Lessons learned from small and medium scale gari processing

Andrew Westby, Keith Tomlins, Aurelie Bechoff, Michael Bradley, Richard Lamboll, Andy Marchant, Andrew Graffham, Deigo Naziri, Ben Bennett, Kolawole Adebayo and Lateef Sanni

4 October, 2016
Ibadan, Nigeria
What do we want to achieve?

Understanding what we want to achieve will mean different types of project with different outcomes. Examples:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Possible types of actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving livelihoods of small-holder farmers (not yet processing)</td>
<td>Increase yields, reduce risks associated with marketing, potentially introduce processing</td>
</tr>
<tr>
<td>Improving livelihoods of small-holer processors</td>
<td>Incremental changes in processing that reduce drudgery and increase profitability, but where possible retain jobs.</td>
</tr>
<tr>
<td>Commercial standardised gari product</td>
<td>Full mechanisation of processing</td>
</tr>
</tbody>
</table>
A range of considerations

Supply, Demand & Competitiveness

- Gari improvement
- New markets
- Turn losses into gains
- New innovations
- Energy efficiency
- Equipment
- Packaging
- Flavour diversification
- Coatings
- Improved nutrition
- Marketing
- Export
- Urbanization
- Gluten free
- Snack food
- Finance
- Supply, Demand
- Competitive analysis

- Environment
- Health & Safety
- Improved nutrition
- Export Coatings Equipment
- Management
- Regulatory system

Making the value chain work in favour of the actors in the chain

Gluten free

Flavour diversification

Urbanization

Marketing

Export

Finance

Management

Regulatory system
Gari is an excellent product

- Adds value to cassava
- Multiple entry points/leves
- Safe from cyanogens (grating, dewatering and roasting)
- Safe from microorganisms (roasting)
- Safe from mycotoxins (rapid processing)
- Long shelf life (low moisture content)
- Convenience food/urban market
- Biofortification
Gari is an excellent product

Ease of entry into gari processing

• Different scales of processing result in products of similar quality.
• Scales include:
  - Individual processors
  - Women/community group
  - Small-medium scale enterprise
• Many opportunities to add value to cassava production or undertake paid work
• Renting services reduces need to own equipment

Abgajowo Processor group outside the Private processor enterprise they hire for processing
Gari is an excellent product

- Cyanogen reduction to safe levels. Data to end of fermentation. Roasting volatalises remaining cyanogens.
In target villages for CAVA project in Nigeria, gari was a major activity. Major constraints were:

– Access to working capital to purchase cassava roots.

– Availability of cassava roots.

Quality management
Currently at SME scale is basic, but can be effective. HACCP based systems likely to be most practical.
## Losses and adding value to waste

NRI studied losses in gari value chain as part of GRATITUDE project in SW Nigeria.

### Physical losses

$24.5$ million

<table>
<thead>
<tr>
<th>Sub-value chain</th>
<th>On farm (t)</th>
<th>Trading, transport and handling (t)</th>
<th>Processing - excl. on farm (t)</th>
<th>Retail and consumption - excl. own-consumption (t)</th>
<th>Total physical losses (t)</th>
<th>Share of used roots (%)</th>
<th>Share by sub-value chain (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own-consumption</td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Gari</td>
<td>39,004</td>
<td>19,307</td>
<td>307,369</td>
<td>0</td>
<td>365,681</td>
<td>9%</td>
<td>76%</td>
</tr>
<tr>
<td>Fufu</td>
<td>18,002</td>
<td>8,911</td>
<td>88,664</td>
<td>0</td>
<td>115,577</td>
<td>6%</td>
<td>24%</td>
</tr>
<tr>
<td>Total</td>
<td>57,006</td>
<td>28,218</td>
<td>396,033</td>
<td>0</td>
<td>481,258</td>
<td>7%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Share by stage of the chain (%)

- On farm: 12%
- Trading: 6%
- Processing: 82%
- Retail: 0%

Total: 100%
## Economic losses (discounting)

