Elements of a harmonized international standard for cocoa flavour assessment – a proposal for further consultation

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http://www.cocoacentre.com;

Third Annual Seminar on Cocoa in the Americas
5-6th September 2016
Sonesta Hotel, Guayaquil, Ecuador.
International initiatives towards recognizing cocoa quality

• 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.
The current state of stakeholders perceptions

• We were all taking different roads to reach a similar destination – “QUALITY”.

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

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

• The feedback producers receive from buyers is often insufficient or difficult to understand.

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

• Producers are not in a good bargaining position with buyers as they rely on the buyers quality assessment for sales decisions.

• We need a set of standardized protocols to assess our cocoa quality and provide our own systematic quality reports.

• We need a Cocoa Quality Assessment Toolkit.
What has been happening address these issues...

• A collaborative effort started in September 2015 talking with producers groups, traders, chocolate makers, research to examine what standards and protocols exist for cocoa quality.

• A review of cocoa and other quality protocols was carried out between Feb – May 2016 to determine what different groups and/or individuals were doing in this area and for related commodities (such as coffee, wine and olive oil).

• A proposal for international standards and protocols on cocoa quality and flavour assessment have been produced to facilitate systematic quality assessment and sharing of information.

• Broader consultation now going with these documents towards building a Cocoa Quality Assessment Toolkit.
Three documents have been produced

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

Darin A. Sukha (PhD)
May 2016

**Elements of a harmonized international standard for cocoa flavour assessment — a proposal for further consultation**

Darin A. Sukha (PhD)
May 2016
Realizing the potential of cocoa is linked to quality...but...What is quality?

• “Quality” may be considered as a specification or set of specifications which are to be met within given tolerances or limits (Kramer and Twigg, 1970).

• Concise Oxford dictionary defines “quality” as “…possessing a degree of excellence…and to be concerned with the maintenance of high quality…” (Oxford, 1980).

• Meeting the requirements or specifications that define high quality for that particular item or product.
What is quality in cocoa?

• Cocoa, “quality” includes the all-important aspects of flavour and purity, and physical characteristics that have a direct bearing on manufacturing performance and aspects such as traceability, geographical indicators and certification to indicate the sustainability of the production methods (CAOBISCO/ECA/FCC, 2015).

• Aspects or specifications of quality in cocoa include:

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

• These criteria affect the value and price paid for a parcel of beans.
Key considerations towards building the Cocoa Quality Assessment Toolkit from the survey

- Identify cocoa quality targets and a definition in a simple way that transcends culture and language.

- Creating a system that is easy to understand, simple to implement across the stakeholder group (cost and equipment wise) and relevant to the purpose but practical.

- Complimentary training and ongoing calibration needed in a cross cultural setting.

- Standardization around identifying a relevant vocabulary/descriptor set and calibrations.

- Creating reference samples to match the descriptors.

- Creating a suitable form to record quality assessments.

- Linking physical assessment cues from cut test with smell and association to flavours and calibrations for this.
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:
  o Raw product quality
    ▪ Definition
    ▪ Positive and Negative Attributes
  o Intermediate and/or final product quality
    ▪ Definition
    ▪ Positive and Negative attributes
    ▪ Conditions for Assessing these Attributes
    ▪ Assessment forms
  o Chemical and physical assessment are defined in complete protocols that are updated as technology evolves
  o 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
  o Training is well documented, standardized and certified with different levels of expertise attainable
Elements of the protocol towards cocoa bean quality and flavour assessment
Elements of the cocoa quality and flavour assessment protocol

• Post Harvest Processing Guidelines
  • Doing what is best for your varieties
    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 the cocoa quality and flavour assessment protocol

