Examining sample preparation protocols, training protocols, flavour attribute sets, vocabulary and glossary of flavour terms used;
- 4) Examining scoring, ranking and scaling systems used, including global quality scoring;
- 5) Examining briefly the factors that affect flavour development in cocoa beans and identify some causes for off flavours in cocoa beans – referring to relevant sections of “CAOBISCO/ECA/FCC Cocoa Beans: Cocoa and Chocolate Industry Quality Requirements. September 2015 (End, M.J. and Dand, R., Editors);
- 6) Developing a draft protocol;

- 7) Sharing the outputs of this review with the working group and incorporate feedback;
- 8) Preparing a proposal for training of farmer cooperatives in the use of the new protocols;
- 9) Preparing a presentation and plan for sharing the proposed protocols with a broader audience.

It is expected that review of proposed protocols should begin with physical evaluation of cocoa beans moving through the value chain with evaluation of liquor and chocolate.

## 2.0 Cocoa Bean Quality Requirements

The International Cocoa Organisation (ICCO) hosted the First World Cocoa Conference in Abidjan, Côte d'Ivoire in November, 2012.<sup>8</sup> The aim of this conference was to build on the previous two successful round table discussions on a sustainable cocoa economy and provided a roadmap towards achieving a sustainable world cocoa economy. It outlined the strategic challenges facing the cocoa value chain, the recommended actions to address them and the responsibilities of the stakeholders in the cocoa sector at national and regional and international levels. This was encapsulated in the "Abidjan Declaration" (See Annex 1). Arising from this were a number of "*Global Cocoa Agenda Actions*" one key action identified was to "*Improve cocoa quality by better communication of industry needs, post-harvest processing and quality assessment.*"

Each cocoa bean has a genetic flavour potential that is either expressed or depressed as it moves along the cocoa processing chain. Best practices express this genetic potential whilst poor practices depress or reduces the expression of full genetic potential. Having a clear understanding of what this potential is, being able to communicate this information and most importantly being able to assess for these attributes are fundamental understandings that have a direct impact on cocoa bean quality.

### 2.1 What is Quality?

"Quality" may be considered as a specification or set of specifications which are to be met within given tolerances or limits<sup>9</sup>. The Oxford dictionary defines "*quality*" as "...possessing a degree of excellence...and to be concerned with the maintenance of high quality..."<sup>10</sup>. In a generic sense, quality refers to meeting the requirements or specifications that define high quality for that particular item or product.

#### 2.1.1 Cocoa Quality

Drawing from the recently revised "*Cocoa Beans: Chocolate and Cocoa Industry Quality Requirements*"<sup>11</sup>, "*Cocoa Quality*" is used in its broadest sense to include not just the all-important aspects of flavour and food safety, but also the physical characteristics that have a direct bearing on manufacturing

<sup>8</sup> <http://www.icco.org/home/world-cocoa-conference-2012.html>

<sup>9</sup> Kramer and Twigg, 1970 "*Quality Control for the Food Industry*", Vol. 1. Fundamentals, 3rd Ed., The AVI Publishing Company, Inc., Westport, Connecticut, 1970.

<sup>10</sup> <http://www.oxforddictionaries.com/definition/english/quality>

<sup>11</sup> CAOBISCO/ECA/FCC, 2015. *Cocoa Beans: Chocolate and Cocoa Industry Quality Requirements*. (End, M.J. and Dand, R., Editors).

performance, and aspects such as traceability, geographical indicators and certification to indicate the sustainability of the production methods.

Aspects or specifications of quality in cocoa therefore include:

1. Flavour
2. Food Safety and Wholesomeness
3. Physical Characteristics
4. Consistency
5. Yield of Edible Material
6. Cocoa Butter Characteristics
7. Colour potential – “Colourability”
8. Traceability, Geographical Indicators and Certification

These are the key criteria affecting a manufacturer’s assessment of “value” of a particular parcel of beans and the ultimate price that it fetches on the international market.

In another document, *“The Model Ordinance of the International Cocoa Standards”*<sup>12</sup> cocoa of merchantable quality is defined as being:

1. Fermented, thoroughly dry, free from smoky beans, free from abnormal or foreign odours and free from any evidence of adulteration.
2. Reasonably uniform in size, reasonably free from broken beans, fragments and pieces of shell, and be virtually free from foreign matter.

When these definitions are applied to cocoa, no matter what the genetic origin, the flavour potential of each marketed cocoa variety can only be expressed by appropriate and adequate post-harvest processing. An overview of the best practices in cocoa production as identified by the ICCO are presented in Annex 2.

In reality, cocoa farmers have very little influence over the cultural factors of cocoa growing, as parameters such as the chemical characteristics of the soil available to them, the genetic make-up of the planting material used and the climatic environment are imposed on them by nature and science. The farmer may exercise some choice in the varieties planted but this is constrained by the diversity and characteristics of the cocoa varieties available from research and extension services in that country or region. The farmer may also be able to exercise some choice regarding the most suitable location on the farm where cocoa is planted.

However, there is not much the farmer can do to affect the end result in terms of quality, apart from concentrating on good cultivation and post-harvest practices through good husbandry of the cocoa farm, including pest and disease control and harvest and post-harvest handling whilst considering social and environmental dimensions of sustainability into production practices.

Recommendations on protocols for physical assessments of cocoa beans will be presented in the complimentary document to this review entitled: “Elements of a harmonized international standard for cocoa flavour assessment – a proposal for further consultation”.

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<sup>12</sup> [http://www.icco.org/about-us/international-cocoa-agreements/cat\\_view/30-related-documents/32-consultative-board-on-the-world-cocoa-economy.html](http://www.icco.org/about-us/international-cocoa-agreements/cat_view/30-related-documents/32-consultative-board-on-the-world-cocoa-economy.html)

### 3.0 Interviews and Reviews

As mentioned in 1.5.1 the activities envisaged for this consultancy were a review of relevant published literature on standards and quality for cocoa, coffee, wine and olive oil but also to connect with relevant individuals in the sector to add to this information set with a view towards proposing a draft quality evaluation protocol.

#### 3.1 Interviews

Fourteen (14) Skype interviews were conducted with the following persons from the following institutions/organisations on the following dates. The conversations gained their perspectives on the growth in interest of fine or flavour cocoa, cocoa quality, their efforts in recognising cocoa and chocolate quality, quality assessment of physical and flavour attributes and the linkages to origin through farmers, informal farmers groups or larger formally constituted farmers cooperatives/associations:

Person(s)	Institution	Call Date
Rick Peyser	Lutheran World Relief	19 <sup>th</sup> February 2016
Ed Seguire	Seguire Cacao Cocoa & Chocolate Advisors	26 <sup>th</sup> February 2016
Cristina Liberati	Equal Exchange	29 <sup>th</sup> February 2016
Juan Francisco Mollinedo	ITZEL Chocolate and AMACACAO	29 <sup>th</sup> February 2016
Carla Martin	Fine Cacao and Chocolate Institute	7 <sup>th</sup> March 2016
Leo Lombardini, Roger Norton and Eric Brenner	Borlaug Institute for International Agriculture, Texas A&M University	9 <sup>th</sup> March 2016
Daniel Domingo	Atlantic Cocoa Company	11 <sup>th</sup> March 2016
Laura Ann Sweitzer and Brad Kintzer	TCHO Chocolate	15 <sup>th</sup> March 2016
John Kehoe	Guittard Chocolate	21 <sup>st</sup> March 2016
Martin Christy	70% and International Chocolate Awards	21 <sup>st</sup> March 2016
Gary Guittard	Guittard Chocolate	22 <sup>nd</sup> March 2016
Colin Gasko	Rogue Chocolatier	29 <sup>th</sup> March 2016
Clay Gordon	The Chocolate Life	27 <sup>th</sup> April 2016
Chloe Doutre-Roussel	Chloé Chocolat	29 <sup>th</sup> April 2016

Representatives from APPCACAO (Asociación Peruana de Productores de Cacao) were contacted and more detailed conversations will occur during the World Cocoa Conference 2016 in the Dominican Republic.

### 3.1.1 Common Needs, Challenges and Questions (Top 20)

In my conversations with some of the individuals listed above and in scanning through summaries of various meetings<sup>13</sup> with bean to bar chocolate makers and researchers who work closely with farmers, cocoa cooperatives and chocolate makers; some common elements arose regarding needs and challenges/limitations faced. These common issues were in the areas of communication of the issues faced, creating a suitable system for quality assessment (physical and flavour), cocoa flavour assessment - protocols, training, calibration and standardization. The Top 20 of these are listed below and have prompted the various approaches being taken by individuals and groups which are discussed in section 3.1.2.

1. Creating and communicating an understanding of cocoa quality to farmers and producers' groups. Identifying the quality targets to meet in an easily understandable way that transcends culture and language.
2. How to best communicate what chocolate makers want to producers and vice versa regarding what they want and the basic context for these needs and what sensory language to use?
3. Understanding who is a grading system for? Farmers? Farmers Cooperatives? Others? Tailoring the system to suit these unique individuals.
4. The varied stakeholders along the cocoa value chain – industry, farmers, cooperatives, eventually consumers – need to trust and buy into the grading or quality assessment programme as something that is beneficial to them and to their community.
5. Many current methods for evaluating cocoa internally requires somewhat specialized and relatively expensive equipment that cannot be brought into the field.
6. Raw bean evaluation, liquor evaluation and chocolate evaluation requires different equipment, protocols and skill sets for assessment. What is the easiest way to get this done in a cost effective manner with appropriate technology?
7. Any system used must be easy to understand, simple to implement across the stakeholder group (cost and equipment wise) and relevant to the purpose but practical enough that they can be implemented reasonably. How to best achieve this?

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<sup>13</sup> Notes from Cacao Sensory Group Meetings arising from the NW Chocolate Festival (August and Nov 2015) and other personal communications.

8. Apart from identifying a relevant vocabulary/descriptor set, there is a need for more standardization around language and calibration as well as formalization behind it.
9. Separating flavours (like astringency, acidity and bitterness) derived from fermentation issues against ancillary flavours (like fruity, floral and nutty) and how to effectively link these to physical cues from smell and cut test with strong association and calibration.
10. Effective panellist training and initial and ongoing calibration is an overarching concern, as well as, finding ways to calibrate successfully in a cross cultural setting.
11. Recognising that creating a suitable tasting form is just one part of the quality assessment approach and that a complimentary training and ongoing calibration programme is another piece.
12. How do we assign global quality scores? What is the best way to achieve this? Calculated? Or opinion based on experience? How much is enough experience to do this?
13. Trying to fit cocoa into the coffee model. Cocoa Grading modelled on Q grading system for coffee, some elements work well and can transfer, others are more difficult to translate across commodities.
14. Does anyone have reference samples? Reliable reference calibration samples (liquor and chocolate) are lacking and produced on an *Ad hoc* or opportunistic basis.
15. Off flavours (like smokey and over fermented) are easier to understand and assess, others (like astringency, tannic notes and acidity) are harder to get across. Ancillary flavour notes are even harder.
16. Most farmers have never tasted chocolate made from their own beans. Giving them that opportunity is vital in the quality transformation process but getting farmers to taste liquor or their beans (and to taste more often) can be a challenge. Hitting the wall of bitterness and moving beyond that.
17. The training materials have to be good, rigorous, up to date with the most recent research. Training must be strong in order to ensure that the knowledge can be transmitted and the information shared widely and the grading system adopted broadly.

18. We need a process. Many people have been working on their own systems. The solution lies in focusing on what works in a system rather than finding fault.
19. There needs to be a thorough methodology with a strict protocol from fermentation, drying, roasting, liquor making etc.
20. There is a need to bring systems forward so that we can start to determine value and look at ways to share that knowledge and information within the industry.

### **3.1.2 Regional and International approaches/initiatives taken by some Individuals and Groups**

Recognising the benefit to their business and the sector at large, some individuals/groups and institutions have created programmes to tackle the needs/challenges and questions listed above. This section takes a look at some of the major regional and international initiatives and programmes. Other national programmes exist but the focus here will be on the larger more formal initiatives. Where protocols are available and published, they are presented in the Annexes.

Cristina Liberati, TCHOSource Program Manager and Grant Projects Coordinator at Equal Exchange best describes the approach to take when looking at each system and comparing them to others. It also forms a good basis for crafting a harmonized system:

1. What information does each system give you? Who is the intended audience/user?
2. How do these different systems help us to achieve the common or top objectives? How could a particular system achieve the objectives?
3. Where are various systems similar and different? Where do they complement each other?
4. What kind of cocoa does each system evaluate (bulk, fine, ultra-premium etc) and what industry are we talking about creating common standards for?
5. Does it work for raw beans, liquor, chocolate, cocoa powder; does it need to work for more than one?
6. Does each system have these key components developed?
  - a. Taster Training Program
  - b. Sample Preparation Protocol
  - c. Physical and Sensory Analysis Procedure
  - d. Are there any major components missing?
  - e. How can we take the best features of each, and reduce the weakest features of each to agree upon something more holistic?

#### **3.1.2.1 TCHO and Equal Exchange**

In talking to Brad Kintzer, Cristina Liberati and Laura Ann Sweitzer, they spoke about the TCHOSource programme and the strategic partnership with Equal Exchange to implement a five-year USAID Cooperative Development Grant that focuses on the three key areas of (i) quality, (ii) productivity and (iii) capitalization. The programme is executed in partnership with cocoa and coffee cooperatives in Peru, Ecuador, and the Dominican Republic. There is an important vertical integration element to this

programme as these cooperatives also supply TCHO and Equal Exchange with beans. This promotes direct market access and strengthens the link between producers and buyers, shortens the feedback loop between producers and consumers and promotes consistence by creating an understanding of flavour and the processing steps contributing to it<sup>14</sup>. There are other linkages at the national research centres in Ecuador (INIAP) and Ghana (CRIG).

This initiative is a big part of TCHO's broader programmes to *"innovate the way things are being done with chocolate"* and with a mission/obsession *"to make New American Chocolate"*<sup>15</sup>. To realise this vision/mission, TCHO works closely with their producer partners to improve physical infrastructure, define processing methodologies via measurement of key ambient and physico-chemical variables during post-harvest processing (including solar drying) to develop *"exceptional flavour profiles"* from their partners. Brad Kintzer describes it as *"encouraging the farmers to become scientists"*.

A key element of the TCHOSource programme and creating *"farmer scientists"* is the setting up of small quality labs in Peru, Ecuador, the Dominican Republic, Ecuador and Ghana. The labs set up in this programme contained the following pieces of equipment:

1. 1 – 2 Drum roasters of 1-2 Kg capacity
2. A Simple bean cooler
3. A *"Krankenstein"* cocoa bean cracker
4. A John Gordon/CPS bean winnower
5. 2 Santha or Premier grinders for liquor making or a larger CocoaTown ECGC 65 Melanger
6. A tempering stone and/or a small table top tempering machine
7. Moulds

According to Brad Kintzer, the rationale for having these labs in origin countries is to bring the very same innovation and technology of their factory lab to their farmer partners, enabling them to make small batches of chocolate and to use these labs as tools to explore flavour. Some countries use the labs fully whilst others do not.

