Cocoa Quality and Flavour Evaluation - a review and steps towards a harmonized international standard

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Fine and Flavour Cocoa Forum
at
Third Edition of the World Cocoa Conference (WCC3),
Barceló Bávaro Convention Centre, Bávaro, The Dominican Republic
General Background

• A number of international initiatives recognising cocoa quality 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.

• They 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.

• A number of bean-to-bar and other companies working with farmers and cooperatives at origin on cocoa quality initiatives.
Our stakeholders perceptions

• We were all taking different roads to reach a similar destination – “QUALITY” - with no real coordination between ourselves.

• Different versions of “cocoa and chocolate quality” definitions used based on the purpose of these initiatives.

• Also, different approaches to arrive at and assess for “cocoa and chocolate quality” at origin and with different bean to bar producers working at origin.

• Stakeholders – farmers’, cooperatives producer and marketing groups were getting confused by all this good intention suddenly focused on quality.

• We needed to step back and look at where we are and take informed steps to move forward.
We needed to step back and...

- Carry out an inventory of all the standards and protocols that exists beyond those developed for the CoEx Programme

- Determine what different groups and/or individuals were doing in this area and in related commodities (such as coffee, wine and olive oil)

- Develop elements a first proposal for international standards and protocols on cocoa quality and flavour assessment for further discussion towards a harmonised approach.
Common Needs, Challenges and Questions arising from the interviews

1. Creating and communicating what is cocoa quality to farmers and producers’ groups. Identifying the quality targets in an easily understandable way that transcends culture and language.

2. Understanding who is a grading system for: Farmers? Farmers Cooperatives? Others? Tailoring the system to suit these unique individuals.

3. Need for trust and buy into the grading or quality assessment programme by stakeholders as something that is beneficial to them and their community.

4. Current methods for evaluating cocoa internally requires specialized and relatively expensive equipment that cannot be brought into the field.

5. What is the easiest way to get this done in a cost effective manner with appropriate technology?

6. 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.

7. There is a need for more standardization around identifying a relevant vocabulary(descriptor set and calibration as well as formalization behind it.

8. Separating flavours (like astringency, acidity and bitterness) derived from fermentation issues against ancillary flavours (like fruity, floral and nutty) and effectively linking these to physical cues from smell and cut test with strong association and calibration.

9. 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.
Common Needs, Challenges and Questions

10. Creating a suitable tasting form is just one part of the quality assessment approach. Complimentary training and ongoing calibration programme is another piece.

11. 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?

12. 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.

13. Reference samples? Reliable reference calibration samples (liquor and chocolate) are lacking and produced on an Ad hoc or opportunistic basis.

14. 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 more challenging.

15. Most farmers have never tasted chocolate made from their own beans. That is vital in the quality transformation process but getting farmers to taste liquor or their beans (and to taste more often) is harder.

16. 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.

17. 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.

18. There needs to be a thorough methodology with a strict protocol from fermentation, drying, roasting, liquor making etc.

19. 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.
Summary findings from Literature Review – Coffee, Olive Oil, Wine

- International coordinating body identified – at least by region (US and lead country in Europe – Italy, France etc.)
- Acceptance of this body by the stakeholders
- Coordinating body has put forward well defined and formalized protocols covering:
  - Raw product quality
    - Definition
    - Positive and Negative Attributes
  - Intermediate and/or final product quality
    - Definition
    - Positive and Negative attributes
    - Conditions for Assessing these Attributes
    - Assessment forms
  - Chemical and physical assessment are defined in complete protocols that are updated as technology evolves
  - Sensory/organoleptic assessment is very well defined and standardized (except for wine)
    - Well Defined Descriptor set and Glossary of terms – Lexicons in some instances
    - Tasting Forms – paper and/or digital
    - Calibration References – taste and aromas
    - Data Analysis
  - Training is well documented, standardized and certified with different levels of expertise attainable
A technical and pragmatic approach to cocoa bean quality and flavour assessment
Elements of a standard for cocoa quality and flavour assessment protocol