• Raw Cocoa Bean Quality Criteria
  o Standardized sampling procedure
  o Cleanliness
    ▪ Odour
    ▪ Foreign matter, contaminants and adulteration
    ▪ Insects and other infestation
    ▪ Broken beans, fragments, bean clusters, other residue
  o Moisture Content
    ▪ Dried to a moisture content 6.5 - 7.5%
  o Other Physical Bean Attributes
    ▪ Bean count
    ▪ Individual bean weight
    ▪ Ranges and categories for different bean sizes
    ▪ Yield of shell
  o 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 the cocoa quality and 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)
    ▪ Chocolate assessment
      - Chocolate formulation (Cocoa mass, Sugar, Butter, Lecithin)
      - Un-tempered Chocolate
      - Tempered Chocolate
    ▪ Flavour testing considerations
      - Testing area
      - Layout
      - Panelist 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 and others)
  - 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) – vocab generation
  - Floral
  - Woody/Resin notes
  - Fruity
  - Vegetative

- Odour Recognition (-ve) – 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
  o Reference liquors
  o Mixtures of reference liquors
  o Known “real samples” in increasing order of flavour complexity

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

• Global Quality
  o Calculated
  o Preference scored (interest and balance)

• Platforms
  o MS Excel
  o Virtual
  o Paper based
### Scaling: 0 – 10 or 0 – 5 or both?

<table>
<thead>
<tr>
<th>Attribute Intensity</th>
<th>Meaning</th>
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<tr>
<td>0</td>
<td>None present</td>
</tr>
<tr>
<td>1</td>
<td>Just a trace and may not be found if tasted again</td>
</tr>
<tr>
<td>2</td>
<td>Present in the sample</td>
</tr>
<tr>
<td>3 to 5</td>
<td>Clearly characterizing the sample</td>
</tr>
<tr>
<td>6 to 8</td>
<td>Dominant</td>
</tr>
<tr>
<td>9 to 10</td>
<td>Maximum that you have experienced in a cocoa sample</td>
</tr>
</tbody>
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</tr>
<tr>
<td>4</td>
<td>Dominant</td>
</tr>
<tr>
<td>5</td>
<td>Extremely dominant</td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th>Descriptor</th>
<th>Description</th>
<th>Examples of Origins/References (for calibration)</th>
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</table>
| Cocoa      | * Describes the typical flavour of cocoa beans that are well fermented, roasted and free of defects - Chocolate bars, fermented/roasted cocoa | * Low intensity = 1-2 (Unfermented cocoa)  
* Medium intensity = 4-6 (Fully Fermented Indonesia, PNG, and Arriba)  
* Strong intensity = 8 (West Africa) |
| Acidity    | * 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 | * Low intensity = 0-2 (West Africa)  
* Medium = 3 (Arriba)  
* Strong = 4-8 (PNG and Malaysia) |
| Bitterness | * Usually due to a lack of fermentation; perceived on the rear of the tongue/throat - Caffeine (Coffee), Beer, Grapefruit | * Low intensity=1-2 (ancient Criollo)  
* Low/Moderate (normal) intensity =3-4 (West Africa)  
* Strong intensity = 7-8 (Unfermented cocoa) |
| Astringency| * 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 | * 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) |
| Sweet      | * Describes liquors with a characteristic flavour of unrefined caramelised cane juice (Panela) - Caramel, brown sugar, fudge | * Low intensity = 0 (West Africa - Ghana)  
* Strong intensity = 5-8, ancient Criollo (Venezuela) |
| Fresh fruit| * 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 | * Low intensity = 1-2 (West Africa)  
* Medium intensity = 3-5 (Fully Fermented Indonesia)  
* Strong intensity = 6-7, (PNG, some Trinidad (TSH)) |
| Browned fruit| * 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 | * Low intensity = 2, (West Africa)  
* Medium intensity = 3-5 (Fully Fermented Indonesia)  
* Strong intensity = 6-7, (PNG, Some Caribbean origins) |
| Nutty      | * Nutty - nut meat  
* Nut skins - associated with some astringent sensation like skins of almond and peanuts etc. | * 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 |
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| **Floral** | 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 | • 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.) |
| **Woody** |  
- 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 | • 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 |
| **Spicy** |  
- Spice tobacco - Tobacco spice is the smell outside a tobacco shop, not ashly and dirty but rather like pipe tobacco, sweet  
- Spice peppery - spicy, peppery, savory | • 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 |
<table>
<thead>
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<th>Description</th>
<th>Examples of Origins/References (for calibration)</th>
</tr>
</thead>
</table>
| 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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<thead>
<tr>
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<th>U</th>
<th>V</th>
<th>W</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>AA</th>
<th>AB</th>
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<tbody>
<tr>
<td>Cocoa</td>
<td>Total Acidity</td>
<td>Acidity - Fruit</td>
<td>Acidity - Acetic</td>
<td>Acidity - Mineral</td>
<td>Bitterness</td>
<td>Sweet</td>
<td>Fruit</td>
<td>Berries</td>
<td>Citrus</td>
<td>Fruit - Dark (cherries/ plum)</td>
<td>Fruit - Tropical (yellow)</td>
<td>Fruit - Dry</td>
<td>Brown/Mature (raisins, prunes)</td>
<td>Overripe</td>
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<td></td>
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<tr>
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<td>0</td>
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Creative Commons Copyrighted
Excel spreadsheet:
z3 ESSeguine-DASukha Master
Sample Evaluation Liquor and Chocolate 20151001
Creative Commons Attribution-ShareAlike 4.0 International License
Rapid sample quality screening sheet for producers
Sensory Assessment of Cocoa Liquors