Sensory training is the next logical step with this technical capacity and under this programme, TCHO has trained farmers and Quality Control persons at cooperatives to taste cocoa liquor and chocolate. According to Brad Kintzer, *"the training enables them to understand the true driver in the value of their product: flavour"*.

I was informed that the sensory training protocol is not formally documented or published as yet since it evolves according to the origin where it is being conducted but focused on (i) aroma, (ii) flavour and (iii) defects. No documents on this were provided.

Aroma and liquor references comprised local examples (liquids or other items) of the aromas of interest that people can relate to are identified and any interesting bean samples from different origins that come to TCHO are retained to make a liquor reference library. Panellist calibration is achieved via video Skype conferences with live tasting sessions and twice a year, a team from TCHO goes to the labs in each

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<sup>14</sup> <http://www.tcho.com/tchosource/#sthash.zLt8O1i0.dpuf>

<sup>15</sup> Ibidem




origin country to do sensory training with positive and negative attributes. Understanding what is a defect was a critical element of the training.

TCHO did some sensory workshops looking at both coffee and cocoa based tasting forms and developed a tasting form loosely based on the SCAA form with a lot of expertise borrowed from coffee. An example of this form is presented in Annex 3 and this is mainly used in Latin America with their partner Asociación Peruana de Productores de Cacao (APPCACAO). Further conversations with representatives from APPCACAO will occur at the World Cocoa Conference in the Dominican Republic in late May 2016. A detailed tasting manual<sup>16</sup> on the use of this form has been prepared as part of the five-year USAID Cooperative Development Grant and is presented in Annex 4. Tasting notes are recorded on the form in the following categories:

1. Odour/Fragrance
2. Acidity
3. Bitterness
4. Astringency
5. Flavour/Aroma (carries a double value towards the Final score)
6. Cleanliness
7. Aftertaste
8. Tasters points
9. Final score

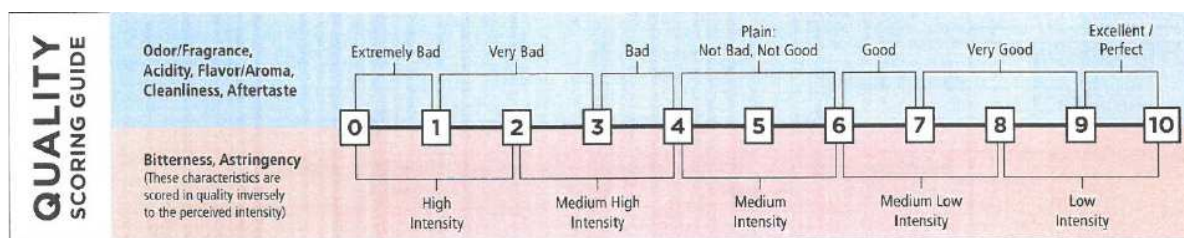
The assessor ranks the “Intensity” of these attributes between low, medium and high and “Quality” is assessed based on a 0 – 10 scale, see Figure 1 below.

INTENSITY	QUALITY: Select a number based on the scoring guide below
High	
Med	
Low	

**Figure 1. Intensity and Quality Scoring Guide from the TCHO/Equal Exchange/APPCACAO cacao sensory analysis tasting form.**

<sup>16</sup> USAID, Equal Exchange, APPCACAO and TCHO, 2015. Manual de la ficha catación de cacao, pp38.

In Quality scoring, Odour/Fragrance, Acidity, Flavour/Aroma, Cleanliness and Aftertaste, a score of 0 is extremely bad and a score of 10 excellent. However, for Bitterness and Astringency, these are scored in quality inversely compared to how they are perceived on the palate. See Figure 2 below.



**Figure 2. Use of the Quality Scoring Guide for positive and negative attributes from the TCHO/Equal Exchange APPCACHAO cacao sensory analysis tasting form.**

Tasters points break down the information to what contributes to the Final Score which is a summation of the scores from the quality scores. Flavour and Aroma quality scores counts double towards the total score.

TCHO also uses an in house flavour profiling form (not shared) that is different to the TCHO/Equal Exchange/APPCACHAO cacao sensory analysis tasting form with the following flavour attributes:

1. Bitterness
2. Astringency
3. Acidity
4. Cocoa
5. Fruity
6. Nutty
7. Citrus
8. Floral
9. Earthy
10. Off notes

The final component of TCHO's quality evaluation programme is using Cropster<sup>17</sup> as a platform to collect data on fermentation, drying, and flavour assessment. TCHO helped adapt this platform from the specialty coffee sector to the emerging specialty cocoa sector and this platform allows for sharing results in real time so that adjustments to processing can be made quickly as conditions change.

Brad Kintzer will like to see a universal protocol for quality assessment and in reviewing and comparing other systems, he expressed the desire to possibly merge aspects of the Cocoa of Excellence tasting form (see next Section) with the TCHO in house flavour profiling with the option to add information on the quality of the flavour giving points towards a 100 - point category scale. In this scale a cocoa that is free from defects would be awarded 80 points and more. The challenge Brad indicated would be in defining these categories and preparing guidelines for them. He also alluded to the need for a two

<sup>17</sup> Cropster (<https://www.cropster.com/en/>) is a cloud-based software platform and database that is widely used for coffee and is now being used for cocoa for insuring traceability and capturing data concerning fermentation, drying, and flavour assessment. Companies can upload their tasting forms and Quality Control forms to Cropster to use this as a platform to facilitate tasting online.

tiered system for cocoa quality assessment. An initial quick assessment and then a more detailed assessment but raised the issues of not making the system too complicated and targeting the users of such two tiered system carefully.

### 3.1.2.2 Cocoa of Excellence (CoEx) programme

The Cocoa of Excellence (CoEx) Programme was initiated in 2008 as a fast track proposal supported by the United Nations Common Fund for Commodities (CFC) and the International Cocoa Organisation (ICCO) entitled: *“Cocoa of excellence: Unravelling and celebrating diverse flavour qualities of cocoas to promote market differentiation”*<sup>18</sup> and was executed through CIRAD<sup>19</sup> (France). Since the first edition in 2009 the programme has evolved significantly and is now executed through Bioversity International (BI) with a number of industry partners<sup>20</sup>.

Successive editions are held every two years and the vision of the CoEx programme is to achieve farmers'/producers' professionalization and long-term sustainability of the cocoa supply chain. This is through recognizing, preserving and valuing cocoa diversity and through promoting and providing global recognition of high quality cocoa.

The specific objectives are to:

1. Develop awareness all along the supply chain on the opportunity to produce high quality cocoa, resulting from genetic diversity, *“terroir”* and craftsmanship of those who prepare cocoa;
2. Facilitate linkages between cocoa producers and operators in the supply chains (cocoa bean traders, chocolate manufacturers, etc.);
3. Expose and educate farmers, chocolate manufacturers and consumers to the diversity of flavours that exist in high quality cocoa;
4. Stimulate and increase capacity of producing countries to recognize, seek out and preserve quality and diversity in cocoa<sup>21</sup>.

The CoEx operates by having each participating country set up a National Organising Committee which may consist of representatives from one or more of the following stakeholder groups: research and development institutions, national cocoa boards, quality control centres, NGO's, export promoting institutions, etc. The National Organising Committee is responsible for announcing the CoEx Programme at the national level, for receiving cocoa bean samples from producers and for sending well fermented and dried bean samples according to set guidelines governing the preparation, quantity, sending and receipt of bean samples to the International Committee as soon as they are available<sup>22</sup>.

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<sup>18</sup> Eskes et al., 2008 *“Cocoa of excellence: Unravelling and celebrating diverse flavour qualities of cocoas to promote market differentiation”* Project proposal submitted to Common Fund for Commodities (CFC) pp. 25.

<sup>19</sup> CIRAD (French Agricultural Research Centre for International Development) is a public industrial and commercial enterprise (EPIC) under the joint authority of the Ministry of Higher Education and Research and the Ministry of Foreign Affairs. CIRAD works with the whole range of developing countries to generate and pass on new knowledge, support agricultural development and fuel the debate on the main global issues concerning agriculture. CIRAD is a targeted research organization, and bases its operations on development needs, from field to laboratory and from a local to a global scale.

<sup>20</sup> <http://www.cocoaofexcellence.org/>

<sup>21</sup> *ibidem*

<sup>22</sup> [http://www.cocoaofexcellence.org/images/stories/cocoa/files/CoEx-2015-TechnicalGuidelines\\_ENGLISH.pdf](http://www.cocoaofexcellence.org/images/stories/cocoa/files/CoEx-2015-TechnicalGuidelines_ENGLISH.pdf)

Before each edition the listing of countries and the amount of samples that are allowed to submit to the CoEx programme are reviewed and revised upward (and sometimes downward) to achieve balance in region representation and to reflect the revised production status of cocoa from a particular country.

For the 2015 Edition, the following countries in Table 1 were invited to submit samples with the following quotas.

**Table 1. Invited countries and regional quota for the 2015 edition of the Cocoa of Excellence Programme.**

<b>Countries/Regions</b>	<b>Maximum number of samples</b>
<b>Africa and the Indian Ocean</b>	<b>70</b>
1. Cameroon	5
2. Central African Republic	3
3. Congo	3
4. Congo DRC	3
5. Cote d'Ivoire	10
6. Equatorial Guinea	3
7. Gabon	5
8. Ghana	10
9. Liberia	3
10. Madagascar	5
11. Nigeria	5
12. Sao Tome and Principe	3
13. Sierra Leone	3
14. Tanzania	3
15. Togo	3
16. Uganda	3
<b>Asia, Pacific and Australia</b>	<b>51</b>
17. Australia	3
18. Fiji	3
19. Hawaii	3
20. India	3
21. Indonesia	10
22. Malaysia	5
23. Papua New Guinea	5
24. Philippines	5
25. Samoa	3
26. Solomon Islands	3
27. Vanuatu	3
28. Vietnam	5
<b>Central America and Caribbean</b>	<b>90</b>
29. Belize	5
30. Costa Rica	5
31. Cuba	5
32. Domenica	3
33. Dominican Republic	10
34. El Salvador	3
35. French Guiana	3
36. Grenada	3
37. Guadeloupe	3
38. Guatemala	3
39. Guyana	3
40. Haiti	3
41. Honduras	3
42. Jamaica	5
43. Martinique	3
44. Mexico	5
45. Nicaragua	3
46. Panama	3
47. Puerto Rico	3
48. Saint-Lucia	3
49. St Vincent and the Grenadines	3
50. Trinidad and Tobago	10
<b>South America</b>	<b>55</b>
51. Bolivia	5
52. Brazil	10
53. Colombia	10
54. Ecuador	10
55. Peru	10
56. Venezuela	10
<b>TOTAL</b>	<b>266</b>

Bioversity International provides the overall programme coordination for the CoEx through an International Organising Committee overseeing the implementation of the CoEx Programme, ensuring that the rules and regulations are applied during the evaluation and screening process. It should be noted that participation in this committee has been voluntary and on a “*pro bono*” basis by many institutions who are committed to the mission and vision of the CoEx.

About 700 to 800 g of each bean sample submitted is used to prepare cocoa liquors and untempered chocolate samples for evaluation (blind tasting) by six to eight international experts in sensory evaluation of cocoa samples. The assessment criteria are harmonized to enable consistency in evaluation methods and scoring.

The following flavour traits are assessed by the sensory panel:

1. Cocoa
2. Acidity
3. Bitterness
4. Astringency
5. Sweet
6. Fresh fruit
7. Brownd fruit
8. Nutty
9. Floral
10. Woody
11. Spicy

Besides specific flavour traits listed above, Global quality scores is given to assess the overall interest of the sample in making high quality chocolates (including use in possible blends). A full CoEx glossary of terms for flavour evaluations with matching descriptors and examples of some origins/reference notes for calibration<sup>23</sup> are also available and presented in Annex 5.

The top 50 high samples are selected from all the samples submitted representing the best flavour quality diversity and the geographic and genetic origins of samples and processed into chocolate made according to a standardised recipe. These chocolates are evaluated blindly by a larger panel of professional chocolate manufacturers and traders and the best samples will from this evaluation according to producing region receive awards at the International Cocoa Awards celebrated at the *Salon du Chocolat* in Paris in October. There is no ordinal ranking of winners, just winners. There is also a business to business (b2b) interface at the CoEx stand at the *Salon du Chocolat* to facilitate direct marketing linkages between top 50 finalists and brokers or chocolate makers.

Technical aspects of the CoEx programme are governed by a Technical Committee (Chaired by Ed Seguire) and great effort has been expended to prepare and publish very detailed technical guidelines<sup>24</sup> covering almost all aspects of the process which include:

1. National Organization Committees
2. International Organization Committee
3. Number of cocoa bean samples per country and region

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<sup>23</sup> Ed Seguire and Darin Sukha, CoEx Edition 2015 <http://www.cocoaofexcellence.org/about-coex/glossary>

<sup>24</sup> ibidem

4. Cocoa bean sample providers
5. Shipment of the cocoa bean samples
6. Information and photos to be provided with each cocoa bean sample
7. Type and quality of cocoa bean samples
  - a. Commercial samples
  - b. Experimental samples
8. Fermentation of the cocoa bean samples
9. Drying of the cocoa bean samples
10. Defects and health of the cocoa bean samples
11. Collecting and storage of the cocoa bean samples
12. Receipt of the cocoa bean samples
13. Evaluation of the cocoa liquors and chocolate
14. Evaluation and nomination of the cocoa bean samples for the International Cocoa Awards
15. Distribution of results

For transparency, these technical guidelines are freely available on the CoEx website<sup>25</sup> and are presented fully in Annex 5. Detailed sample preparation guidelines have also been documented by the CoEx Technical Committee for making liquor and formulation of the dark chocolates for final assessment and are made available to any submitting country on request.

The CoEx is constantly evolving and the Technical Committee is currently formalising detailed protocols for calibration of its evaluation panel, including the creation of a reference sample set for this purpose. Feedback on the assessments of each sample is sent to each sample submitter and a forum for dialogue is being created to provide further information to submitting countries with a view to improving the quality of samples submitted to the programme.

### **3.1.2.3 Fine Cacao and Chocolate Institute (FCCI)**

In talking to the Fine Cacao and Chocolate Institute (FCCI) founder, Carla Martin and from their website<sup>26</sup>, FCCI is a non-profit organization devoted to identifying, developing, and promoting fine cacao and chocolate, primarily by addressing ethics and quality issues in the supply chain<sup>27</sup>. The FCCI is also developing educational programmes for consumers, chocolate professionals, specialty retailers, and foodservice professionals as well as conducting research and disseminating information on fine cacao and chocolate origin, processing, production, quality, and ethics. The broader rationale being building a knowledge centred community by creating opportunities for knowledge sharing and mutual understanding throughout the cacao-chocolate supply chain.

