

Evidence for applying the concept of “Terroir” in cocoa flavour and quality attributes

Elements of a harmonized international standard for cocoa flavour assessment



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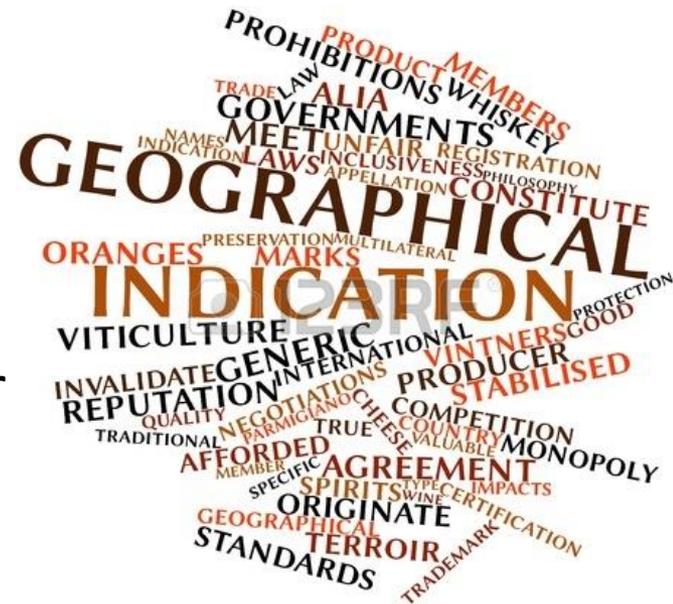
St. Augustine.



<http://www.cocoacentre.com>; <http://www.cacaocentre.com>.

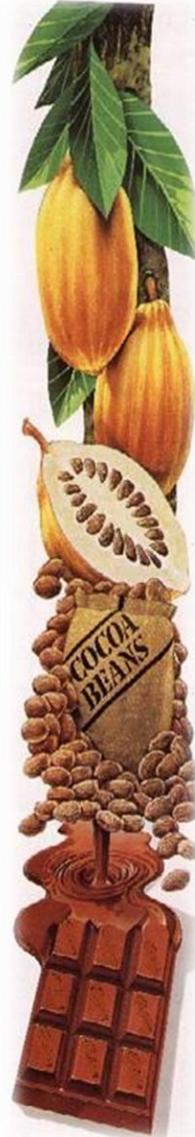
Setting the stage – Quality and Flavour Assessment Theme

1. The dawn of a “quality centric” cocoa industry
2. Evidence for applying the concept of “Terroir” in cocoa
3. Harmonised standards for cocoa flavour assessment



The last 15 – 20 years - Dawn of a “quality-centric” cocoa industry

- Linking the impact of physical quality on flavour.
- Heightened awareness for recognising bean origins and genetics used in various chocolates.
- Market evolution towards dark and ‘origin specific’ chocolates.
- Health benefits of dark chocolate consumption.
- Research on more quantitative methods towards assessing and defining cocoa quality – GC, HPLC, SPME, NIR etc.
- Chocolate companies and industry groups making direct interventions at origin to improve cocoa quality



- Birth of the craft or artisanal chocolate segment
- Different criteria for cocoa “quality” have been developed with varying levels of depth, clarity and consistency.
- A number of international initiatives recognising desirable quality attributes and/or facilitating niche marketing launched within the last 8 – 10 years.
- Each initiative trying to link flavour quality to either genetics, farm or region.
- Chocolate being enjoyed as an experience



Global Cocoa Agenda – sets the stage



INTERNATIONAL COCOA ORGANIZATION

- The Global Cocoa Agenda was agreed at the First World Cocoa Conference, Abidjan, Côte d'Ivoire in November, 2012.
- It provides the roadmap towards achieving a sustainable world cocoa economy and outlines:
 - 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

Global Cocoa Agenda Actions



INTERNATIONAL COCOA ORGANIZATION

...“Improve cocoa quality by better communication of industry needs, post-harvest processing and quality assessment” ...



