Quality of traded raw cocoa: Origin specific variation, correlations of quality determining factors and development of a „cocoa quality system“

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Introduction - Quality of cocoa

is determined by
- origin
- Category „bulk“ cocoa or „fine or flavour“ cocoa

is evaluated by various physical, chemical and or organoleptical analysis:
- Cut-test
- analysing contaminants
- absence of off-flavours // presence of Fine aroma notes

Cocoa experts often describe origin or even provenance specific differences between traded cocoa lots -
But what exactly makes the difference?
Approaches - Methods

1. Measure the Heterogeneity of 230 traded cocoa samples from 33 origins.

<table>
<thead>
<tr>
<th>physico chemical parameters:</th>
<th>Cut test, seed weight, weight distribution... photos of the cut beans</th>
</tr>
</thead>
<tbody>
<tr>
<td>biochemical parameters</td>
<td>pH, acetic- and lactic acid Theobromine, caffeine, nitrogen, free amino acid content epicatechin and catechin content, total polyphenols fat content and fat composition, free fatty acids...</td>
</tr>
</tbody>
</table>

PCA, Discriminant Analysis were conducted on a sample set including 120 samples and 22 origins.
2. Approach: Inkubation and Fermentation tests, analysing Fermentation stages

Fermentation test conducted in Trinidad and Incubation tests from the Laboratory in Germany delivered further background information in understanding the dynamics and correlation between quality determining factors.
results: Heterogenity of traded cocoa

Origin?

Parameter?

Post Harvest?

based on results of 37 parameters: amount of slaty, violet, brown bean weight

testa=shell [g], testa=shell [%]
pH-value

nitrogen

epicatechin, total phenolics antioxidative capacity

acetic acid, lactic acid

caffein (c), theobromin (t), ratio t/c

GABA-value

total and single free amino acids

fat content, POP-triglycerides

stearic acid, oleic acid, palmitic acid

105 samples, 37 variables, n=5

2022 International Symposium on Cocoa Research (ISCR), Montpellier, France
results: PCA from 37 Parameters

- pH
- Polyphenols
- % Violet
- % Slaty
- Free amino acids
- Lactic acid
- Caffeine

Principal component analysis: 105 samples, 37 variables, n=5
Results: discriminant analysis

Differences were caused by both factors: the genotype and the post harvest process

- based on results of 37 parameters:
  - amount of slaty, violet, brown bean weight
  - testa=shell [g], testa=shell [%]
  - pH-value
  - nitrogen
  - epicatechin, total phenolics
  - antioxidative capacity
  - acetic acid, lactic acid
  - caffeine (c), theobromin (t), ratio t/c
  - GABA-value
  - total and single free amino acids
  - fat content, POP-triglycerides
  - stearic acid, oleic acid, palmitic acid
Results: further correlations...

Fine or Flavour Cocoa: low ratio of Theobromine/Caffeine

Cros, E. cocoa Meeting in Paris, 2006
Results: further correlations...

- Seed weight
- pH
- GABA
- Epicatechine
- Total phenols
- Acetic acid
- Lactic acid
- Free Amino acids
- T/C Portion
- Fat content

Fermentation...
Fermentation...
Genetic...
Results: variability within origin...

Fermentation stages = highest variability
How to classify an unknown sample?

Characterisation of fermentation stages and possible constellation of related parameters.

<table>
<thead>
<tr>
<th>Post-Processing</th>
<th>Composition</th>
<th>Aroma</th>
<th>Contaminants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Epicatechin</td>
<td>Catechin</td>
<td>FAME</td>
</tr>
<tr>
<td>slaty</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>violets</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>mouldy beans</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>insect infested</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>overfermented</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>doubles</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>germinated</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>bean weight</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>different sizes</td>
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</tbody>
</table>
Cocoa Quality System: Assistance to understand the interrelation of Quality determining factors.
Cocoa quality summary gives advice where adjustment is needed, or what to expect. To be continued...

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Data sets are based on the projects:


- "Charakterisierung chemischer Indikatoren in Rohkakao unterschiedlicher Fermentationsstadien" (founded by the german industrial collective research. IGF "Otto-von-Guericke" e.V. AiF ( AiF-FV-Nr. 14491-N)