The FCCI offers “*The Cacao Grader Intensive*”, a three-day training course in which participants learn fine cacao and chocolate grading techniques. According to Carla Martin, the course combines in-depth lectures on fine cacao and chocolate with intensive hands-on training in cacao and chocolate sample preparation and analysis. It assumes some familiarity with cacao as well as chocolate and liquor tasting and participants are required to complete introductory readings and begin cacao sample preparation and evaluation practice prior to the class.

<sup>25</sup> <http://www.cocoaofexcellence.org/about-coex/objectives>

<sup>26</sup> <https://chocolateinstitute.org/>

<sup>27</sup> <http://aaas.fas.harvard.edu/people/carla-martin>

From the FCCI website<sup>28</sup>, lectures cover the following topics:

1. History and culture of fine cacao and chocolate;
2. Factors in fine cacao and chocolate quality - genetics and agronomy, post-harvest processing, storage and transport, and chocolate making;
3. Science of cacao-chocolate flavour and sensory analysis;
4. Supply chain - market basics, cacao sourcing, economics, politics, culture; and
5. Ethics and transparency - social and environmental responsibility, certifications, models for success.
6. Hands-on training is also provided on:
  - a. External evaluation of raw cacao;
  - b. Cut test;
  - c. Cacao sample protocol and preparation;
  - d. Cacao sample organoleptic evaluation;
  - e. Sensory analysis techniques and exercises - e.g. defect tasting, sensory deprivation, triangulation, calibration;
  - f. Development of sensory lexicon; and
  - g. Tasting and evaluating chocolate liquor and finished chocolate.

The course is conducted in a small group setting to allow significant interaction with the instructors and fellow class members. The materials were developed in consultation with certified coffee Q grading instructors, chocolate industry experts, and scholars of sensory evaluation<sup>29</sup>. The typical schedule for the course over the three days includes:

- Before course:
  1. Review syllabus
  2. Complete introductory readings
  3. Practice cacao sample preparation and evaluation
- Day 1:
  1. Introduction to fine cacao and chocolate [lecture]
  2. Introduction to sensory analysis [lecture]
  3. Defining fine cacao and chocolate quality [lecture]
  4. Cacao external evaluation and cut test training [practicum]
- Day 2:
  1. Organoleptic exercises [practicum]
  2. Cacao sample preparation and sensory evaluation training [practicum]
  3. Fine cacao-chocolate quality chain of custody and ethics [lecture]
  4. Chocolate liquor and finished chocolate tasting [practicum]
- Day 3:
  1. Sensory analysis techniques [practicum]
  2. Calibration exercises [practicum]
  3. Evaluation of cacao samples [practicum]

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<sup>28</sup> <https://chocolateinstitute.org/>

<sup>29</sup> ibidem

In addition to Carla Martin, the instructors for this course also currently include Colin Gasko (of Rogue Chocolatier, located in Three Rivers, Massachusetts.<sup>30</sup>) as well as Chloe Doutre-Roussel (of Chloe Chocolat<sup>31</sup>).

Carla, Colin and Chloe shared their views/needs and experiences regarding cocoa and quality flavour evaluations as well as their vision for protocols in this system. Both Carla and Colin agreed on the need for a tiered approach to quality evaluation dealing firstly with external bean and physical evaluations such as:

- Bean count
- Waste
- Bean size
- Black beans
- Cut Test

Colin was keen on the development and use (in a repeatable way) of cocoa cut test charts linked to specific bean attributes such as:

- Pale bean mutant varieties (such as CATONGO) (Blond beans)
- Forastero bean types
- Spotting inside of beans often linked to Theobromine deposits
- Assessing the gradation of fermentation by associating the amount violet or purple beans to indicate the degree of residual tannin/polyphenol levels.

Chloe spoke at length about the need to refine the way in which beans are converted into liquor and chocolate for evaluation and she indicated that current methods over roast most beans for this initial evaluation process. Colin also shared his views that most “low tech” sample preparation protocols using toaster ovens or rotary roasters at origin produced beans that were either over roasted or without an appropriate roast. Looking at coffee, he saw that for cupping, the roast was low with the same level of browning. In searching for an effective way to apply this to cocoa, there was the conflict between the high cost of and over complexity of a precision roaster operating in the sometimes basic conditions at origin. His solution arrived at together with Carla is the FCCI cacao sampling protocol (see Annex 6) which uses a West Bend Air Crazy 3.5 Quart popcorn popper to gently “puff” (not roast) the shells on a bean sample for hand picking and then using a Krups 3 Oz coffee grinder to make a coarse powder that is either tasted at this stage or mixed with white cane sugar or xylitol for tasting in a stemless wine glass.

Regarding their thoughts on sensory evaluation, the trio considered that the first step should be creating a well-defined and representative standard reference set for ‘defects’ and ‘aromas’ for use in training calibrated cocoa graders, then use these individuals as master trainers to “train the trainers” at the quality control labs in various cooperatives. This system will then be supported by periodic re-calibration exercises of both the master trainers and other trainers. Chloe indicated that the creation of a standard reference set could be outsourced to an appropriately experienced company or university

In their discussion on flavour assessment protocols, Chloe, Colin and Carla indicated that there was a need to define, understand and differentiate between simple and complex aromas and tastes with appropriate calibration at the heart of a suite of training tools available to the different stakeholder

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<sup>30</sup> See [www.roguechocolatier.com](http://www.roguechocolatier.com)

<sup>31</sup> See [www.chloe-chocolat.com](http://www.chloe-chocolat.com)



groups in the cocoa value chain. They believed that ideally this system should be simple, not too intimidating and broadly implementable and have standardised reference samples for calibration and updated re-training. Chloe believed that the larger chocolate companies (*“big business”*) had a role to play in disseminating information and protocols but not necessarily in creating them.

The system they propose draws heavily from the coffee Q grading system (Discussed in Section 3.2.1.1) having training ranging from threshold and extremes for both aroma perception, basic tastes and flavour attributes across a wide range of flavour attributes presented in the Fine Cacao and Chocolate Institute cacao grader evaluation form (see Annex 7). Towards this end, Colin is pursuing the creation of cocoa specific aroma kits with a Natural Perfumer (Mandy Aftel)<sup>32</sup>. Both were also keen on having a reduced sensory attribute intensity scoring scale of 0 - 5 instead of 0 – 10. These protocols for panellist training and calibration were still being refined and to the best of my knowledge, not formally published as yet but a full syllabus of the FCCI three-day training course is made available to registered participants.

### 3.1.2.4 International Chocolate Awards

The International Chocolate Awards is a competition that recognises excellence in fine chocolate making and in the products made with fine chocolate<sup>33</sup>. The awards were founded in 2012 and are run by a group of independent international partners based in the UK, Italy and the USA. The ultimate aim of the International Chocolate Awards is to support companies producing fine chocolate and chocolatiers, small companies and artisans working with fine chocolate by helping these markets to grow and develop whilst supporting the farmers that grow fine cacao<sup>34</sup>.

Competitions are held in a growing number of countries and regions around the world, including Italy, the UK, USA, Germany, Scandinavia, Belgium and other locations, with more competitions added each year. Winners of the regional competitions are judged together at the World Final, which celebrates the best entries of the year. Judges include a wide range of experts, tasters, pastry chefs, food journalists, bloggers, sommeliers, chefs and a permanent Grand Jury<sup>35</sup>. As with the CoEx and HCP, the sample preparation and judging system for the International Chocolate Awards are well documented<sup>36</sup>

By making consumers more aware of the work and craft that goes into the best fine chocolate products, the International Chocolate Awards tries to help the fine chocolate industry to grow and develop in established regions as well as new markets. By helping to identify the best chocolate made with the best cacao, they hope to help chocolate makers, chocolatiers and cacao farmers continue to succeed at producing the world’s best fine cacao and fine chocolate.

In talking to Martin Christy<sup>37</sup> (founder of 70%) to learn more about the awards, its process and ways in which the judging is evolving to “manage subjectivity”<sup>38</sup>, he referred to it as “Managed Subjectivity”. Martin has been working on this concept with Alex Rast (from the University of Manchester)<sup>39</sup> and together, they are exploring neural models for chocolate taste perception to generate a systematic,

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<sup>32</sup> <http://www.aftelier.com/>

<sup>33</sup> <http://www.internationalchocolateawards.com/about/>

<sup>34</sup> *ibidem*

<sup>35</sup> *ibidem*

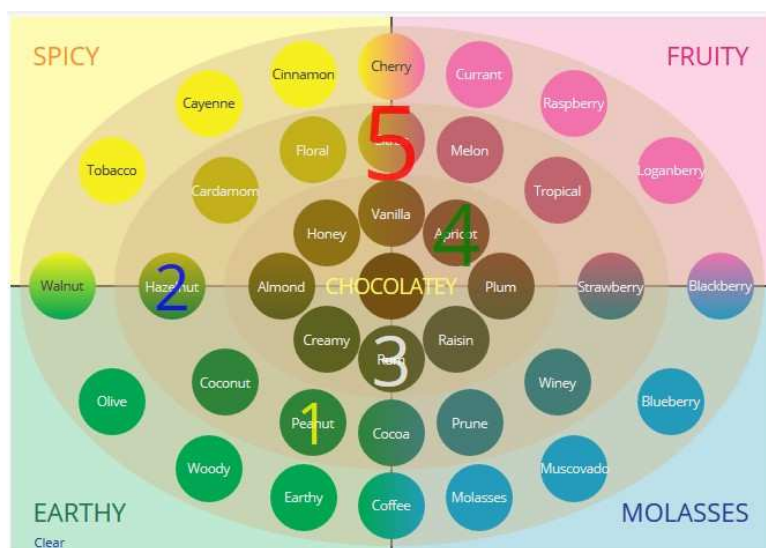
<sup>36</sup> *ibidem*

<sup>37</sup> <http://www.seventypercent.com/about/>

<sup>38</sup> <http://www.internationalchocolateawards.com/judging-system-and-forms/>

<sup>39</sup> <http://www.internationalchocolateawards.com/alex-rast/>

human-sensory-based system for mapping and describing chocolate flavour from bean to bar. Figure 3<sup>40</sup> presents a 37-point flavour model for Seventy % based on this system and is linked to natural references.



**Figure 3. The Seventy % flavour model based on a neural model for chocolate taste perception**

The neural model for chocolate taste perception is linked to published work that basic sensory perceptions (undesirable, bitter pungent, repulsive, fruity, nutty, floral, vegetal, and sweet chocolate) can be totally explained by aroma compounds assessed from roasted cocoa powder released by steam distillation and solvent extraction separated by adsorption chromatography in six fractions depending on the polarity<sup>41</sup>.

In talking to Martin Christy and looking at information presented on the International Chocolate Awards website<sup>42</sup>, the system used accepts that that chocolate judging is a matter of taste, and that personal sensorial aspects such as flavour are paramount. As such, the scoring system used helps guide judges on exactly what each mark means by identifying key areas in the assessment of a chocolate sample whilst assigning marks out of five for each of the following areas:

1. Execution
2. Formulation
3. Interpretation
4. Taste

Each of these receives a mark out of five, with a weighting towards a 100% total. Guidance statements are given for each mark that help judges quickly and consistently decide which mark is appropriate. In addition to the total score out of 100, judges are asked to indicate whether a product deserves an

<sup>40</sup> Provided by Martin Christy (310316).

<sup>41</sup> Bonvehí, J. (2005). "Investigation of aromatic compounds in roasted cocoa powder". European Food Research and Technology July 2005, Volume 221, Issue 1, pp 19-29

<sup>42</sup> <http://www.internationalchocolateawards.com/judging-system-and-forms/>

award, again on a scale of 1-5 to give a second evaluation of the product which is used by the Grand Jury when considering which products should receive an award.

Feedback from the judges (both negative and positive) is provided to entrants using fixed feedback statements on the entry form that address technical aspects of the sample judging. These require a judge to become familiar with the statements and then tick the appropriate letters.

Judges also to give an overall 'mark out of 10' as a final statistical check. This mark does not count towards the total judging, but gives us a way to check for statistical variation or errors so that a judge cannot give low section marks but a high check total.

Palate fatigue, cleansers and calibration are also considered under the in the International Chocolate Awards methods. To reduce panellist and palate fatigue, judging is done in stages or tiers with a first round of 'auditions' where all samples are tested by a small panel who vote on whether or not the sample has a chance to win an award. If a majority vote yes, the sample goes through to main judging. If the majority reject the sample, the product does not go through. If there is doubt or a borderline decision, then the sample is let through.

Palate calibration drift and fatigue is managed by tasting four different couvertures before judging begins, then retesting on of these every 5 or 6 samples to see how much drift occurs. This starts to happen after 15-20 samples so any judge tastes 15 samples in one session with a maximum of 20 in sessions that last 1.5 hours. There is a one-hour break then one more session is run.

Palate cleansing is achieved via a soupy polenta to remove the build-up of tannins and sugar. Water, bread, apples, crackers are also available and used during the judging sessions.

Martin also provided some insight into his more recent work in cocoa bean quality assessment at origin and in trying to have a system that is usable on the ground with farmers and starts off simply then building on complexity guiding the farmers, producers and member of cooperatives to get their perspective on what is good and poor quality. He indicated that if equipment is provided at origin to make liquors they should be supported by properly defined protocols to avoid creating burnt or over roasted liquors for "*at origin*" evaluation.

The steps in the process outlined by Martin involves a protocol for liquor and deshelled beans followed by rapid screening. He indicated that more details will be provided at a special session on Fine or Flavour cocoa on 26<sup>th</sup> May immediately after the World Cocoa Conference in the Dominican Republic (22 – 25<sup>th</sup> May, 2016).

He did share some perspective on flavour evaluation, indicating that a common language is needed and well defined protocols are needed from:

1. Initial dry bean screening
2. Roasted cocoa bean evaluation
3. Liquor evaluation
4. Chocolate evaluation.

On the point of assigning Global Quality scores he referred to the system used for the International Chocolate Awards using an expert panel and not an untrained panel, having qualitative statements linked to specific criteria and was against having a score out of 10.

### 3.1.2.5 Heirloom Cocoa Preservation Initiative

According to Gary Guittard, President of the Guittard Chocolate Company, about the Heirloom Cacao Preservation Fund *“Flavourless, high-yielding trees are not the only option in the fight against the global degradation of cacao. Numerous specialty chocolate manufacturers and chocolatiers whose livelihood depends on fine-flavoured cocoa have come together to work with local farmers on every continent to preserve heirloom cacao. That’s what the HCP supports.”*<sup>43</sup>. This was launched in 2012 in partnership with the United States Department of Agriculture (USDA) and the Fine Chocolate Industry Association, as the Heirloom Cacao Preservation Initiative. Later a not-for-profit organization (Heirloom Cacao Preservation Fund) (HCP) was set up in collaboration with the USDA. The HCP fund was formed in response to the global pressures of environmental change, deforestation, and economic influences threatening the world’s supply of high quality, flavourful cacao<sup>44</sup>. The HCP is the first initiative to identify and map for high quality, flavour cacao linking flavour to the trees and to certify growers of these trees.

