Quantitative Analysis of Cooked Rice Grain Texture

Yanco Rice Quality Team

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Introduction

Rice varieties with different quality and texture are used to make different types of foods.
Introduction

Factors affecting cooked rice texture
- Amylose content
- Post-harvest processing
- Cooking methods
  - South and East Asians: rice cooker, particular water ratio
  - Indians: boiling in excess water
  - Americans: use large amount of water then drained

Current methods (*indirectly measures texture*)
- RVA (setback correlated with firmness)
- Gel texture analysis (gel firmness)
Introduction

Texture analysis

• Sensory panel
  High cost for training and maintaining the panel
  Not ideal for screening purpose

• Instrumental approach
  Less cost and less time-consuming
  • Texture analyser
    Mimic the first bite of a food sample

probe  →  Rice  →  Scale

Firmness  Stickiness
Aims of study

• Develop a method to directly measure cooked rice texture
• Compare textures of breeding lines and existing varieties
• Determine the contribution of different grain quality factors affecting the texture (amylose content, gelatinisation temp, RVA parameters, etc.)
Materials

30 varieties from Leeton farm, C2016
Selected based on
- Different grain dimensions
- Apparent amylose content 7~27 %
- Gelatinisation temp (GT) 65~79 °C
- Optimum cooking time 14~21 min
Method

Cooking method

- Excess water method with
  - Standard cooking time
  - Standard water ratio

Instrumental texture analysis

- Excess water drained after cooking
- Single layer cooked rice grains
- Two cycle compression
Method

Cooking in RVA

- 1g white rice contained in tea ball mesh and rinsed with tap water
- Add water up to 4g in a RVA can
- Seal the can with lid on using the thermo tape
- Load on to RVA machine
- Run the standard cooking profile

95°C, 21min

- Remove the lid after cooking to release the steam
- Replace with another lid at 1 min to keep it warm for 3 min on the bench
Texture Profile Analysis (TPA) using TXT

- Weigh and prepare 1g cooked rice sample within the mark on a glass plate in 1 min
- Run the standard test profile
  Two cycle compression, compress to 80% sample height

*Technical tips:*
*Each single grain sits on its side and spread well. Sample height is negatively correlated with firmness for the same sample.*
Results - theory

Texture Profile

(Firmness) Peak force

(Ration of Area 3 and 4 is cohesiveness)

Area 3 (Stickiness)

Area 4

Cycle 1

Cycle 2
Results - Firmness

Firmness (g)

- Control
- Amylose

- 7%~9%
- 17%~21%
- 25%~27%

Different letters indicate significant differences (p < 0.05)
Results - Firmness

<table>
<thead>
<tr>
<th>Amylose content</th>
<th>7%~9%</th>
<th>17%~21%</th>
<th>25%~27%</th>
</tr>
</thead>
</table>

![Graph showing firmness and gelatinization temperature for various rice varieties.](image)
Results - Firmness

\[ y = 77.459x + 2027 \]
\[ R^2 = 0.7664 \]

\[ y = 3.2828x + 3020.5 \]
\[ R^2 = 0.4789 \]
Results - Stickiness

- Calmochi101: 7%~9%
- TDK11: 17%~21%
- HomMaliNaw: 25%~27%
- Tarra140: control
Results - Stickiness

![Graph showing stickiness and gelatinization temperature for various rice varieties.](https://example.com/graph.png)

- **Amylose content**
  - 7%~9%
  - 17%~21%
  - 25%~27%

- **Varieties**
  - TDK11
  - HMN
  - Calmochi101
  - TDK11
  - Reiziq
  - YRM69
  - Koshi
  - Nipponbare
  - IRAT109
  - Doongara
  - IR64
  - L205
  - Fin
  - SHZ2
  - BD192
  - Calmochi 201
  - Fin
  - Amber33
  - Doongara
  - SHZ2
  - BD192
  - L205
Results - Stickiness

\[ y = -0.0505x + 274.95 \]
\[ R^2 = 0.4697 \]
Results - Stickiness

For OCT (°C), the relationship between stickiness and OCT is given by:

\[ y = 13.949x - 171.71 \]

with an \( R^2 = 0.5255 \) for None Waxy samples.

For Setback (RVAU), the relationship between stickiness and setback is given by:

\[ y = -13.129x + 1146.2 \]

with an \( R^2 = 0.7708 \) for the same samples.
Summary

• Used TVT machine to measure texture directly
• Compared results to gel firmness
• Explored texture correlation with OCT, GT, RVA setback parameter
• The outlier varieties in the texture profile of each amylose group were found
Future work

• More quality data for covariant analysis
• Amylose & amylopectin structure analysis by CE/SEC
• Look at the outliers
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