Development and trials of a small-capacity pilot flash dryer for cassava-derived products

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Sun drying has many limitations:
- Land requirement
- Product quality: contamination + drying time
- Economic risk: dependence on weather conditions

Increasing capacity requires a more reliable process
Artificial drying is energy-intensive and costly
- 70-80% of energy use
- Up to 30% of processing cost

To be profitable, it must be energy-efficient
Approach to downscaling flash drying technology

- No consensus on the design of flash dryers: Diversity of shapes and operating conditions
- Most small-scale flash dryers in are inefficient
Approach to downscaling flash drying technology

**MODELLING AND SIMULATIONS**

Validated with data from industrial dryers

**DESIGN GUIDELINES**

for an *energy-efficient* flash dryer

- **Pipe length**: > 20 m
- **Air velocity**: 10 – 15 m/s
- **Air temperature**: 180 °C
- **Air / Starch ratio**: 9 – 11

Development of a pilot flash dryer

Pipe dimensions:
- Diameter: 15 cm
- Length: 15 - 35 m
- Height: 7 m

TECHNICAL SPECIFICATIONS

- Drying capacity: 50-100 kg/h dry starch
- Product moisture:
  - Inlet: 35-40% w.b.
  - Outlet: 12-13% w.b.
- Operating conditions:
  - Air velocity: 10-25 m/s
  - Air temperature: 130-200°C
  - Pipe length: 16-35 m
Drying experiments: trials description

- **Drying material:**
  - **Native cassava starch** from a local cassava processor
  - **Pre-drying** in the sun to reach 35 – 40% moisture content

- **9 trials, screening of operating conditions:**
  - Air velocity: 12 to 20 m/s
  - Air temperature: 140 to 180°C
  - Dying length: 19 m and 29 m
  - Feed rate: 50 – 150 kg/h
Drying experiments: results

- Stability of operation
Drying experiments: results

- Energy consumption

Efficient large-scale

It is possible to build small-capacity flash dryers with high efficiency!
Drying experiments: results

- **Energy consumption**

<table>
<thead>
<tr>
<th>TRIAL #</th>
<th>Pipe length</th>
<th>Feed rate</th>
<th>Temperature</th>
<th>Output moisture</th>
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<tbody>
<tr>
<td>1</td>
<td>19 m</td>
<td>78 kg/h</td>
<td>180 C</td>
<td>11.5%</td>
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<td>29 m</td>
<td>52 kg/h</td>
<td>135 C</td>
<td>14%</td>
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</table>

**GELATINIZATION < 1%**
Research and development perspectives

- **Scaling project**: 3 pilot sites in DRC, Nigeria and Uganda
  - Partnership with local *cassava processors* and *equipment manufacturers*
  - **Co-design**, construction and installation of *flash dryers*
  - **Capacity building** of stakeholders and *performance follow-up*

- **Research and innovation topics**:
  - Mechanical *dewatering*
  - Renewable energy supply: *biogas*, *solid biomass*
  - Drying other powder products: other starches and flours, peels, fibers

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Thank you!

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