The HCP’s Heirloom designations are its first steps to realizing its mission:

1. Identifying the finest flavour cacaos in the world;
2. Linking their flavour to genetics for natural reproduction;
3. Preserving and propagating them now and for future generations; and
4. Recognizing and rewarding the growers who cultivate them<sup>45</sup>.

The protocols used in the HCP are very well documented and cover sample submission to the HCP, all the sample preparation and assessment protocols and use of the HCP designation. These are available online from the HCP website<sup>46</sup> and are presented in full detail in Annexes 8 and 9 respectively.

As a short summary, the HCP requires three (3) kilograms of cocoa beans – cleaned and dried weight – representing the population of trees and commercial shipment quantity proposed Heirloom designation. The HCP defines “cleaned” as having all broken. These beans are submitted to the HCP after filling out an online application form. The HCP also provides details on what kind of beans should be submitted, outlining some general guidelines for quantities and post-harvest processing best practices, including storage, pre-shipping and shipping requirements. Modified fermentations with the addition of fruit pulp or juices are not allowed submission for consideration by the HCP.

There are raw bean characterisation tests and cut tests are carried out on samples. This is followed by roasting according to specific temperature × time combinations depending on the cocoa variety submitted. Liquor preparation is done according to specific meticulously documented protocols and chocolates are made according to a fixed recipe with guidelines provided for the type of sugar cocoa butter used. The liquor is evaluated by Pulsed Nuclear Magnetic Resonance (PNMR) to determine butter fat content and there are set guidelines for the storage of both cocoa liquors and chocolate before flavour evaluation.

All samples are coded for blind evaluation of liquor and chocolate carried out individually by an international tasting panel made up of nine experts in six countries with a minimum of 15 years’ experience in chocolate. All of the panellist have served as professional evaluators of cacao bean flavour and give a wide field view of the cacaos of the world, the cocoa supply, and fine chocolate

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<sup>43</sup> <http://hpcacao.org/abouthcp/hcp-partners/>

<sup>44</sup> *ibidem*

<sup>45</sup> <http://hpcacao.org/2015/12/20/new-heirloom-cacaos/>

<sup>46</sup> <http://hpcacao.org/hcpapp/hcpevaluation/>

production<sup>47</sup>. The HCP tasting panel evaluation protocol retains the uniqueness of the established approaches of each individual panellist towards evaluating liquor and chocolate that they would have developed over time. As such, there is no purpose designed HCP tasting protocol.

As a result of this unique approach, the HCP has a detailed sequence of events to guide the decision making process for conferring Heirloom Designation to a sample<sup>48</sup>. The tasting panel's initial sensory evaluations of liquor and chocolate samples are provided in the format that each panellist currently uses and the panellists then translate their evaluations into HCP global scores for flavour, write short evaluations of the liquor and chocolate, and make a "Yes/No" vote for Heirloom designation based on this scoring and evaluation. In addition to a written sensory evaluation of liquor and chocolate, panellists make two standard attribute evaluations from 1-10 (10=maximum) for: (i) Overall Flavour (Quality and Balance); and (ii) Unique Flavour (distinctive or unusual flavour profile of long term value to the cocoa community worthy of preservation).

These individual results are forwarded to the Chair of the HCP tasting panel (Ed Seguire) to collate, schedule a conference call with the tasting panel to review the results and prepare a final report. Full panel participation on the call, though not mandatory, is preferable. Any unavailable panellists on the conference call are contacted separately for their views which are shared again with the panel before a decision on Heirloom Designation is made via a supermajority vote (70% or more).

If there is a simple majority, tie, or minority vote against Heirloom Designation, the sample does not receive HCP designation as Heirloom flavour but will receive a score from the panel. If the panel perceives that the beans display the potential for heirloom, regardless of whether there are any processing issues, the panel may vote to allow the applicant to re-submit the beans for re-evaluation under a separate set of rules for *"Evaluation Troubleshooting"*.

There are also detailed guidelines regarding the use of the HCP mark<sup>49</sup> as HCP is not a certifying agency per se. Rather, the HCP Mark recognises valued flavour of a specific stand/orchard/farm of trees from which the beans were submitted and leaf samples were taken for genetic analysis. This HCP designation is transferable to trees propagated immediately adjacent to the HCP designated stand but requires HCP approval if the individual genetics of that stand is planted by same the grower at the same location with more than 20 metres separation. Heirloom designation does not apply to similar trees grown in the vicinity or any region not owned and operated by the grower no matter how close-by they are and no matter how similar their genetics more on this designation and use process is well documented on the HCP website<sup>50</sup>.

### **3.1.2.6 AMACACAO and CUNAKakaw**

In December 2014, eighteen cacao and chocolate producers from Guatemala, Nicaragua, El Salvador, Honduras and Belize signed the statutes of a new regional business association called AMACACAO, the Meso-American Association of Fine Cacao and Chocolate. This new association began to work together to implement a common marketing strategy and establish common quality standards.

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<sup>47</sup> ibidem

<sup>48</sup> ibidem

<sup>49</sup> <http://hpcacao.org/hcpapp/use/>

<sup>50</sup> ibidem

In talking to Juan Francisco Mollinedo of ITZEL Chocolate and President of AMACACAO, the main reason for creating this new association was to strengthen the position of Central America as a producer of fine cacao and chocolate for international markets. Central America is believed to be the cradle of cacao. Long before Europeans arrived in Latin America and “discovered” it, the Mayans from Central America already considered cacao to be the food of the gods<sup>51</sup>.

The Centre for the Promotion of Imports from developing countries (CBI) <sup>52</sup> is supporting AMACACAO and producers from the region to build on their longstanding heritage as cacao producers and re-establish their place in international markets.

CUNAKakaw is the standard that is being implemented, adopted, and monitored by AMACACAO<sup>53</sup>, with a strong commitment for regenerating cacao and chocolate production in Meso-America together with a guarantee for quality products, managed under a strict Internal Control System

The control system provides a Guarantee of Origin of a CUNAKakaw product, that whether it is a cocoa bean, cocoa liquor or chocolate, is always from the traditional Mayan territories in Belize, El Salvador, Guatemala, Honduras, Nicaragua, and the South of Mexico - 100% produced in country of origin. The following guarantees are to be provided under the CUNAKakaw standard which is still being formulated for circulation between the member organisations for discussions and final adoption.

The Guarantee of Cocoa Bean Quality incorporating the following<sup>54</sup>:

- Physical parameters for fermentation, drying and defects
- Sensory parameters, analysed by external experts
- Phytosanitary and food safety parameters, such as heavy metals, etc.
- Genetically, mostly Trinitario and Criollo cacao
- Adequate storage and transport conditions
- Traceability to the farm level

Guarantee of Cacao Liquor Quality incorporating the following:

- Only made with beans that comply with CUNAKakaw criteria.
- Mild profile roasting
- Complies with microbiological norms adopted by the industry
- Good Manufacturing Practices

Guarantee of Quality for Couverture and Final Products (Chocolate, Bonbons, etc):

- Only made with beans or cacao liquor that comply with CUNAKakaw criteria
- A minimum of cacao / cacao liquor content
- No other vegetable fats
- Particle size or fineness of < 20 microns

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<sup>51</sup> <http://news.cbi.eu/new-regional-business-association-in-central-america>

<sup>52</sup> (CBI) is part of the Netherlands Enterprise Agency and commissioned by the Ministry of Foreign Affairs of the Netherlands. Established in 1971 in order to support producers / exporters to get a foothold on the market in the Netherlands, support to Business Support Organizations in improving their capabilities and to act as a Matchmaker between suppliers and buyers. In 1991 the activities were expanded to EU.

<sup>53</sup> <http://www.cunakakaw.com/>

<sup>54</sup> ibidem

- 100% Produced in the country of origin

#### Guarantee for Social Responsibility

- Complies with social national legislation, such as no child labour
- Commitment to work toward continuous improvement of working conditions
- Add value to Central American chocolate makers by producing in country of origin

#### Guarantee for Environmental Responsibility

- Sustainable soil management / Good Agricultural Practices
- Cultivation under an agro-forestry-system
- Transparency from all members about their practices<sup>55</sup>

### 3.1.2.7 The Cocoa Research Centre

Cocoa Research Centre (CRC) of the University of the West Indies (St. Augustine, Trinidad) is regarded as one of the oldest cocoa research centres in the world with an 85-year legacy in research. It was first established in 1930 as the Cocoa Research Scheme of the Imperial College of Tropical Agriculture, in response to the introduction of a Witches' Broom Disease (WBD) in Trinidad and Tobago. At that time Trinidad was the 5<sup>th</sup> largest producer of cocoa in the world and this disease was having a devastating effect on the economy of Trinidad and Tobago. This early work led to the development of varieties tolerant to WBD as well as the selection of the Imperial College Selections (ICS) by Dr. F.J. Pound. Its pioneering work on pathology, disease resistance, cocoa agronomy and propagation is recognized globally. The cocoa research scheme was subsumed as part of the University of the West Indies, following independence of Trinidad and Tobago in 1962. From 1981 to 1996 the CRC consolidated the cocoa collections from its early expeditions from Peru, Ecuador and Colombia, into a single collection, referred to as the International Cocoa Genebank Trinidad (ICGT) with support from Economic Development Fund. The ICGT has since grown and now houses approximately 2,400 cocoa varieties and is recognized by Bioversity International as a Universal Collection, the largest and most diverse in the world. In 2012, it was elevated to the status of a Research Centre at the University of the West Indies.

Starting from 1935, an era of pioneering work on processing, biochemistry and quality attributes of fresh cacao was conducted at the CRC. Further studies within this period encompassed identification and gross estimation of the main chemical components in fresh and fermenting cocoa beans. Between 1951-1976 this era of research evolved from the previous investigations and examined fermentation and drying of cacao both in terms of technique and scale with respect to quality indicators. Attempts to conduct sensory studies were made during this era. More detailed biochemical investigations into specific classes of flavour influencing compounds in cured, dried and roasted beans were also carried

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<sup>55</sup> ibidem

out<sup>56</sup>. This formed the basis of more recent work in this area at CRC and around the world. Findings from all these investigations have been published in the Cocoa Research Annual Reports<sup>57</sup>.

From 1977 to 1994, no flavour research was carried out at that CRC, but significant advances were made in Malaysia at the BAL plantations. The culmination of the Malaysian studies was a series of standardised protocols for fermentation, drying, cocoa liquor preparation, sensory panel training and sensory evaluation exercises<sup>58, 59</sup>. These were adopted and applied to flavour research that was re-initiated in Trinidad in 1995.

### **3.1.2.7.1 Current work on Flavour and Quality**

Since 1995, post graduate research into the further refinement and modification of those standardised protocols first suggested in 1994 have resulted in their adoption and use for fermenting and drying small scale batches of cocoa, as well as, for tracking the progress of fermentations, carrying out physical bean quality assessment, preparation of cocoa liquor, panellist training and sensory evaluations of cocoa liquor in many internationally funded projects. See Table 2 which some of the internationally funded projects using the standardised methods developed by the Cocoa Research Centre.

The protocol for panellist training used at the Cocoa Research Centre has been published in peer reviewed journals and validated quantitatively against Near Infrared Reflectance Spectrometry (NIRS)<sup>60, 61</sup> (See Annexes 10 and 11 for copies of these papers). The 10 attribute tasting form used at CRC (presented in Annex 12) was revised in 2016 and uses open ended 10 cm line scale that scores intensity from 0 – 10 (0 - absent and 10 - extreme) with the middle point (coinciding to a score of 5) identified by a faint line. The form considers 10 flavour attributes *viz.* cocoa, acid, astringent, bitter, fruity, floral, nutty, raw/beany/green, sweet/malt/caramel flavours and global quality. Panellists identify and score any “other” ancillary flavours (positive notes) or defects (such as smoky, hammy, mouldy, over ripe, dirty and unfermented) that are apparent in the cocoa liquors in a section for ‘other’ flavour. There is a space below to also record written general comments about the sample.

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<sup>56</sup> Sukha, D.A. and Butler, D.R. (2002). “Cocoa flavour research in Trinidad: recent developments”. Proc. of: 13th International Cocoa Research Conference, Kota Kinabalu, Malaysia. 9 – 14 October 2000. p. 879-885. Nigeria: COPAL.

<sup>57</sup> Posnette, A.F. (1986). “Fifty years of cocoa research in Trinidad and Tobago”. Cocoa Research Unit, The University of the West Indies, St. Augustine, 131pp.

<sup>58</sup> Clapperton, J. F., Lockwood, G., Yow, S. T. K. and Lim, D. H. K. (1994) Effects of planting materials on flavour, Cocoa Growers' Bulletin 48: 47-59.

<sup>59</sup> Biscuit, Cake, Chocolate and Confectionery Alliance (BCCCA) (1996) “Cocoa beans - Chocolate Manufacturers' Quality Requirements”. (4th Ed), London: BCCCA.

<sup>60</sup> Sukha, D.A.; Butler, D.R., Umaharan, P. and Boulton, E. (2008). “The use of an optimised assessment protocol to describe and quantify different flavour attributes of cocoa liquors made from Ghana and Trinitario beans”. Journal of European Food Research and Technology 226 (3): 405-413. DOI. 10.1007/s00217-006-0551-2, Published online by Springer-Verlag 8 December 2006.

<sup>61</sup> Sukha, D.A.; Butler, D.R.; Comissiong, E.A. and Umaharan, P. (2014). “The impact of Processing Location and Growing Environment on flavour in cocoa (*Theobroma cacao* L.) – implications for “Terroir” and Certification – Processing Location study”. Acta Hort. (ISHS) 1047:255-262 [http://www.actahort.org/books/1047/1047\\_31.htm](http://www.actahort.org/books/1047/1047_31.htm).



**Table 2. Internationally funded projects and post graduate research using the standardised cocoa quality assessment methods developed by the Cocoa Research Centre.**

Project Title	Participating Country/Countries	Duration
The Influence of Fermentation and Drying on the Flavour and Quality of Selected Cacao ( <i>Theobroma cacao</i> L.) Genotypes	Trinidad and Tobago	1995 - 1997
The CFC/ICCO/INIAP Cocoa Project “To establish the physical, chemical and organoleptic parameters to differentiate between fine and bulk cocoa”	Ecuador, Venezuela, Papua New Guinea, Trinidad and Tobago	2001 - 2006
The influence of processing location, growing environment and pollen donor effects on the flavour and quality of selected cacao ( <i>Theobroma cacao</i> L.) genotypes	Trinidad and Tobago	2001 - 2008
CFC/ICCO/Bioversity Project Cocoa Productivity and Quality Improvement: a Participatory Approach	Costa Rica, Papua New Guinea, Brazil, Côte d’Ivoire, Ghana, Nigeria, Trinidad and Tobago, Venezuela, Ecuador, Cameroon, Malaysia, Peru, UK	2004 - 2009
An assessment of the quality attributes of the Imperial College Selections (ICS) cocoa ( <i>Theobroma cacao</i> L.) clones	Trinidad and Tobago	2006 - 2012
Identification and promotion of ancient cacao diversity through modern genomics methods to benefit small-scale farmers	Trinidad and Tobago, Canada, USA,	2009 - 2011
Developing flavour and chemical signature profiles for cocoa in cocoa growing areas in Trinidad towards supporting Geographical indications	Trinidad and Tobago	2013 - 2014
Fermentation requirement and flavour signature profiles of various Cocoa Genetic Groups	Trinidad and Tobago, Germany, USA	2012 - present

The Cocoa Research Centre also produced a Cocoa Cut Test Chart in collaboration with the University of Hamburg<sup>62</sup> with the aim of standardising the presentation of images for some of the major cut test categories. This is presented in Annex 13.