Greater appreciation of the interconnectivity along the cocoa value chain affecting flavour development



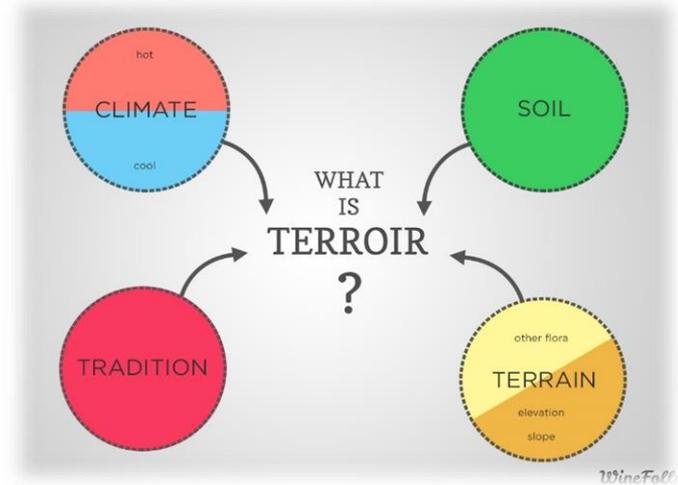
← Growing environment and care of tree

← Genetic flavour potential

← Pre harvest conditions

← Post harvest processing

← During chocolate manufacturing



Collecting evidence towards understanding “Terroir” effects



- Two separate studies to demonstrate the importance of:
 1. Processing Location (PL)
 2. Growing Environment (GE)

on the flavour attributes of selected cacao varieties



Experimental design

Processing Location study

- Three different Processing Locations
 - **La Reunion Estate, Centeno (LRE)**
 - **Manickchand Estate, Sangre Grande (ME)**
 - **San Juan Estate, Gran Couva (SJE)**
- Six (6) contrasting varieties harvested from the same growing environments over the 3 crop years

Growing Environment study

- Same varieties from four different Growing Environments
 - **International Cocoa Genebank Trinidad (ICGT)**
 - **La Reunion Estate (LRE), Centeno**
 - **University of the West Indies (UWI), St. Augustine Campus**
 - **Marper Farm, Manzanilla**
- Same Processing Location used over the three crop years
 - **Manickchand Estate**

Independent quality assessments to examine “Terroir” effects – using standardised methods

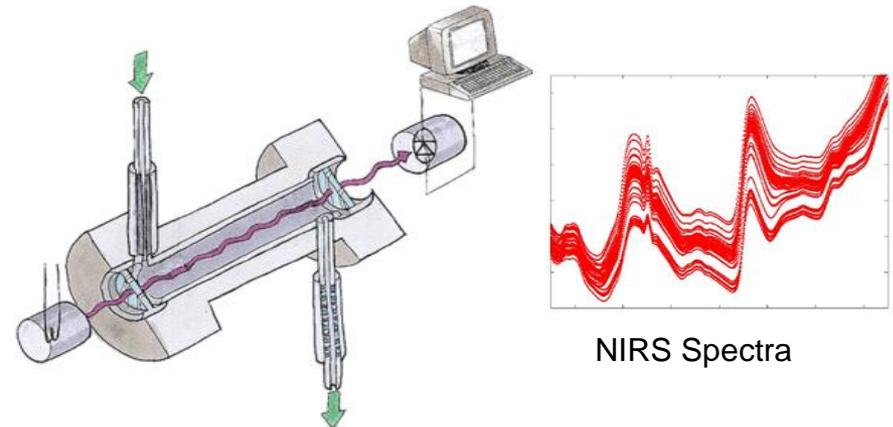
Flavour evaluations

- Preparation of liquor samples for flavor evaluation
- Sensory panel training and evaluation
- Data analysis