Estimated volume of roots affected by economic losses and value of losses by sub-value chain

<table>
<thead>
<tr>
<th>Sub-value chain</th>
<th>Price for good quality root at the point of the chain where discount may be applied ($/t)</th>
<th>Share of lower quality root with discounted price (%)</th>
<th>Volume of roots with discounted price (t)</th>
<th>Weighted average of price for root at the point of the chain where discount may be applied ($/t)</th>
<th>Total value of economic losses in the sub-value chain ($)</th>
<th>Share of current retail value (%)</th>
<th>Share by sub-value chain (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own-consumption</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>60</td>
<td>0</td>
<td>-</td>
<td>0%</td>
</tr>
<tr>
<td>Gari</td>
<td>67</td>
<td>20%</td>
<td>706,949</td>
<td>63</td>
<td>14,138,983</td>
<td>2%</td>
<td>68%</td>
</tr>
<tr>
<td>Fufu</td>
<td>67</td>
<td>20%</td>
<td>336,924</td>
<td>63</td>
<td>6,738,479</td>
<td>5%</td>
<td>32%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>16%</td>
<td>1,043,873</td>
<td></td>
<td>20,877,462</td>
<td>3%</td>
<td>100%</td>
</tr>
</tbody>
</table>

## Combined Physical and Economic losses

Estimated total value of physical and economic losses by sub-value chain

<table>
<thead>
<tr>
<th>Sub-value chain</th>
<th>Total value of physical losses in the sub-value chain ($)</th>
<th>Total value of economic losses in the sub-value chain ($)</th>
<th>Total value of post-harvest losses in the sub-value chain ($)</th>
<th>Share of current retail value (%)</th>
<th>Share by sub-value chain (%)</th>
<th>Ratio physical/economic losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own-consumption</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0%</td>
<td>-</td>
</tr>
<tr>
<td>Gari</td>
<td>24,118,677</td>
<td>14,138,983</td>
<td>38,257,660</td>
<td>6%</td>
<td>73%</td>
<td>1.7</td>
</tr>
<tr>
<td>Fufu</td>
<td>7,585,129</td>
<td>6,738,479</td>
<td>14,323,608</td>
<td>11%</td>
<td>27%</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td>31,703,806</td>
<td>20,877,462</td>
<td>52,581,268</td>
<td>7%</td>
<td>100%</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Losses and adding value to waste

Wastes

Estimated loss of viable cassava flesh due to inadequate peeling and potential loss reduction

<table>
<thead>
<tr>
<th>Sub-value chain</th>
<th>Estimated amount of peels - excluding discharged parts (t)</th>
<th>Potential amount of peels with efficient peeling - 18% (t)</th>
<th>Potential additional flesh with efficient peeling (t)</th>
<th>Price of the FCR at the peeling point ($/t)</th>
<th>Estimated value of losses due to inefficient peeling ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own-consumption</td>
<td>330,036</td>
<td>270,029.52</td>
<td>60,007</td>
<td>60</td>
<td>5,600,394</td>
</tr>
<tr>
<td>Gari</td>
<td>777,644</td>
<td>636,254.25</td>
<td>141,390</td>
<td>67</td>
<td>9,425,989</td>
</tr>
<tr>
<td>Fufu</td>
<td>370,616</td>
<td>303,231.54</td>
<td>67,385</td>
<td>67</td>
<td>4,492,319</td>
</tr>
<tr>
<td>Total</td>
<td>1,478,296</td>
<td>1,209,515</td>
<td>268,781</td>
<td></td>
<td>17,518,702</td>
</tr>
</tbody>
</table>

Some oyster mushroom species grow well on cassava waste (peels and stems) and perform as well as sawdust used in the Netherlands.
Small scale operations don’t have systems for dealing with waste

Other presentations on peel
The challenge of nutritional retention

- Three varieties of biofortified cassava (TMS 01/1371; 01/1368 and 01/1412) were processed into gari in Nigeria on a research station and by processors in the field.