<sup>62</sup> Cocoa Cut Test Chart, (2010). Produced collaboratively by: Cocoa Research Centre, The University of the West Indies, St. Augustine. Trinidad and Tobago and Biocentre Klein Flottbek and Botanical Garden, Ecology and Biology of Useful Plants, University of Hamburg. Germany. Photos by: Christina Rohsius; Compilation by: Darin Sukha (PhD) Version 2 © 2010.

### 3.1.2.8 Seguine Cacao Cocoa & Chocolate Advisors

Seguine Cacao Cocoa & Chocolate Advisors was established by Ed Seguine in November 2013 in response to the need for advice to farmers, cooperatives, research groups and bean to bar companies on maximising the genetic flavour potential of cocoa beans from different origins. The work of Ed Seguine spans the entire value chain from tree selection (genetic screening) to optimised post-harvest processing and then secondary processing into chocolate with flavour evaluation of both liquor and chocolate using a licenced 50 attribute scale system<sup>63</sup>.

Ed Seguine has worked for over 30 years with various scale operations (from a little as 100 g to well over 1 ton) to create chocolates that bring a unique perspective and palette to the fine or flavour cocoa sector in the ability to create and document procedures and protocols for operations along the cocoa value chain and a capacity to taste and both quantitatively and qualitatively score cocoa liquor and chocolate at a high capacity. The well documented procedures and protocols available from the CoEx, HCP and Cocoa Research Centre all benefit from the capacity that Seguine Cacao Cocoa & Chocolate Advisors brings.

The current sensory evaluation protocol that Ed Seguine uses evolved in collaborations with the Cocoa Research Centre<sup>64</sup> over past collaborative projects and the 50 attribute scale used is presented fully in Annex 14 with validation by use in international projects with peer reviewed Journal publications arising from the datasets. As a summary, the glossary of terms, attribute intensity scores are the same for the CoEx Programme: Glossary of terms for flavour evaluations with matching descriptors and examples of some origins/reference notes for calibration<sup>65</sup>. The flavour wheel with these glossary of terms is presented in Figure 4 and are also presented the ECA/FCC/CAOBISCO document<sup>66</sup>. This publication will be formally launched at the World Cocoa Conference to be held in the Dominican Republic between 22 – 25<sup>th</sup> May, 2016.

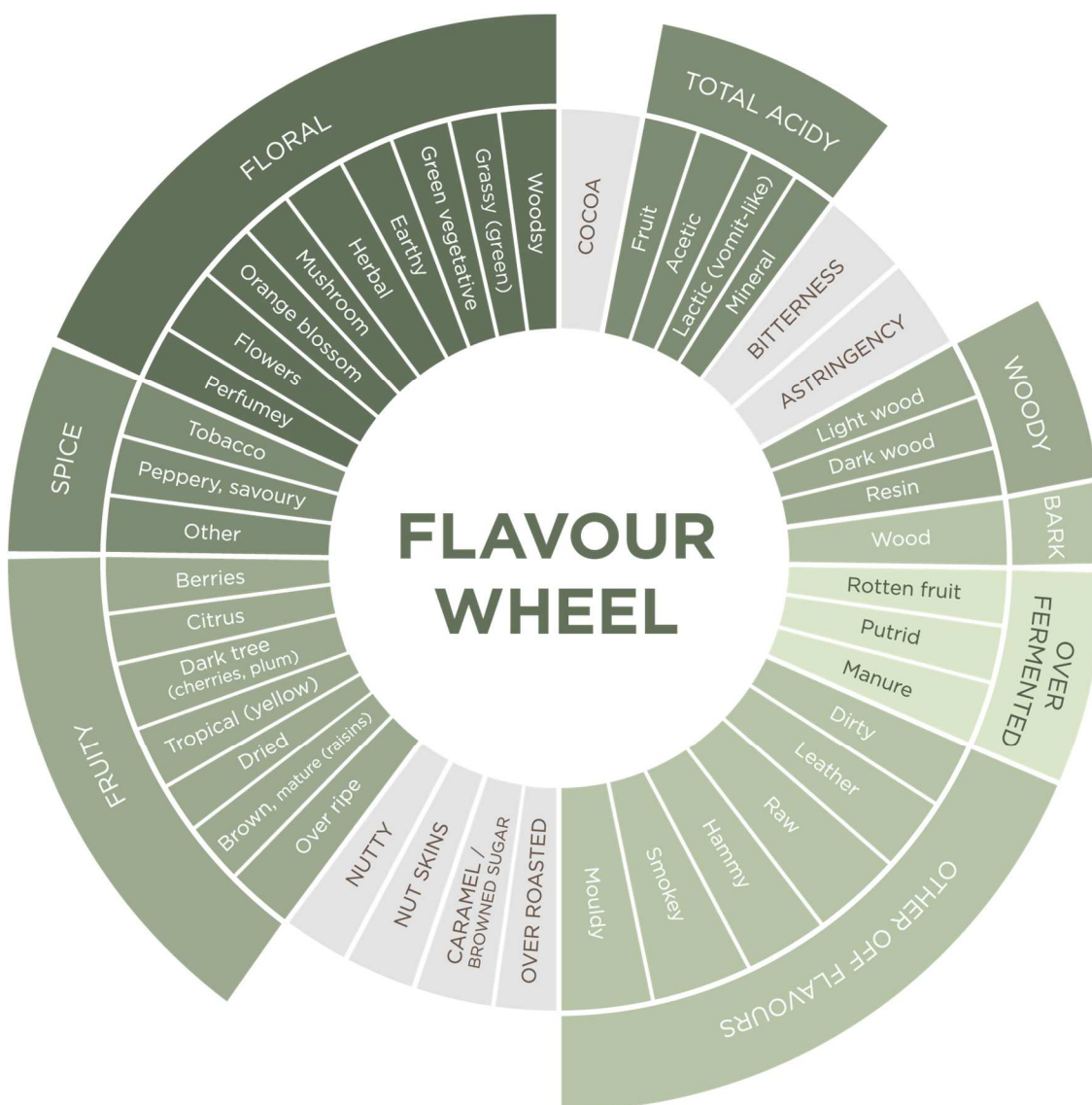
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<sup>63</sup> Master Cocoa Liquor and Chocolate Evaluation for Scientific Use - 50 Attribute Scale Creative Commons Copyrighted Excel spreadsheet: zz3 ESeguine-DASukha Master Sample Evaluation Liquor and Chocolate 20151001 Creative Commons Attribution-ShareAlike 4.0 International License Available through Seguine Cacao Cocoa & Chocolate Advisors, LLC

<sup>64</sup> ibidem

<sup>65</sup> Ed Seguine and Darin Sukha, CoEx Edition 2015

<sup>66</sup> ibidem



**Figure 4. Flavour wheel according to Sukha and Seguire (2015) with main categories and sub categories for both liquor and chocolate<sup>67</sup>**

### 3.1.2.9 Puratos Belcolade

The cocoa bean manual from Puratos Balcolade<sup>68</sup> was provided to inform this review. This manual is presented in Annex 15 and is a guideline in the different steps of evaluating of the quality and processing of small cocoa bean quantities at Puratos Belcolade according to their grading system. The goal of the Puratos Belcolade cocoa bean manual is to collect the right information about a particular

<sup>67</sup> CAOBISCO/ECA/FCC, (2015). "Cocoa Beans: Chocolate and Cocoa Industry Quality Requirements". (End, M.J. and Dand, R., Editors). Adapted from the Cocoa Research Centre, Sensory Training Guide, (2015). Cocoa Research Centre, UWI.

<sup>68</sup> Nele Van Herewegen, Cocoa Bean Manual Belcolade 25pp

bean sample, define and explain evaluation methods as well as set up a standardized system for grading or classifying cocoa beans. It also serves to compare production coming from different cocoa bean farms and also sets up methods to carry out flavour evaluation screening of chocolates and cocoa mass.

The following standard chocolate recipe is used for assessing the performance of cocoa beans from fermentation trials which is also in the CoEx programme: 45.9% cocoa mass, 43.7% sugar, 10% cocoa butter and 0.5% lecithin.

As a summary, the cocoa bean manual from Puratos Balcolade covers standardised steps for:

1. Sampling
2. Information on incoming beans
3. Moisture determination – moisture meter and traditional gravimetric method
4. Physical appearance
5. Bean Count
6. Bean cut test - including germinated cocoa beans
7. Classification of the results following the Puratos grading system – See Table 3
8. Additional tests on cocoa beans – including pH
9. Roasting
10. Pre-grinding with the cocoa bean breaker
11. Winnowing
12. Grinding
13. Lab trials on cocoa mass and cocoa butter – including free fatty acid, acidity via pH, amount of shells in cocoa mass, solid fat content, cadmium and microbiology (total plate count, *Enterobacteriaceae*, molds, salmonella and yeast). The latter two tests are done by an external accredited lab.

The evaluation form for cocoa mass is presented in Annex 16. With explanations on the use of the 0 – 5 scale where:

- 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

**Table 3. A summary of the results from physical tests are Classification following the Puratos Belcolade physical quality grading system<sup>69</sup>**

PURATOS GRADING		Type 1	Type 2	Type 3	Unacceptable
<b>MOISTURE</b>	Moisture	max 8% min 56%	max 8% min 5%	max 9% min 5%	max 9% min 5%
<b>PHYSICAL APPEARANCE</b>	Living insects	absent	absent	absent	present
	Smoky	absent	absent	absent	detected
	Moldy (exterior)	< 50%	< 50%	< 50%	> 50%
	Siblings/twins/double	max 2%	max 2,5%	max 2,5%	> 2,5%
	Flats	max 5%	max 6%	max 7%	> 7%
	Broken	max 5%	max 5%	max 5%	> 5%
	Shells	max. 4%	max. 4%	max. 4%	> 4%
	Impurities	max 1%	max 1%	max 1%	> 1%
	Foreign bodies	max 0,3%	max 0,3%	max 0,3%	> 0,3%
	Black beans	TBD	TBD	TBD	TBD
	<b>Waste</b>	max 1%	max 5%	max 6%	> 6%
<b>BEAN COUNT</b>	# beans/100 g	max 90	max 100	max 100	>100
<b>BEAN CUT TEST</b>	Germinated (before cutting the beans)	max 2%	max 5%	max 6%	> 6%
	Moldy	max 1%	max 4%	max 10%	> 11%
	Slaty	max 1%	max 5%	max 5%	> 5%
	damaged by insects	max 1%	max 5%	max 5%	> 5%
	Violet (partly or fully)	max 20%	max 40%	max 60%	> 60%
	over-fermented	max 2%	max 4%	max 6%	> 6%

### 3.1.2.10 General comments

The majority of systems presented in this section were extracted from the interviews conducted and documents provided. They show that, with a few exceptions, many systems/protocols are still be developed or evolving. The level of details provided depended on how far along the process the protocols were. It was interesting to note that apart from some tasting forms and general sample preparation guides (mainly from TCHO and FCCI), the Cocoa of Excellence, the Heirloom Cocoa Preservation Fund, the Cocoa Research Centre and Appendix B of the revised ECA/FCC/CAOBISCO Cocoa Beans: Chocolate and Cocoa Industry Quality Requirements and International Chocolate Awards were the only initiatives/entities with their protocols fully documented or presented in meticulous detail and readily available from specific websites, conference proceedings, publications or peer reviewed journal articles. The protocols used by the Cocoa Research Centre and Seguire Cacao Cocoa & Chocolate Advisors were the only ones found in this review that have generated quantitative datasets robust enough to undergo statistical analysis for peer reviewed journal articles utilising this data. The protocols used in the World Coffee Research Sensory Lexicon discussed in Section 3.2.1.2 have also been used to produce data used for peer reviewed journal articles.

<sup>69 69</sup> Nele Van Herewegen, Cocoa Bean Manual Belcolade. pp17.

## 3.2 Literature Reviews

Literature related to quality assessment in olive oil, wine and coffee were reviewed to identify what protocols were used in physical assessment (in some instances) and flavour quality assessment. Whilst many documents were reviewed, only the relevant aspects of these literature reviews will be presented in the context of how they relate to cocoa.

### 3.2.1 Review of Standards in Coffee

In conducting the interviews and reviewing the literature, the standards used for coffee were the ones that many people were trying to use to model their approaches, procedures and tasting forms for cocoa quality evaluation. Rick Peyser, Sr. Relationship Manager, Coffee & Cocoa for Lutheran World Relief, shared his experiences with coffee and the development of standards for both raw coffee and roasted product for the Speciality Coffee Association of America (SCAA), which is a trade association, through the Coffee Quality Institute (CQI) that was set up to do this task. The result was the “Q Coffee System” that was started by Ted Lingle<sup>70</sup> as well as a series of SCAA publications<sup>71</sup> which includes:

1. Arabica Green Coffee Defect Handbook
2. Water Quality Handbook
3. The Coffee Cupper's Handbook
4. The Coffee Brewing Handbook
5. The Basics of Cupping Coffee
6. The Basics of Brewing Coffee
7. The Coffee Biology Field Glossary

#### 3.2.1.1 The Q Programme

The fundamental principle behind the “*Q Programme*” is that in order to build a foundation and to continue to push the “Speciality Coffee”<sup>72</sup> movement forward, it was important to have everyone speak the same language. This was the fundamental aspect of quality set forth by the SCAA, and the Q program was created and administered by the CQI to achieve this goal. One of the other goals of the Q program was to unite buyers and sellers through a common quality based language. The rationale was to essentially link coffee producers and exporters who are looking to sell their coffee with buyers who are willing to pay a premium price for high-quality coffee.

As such, the Q Programme started as a two-phase cupping competition and auction program that attempted to replicate the success of the Cup of Excellence (COE), but on a larger scale. The initial competition and auction took place in Guatemala, and respected cuppers were invited to participate as judges, the main differences between the Q and the COE was the actual size of green coffee lots. The Q auction samples represented lots of more than 200 bags of green coffee, whereas the COE samples much smaller lots of coffee. It is important to note that auctions don’t work for the ordinary commerce

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<sup>70</sup> <http://www.coffeeinstitute.org/about-us/staff-board/ted-lingle-bio/>

<sup>71</sup> <https://www.coffeebooks.com/scaa.php>

<sup>72</sup> The term “Specialty Coffee” was coined by Erna Knutsen during a 1974 interview in the Tea & Coffee Trade Journal. She is considered to be one of coffee’s living legends and used it to describe unique coffees from Ethiopia, Yemen and Indonesia that have been produced in unique and special micro-climates.

of coffee, as roaster/buyers are more interested in contracting prices for future deliveries than waiting for the results for an auction to determine prices for current deliveries.