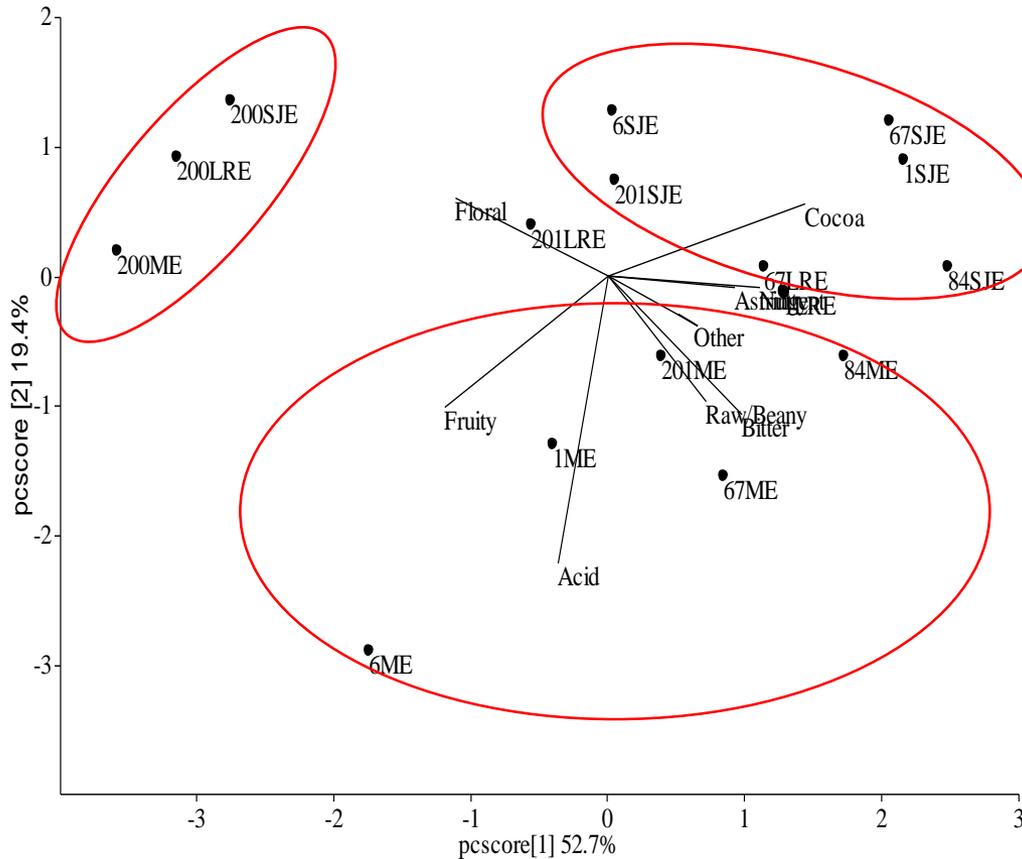


Near Infrared Reflectance Spectroscopy (NIR)