• Raw Cocoa Bean Quality Criteria
  - Standardized sampling procedure
  - Cleanliness
    - Odour
    - Foreign matter, contaminants and adulteration
    - Insects and other infestation
    - Broken beans, fragments, bean clusters, other residue
  - Moisture Content
    - Dried to a moisture content 6.5 - 7.5%
  - Other Physical Bean Attributes
    - Bean count
    - Individual bean weight
    - Ranges and categories for different bean sizes
    - Yield of shell
  - Degree of fermentation and presence of defects
    - Clear criteria for bean defects in order of importance
    - Assessed via standardized cut test methods with standardized charts
    - Cut test charts relevant to different varieties
    - Internal ridging with standardized charts
    - Clearly defined categories for degrees of fermentation and grading based on the cut test


ISO Standards
Elements of a standard for cocoa quality and flavour assessment protocol

• Post Harvest Processing Guidelines
  o Pre-harvest
    ▪ Environmental aspects
    ▪ Cultivation Methods
      ‧ Varieties
      ‧ Pest and Disease
      ‧ Cadmium
  o Harvesting
    ▪ Maturity
    ▪ Storage
    ▪ Opening
  o Post-harvest
    ▪ Fermentation
      ‧ Method and Quantity
      ‧ Turning Regime and Duration
    ▪ Drying
      ‧ Method and Quantity
      ‧ Turning Regime and Duration
    ▪ Storage
      ‧ Mould growth and infestation
      ‧ Fat degradation
  o Quality control before sale
  o Transportation and Shipping


ICCO Guidelines on Best Practices in Cocoa Production
Elements of a standard for cocoa quality flavour assessment protocol

• Quality Control
  o Raw Cocoa Bean Quality Criteria — see before
  o Flavour Assessment
    ▪ Raw bean assessment
      ‐ Coarse Powder (with or without a sweetener)
    ▪ Roasted bean assessment
      ‐ Roasting (Method, Equipment, Temperature × Time)
      ‐ Breaking
      ‐ Winnowing
      ‐ Coarse Powder (with or without a sweetener)
      ‐ Coarse Liquor
      ‐ Smooth Liquor
    ▪ Chocolate assessment
      ‐ Chocolate formulation (Cocoa mass, Sugar, Butter, Lecithin)
      ‐ Un-tempered Chocolate
      ‐ Tempered Chocolate
    ▪ Flavour testing considerations
      ‐ Testing area
      ‐ Layout
      ‐ Panellist training (Association, Vocab generation, Calibration and Intensity)
      ‐ Tasting design, sample randomization and presentation
      ‐ The evaluation process (Tasting forms, tasting process, data collected)
      ‐ Flavour descriptors/glossary of terms
      ‐ Interpretation and display of results (Stats fit for purpose)

Some specific elements of Panellist Training (1)

2 week training to start a process

- **General Screening**
  - Attitude towards tasting
  - Time and Availability
  - Health and Allergies
  - Smoking and Tobacco usage

- **Basic Tastes Screening (Solutions)**
  - Identification
  - Threshold

- **Basic Tastes (Core Attributes)**
  - Coarse Powders
  - Liquor
  - Chocolate

- **Basic Tastes (Vocab generation from reference samples)**
  - Cocoa
  - Acid (Citric, Acetic)
  - Astringency
  - Bitterness

- **Ranking and Scoring of Core Attributes**
Some specific elements of Panellist Training (2)

• Ancillary Flavours (Vocab generation from reference samples)
  - Fruity
  - Floral
  - Fruity and Floral
  - Caramel/Malt
  - Nutty
  - Green Vegetative

• Odour Recognition (+ve) (Le Nez du Vin) – vocab generation
  - Floral
  - Woody/Resin notes
  - Fruity
  - Vegetative

• Odour Recognition (-ve) (Le Nez du Vin) – vocab generation
  - Animal
  - Musty
  - Earthy
  - Rubber