The Q Certification system was developed to add structure in support of the Q Programme (for both green coffee beans – Arabica, Robusta and Blends and cupping) and Q Graders were the trained and licensed individuals who assessed for and assigned the quality attributes defined in the Q certification system to different lots of coffee. The Q Grading Course was the natural corollary of this structure and In-Country Partners (ICP) are critical elements to facilitate Q Grading around the world.

As a summary, according to the CQI<sup>73</sup> the Q Coffee System identifies quality coffees and brings them to market through a credible and verifiable system with a common standard for both Q Arabica, (Specialty Grade) and Q Robusta (Fine Robusta Grade) coffee. This has resulted in a universally shared language and standard top scoring for different lots of coffee to engage the industry at the producer level to identify lots for specialty, at the export/import level by certifying individuals to grade coffees, and at the buyer level to offer a consumer-facing product with the Q mark. This system's infrastructure has resulted in greater opportunity for producers to access the premium price in the market and improve their economic viability. Other benefits include:

1. The systematic approach to quality clearly linked to marketing opportunities
2. Logical level of structure and organisation to address the needs identified
3. Meticulous documentation of standards and sample preparation protocols
4. Standardisation of training methods
5. Calibration with defined protocols
6. A common language with
  - a. A Lexicon and glossary definitions
  - b. References
  - c. Flavour wheels
7. Certification and niche marketing
8. Recognition and "Buy In" from all players in the sector

More details on the Q certification system and Q grading system are found on the CQI<sup>74</sup> and SCAA websites<sup>75</sup>. Whilst the benefits of the Q programme are still being realised as the Specialty Coffee sector grows, its immediate benefit has been the influential role it has played in creating and sharing knowledge, language and building skill sets that leads to more sophisticated and empowered professionals in the sector who understand the value of their own product.

#### **3.2.1.1.1 The Q Standards**

According to the SCAA, coffee which scores 80 points or above on a 100-point scale is graded "*Specialty*". Specialty coffees are grown in special and ideal climates, and are distinctive because of their full cup taste and little to no defects. The unique flavours and tastes are a result of the special characteristics and composition of the soils in which they are produced. The specialty segment is the most rapidly growing portion of the coffee industry. In the U.S., specialty coffee has increased its market

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<sup>73</sup> <http://www.coffeeinstitute.org/our-work/q-coffee-system/>

<sup>74</sup> *ibidem*

<sup>75</sup> <http://scaa.org/?page=resources&d=coffee-standards>

share from 1% to 20% in the last 25 years<sup>76</sup>. With a clear definition of Speciality Coffee, the standards defined in the Q Programme are discussed under the following headings<sup>77</sup>:

1. Green Coffee Standards
  - a. Allowable Defects for Specialty Grade Coffee
  - b. Green Grading Sample Size
  - c. Lighting for Green Grading
  - d. Surface for Grading
2. Cupping Standards
  - a. Coffee to Water Ratio
  - b. Cupping Vessel
  - c. Cupping Water Temperature
  - d. Cupping Water
  - e. Grind for Cupping
  - f. Roast for Cupping
  - g. Roast Level for Cupping
  - h. Cupping Room Size
  - i. Cupping Spoons
  - j. Cupping Tables
3. Roasting Standards are proposed for different coffee types
4. Water Standards
5. Brewing Standards

The SCAA in collaboration with Flavor Dynamics Inc. have produced a taste training kit with 15 flavour essences<sup>78</sup> formulated to illustrate the nuances and taints found in coffee. These highly concentrated food grade flavourings that are intended to be used in training aimed at guiding the recognition and association of various aroma and taste characteristics in coffee. The flavourings are added via a predetermined number of drops into 4 ounces of mild coffee brewed to a strength of 800 ppm and 18% extraction (40 grams of relatively coarse ground coffee to 1 litre of water). The kit consists of a booklets and three standard taste concentrates:

1. Salt
2. Sweet
3. Sour

This is followed by 12 standard flavour concentrates:

1. Peanuttty
2. Caramelly
3. Earthy
4. Herby
5. Fruity
6. Spicy
7. Winey

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<sup>76</sup> [https://en.wikipedia.org/wiki/Specialty\\_coffee](https://en.wikipedia.org/wiki/Specialty_coffee)

<sup>77</sup> <http://scaa.org/?page=resources&d=coffee-standards>

<sup>78</sup> SCAA/Flavor Dynamics Taste Training Kit, SCAA, 1995.



8. Chocolatey
9. Floral
10. Grassy
11. Nutty
12. Turpeny

The kit is intended to be used in conjunction with the SCAA Flavour Wheel. This was originally published in 1995 and has been the industry standard for 21 years (See Figure 5), it was recently updated in February 2016. Although there is strong overlap with SCAA's original flavour wheel, there are important differences and to design the new flavour wheel, the SCAA partnered with the Food Science and Technology Department at University of California, Davis, to understand how coffee tasters associate the flavour attributes presented with each other. The new Coffee Taster's Flavour Wheel is licensed for use under the Creative Commons Attribution-Non Commercial-No Derivatives 4.0 International (CC BY-NC-ND 4.0).



Figure 5. The SCAA flavour wheel with main categories and sub categories<sup>79</sup>

<sup>79</sup> [http://www.scaa.org/chronicle/wp-content/uploads/2016/01/SCAA\\_FlavourWheel.01.18.15.jpg](http://www.scaa.org/chronicle/wp-content/uploads/2016/01/SCAA_FlavourWheel.01.18.15.jpg)

### 3.2.1.1.2 The Q Grading Course

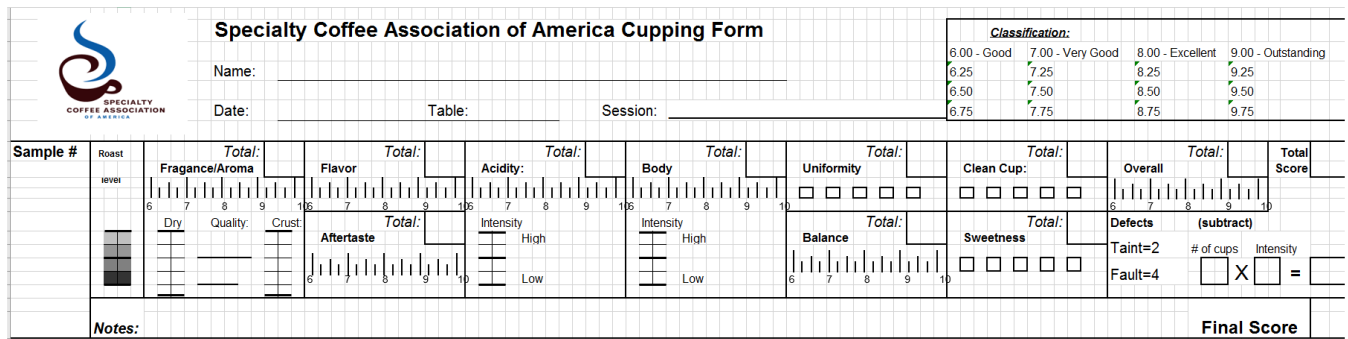
The CQI organises Q Courses for both Arabica and Robusta graders and instructors. The Q Grading course consists of a series of well-orchestrated sensory and written tests run over the course of five days. All tests are written and executed in the same way, all over the world. Participants must pass all of the 22 tests to receive their Q Grader certification and become Licensed Q Graders. There are more than 2,000 Q Graders around the world.

The Instructor must firstly be a licensed Q Grader to qualify for the position and undergo an extensive apprenticeship program with the CQI working with two mentors to complete a four-part apprenticeship that must be finished within two years and be approved by CQI. There are less than 40 certified Q instructors in the world.

### 3.2.1.1.3 Sample Evaluation with the SCAA Tasting Form

Sensory testing with the SCAA testing form (Figure 6) is performed for three reasons:

1. To determine the actual sensory differences between the samples
2. To describe the flavour of the samples
3. To determine the cupper's preference for the samples



The SCAA Specialty Coffee Association of America Cupping Form is a detailed sensory evaluation tool. It includes a classification table at the top right, a main scoring grid for 10 attributes, and a final scoring section at the bottom.

Classification:			
6.00 - Good	7.00 - Very Good	8.00 - Excellent	9.00 - Outstanding
6.25	7.25	8.25	9.25
6.50	7.50	8.50	9.50
6.75	7.75	8.75	9.75

**Sample #** \_\_\_\_\_

**Roast** \_\_\_\_\_

**Notes:** \_\_\_\_\_

**Final Score** \_\_\_\_\_

**Figure 6. The SCAA Tasting Form with important attributes, quality scale and final scoring categories**

The cupping form provides a systematic means of recording 10 important flavour attributes for either Arabica or Robusta coffee: Fragrance/Aroma, Flavour, Aftertaste, Salt/Acid Aspect Ratio, Bitter/Sweet Aspect Ratio, Mouthfeel, Balance, Uniform Cups, Clean Cups, and Overall. Defects, both Taints and Faults, may also be recorded on the form.

Using the Quality Scale for Specific Flavour Attributes, there will be positive scores of quality reflecting a judgment rating of the cupper. For defects there are negative scores denoting unpleasant flavour sensations. Finally, there is an overall "Final" score based on the flavour experience of the individual cupper as a personal appraisal. These are rated on a 16-point scale representing levels of quality in quarter point increments between numeric values from 6 to 10.

These levels in the Quality Scale are:

<i>Quality scale:</i>			
6.00 – Good	7.00 – Very Good	8.00 – Fine	9.00 – Outstanding
6.25	7.25	8.25	9.25
6.50	7.50	8.50	9.50
6.75	7.75	8.75	9.75

The scale theoretically ranges from a minimum value of 0 to a maximum value of 10 points. The lower end of the scale (0.25 to 5.75) is applicable to commercial coffees, which are cupped primarily for the assessment of defect types and intensities.

Individual Component Scores are recorded for some positive attributes where there are two marked scales. The vertical (up and down) scales are used to rank the *intensity* of the listed sensory component and are marked for the evaluator's record. The horizontal (left to right) scales are used to rate the panellists' *preference* of the particular component based upon their perception of the sample and experiential understanding of quality. The attribute score is recorded in the appropriate box on the cupping form. Aspects of the Fine Robusta Cupping Protocols and Standards and Details of the attributes used on the SCAA Tasting Form are described fully in Annex 17<sup>80</sup>. As a summary, some of the attributes are listed with a short description of each afterwards:

1. Fragrance/Aroma
2. Flavour
3. Aftertaste
4. Salt/Acid Aspect Ratio
5. Bitter/Sweet Aspect Ratio
6. Mouthfeel
7. Balance
8. Uniform Cups
9. Clean Cups
10. Overall
11. Final Scoring

**1. Fragrance/Aroma:** This included the aromatic aspects of coffee and 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). Specific aromas (positive and negative) noted in Fine Robusta coffees include:

- *Enzymatic notes:* 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:* Vanilla, Butter, Caramel, Cocoa and Walnuts; while those commonly found in off-grade Robusta coffees include Toasted Bread and Roasted Peanuts.
- *Dry Distillation notes:* Malt; while those commonly found in off-grade Robusta coffees include Pepper, Cedar, and Pipe Tobacco.
- *Aromatic Taints:* Coffee Pulp; while those commonly found in off-grade Robusta coffees include Earthy, Medicinal, Smoke, Rubber, and Straw.

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<sup>80</sup> <https://finerobusta.coffee/cupping-protocols/sample-evaluation/>

**2. Flavour/Nose:** This represents the principal character of the coffee being assessed. It is a combination of first impression aroma and taste to final and after tastes perceived from both the palette and retro-nasal aromas that go from the mouth to nose. Common flavour notes found in Fine Robusta coffees 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.

Off flavour notes often associated in off-grade Robusta coffees 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

**3. 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. A low score is assigned when an aftertaste is short or unpleasant

**4. Salt/Acid Aspect Ratio:** This ratio is responsible for the pleasing and delicate taste derived from distinguishable acidity and sweetness in Robusta coffees, stemming from the presence of fruit acids and sugars. The noticeable perception of acidity is one of the key taste differences between Fine Robusta and off-grade Robusta coffees.

**5. Bitter/Sweet Aspect Ratio:** Both bitter and sweet taste sensations are present in Robusta coffees. Fine Robusta coffees have a low bitter and high sweet aspect in their taste, Commercial Robusta coffees have a high bitter and low sweet aspect in their taste.

**6. Mouthfeel:** Mouthfeel is based upon the tactile feeling of the liquid in the mouth, especially as perceived between the tongue and roof of the mouth. Mouthfeel has two distinct aspects: weight and texture.

**7. 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." Balance scores are reduced if samples are lacking in one or more attributes or if some attributes are overpowering.

**8. Uniform Cups:** Uniform Cups refers to consistency of flavour of the different cups of the sample tasted. This is like a repetition of tasting the same sample in different cups.

**9. Clean Cups:** Clean Cups refers to a lack of interfering negative impressions and the total experience from first tasting to final aftertaste. Off flavour negatively influence this score.

**10. Overall:** 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. This is meant to reflect the holistic experience of the sample as

perceived by the individual cupper. A sample could have highly pleasant attributes, but not quite “measuring up” to the cupper’s expectation would receive a lower rating. A coffee that met expectations regarding its character and is also reflective of this particular origin flavour qualities would receive a high score.

**11. Final Scoring:** The Final Score is calculated by first summing the individual scores given for each of the primary attributes in the box marked “Total Score.” Defects are then subtracted from the “Total Score” to arrive at a “Final Score.” The SCAA Scoring Key shown in Table 4 describes the range of coffee quality for the Final Score, with scores above 80 equating to Fine Robusta coffees.

**Table 4. The SCAA scoring key to describe the range of coffee quality for the Final Score**

Total Score	Quality Description	Classification
90-100	Outstanding	Very Fine
80-90	Fine	Fine
70-80	Very Good	Premium
60-70	Average	Usual Good Quality
50-60	Fair	Usual Good Quality
40-50	Fair	Commercial
< 40		Exchange Grade
< 30		Below Grade
< 20		Off Grade
< 10		Triage

### 3.2.1.2 World Coffee Research Sensory Lexicon<sup>81, 82, 83</sup>

Having a universal language for the sensory qualities of coffee, and a tool for measuring them, is the necessary first step to understanding what causes coffee to taste, smell, and feel the way it does. Towards this end, The World Coffee Research (WCR) created the Sensory Lexicon that was launched in January 2016 to enable coffee scientists to conduct research that will make coffee better by having a reliable and repeatable way to measure the flavours and their relative magnitude.