- Bean sample preparation
- Collecting spectra
- Data analysis

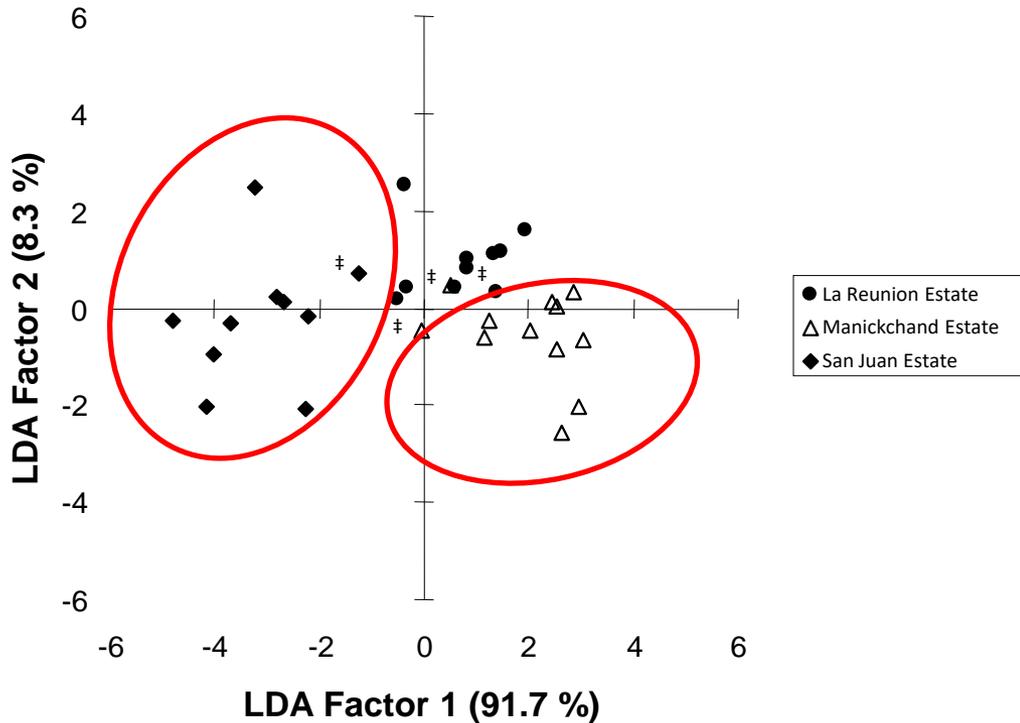


Flavour Evaluation Results - Processing Location effects



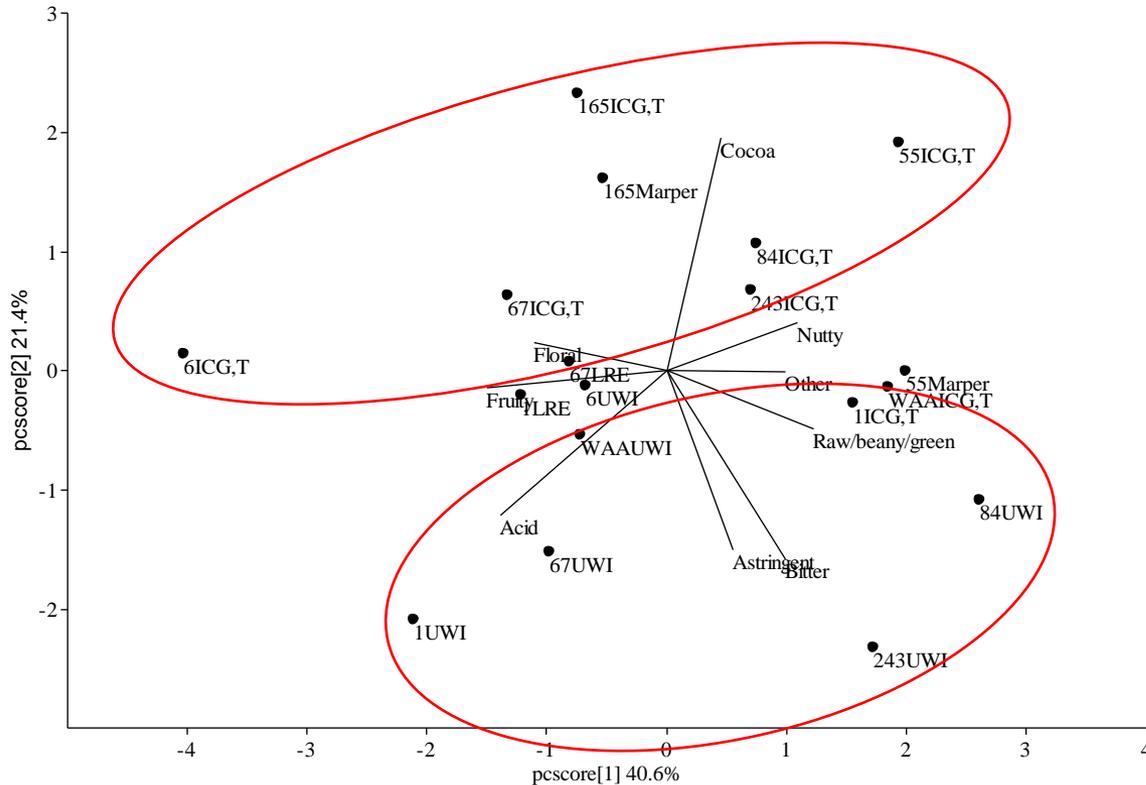
- Samples grouped according to where they were processed NOT by variety.
- 3 PC's accounted for 86% of Variation.
- Clonal effect was observed for CCL 200 in Floral flavor.
- SJE was associated with Cocoa & Nutty flavours.
- ME was associated with Fruity, Acid, Raw/beany/green, bitter and Other flavours.
- LRE in between these two.

NIR Evaluation Results - Processing Location effects



- Perfect discrimination of the varieties used
 - Classification rate of 100%
- Discrimination between processing locations
 - Classification rate of 87%
- **Conclusions**
 - **There is a processing location effect**
 - **There is also a strong clonal effect**

Flavour Evaluation Results – Growing Environment effects



- Samples generally grouped according to where they were grown NOT by variety.