• Off flavours (Vocab generation from reference samples)
  - Over fermented
    - Over ripe fruit
    - Lactic Acid
    - Ammonia
    - Dirty
    - Putrid
  - Smokey (wood)
  - Mouldy
  - Unfermented
  - Animal/Farm Yard
  - Oily (tar)
Some specific elements of Panellist Training (3)

- **Flavour Profiling using**
  - Reference liquors
  - Mixtures of reference liquors
  - Known “real samples” in increasing order of flavour complexity

- **Scaling elements to consider**
  - 10 point scale for certain core attributes
  - 5 point scale for other ancillary attributes
  - 5 point scale throughout with a multiplier

- **Global Quality**
  - Calculated
  - Preference scored (interest and balance)

- **Platforms**
  - MS Excel
  - Virtual (like Cropster and others)
  - Paper based
Scaling: 0 – 10 or 0 – 5 or both?

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<tr>
<th>Attribute Intensity</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>0</td>
<td>None present</td>
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<td>1</td>
<td>Just a trace and may not be found if tasted again</td>
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<td>2</td>
<td>Present in the sample</td>
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<td>3 to 5</td>
<td>Clearly characterizing the sample</td>
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<td>6 to 8</td>
<td>Dominant</td>
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<tr>
<td>9 to 10</td>
<td>Maximum that you have experienced in a cocoa sample</td>
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<td>Extremely dominant</td>
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# Sensory Assessment of Cocoa Liquors

**Name:** 

**Date:** 

**Session:** 

**Sample Code:** 

Taste sample and mark off the point on the line that corresponds to the intensity of each attribute.

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<thead>
<tr>
<th>Attribute</th>
<th>Absent</th>
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<tr>
<td>Cocoa flavour</td>
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<td>Floral flavour</td>
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<td>Nutty flavour</td>
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<td>Raw/beany/green</td>
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<tr>
<td>Global Quality</td>
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**Comments:** 

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Cocoa of Excellence Programme – sensory evaluation form

### LIQUOR EVALUATION DESCRIPTORS - Please indicate a mark of 0-10

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Cocoa</th>
<th>Acidity</th>
<th>Bitterness</th>
<th>Astringency</th>
<th>Sweet</th>
<th>Fresh Fruit</th>
<th>Browned Fruit</th>
<th>Nutty</th>
<th>Floral</th>
<th>Woody</th>
<th>Spicy</th>
<th>Browned / Roast</th>
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<thead>
<tr>
<th>Mouldy</th>
<th>Smoky / Hammy</th>
<th>Putrid / Over Fermented</th>
<th>Dirty</th>
<th>Other Off</th>
<th>LIQUOR comment</th>
<th>Global Quality SINGLE SCORE Liq and Choc 0-10</th>
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<td>9 to 10</td>
<td>Maximum that you have experienced</td>
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</tbody>
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Cocoa of Excellence Programme (CoEx): Glossary of terms for flavour evaluations with matching descriptors and examples of some origins/reference notes for calibration.