**PROCESSING**

- True retention (TR) in trans-β-carotene
- Levels ranged between 34-49%
- Provitamin A losses are mostly due to physical losses (i.e. in the juice grating and pressing)
- Fermentation time did not have an impact on the level of trans-β-carotene degradation
- Roasting temperature reduced trans-β-carotene
- Loss of water during processing concentrated the product in provitamin A

**STORAGE**

- Storage of gari resulted in significant losses after a few weeks at ambient temperature: 70% (TR) was retained after 15 days at 30°C

This work was supported by:
• The challenge of peeling

• Significant physical losses
• Lower in some countries were use alternative peelers
• Major source of employment
• Mechanical peeling better?
• Reduce environmental impact
Dewatering/pre drying to reduce energy use

• More water removed in dewatering – less energy (fuelwood) used in drying.
• For HQCF, typically use 32t truck jack
• Further improvements possible
Dewatering/pre drying to reduce energy use

Mechanical de-watering SME jack press

- Most use 32t truck jacks
- Reduce moisture content from 65-70% to 42-50%
- Moisture reductions are highly variable due to combination of engineering and operational issues
- In collaboration with a Nigerian fabricator NRI has demonstrated improved press reduces to 36-38% moisture equates to a 19% saving on fuel during artificial drying
Possible application of a novel low energy drying technique for food, mineral and chemical particulates
Principle of operation of the SURFACE MOISTURE REMOVAL technology ("SMR")

- For moisture located ON THE SURFACE of the particles
- Ideal for material that has been washed or processed in water
- Uses air to blow water off the particle surface
- Avoids the need to evaporate the water
- Hence much reduced energy requirement
Prototype system in the pilot plant at The Wolfson Centre

- Close up of the drying head
- Test rig for 500-1000 kg/hour throughput
Example performance data

- Device tested on many different materials
- E.g. On coffee grounds, processing 500 kg/hr 10% by weight of water removed using an energy flow of around 25% of what would be required for thermal drying
- Performance is highly dependent on the particle properties, amount of water etc. – but the above is typical
- Best performance is achieved on material that is very wet on its surface
Concerns about health impacts of gari roasting
Concerns about health impacts of gari roasting

- No known research reported on health impacts on gari roasters but are concerns
- Anecdotal evidence from elsewhere:
- WHO air quality model shows 92% world’s population lives in places where air quality levels exceed WHO limits

WHO (2000) /UN (2014) estimates that a million children die/year in least developed and LMICs from acute respiratory infections. Major is air pollution from the wood, animal dung, and other biofuels that are burnt everyday in their own homes
UN 2014. Ca. 3 billion people cook over fires (charcoal, wood, or animal waste) = 1.9 million deaths/year – women/ girls disproportionately vulnerable.
Gari processors often work outdoors, inhale smoke over long hours. This is an important area of research to a) get evidence of the risk to drive policy and b) develop low cost and safer alternatives
We know little about consumer acceptability

- Explored gari acceptance with Harvestplus (research) and RTB (review) funding.
- Review indicates acceptance explained by variety, maturity, substitution for other starches/flours, fermentation times, shelf-life etc.
- H+ research explored gari acceptance made from biofortified cassava = good acceptance and increased willingness to pay if consumers given information (Bechoff, Oparinde and others).

Gaps
- Size and value of gari markets and for new product innovations and interventions
- Drivers of gari markets, opportunities (urbanisation, exports), threats (competing products, high producer cost) and risks (disease, climate change)
Marketing currently basic, but what does the future hold?

- Is the gari market saturated? What next?
Summary

- Understand what we want to achieve
- A range of considerations
- **Gari is an excellent product**
- Not just about technology
- Losses are significant and potential to add value
- The challenge of peeling
- Dewatering/pre drying to reduce energy use
- Concerns about health impacts of roasting
- We know little about consumer acceptability
- Marketing so far basic, but is this an indication of the future?