- 3 PC's accounted for 76.6% of Variation

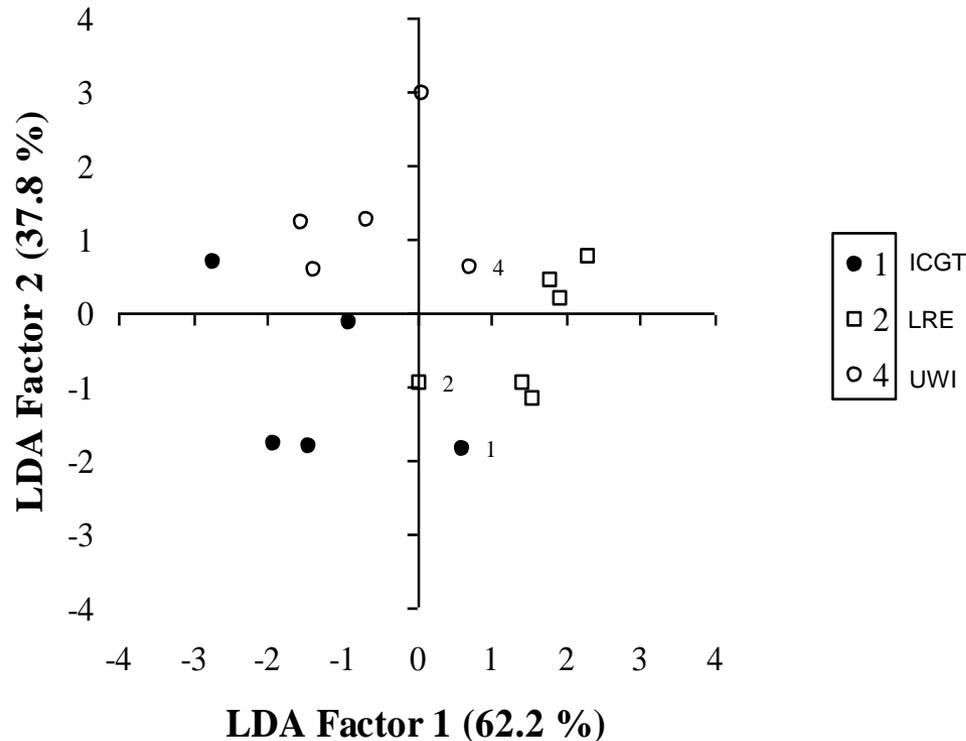
- UWI GE was associated with acid, astringent, bitter and raw/beany/green flavours

- ICGT and Marper GE was associated with cocoa, nutty and other flavours

- ICGT was also associated floral flavour

- UWI and LRE GE was associated with fruity and acid flavours

NIR Evaluation Results – Growing Environment effects



- Discrimination of the four different growing environments
 - Classification rate of 62.9%
- Some overlap in discriminating between ICGT and Marper GE
- Better discrimination of the ICGT, LRE and UWI growing environments after removing Marper
 - Classification rate of 81.2%
- **Conclusions**
 - **Growing environment effect is present but not as strong as the processing location effect from the flavor and spectral profiles**

Elements of a harmonized international standard for cocoa flavour assessment

A technical and pragmatic approach to cocoa bean quality and flavour assessment



Working towards an international standard on cocoa quality and flavour assessment with the following goals:

- To enable a clear communication throughout the value chain (cocoa producers, bean buyers/traders, chocolate makers and other users), using a common language:



1. to identify the intrinsic flavour attributes and characteristics (flavour potential) of the beans when beans are converted into chocolate and,



2. to unlock the value of cocoa beans and empower producers and buyers so that users can decide how to use the beans through targeted marketing flavour customisation to meet customers' needs.



Steps taken towards a technical and pragmatic approach to cocoa bean quality and flavour assessment...

- Working group on International Standards for the Assessment of Cocoa Quality and Flavours was established in September 2015 under the coordination of The Cocoa of Excellence Program.
- Inventory of all the standards and protocols that exists carried out and documented.
- Determined what different groups and/or individuals were doing in this area and in related commodities (such as coffee, wine and olive oil).
- Developed elements a first proposal for international standards and protocols on cocoa quality and flavour assessment.
- Stakeholder consultations and further discussion towards a harmonised **international standard on cocoa quality and flavour assessment**.



Thematic elements of the standard after stakeholder consultations

Identifying the intrinsic flavour attributes and characteristics from beans to chocolate



Part A:
coarse powder
(unroasted
beans)



Part B:
coarse powder
(roasted beans)