Reference: Ed Seguine and Darin Sukha, CoEx Edition 2015

<table>
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<tr>
<th>Descriptor</th>
<th>Description</th>
<th>Examples of Origins/References (for calibration)</th>
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<tbody>
<tr>
<td>Cocoa</td>
<td>• Describes the typical flavour of cocoa beans that are well fermented, roasted and free of defects - Chocolate bars, fermented/roasted cocoa</td>
<td>• Low intensity = 1-2 (Unfermented cocoa) • Medium intensity = 4-6 (Fully Fermented Indonesia, PNG, and Arriba) • Strong intensity = 8 (West Africa)</td>
</tr>
<tr>
<td>Acidity</td>
<td>• Citric Acid - Fruit • Acetic Acid - Vinegar (you can smell it in the sample) • Lactic Acid - Vomit like, like in sour milk or molasses • Mineral Acid - Metallic tasting</td>
<td>• Low intensity = 0-2 (West Africa) • Medium = 3 (Arriba) • Strong = 4-8 (PNG and Malaysia)</td>
</tr>
<tr>
<td>Bitterness</td>
<td>• Usually due to a lack of fermentation; perceived on the rear of the tongue/throat - Caffeine (Coffee), Beer, Grapefruit</td>
<td>• Low intensity=1-2 (ancient Criollo) • Low/Moderate (normal) intensity =3-4 (West Africa) • Strong intensity = 7-8 (Unfermented cocoa)</td>
</tr>
<tr>
<td>Astringency</td>
<td>• Usually due to a lack of fermentation; mouth drying and/or puckering effect which boosts the production of saliva; perceived between tongue and palate or at the back of the front teeth - Raw nut skins, Banana skins, some wines</td>
<td>• Low intensity=2-3 (ancient Criollo) • Moderate (normal) intensity = 3-4 (some West Africa) • Medium intensity = 5-6 (Arriba) • Strong intensity = 7-8 (Unfermented cocoa)</td>
</tr>
<tr>
<td>Sweet</td>
<td>• Describes liquors with a characteristic flavour of unrefined caramelised cane juice (Panela) - Caramel, brown sugar, fudge</td>
<td>• Low intensity = 0 (West Africa - Ghana) • Strong intensity = 5-8, ancient Criollo (Venezuela)</td>
</tr>
<tr>
<td>Fresh fruit</td>
<td>Broad range of fresh fruits • Fruit berry - currants, not fully ripe raspberry • Fruit citrus - essence of citrus • Fruit tropical - banana, passion fruit, orange, almost always some citrus note involved</td>
<td>• Low intensity = 1-2 (West Africa) • Medium intensity = 3-5 (Fully Fermented Indonesia) • Strong intensity = 6-7, (PNG, some Trinidad (TSH))</td>
</tr>
<tr>
<td>Browned fruit</td>
<td>• Fruit dark tree - plum, dark cherry • Fruit dried - dried apricot, banana etc., caramelisation of fruit sugar, essence of a fruit that has undergone the drying process, sulphur and nutty notes also • Fruit over ripe - beginning of over fermentation, over ripe fruit as a step to over fermentation • Fruit brown - prunes or dates</td>
<td>• Low intensity = 2, (West Africa) • Medium intensity = 3-5 (Fully Fermented Indonesia) • Strong intensity = 6-7, (PNG, Some Caribbean origins)</td>
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<tr>
<td>Nutty</td>
<td>• Nutty - nut meat • Nut skins - associated with some astringent sensation like skins of almond and peanuts etc.</td>
<td>• Frequently just as a note = 2-3 but can be pronounced 5-8 (ancient Criollo types) • Too low roast or under fermentation of most origins</td>
</tr>
<tr>
<td>Descriptor</td>
<td>Description</td>
<td>Examples of Origins/References (for calibration)</td>
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<tr>
<td>Floral</td>
<td>Broad range from green grassy vegetative to flowers and perfumed types notes • Floral - coming from natural environment you can get this by taking a walk in your garden, green earthy, herbal and woody • Floral grassy - green on fresh cut grass, very fresh grass, young leaf (green floral) • Floral green vegetative (dark green) - green vegetative, old cocoa leaf crushed, dark green note. Green beans, cooked bell peppers (dark green vegetables) • Floral woody (generic) - was grown now dried essential oil, structural bases, going for walk in forest before winter, the dried flowers • Floral mushroom - mushroom, meaty, savory, MSG • Floral earthy - forest after the rain, smell of dampness coming up from the cocoa estate soil • Floral Herbal - Aged dried spices. Commonality of all the dried herbs and linked with astringency at times • Floral perfumy - a persistence that lingers like when fixatives (e.g. Vanilla) added to perfume to kick the smell into a persistent mode • Floral flowers - breathe it in and it’s gone. Difference between most roses and a Lincoln rose • Floral orange blossom - is essentially floral-flowers but with orange blossom flavor specifically</td>
<td>• Absent - Low intensity = 0-2, (West Africa) • Medium - Strong intensity =3-7, (Arriba, Scavina, some Trinidad (TSH)) • Floral Orange Blossom - Peru, Ecuador • Ecuador origin beans tend to be floral, herbal, floral orange blossom, earthy • Floral mushroom and earthy are positive attributes (not earthy associated with off flavors musty, moldy, etc.)</td>
</tr>
<tr>
<td>Woody</td>
<td>• Woody light wood - ash, beach, maple, white pine, cut cocoa tree • Woody dark wood - oak, walnut, teak • Woody resin - pitch pine, balsam of dark or light tree resins</td>
<td>• Woody light wood and Woody resin are often (but not always) associated with under fermented and acidic beans • Woody dark wood is often (but not always) associated with well fermented beans</td>
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<tr>
<td>Spicy</td>
<td>• Spice tobacco - Tobacco spice is the smell outside a tobacco shop, not ash and dirty but rather like pipe tobacco, sweet • Spice peppery - spicy, peppery, savory</td>
<td>• As a note = 1, or clearly present in the sample = 2-3 • Spice tobacco from West Africa, particularly Ivorian beans • Spice peppery - mainly Columbian and Peruvian origins</td>
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<tr>
<td>Descriptor</td>
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<td>Examples of Origins/References (for calibration)</td>
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| Global quality | • Goes beyond simple attributes but is intended to reflect an overall attribute standing. It is NOT a score derived from any formula or calculation from the attributes but stands on its own for each evaluator to indicate  
  • It gives an impression of overall quality | • No off flavour must be present in giving a high scoring (>5) for Global quality  
• We expect the beans to be good and not have those defects. If they do, the overall quality would be not very good =1-4  
• Zero for global quality means a serious flaw is present. This is not a “veto” but is a very clear opinion of the quality—or in this case lack thereof |
| Off flavours  | • Hammy - carved meats, ham, and improper fermentation  
• Smoky - happens when burning vegetative matter (wood, grass, cocoa hulls, etc.). Other off flavours - cocoa contaminated with diesel fumes  
• Leather - not freshly tanned in a leather store, but rather more like leather with sweat and urine, like horse saddles  
• Over fermented manure - farm yard, manure  
• Over fermented putrid - Feces  
• Dirty – unpleasant dirty character, like dirty utensils, often associated with quality of astringency, increased astringency = increased dirty flavor etc. Function of dusty  
• Bark wood - not good, typically unpleasant, dry, dusty, smelly, not a clean smell. Under fermented, astringency, raw, leather, dirty tend to be associated with bark wood as well |
Broader Attribute set (45 descriptors): ESS and DAS