In talking to Leo Lombardini, Roger Norton and Eric Brenner of the Borlaug Institute for International Agriculture at the Texas A&M University, the sensory Lexicon represented what they considered “*The largest collaborative research project on coffee’s flavours and aroma ever done*”. It was created at the Sensory Analysis Centre at Kansas State University and identifies 110 flavour, aroma, and texture attributes present in coffee, whilst providing references for measuring their intensity. Its’ purpose is to advance understanding of coffee quality and how it is created, so that coffee quality can be continually increased. The World Coffee Research Sensory Lexicon is presented in its entirety in Annex 18 and is freely available at for downloading<sup>84</sup> and printing of copies for personal use. After 20 years, The SCAA

<sup>81</sup> <http://worldcoffeeresearch.org/read-more/news/174-world-coffee-research-sensory-lexicon>

<sup>82</sup> Sanchez, K. and Chambers, E. (2015), How Does Product Preparation Affect Sensory Properties? An Example with Coffee. *Journal of Sensory Studies*, 30: 499–511. doi: 10.1111/joss.12184

<sup>83</sup> Di Donfrancesco, B., Gutierrez Guzman, N. and Chambers, E. (2014), Comparison of Results from Cupping and Descriptive Sensory Analysis of Colombian Brewed Coffee. *Journal of Sensory Studies*, 29: 301–311. doi: 10.1111/joss.12104

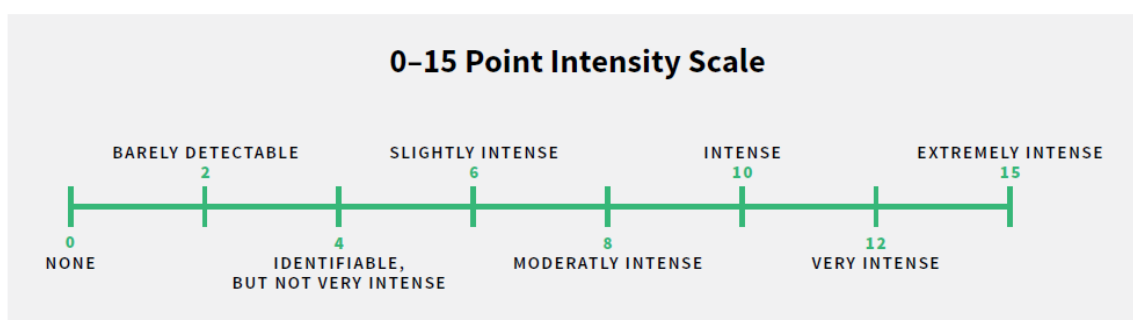
<sup>84</sup> [http://worldcoffeeresearch.org/images/pdfs/WCR\\_Sensory\\_Lexicon\\_Edition\\_1\\_2016.pdf](http://worldcoffeeresearch.org/images/pdfs/WCR_Sensory_Lexicon_Edition_1_2016.pdf)

also used the new information coming from the Sensory Lexicon to revise the Coffee Flavour Wheel (See Figure 5.)

### 3.2.1.3 What the World Coffee Research Sensory Lexicon *IS*

The World Coffee Research Sensory Lexicon<sup>85</sup> is descriptive and does not have categories for “good” and “bad” attributes, nor does it allow for ranking coffee quality. It is purely a descriptive tool, which allows one to say with a high degree of confidence that a coffee tastes or smells a particular way linked to a specific reference. It is also quantifiable in terms of giving a flavour or aroma reference with a stated attribute intensity on a 15-point scale. This allows comparison of differences amongst coffees with a higher degree of precision. The Sensory Lexicon is also considered to be replicable when used properly by trained sensory professionals the same coffee evaluated by two different people.

For each attribute there is a descriptive name given whether it is a taste, smell, or mouthfeel. Then there is a definition that clarifies and describes what the attribute name means. This is followed by references being provided for each attribute that serve as the standard against which that attribute is measured. There may be up to four references for a particular attribute. Each reference is given an intensity score on a scale of 1 to 15 (See Figure 7). This score is the critical factor that makes the Research Sensory Lexicon unique as it gives not only a description but also a measurement of the amount of a given flavour or aroma attribute in a coffee sample to give evaluators to ability to compare the strength of the attribute in the sample against the strength in the reference(s) and to assign the appropriate score to the sample. Finally, there are instructions for the preparation and serving of the references.



**Figure 7. The meaning of increments in the 0 - 15 Point Intensity Scale used in the World Coffee Research Sensory Lexicon<sup>86</sup>.**

<sup>85</sup> [http://worldcoffeeresearch.org/images/pdfs/WCR\\_Sensory\\_Lexicon\\_Edition\\_1\\_2016.pdf](http://worldcoffeeresearch.org/images/pdfs/WCR_Sensory_Lexicon_Edition_1_2016.pdf)

<sup>86</sup> *ibidem*

#### 3.2.1.4 What the World Coffee Research Sensory Lexicon *IS NOT*

As stated in the lexicon<sup>87</sup>, it is not a replacement for cupping or other sensory tools. Rather it is an additional evaluation tool available to coffee sellers and buyers. Cupping is a very specific and important evaluation process and is useful for coffee producers, buyers, and others in the coffee business for evaluating coffee defects and coffee quality.

It is not truly global since the references used in the lexicon are only widely available in the United States. It is also not finished but rather evolving as new vocabulary descriptors are identified linked to new coffee varieties discovered or developed, processing, roasting, and preparation methods change or expand. This first version was developed based on the review of 105 Arabica coffee samples which though comprehensive is not exhaustive

The Lexicon is also not a tool for evaluating defective coffees since this present edition was developed using only non-defective coffees.

#### 3.2.2 Review of Standards in Olive Oil

The International Olive Council (IOC) officially governs 95% of international olive oil production and holds great influence over the rest. It is an intergovernmental organisation of states that produce olives or products derived from olives, such as olive oil. The EU regulates the use of different protected designation of origin labels for olive oils. The United States is not a member of the IOC and is not subject to its authority. In 2010, the U.S. Department of Agriculture (USDA) adopted new voluntary olive oil grading standards that closely parallel those of the IOC, with some adjustments for the characteristics of olives grown in the United States<sup>88</sup>.

Based on guidelines laid down by the IOC and USDA there are specific categories of olive oils each with their different quality attributes (some linked to origin), value and price points. In countries that adhere to IOC standards, as well as in Australia, and under the voluntary USDA labelling standards, the following categories are recognised with distinct definitions and quality criteria:

**1. Extra-virgin olive oil:** Comes from virgin oil production only, and is of higher quality: among other things, it contains no more than 0.8% free acidity, and is judged to have a superior taste, having some fruitiness and no defined sensory defects. Extra-virgin olive oil accounts for less than 10% of oil in many producing countries; the percentage is far higher in the Mediterranean countries (Greece: 80%, Italy: 65%, Spain 50%).

**2. Virgin olive oil:** Comes from virgin oil production only, but is of slightly lower quality, with free acidity of up to 1.5%, and is judged to have a good taste, but may include some sensory defects.

**3. Refined olive oil:** is the olive oil obtained from virgin olive oils by refining methods that do not lead to alterations in the initial glyceridic structure. It has a free acidity, expressed as oleic acid, of not more than 0.3 grams per 100 grams (0.3%) and its other characteristics correspond to those fixed for this category in this standard. This is obtained by refining virgin olive oils with a high acidity level or organoleptic defects that are eliminated after refining. Note that no solvents have been used to extract

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<sup>87</sup> ibidem

<sup>88</sup> [https://en.wikipedia.org/wiki/Olive\\_oil#Regulation](https://en.wikipedia.org/wiki/Olive_oil#Regulation)

the oil, but it has been refined with the use of charcoal and other chemical and physical filters. Oils labelled as Pure olive oil or Olive oil are primarily refined olive oil, with a small addition of virgin-production to give taste

For the United States, the categories are:

- 1. U.S. Extra Virgin Olive Oil** for oil with excellent flavour and odour and free fatty acid content of not more than 0.8 g per 100 g (0.8%);
- 2. U.S. Virgin Olive Oil** for oil with reasonably good flavour and odour and free fatty acid content of not more than 2 g per 100 g (2%);
- 3. U.S. Virgin Olive Oil Not Fit For Human Consumption Without Further Processing** is a virgin (mechanically-extracted) olive oil of poor flavour and odour, equivalent to the IOC's lampante oil;
- 4. U.S. Olive Oil** is a mixture of virgin and refined oils;
- 5. U.S. Refined Olive Oil** is an oil made from refined oils with some restrictions on the processing.

From the above one can infer that one key parameter used to characterise an oil is its acidity. In this context, "*acidity*" is not chemical acidity in the sense of pH, but the percent (measured by weight) of free oleic acid. Measured by quantitative analysis<sup>89</sup>, acidity is a measure of the hydrolysis of the oil's triglycerides: as the oil degrades, more fatty acids are freed from the glycerides, increasing the level of free acidity and thereby increasing hydrolytic rancidity. Another measure of the oil's chemical degradation is the peroxide value, which measures the degree to which the oil is oxidized damaged by free radicals, leading to oxidative rancidity. Phenolic acids present in olive oil also add acidic sensory properties to aroma and flavour.

### 3.2.2.1 The International Olive Council – focus on sensory evaluation

The International Olive Council (IOC)<sup>90</sup> has developed a comprehensive range of protocols for physical assessment of olives, as well as, chemical and sensory assessment of olive oil in order to determine its' quality and commercial trade value. These protocols are freely available on their website<sup>91</sup>.

To classify its organoleptic qualities, olive oil is judged by a panel of trained tasters in a blind taste test recognizing the absence and/or presence of specific positive and negative (defective) attributes. Only three positive attributes — fruitiness (either green or ripe fruit), bitterness and pungency — are quantified on the profile sheet. The official IOC profile sheet includes five standard defects: fusty/muddy sediment, musty, winey vinegary, rancid and metallic. Space is left to note negative attributes other than the classic defects. While the IOC assessment offers an objective method to determine if an oil has defective flavours or not, this method does not allow for descriptions of flavours because descriptive language is subjective.

There is however a very formalised approach taken to flavour assessment starting with guidelines for taster and panel leader training in the sensory assessment of table olives and panel management

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<sup>89</sup> ibidem

<sup>90</sup> <http://www.internationaloliveoil.org/estaticos/view/224-testing-methods>

<sup>91</sup> ibidem



according to numbered IOC standards. See Annex 19 for these complete guidelines as well as an assemblage of terms and definitions associated with sensory analysis of olive oil.

In panel assessments, generally a group of 8 to 12 persons, selected and trained to identify and measure the intensity of the different positive and negative sensations perceived using identification of threshold concentration of a series of key quality attributes in 12 samples prepared by diluting a Virgin Olive Oil characterized by a very high intensity of a given attribute in an odourless and tasteless medium (refined oil or paraffin).

Sensory assessment is carried out according to codified rules, in a specific tasting room, using controlled conditions to minimize external influences, using a proper tasting glass and adopting both a specific vocabulary and a profile sheet that includes positive and negative sensory attributes. Collection of the results and statistical elaboration. Oils are identified with a random three-digit number or letter combination that is not familiar in any way, to prevent order bias. The colour of olive oil, which is not significantly related to its quality, may produce expectations and interferences in the flavour perception phase. In order to eliminate any prejudices that may affect the smelling and tasting phases, panelists use a dark-coloured (blue or amber-coloured) tasting glass. Tasters are isolated from one another with dividers. For the most accurate evaluation, olive oils are warmed to 80°F (26.5°C) on a warming mat. Because flavours based in oil coat the mouth, throat and nasal cavity, they tend to linger, which influences the reaction to subsequent samples and quickly fatigues the senses. A resting time of 5 minutes is required between oils, and green apples and water are used as palate cleansers to minimize sensory fatigue. Panelists usually taste from three to five oils in 30 minutes.

In Objective assessment, tasters measure specific attributes in oil samples. When a taster perceives an attribute, he/she marks the line according to the attribute's intensity beginning with zero at the left and continuing across the line to the right for higher intensities. Upon completion of the tasting, the marks are measured in centimetres to create the taster's score, which is then compared with other tasters to create an aggregate panel score.

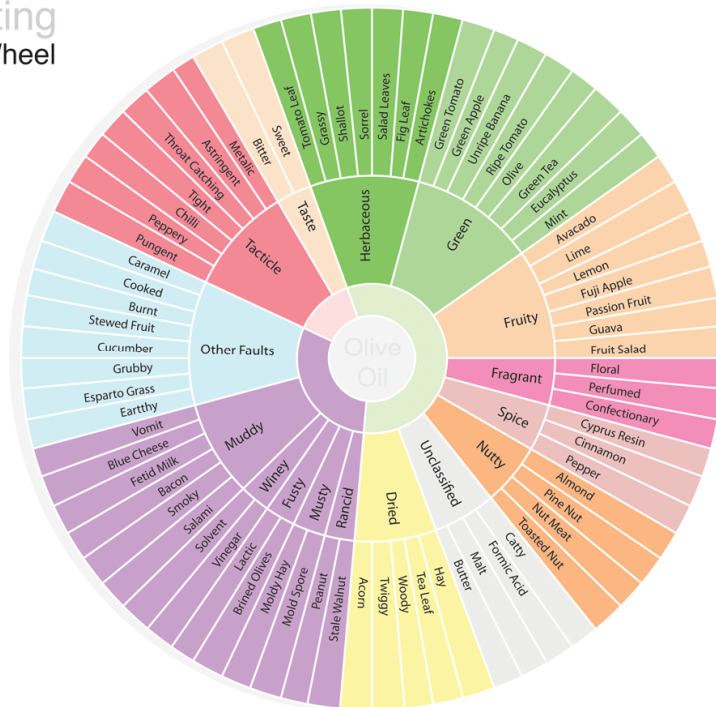
The Mario Solinas Competition is sponsored each year by the IOC. This scoring sheet is used for the subjective assessment of oil samples as tasters score qualities such as the harmony/balance and complexity of flavours, which are not scientific concepts. In this assessment method, a perfect score is 100 with up to 35 points awarded for the oil's aroma, 45 points for the oil's flavour (including retro-nasal aroma), and the final 20 points split between complexity and persistence (how long the flavour lingers in one's mouth). The official standardized scoring sheets used by IOC recognised panels are presented in Annex 20.

### **3.2.2.2 University of California Initiatives in Flavour Assessment**

The University of California Cooperative Extension Olive Oil Research Taste Panel and the University of California Davis Olive Oil Taste Panel, have both developed assessment methods that combines the objective scoring of attributes with the subjective designation of descriptions of the oil in one tasting sheet compared to two sets of assessments for the IOC. However, the UC Cooperative Extension Olive Oil Research Taste Panel uses a 15-point scale whilst the UC Davis Olive Oil Taste Panel uses a 10-point scale. These two sets of sensory evaluation forms with objective and subjective scoring attributes are presented in Annex 21.

## Olive Oil Tasting The Recognose Wheel

16 sensory classes  
and 72 different terms  
used to describe  
the complex range  
of aromas and tastes  
found in virgin olive oils



**Figure 8. The Recognose Olive Tasting Wheel with 72 different terms under 16 categories.**

### 3.2.3 Review of Standards in Wine

Wine has been produced for thousands of years. The earliest evidence of wine to date was found in the country of Georgia, where 8000-year old wine jars were uncovered. Traces of wine have also been found in Iran with 7,000-year-old wine jars. The earliest form of grape-based fermented drink however, was found in northern China, where archaeologists discovered 9000-year old pottery jars<sup>92</sup>.