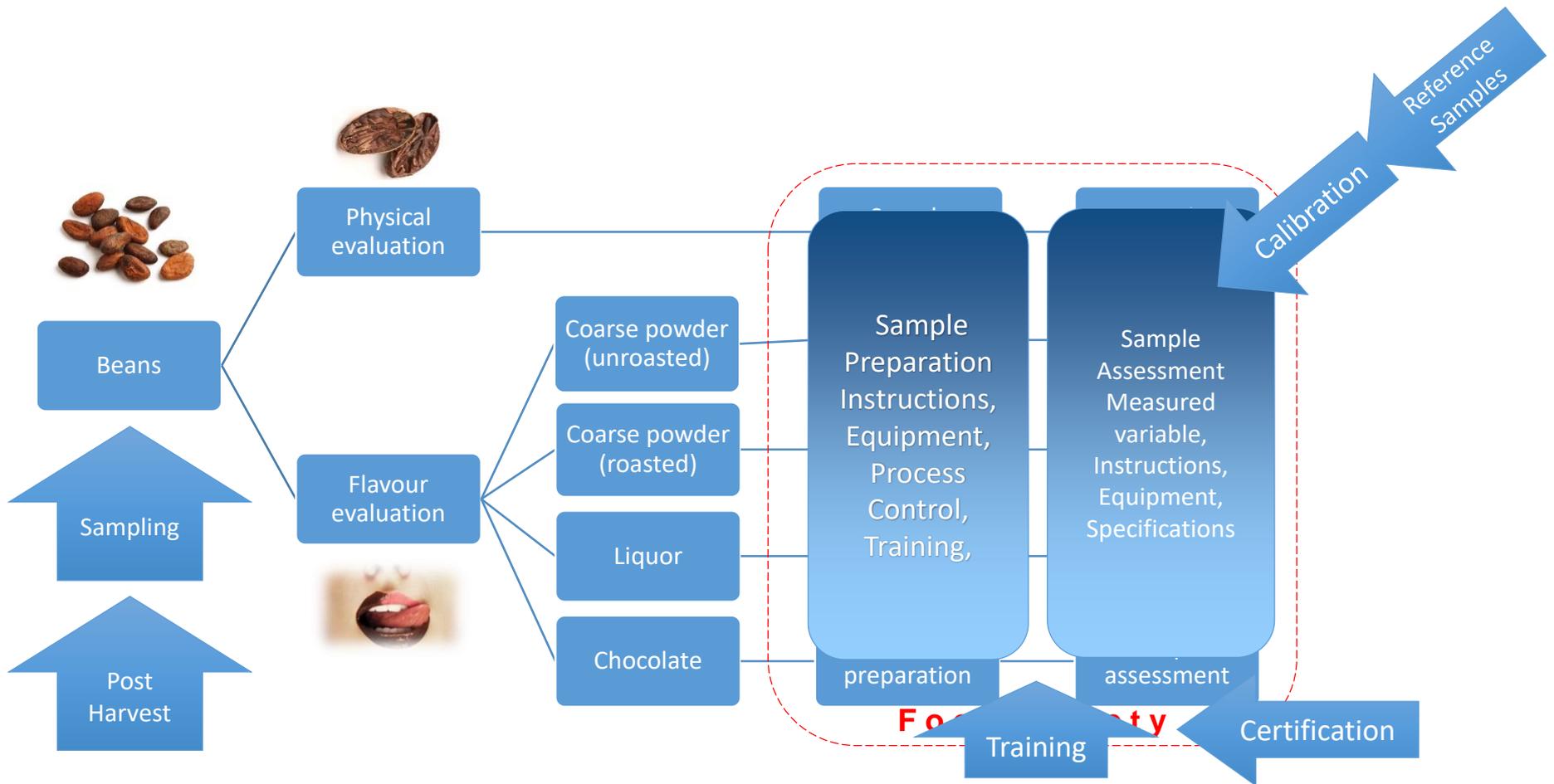
Part C:
cocoa liquor



Part D:
chocolate

----- with cross cutting elements -----

Thematic elements of the proposed standard



What we have already to refer to and include...

- **Post Harvest Processing Guidelines**

- **Pre-harvest**

- Environmental aspects
- Cultivation Methods
 - Varieties
 - Pest and Disease
 - Cadmium