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Excel spreadsheet:
zz3 ESSeguine-DASukha Master
Sample Evaluation Liquor and Chocolate 20151001
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Max 100 points

Taster's Notes

+ ___________________________

- ___________________________
Some specific considerations for flavour profiling

- Panel of at least six trained persons

- Factorial statistical design that incorporates hidden reference liquors

- Calibration control samples to taste at the start of each flavour profiling session:
  - Ghana
  - Madagascar

- Samples coded with at least 3-digit random numbers (avoiding 001 – 9)

- At least three replications of tasting of the same samples to deal with:
  - Positional Bias
  - Carry over effects

- Timing and number of sessions daily
  - A.M. vs P.M.

- Profiling vs Difference testing

- Global Quality Scores

- Data analysis
  - Testing panelist consistency
  - Treating with inconsistent data
  - Sample quality flavour assessment
  - Fit for Purpose data analysis and presentation
Rapid sample quality screening sheet for producers
# Fine Cacao and Chocolate Institute Cacao Grader Evaluation

**External evaluation, whole beans**

**External attributes**
- Basic attributes (100g beans)
  - Bean count
  - Moisture content %
  - Size (qualitative)
  - Detritus % by weight
- External defects (100 beans, count)
  - Black
  - Severely moldy
  - Germinated
  - Insect damaged
  - Clumped
  - Cut

**Raw bean aroma**
- Positive/Neutral
  - Vinegar
  - Cocoa
  - Nutty
  - Fruity
  - Spicy
  - Floral

**Cut test (100 beans, count)**
- Fermentation level
  - Fully brown
  - Partially brown
  - Violet
  - Violet unfissured
- Defective
  - Slaty
  - Moldy
  - Germinated
  - Insect damaged
  - Overfermented

