INFLUENCE OF ORIGIN AND THERMAL PROCESSING ON THE AROMA QUALITY OF COCOA FRUIT PULP FOR ITS USE AS A FOOD INGREDIENT

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Cocoa, more than just beans

- Production of around 5.2 million tons of beans in 2021
- Cocoa beans make up only 20-30% of the fruit.
- About 70-80% of the biomass is lost in the process.
- European consumers want sustainable and new products.
- Partial de-pulping prior fermentation can accelerate this step and improve the later quality of cocoa beans.
- In 2019 cocoa pulp was approved by EFSA as an ingredient from a third country.
- Cocoa pulp has not been completely characterised
How does the origin affect the composition of cocoa pulp?

- Nicaragua
- Cameroon
- Vietnam
- Indonesia
## Chemical composition of cocoa pulps from different origins

<table>
<thead>
<tr>
<th>Sample</th>
<th>Dry Matter [%]</th>
<th>pH-value [-]</th>
<th>Brix [%]</th>
<th>Water activity [-]</th>
<th>Ash [% in the DM]</th>
<th>Protein [% in the DM]</th>
<th>Fat [% in the DM]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam</td>
<td>19.72 ± 0.0</td>
<td>3.50 ± 0.0</td>
<td>17.47 ± 0.2</td>
<td>0.9823 ± 0.001</td>
<td>1.68 ± 0.0</td>
<td>4.67 ± 0.0</td>
<td>0.8 ± 0.0</td>
</tr>
<tr>
<td>Cameroon</td>
<td>19.23 ± 0.3</td>
<td>3.85 ± 0.0</td>
<td>16.1 ± 0.1</td>
<td>0.9923 ± 0.003</td>
<td>2.15 ± 0.0</td>
<td>4.44 ± 0.0</td>
<td>0.27 ± 0.0</td>
</tr>
<tr>
<td>Indonesia (SUL1)</td>
<td>11.21 ± 0.2</td>
<td>4.06 ± 0.0</td>
<td>9.73 ± 0.1</td>
<td>0.9840 ± 0.005</td>
<td>2.29 ± 0.1</td>
<td>4.73 ± 0.0</td>
<td>0.31 ± 0.1</td>
</tr>
<tr>
<td>Indonesia (SUL2)</td>
<td>16.85 ± 0.1</td>
<td>3.39 ± 0.0</td>
<td>15.30 ± 0.3</td>
<td>0.9860 ± 0.002</td>
<td>1.81 ± 0.1</td>
<td>3.28 ± 0.0</td>
<td>0.35 ± 0.0</td>
</tr>
<tr>
<td>Indonesia (MCC2)</td>
<td>28.59 ± 0.0</td>
<td>4.04 ± 0.0</td>
<td>25.97 ± 0.2</td>
<td>0.9641 ± 0.003</td>
<td>1.79 ± 0.1</td>
<td>4.50 ± 0.0</td>
<td>0.21 ± 0.0</td>
</tr>
<tr>
<td>Nicaragua (TSH565)</td>
<td>14.36 ± 0.7</td>
<td>3.68 ± 0.0</td>
<td>16.53 ± 0.1</td>
<td>0.9820 ± 0.002</td>
<td>n.d</td>
<td>8.29 ± 0.0</td>
<td>n.d.</td>
</tr>
</tbody>
</table>
Aroma Properties of Cocoa Fruit Pulp from Different Origins

- 65 aroma-active regions within FD 2 and FD 1024
- 36 odorants identified in all cocoa pulps
- Aldehydes were the most predominant group, followed by carboxylic acids, lactones, phenols and ketones.
- Some odorants with high FD factors: \textit{trans}-4,5-epoxy-(E)-decenal, 2- and 3-methylbutanoic acid, 3-(methylthio)propanal, 2-isobutyl-3-methoxypyrazine, \((E,E)\)-2,4-nonadienal, \((E,E)\)-2,4-decadienal and linalool

<table>
<thead>
<tr>
<th>Origin</th>
<th>Aroma description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>fatty, cheesy, green and phenolic</td>
</tr>
<tr>
<td>Vietnam</td>
<td>fatty, green and smoky</td>
</tr>
<tr>
<td>Cameroon</td>
<td>butter-like, popcorn-like, flowery and fruity</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>fruity, flowery, but also exhibited honey, clove and vanilla-like notes</td>
</tr>
</tbody>
</table>

Table 1: Aroma description of cocoa pulp distillates from different origins
Effects of thermal processing technologies on the sensory profiles, aroma composition, colour and microbiological stability

- Transport of fresh fruits is costly
- High water content (>80% of the total weight)
- High sugar content (13% in the fresh weight)
- Need for processing protocols to preserve cocoa pulp
  - Pasteurisation (80°C, 20 min)
  - UHT (135°C, 30 s)
- Sensory profiles by descriptive methods and GC-MS/O
- Microbiological analyses
- Colour determination
- Storage tests for 24 weeks at 4 °C and 23 °C
Preservation trials with farmers’ cooperative in Bali
- Pulp from partially de-pulped cocoa beans.
- Dilution 1:1 scored highest in preference, but was highly viscous. Dilution 1:9 showed an ideal viscosity but lacked in sweetness.
- Pasteurisation took place at 80 °C for 10 min.
- Room for hygienic production is in planning.
- Commercialization of pulp beverages in Jakarta and Bali.

Special acknowledgement: Ariza Sari Budi (ICCRI)
Conclusions

- Cocoa pulp from different origins exhibit different aroma properties, enabling a broad range of food products.
- Pasteurisation and UHT are suitable and reliable technologies for cocoa pulp preservation. However, performing a pasteurisation at farm level requires less apparatus effort.
- A cold storage is recommended to maintain the cocoa pulp’s colour and prolong the aroma profile.
- Diluting the pulp facilitates the preservation and filling steps.
- By processing and selling cocoa pulp, farmers may profit from new sources of income.

“Our motivation is that innovation [...] will be able to bring cocoa farmers to a better direction. [...] we want to get additional income from the cocoa pulp process.”

-Cocoa farmer, Bali, 14.10.2022
Thank you for your attention!
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