- **Harvesting**

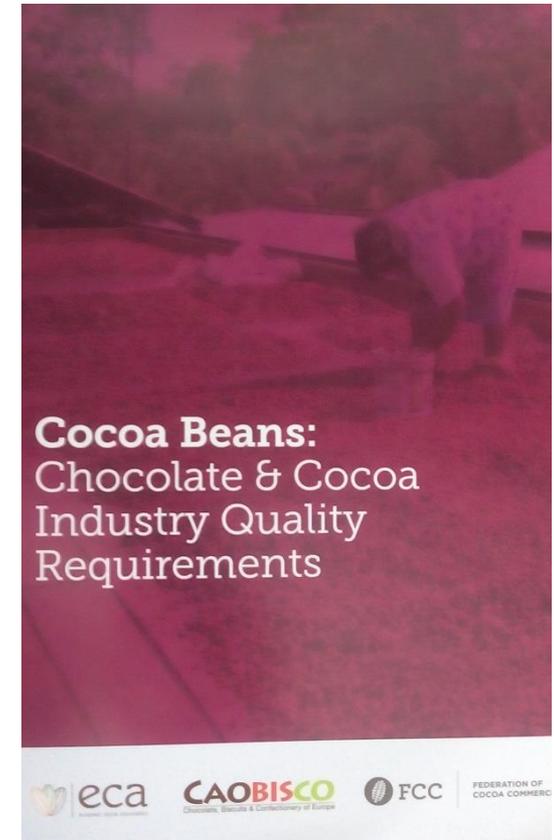
- Maturity
- Storage
- Opening

- **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

- **Quality control before sale**

- **Transportation and Shipping**



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

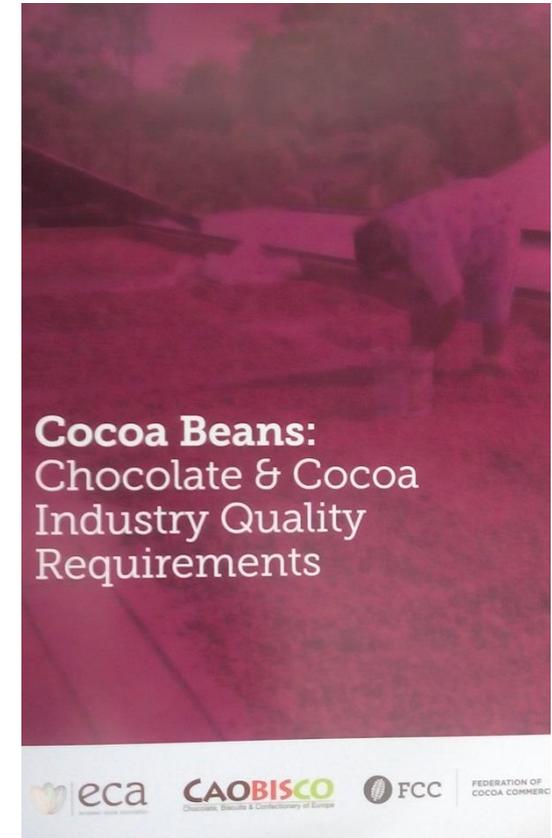
ICCO Guidelines on Best Practices in Cocoa Production



What we have already to refer to and include...

- **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



CAOBISCO/ECA/FCC, (2015). "Cocoa Beans: Chocolate and Cocoa Industry Quality Requirements". (End, M.J. and Dand, R., Editors)