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

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Absent</th>
<th>Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocoa flavour</td>
<td>0</td>
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</tr>
<tr>
<td>Acidity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astringency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitterness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruity flavour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floral flavour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutty flavour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw/beany/green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweet/Caramel/Malt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other flavours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global Quality</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

**TCHO - CACAO SENSORY ANALYSIS FORM**

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Quality</th>
<th>Quality Points</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fragrance</td>
<td>5 points</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Acidity</td>
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<tr>
<td>Astringency</td>
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<td></td>
</tr>
<tr>
<td>Bitterness</td>
<td>10 points</td>
<td></td>
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<table>
<thead>
<tr>
<th>Flavours</th>
<th>Details</th>
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<tbody>
<tr>
<td>Cocoa</td>
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</tr>
<tr>
<td>Sweet</td>
<td></td>
</tr>
<tr>
<td>Fresh</td>
<td>Fruit</td>
</tr>
<tr>
<td>Browned</td>
<td>Nutty</td>
</tr>
<tr>
<td>Floral</td>
<td>Woody</td>
</tr>
<tr>
<td>Spicy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Defect free/clean</th>
<th>30 points</th>
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<tbody>
<tr>
<td>Balance</td>
<td>5 points</td>
<td>0</td>
</tr>
<tr>
<td>Aftertaste</td>
<td>6 points</td>
<td>0</td>
</tr>
<tr>
<td>Taster’s Points</td>
<td>10 points</td>
<td>0</td>
</tr>
</tbody>
</table>

**Final Quality Score**

0 Max 100 points

**Taster’s Notes**

+ [ ]

- [ ]
New way to visualize flavour profiles – “filled pie slices”
Take home points...

• Cocoa is food. Most farmers have never tasted chocolate made from their own beans. That is vital in the quality transformation process.

• Finding a common language so that different people along the value chain can talk about quality and understand each other.

• We need high quality cocoa linked to specialty marketing to derive maximum value from the small production volumes, great potential and renewed interest towards cocoa in the Americas.

• The time is right for having a Cocoa Quality Assessment Toolkit with technically sound and simple protocols for cocoa bean quality and flavour assessment.

• First positive steps have been taken in this direction.

• Training and building human capacity at all levels in the cocoa value chain is needed towards realizing this goal.
What is fine or flavour cocoa?

Uniqueness and Diversity...a spectrum of flavour...
Attribute intensity

**Ecuador vs Ghana**

- **Cocoa Acid**
- **Astringent**
- **Bitter**
- **Fruity**
- **Floral**
- **Nutty**
- **Raw/green**
- **Other**

**Papua New Guinea vs Ghana**

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

**Trinidad and Tobago vs Ghana**

- **CCL 200**
- **CCL 201**
- **CCL 202**
- **CCL 217**

**Venezuela vs Ghana**

- **GUASARE**
- **C. MERIDA (SJU)**
- **C. MERIDA (ZEA)**
- **PORCELANA**

**Cocoa Research Centre**
PCA plot of different country clones vs Ghana

- Ghana reference
- Ecuador
- PNG and T&T
- Venezuela