**Overall impression**
- Overall

---

**Organoleptic evaluation, shelled ground beans**

**Taste**
- Acidity
- Bitterness
- Astringency

**Aroma**
- Positive/Neutral
  - Cocoa
  - Fresh fruit
  - Dried fruit
  - Vegetal
  - Herbal
  - Floral
  - Nutty
  - Spicy
  - Caramel/Malty/Candied
  - Buttery

**Defective**
- Hammy
- Smoky
- Musty/Moldy
- Ammonia
- Putrid/Garbage
- Rancid/Cheesy
- Medicinal/Phenolic
- Sulfurous/Rubbery
- Pungent
- Sweaty
- Metallic
- Meaty
- Woody
- Animal
- Heated fat

---

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Cocoa Bean Physical and Sensory Quality Evaluation Form

Name: ___________________________  Sample Code: ___________  Date: ___________

**Physical Quality Assessment**

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<th>External Defects (100 beans)</th>
<th>Overall Impression (0 - 10)</th>
<th>Sensory Quality Assessment</th>
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<td>Cut Test (100 beans)</td>
<td>☐ Cut/Damaged Beans</td>
<td>☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
</tbody>
</table>

**Degree of Fermentation**

<table>
<thead>
<tr>
<th>Defects</th>
<th>Core Flavour Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Fully Brown</td>
<td>☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>☐ Light Brown</td>
<td>☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>☐ Part Purple/Part Brown</td>
<td>☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>☐ Violet turning purple</td>
<td>☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>☐ Violet unissued</td>
<td>☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
</tbody>
</table>

**Radar Plot of key flavours**

- Cocoa
- Nutty
- Fruity
- Floral
- Astringent
- Sweet/Alcohol
- Other
- Add
- Vegetative
- Astringent
- Sour
- Lactic Acid
- Mineral Acid
- Cocoa
- Rancid/Oily
- Ammonia
- Bitterness
- Bitterness
- Leather/Sweaty

<table>
<thead>
<tr>
<th>Category of Fissuring</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td></td>
</tr>
</tbody>
</table>
Fissuring Scale

U.S. Patent


Cut test Photos

Cocoa Cut Test Chart

Slightly Over Fermented

Well Fermented

Well Fermented (Pale)

Slaty and Unfermented

Slaty Turning Violet

Violet

Violet Turning Brown

Partly Purple and Partly Brown

Mouldy

Mouldy and Infested

1 cm
What is fine or flavour cocoa?

Uniqueness and Diversity...a spectrum of flavour...
Ecuador vs Ghana

Papua New Guinea vs Ghana

Trinidad and Tobago vs Ghana

Venezuela vs Ghana

CCAT 2664
CCAT 4688
La Gloria
Ghana

KA 2-106
KA 73-14/1
KA 16-2/3
NAB 11
Ghana

CCL 200
CCL 201
CCL 202
CCL 217
Ghana

GUASARE
C. MERIDA (SJU)
C. MERIDA (ZEA)
PORCELANA
Ghana

Malt/caramel
PCA plot of different country clones vs Ghana
RDMAIC approach in 6σ

• **R**ecognizing the right problem to work on.

• **D**efining the system and their requirements.

• **M**easuring key aspects of the current process and collect relevant data to address the problem.

• **A**nalysing the data obtained to:
  - Investigate and verify cause-and-effect relationships.
  - Determine what the relationships are.
  - Ensure that all factors have been considered.
  - Seek out the root cause of the problem under investigation.

• **I**mproving or optimizing the current process based upon data analysis and standard work to create a new process.

• **C**ontrolling the new process to ensure that any deviations from the target are corrected before they result in defects.
  - Implement appropriate control systems for the process.
Take home points...

• The time is right for this

• First positive steps have been taken

• More conversation/consultation needed

• Need to keep conversations positive, taking elements from everyone to define protocols

• Use learning from the other crops where appropriate to shorten the time

Six Sigma 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 – from manufacturing to transactional and from product to service.