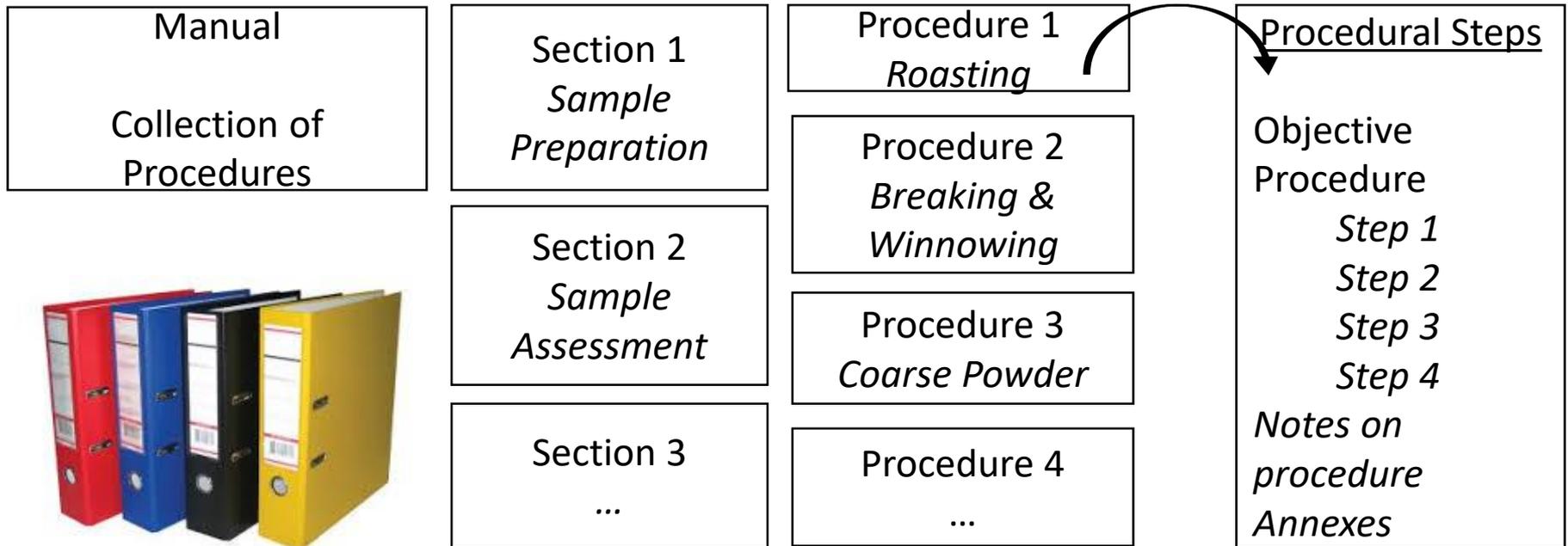
ISO Standards



Flavour evaluation of beans

PART	PROCESS	METHOD			EQUIPMENT	PROCESS CONTROL	
		Options	Instructions			Parameters	Specification
			in proposal	Referenced document			
Coarse Powder (roasting does not apply for unroasted beans)	Roasting	Precise Roasting Mapping	yes	CAOBISCO/ECA/FCC, 2015) Sukha&Seguine, 2015	mechanical convection oven	Time & Temperature	Trinitario: 120°C x 25 min "Forastero": - 130°C for 25 min Criollo ancient Types: 112°C for 25 min Criollo Types - 120°C for 25 min PLUS OR ONLY based on considerations by bean size and moisture content
	Breaking and Winnowing	50 beans samples	yes	FCCI, 2016	pop corn machine (optional), elimination of shell by hand	Shell amount	absence
		Low throughput system for small samples	yes	Sukha&Seguine, 2015	hair dryer -bag -rolling pin -tweezers		
		High throughput system	yes	Sukha&Seguine, 2015	-mechanised winnow system -tweezers		
Grinding		yes	FCCI, 2016	100 gram stainless steel blade coffee grinder	Particle size	500 µ	
Cocoa Liquor	Liquefy		yes	CAOBISCO/ECA/FCC, 2015 Sukha et al, 2008 Sukha&Seguine, 2015	-Laboratory scale melangeurs for 200-2500 g nibs -micrometer	Particle size	14-25 µ or 25 - 30 µ
						Temperature	
Chocolate	Formulation		yes	CAOBISCO/ECA/FCC, 2015 Sukha et al, 2008 Sukha&Seguine, 2015	-Scale	Ingredients	type and proportion
	Mixing/Conching		yes	CAOBISCO/ECA/FCC, 2015 Sukha et al, 2008 Sukha&Seguine, 2015	-Laboratory scale melangeurs for 200-2500 g nibs -micrometer	Particle size	max 20µ
						Temperature	
	Tempering	Manual	yes	CAOBISCO/ECA/FCC, 2015 Sukha et al, 2008 Sukha&Seguine, 2015	Marble table Thermometer Double boiler	Temperature curve	45°C (113 F) 27°C (80.6 F) 31°C (87.8 F)
Automatic		yes		Tempering machine			

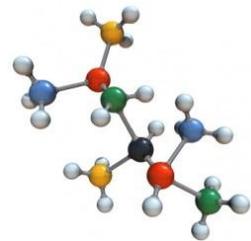
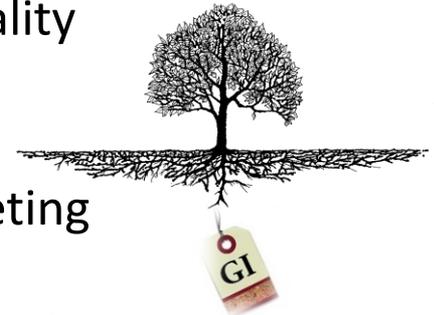
Process outcome - ready to use document with updated versions as required



Making a distinction between sample preparation and evaluation method/procedure

The importance of all this...

- Approaches for niche marketing of cocoa at highest prices based on reputation, quality, origin (country, region variety) and history.
- Tools to understand and build a pedigree of fine or special quality cocoa.
- Considerations for building cocoa brands towards niche marketing through:
 - Certification for **Environmental and Social Responsibility** certification
 - Certification via **Branding, Trade Marking and Geographical Indications**
 - Differentiation based on intrinsic flavour attributes of the **cocoa beans**
 - Genetic Branding
 - Flavour Maps
 - Aroma volatile fingerprinting
 - Chemosensory fingerprinting
 - Differentiation based on **chocolate** made from beans



Sensomics



Acknowledgements

“Terroir” study

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 - Manickchand Estate, Sangre Grande
 - San Juan Estate, Gran Couva
 - Marper Farm, Manzanilla
- All Sensory panellists
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- Lindt & Sprüngli AG International (Switzerland)
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Standards