Regulations govern the classification and sale of wine in many regions of the world. European wines tend to be classified by region (e.g. Bordeaux, Rioja and Chianti), while non-European wines are most often classified by grape (e.g. Pinot noir and Merlot). Market recognition of particular regions has recently been leading to their increased prominence on non-European wine labels<sup>93</sup>.

#### 3.2.3.1 The International Organisation of Vine and Wine

The International Organisation of Vine and Wine (OIV) is an intergovernmental organisation of a scientific and technical nature of recognised competence for its works concerning vines, wine, wine-based beverages, table grapes, raisins and other vine-based products. This non-governmental organisation was created in 1924 by six producer states in response to the global viticultural crisis, the

<sup>92</sup> <https://en.wikipedia.org/wiki/Wine>

<sup>93</sup> ibidem

OIV has developed and adapted to become, since 2001, the scientific and technical reference organisation for the entire vitivinicultural field. Its 46 Member States account for more than 85% of global wine production and nearly 80% of world consumption. There are also 10 non-governmental international organisations that participate as observers<sup>9495</sup>.

The OIV makes its publications, standards, congress proceedings and overview of collective expertise freely available. The OIV provides databases (of statistics, geographical indications, vine varieties and training programmes) as well as a press review. The OIV is a patron of scientific events in the field of vine and wine, and of international wine competitions.

With a strategic vision the OIV contributes:

1. To promote sustainable vitiviniculture
2. To establish rules of authenticity for vitivinicultural products and promote good regulatory practices
3. To understand developments in the market and the dynamics of the field
4. To contribute to the safety of consumers and take their expectations into account
5. To strengthen international cooperation and governance of the OIV<sup>96</sup>

#### **3.2.3.1.1 OIV Technical Guidelines**

The OIV provides technical guidelines on definitions of vitivinicultural products as well as their labelling, oenological practices and specifications of oenological products. Texts are also published concerning methods of analysis (chemical and microbiological), guaranteeing the authenticity of vine products, quality assurance in oenological laboratories, for the determination of the analytical composition of wines, musts and spirituous beverages of vitivinicultural origin and wine vinegars for inspection procedures. Finally, statistical analyses in relation to vineyard surface area, production (fresh grapes, dried grapes, wine), trade and consumption are available.

However, it was interesting to note that no specific information is provided on a standardised method of tasting and panel training for wine flavour evaluation was available from the website or published by the OIV<sup>97</sup>.

#### **3.2.3.2 Wine Tasting**

Wine tasting is the sensory examination and evaluation of wine. Wines contain many chemical compounds similar or identical to those in fruits, vegetables, and spices. The sweetness of wine is determined by the amount of residual sugar in the wine after fermentation, relative to the acidity present in the wine. Dry wine, for example, has only a small amount of residual sugar.

It is through the aromas of wine that wine is tasted. The human tongue is limited to the primary tastes perceived by taste receptors on the tongue-acidity, bitterness, saltiness, sweetness and savouriness. The

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<sup>94</sup> <http://www.oiv.int/>

<sup>95</sup> [https://en.wikipedia.org/wiki/International\\_Organisation\\_of\\_Vine\\_and\\_Wine](https://en.wikipedia.org/wiki/International_Organisation_of_Vine_and_Wine)

<sup>96</sup> <http://www.oiv.int/en/international-organisation-vine-and-wine/presentation-oiv>

<sup>97</sup> <http://www.oiv.int/en/technical-standards-and-documents/>

wide array of fruit, earthy, floral, herbal, mineral and woody flavour perceived in wine are derived from aroma notes. In wine tasting, wine is often smelled before being drunk in order to identify some components of the wine that may be present. Different terms are used to describe what is being smelled. Generally, a distinction made between “*aromas*” and “*bouquet*”. An aroma refers to the smells unique to the grape variety and are most readily demonstrated in a varietal wine. The term bouquet include the smells derived from fermentation and exposure to oak. The aromas of wines are sub-divided into three categories-primary, secondary and tertiary aromas. Primary aromas are those specific to the grape variety itself. Secondary aromas are those derived from fermentation and oak aging. Tertiary aromas are those that develop through bottled aging.

Detecting an aroma is only part of wine tasting. The next step is to describe or communicate what that aroma is and it is in this step that the subjective nature of wine tasting appears. This could probably account for the lack of standards in this area from the OIV. Different individuals have their own way of describing familiar scents and aromas based on their unique experiences as well as due to the varying levels of sensitivity and recognition thresholds among of some aromatic compounds. This is why one taster may describe different aromas and flavours from another taster sampling the very same wine.

The use of wine tasting descriptors allows the taster to qualitatively (not quantitatively) relate the aromas and flavours that the taster experiences and can be used in assessing the overall quality of wine<sup>98</sup>. The individual nature of tasting means that descriptors may be perceived differently among various tasters.<sup>99</sup> There are over 82 descriptors used in wine tasting and these are best captured in aroma wheels.

### 3.2.3.2.1 The Wine Aroma Wheel

The Wine Aroma Wheel<sup>100</sup> is a tool to learn about wines and enhance one’s ability to describe the complexity of flavour in red and white wines. The wheel has very general terms located in the centre (e.g. fruity or spicy), going to the most specific terms in the outer tier (such as strawberry or clove). These terms are *not* the only words that can be used to describe wines, but represent ones that are most often encountered. The purpose of the wine aroma wheel is to facilitate communication about wine flavour by providing a standard terminology.

According to Ann C. Noble creator of The Wine Aroma Wheel (See Figure 9), it was created to democratize the experience of drinking wine. To avoid creating unnecessary distance and mystique in wine aroma perception. Aroma is the starting point; it is the most definitive thing about wine. We lump taste and smell together in what is called “*taste-referred olfaction*” – smell and taste are layered and comingled<sup>101</sup>.

Words included on the wheel are terms that are specific and analytical and not hedonic or the result of an integrated or judgmental response. Aroma and taste guides are intended to be training wheels, not touchstones. They are meant to give support as we gradually move beyond simply knowing we prefer wine to helping us more deeply understand and articulate why.

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<sup>98</sup> [http:// The-Wine-Bible-Karen-MacNeil/dp/1563054345](http://The-Wine-Bible-Karen-MacNeil/dp/1563054345)

<sup>99</sup> [https://en.wikipedia.org/wiki/Wine\\_tasting\\_descriptors](https://en.wikipedia.org/wiki/Wine_tasting_descriptors)

<sup>100</sup> <http://winearomawheel.com/>

<sup>101</sup> Sethi, S. (2015). Bread, Wine, Chocolate - The Slow Loss of Foods We Love. HarperCollins, 350pp.

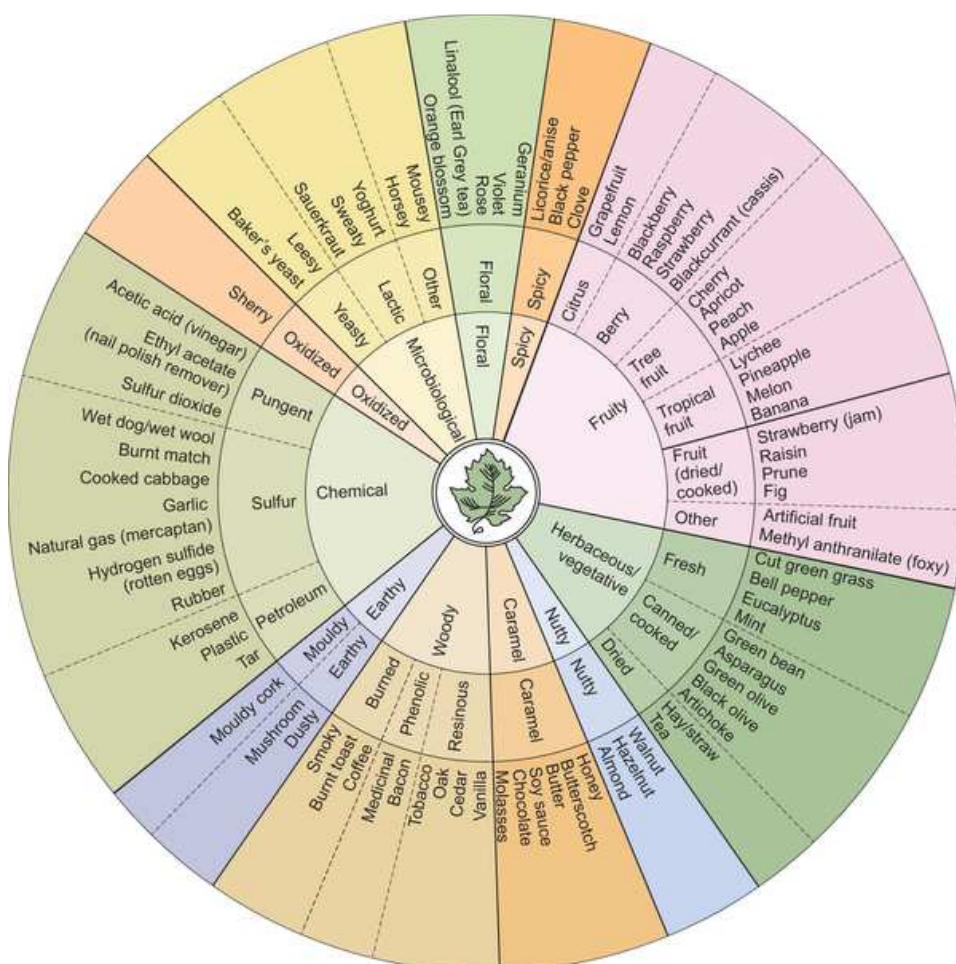


Figure 9. The Wine aroma Wheel<sup>102</sup>

### 3.2.3.2.2 The Italian Sommelier Association Wine Tasting Protocol

One of the key building blocks of the sommelier certification course offered by the Italian Sommelier Association (ISA) is their standardized wine tasting protocol. This is a protocol that has been devised over the years by the association with a view to making wine evaluations and reviews more uniform as much as possible through the use of a common procedure and a common vocabulary.

The ISA-protocol wine tasting is divided into three main phases, as follows:

1. Visual Analysis
2. Scent Analysis

<sup>102</sup> Copyright A C Noble, 2009. [ann@winearomawheel.com](mailto:ann@winearomawheel.com); [www.winearomawheel.com](http://www.winearomawheel.com)

### 3. Taste-Scent Analysis

Each phase is divided into multiple steps, each of which needs to be addressed by the taster using the ISA standardized vocabulary and the ISA wine tasting sheet<sup>103</sup>. There are 116 wine tasting terms in the ISA vocabulary and these are formalized in their Wine Glossary<sup>104</sup>.

**1. Visual Analysis:** Cues from visual analysis include:

- Clarity
- Color
- Viscosity
- Effervescence - Sparkling wines

**2. Scent Analysis:** These include:

- Intensity – aroma and bouquet
- Complexity
- Description of the aromas – using aroma wheels to assist
- Quality

**3. Taste-Scent Analysis:** This represents the full assessment where:

- Softness
- Hardness
- Structure
- Final assessment - in terms of balance, Intensity, Persistence or Finish, Quality, Aging and Harmony are described.

#### 4.0 The Evolutionary Pathway – Learning from Coffee, Olive Oil, Wine and What Exists in Cocoa

The common elements identified when all the literature reviews were carried out for coffee, olive oil and wine was that there is an international body responsible for that commodity that is recognised by more than 80% of the global market for that commodity. One of the main functions these international bodies performed, apart from marketing and other stakeholder interests, were to produce technical standards relative to product definitions and to provide detailed physical and chemical quality and monitoring protocols for the commodity. With the exception of wine which had no formal standards from its governing body, flavour and organoleptic assessment formed a key component of the quality monitoring protocols produced with tasting and aroma wheels and defined sensory descriptors with a lexicon (as is the case for coffee).

A compendium similar to what was listed from the SCAA and in the Sensory Lexicon does not exist for cocoa at the moment although we have the global bodies of ICCO and WCF governing the cocoa sector. It was interesting to infer from my conversation with Rick Peyser that cocoa is closely following the evolutionary path taken by coffee in terms of the development of standards and protocols as well as in

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<sup>103</sup> [http://www.aismilano.it/index.php?option=com\\_content&view=article&id=851:scheda-analitico-descrittiva-del-vino&catid=904:materiale-didattico&Itemid=222](http://www.aismilano.it/index.php?option=com_content&view=article&id=851:scheda-analitico-descrittiva-del-vino&catid=904:materiale-didattico&Itemid=222)

<sup>104</sup> <http://florastable.com/fst-wine-glossary/>

having an overarching international body to oversee this. The impression shared was that with the experiences and learnings from coffee, hopefully cocoa will be able to “leap frog” a few steps forward at a faster rate along this evolutionary path.

This was apparent whilst carrying out the interviews. The process towards greater industry organisation with standardisation of quality in coffee started when companies realised that farmers needed a target regarding how their practices contribute to final flavour. With coffee, the next step was setting up cupping labs at the cooperative level to allow farmers to assess the quality of their production. These labs then started working with buyers and with cuppers from the cooperatives tasting along with buyers to calibrate and align their palettes to select samples with particular flavour attributes whilst developing a glossary of descriptors with intensity scores. Training and the creation of references linked to a flavour wheel was next in the evolutionary process and borrowed heavily from wine for this.

The next step was simultaneous cupping via Skype to understand the flavours perceived to communicate and calibrate everyone with a shared glossary. There was a tiered system where sharing flavour profiles for improving quality was for the common good and linking this to common standards for buying coffee was understood. But the flavour profiles of speciality blends were not shared. Sharing at the first tier benefitted the entire chain, including the more lucrative speciality blends.

Cocoa, although very different from coffee in terms of the tasting matrix – a fatty matrix as opposed to a water based mixture - is playing the “catch up game” and from Section 3.1.1 where Common Needs, Challenges and Questions from the interviews were expressed, we have had the same realisation in cocoa about giving farmers a quality target to meet and are trying to find ways to communicate this across cultures and languages whilst at the same time have started working with origin to develop the capacity to prepare samples for learning.

This is more challenging with cocoa as the more involved processing system and fat based matrix affects viscosity, mouth feel, bitterness and astringency as well as the presentation of ancillary flavours. The development and presentation of the latter ancillary flavours also differs greatly with roasting level as with coffee. At the moment, approaches used differ between no roast (raw bean assessment), minimal roast (par roast) assessment, low roast to burnt beans.

We are also at the point where various entities along the value chain are working on finding the most appropriate way to calibrate and align master tasters and trainers whilst at the same time trying to figure out what attributes are desirable, for sometimes different purposes ranging from:

- Simple quality control
- Expanding market linkages
- Securing price premiums,
- Recognising quality
- Linking genetic to quality
- Awarding diversity and quality

These entities are also trying to find suitable “*origin friendly*” aroma and taste references as well as cocoa based references to facilitate flavour associations in training and calibration exercises much like the Coffee Lexicon. Thus we are evolving along a path that will eventually lead us towards auctioning system for cocoa much like what exists for premium and speciality coffee under the Q auction.

## ANNEXES