Degree of milling effects on rice cooking characteristics

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Outline

• Introduction
• Cooking characteristics using excess water
  – Gelatinization kinetics
  – Peak force kinetics
  – Moisture absorption kinetics
  – Texture and flavor determined by a sensory panel
  – Energy requirements
• Results
• Summary

Factors to be assessed

• Sensory and rheological characteristics of cooked rice:
  - Gelatinization, peak force (hardness) and moisture content (MC) kinetics of rice with different SLCs
  - Sensory analysis of cooked rice with different SLCs
• Energy use:
  - Cooking rice with different SLCs
• Human nutrition:
  - Blood glucose response and satiety index of cooked rice with different SLCs

Objective

To evaluate the effect of degree of milling (SLC) on rice hydration, texture, sensory and energy characteristics when cooking in excess water and when using fixed water-to-rice ratios

Premise of study

Could nutritional and energy-use aspects of rice consumption be enhanced by reducing the degree of milling; leaving more bran on kernels?

Leaving more bran on kernels

Beneficial to human nutrition

Reduce energy use?

- Less energy would be used for milling operations
- However, would more energy be required to cook rice with low milling degrees (high surface lipid contents)?

Energy requirements are affected by cooking kinetics
Rice lots
(obtained from a commercial mill; Riceland Foods)

<table>
<thead>
<tr>
<th>Non-parboiled</th>
<th>Parboiled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown (2.3% TLC)</td>
<td>Brown (2.3% TLC)</td>
</tr>
<tr>
<td>0.55% SLC</td>
<td>0.95% SLC</td>
</tr>
<tr>
<td>0.40% SLC</td>
<td>0.70% SLC</td>
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<tr>
<td>0.20% SLC</td>
<td>0.45% SLC</td>
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<tr>
<td>0.15% SLC</td>
<td>0.40% SLC</td>
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</tbody>
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Excess water cooking

Experimental design for excess water tests

Cooking kinetics

Gelatinization kinetics

After 12 min of cooking, 10 kernels are pressed using square plates.

5 g of head rice in 100 mL of boiling water

Gelatinization kinetics for non-parboiled rice
Peak force kinetics (Hardness) - texture analysis

40 g of head rice in 350 mL of boiling water

After 12 min of cooking, 5 g of kernels are placed on a strainer

Plastic bag held at lab temperature (~20°C) for 30 min

These steps were repeated every minute until 60 minutes of cooking

Moisture content kinetics

When the cooked rice is on the strainer, approx. 4 g are placed in an aluminum pan

The pans are placed in a desiccator for 15 min. Then, the mass of the pan and cooked rice is taken.

The pans are placed in an oven at 130°C for 24 h, put in a desiccator for 15 min, and weighed.

Texture analyzer output

Peak force and moisture content for non-parboiled rice

Peak force and moisture content for parboiled rice

Moisture content of non-parboiled vs. parboiled

Inflection points were assumed to represent the cooking duration to attain “well-cooked rice.”
Cooking durations to attain ‘well-cooked’ rice

Peak force of non-parboiled vs. parboiled

Energy requirements to cook in excess water

Sensory characteristics (Texture and flavor)

Recap of excess water cooking

Fixed water-to-rice ratio cooking
Experimental design

Method fixed water-to-rice ratio

Cooking duration: when the rice cooker turns off (determined when water has all been absorbed or evaporated through the vent)

Energy use: recorded by the Watt meter

Moisture content and peak force measured at the end
Cooking energy comparisons

Summary

- Milling degree had little to no effect on cooked rice hydration, texture and flavor for all milled samples when using both excess water and fixed water-to-rice ratios.
- Parboiled milled rice had less MC and greater hardness than non-parboiled milled rice at a given cooking duration/water-to-rice ratio.
- Differences in cooking characteristics between milled and brown rice were less pronounced for parboiled than non-parboiled rice.

Summary cont.

- In general, excess water cooking required more energy than fixed water-to-rice ratio cooking.
- Rice could be milled to lower degrees (up to 0.55% for non-parboiled and up to 0.95% SLC for parboiled rice), without affecting cooking energy and eating quality.

Thank you