Characterization of broken rice kernels created by moisture-adsorption fissuring - an extended study

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Introduction

Kernel at high MC exposed to a low-RH environment (DESORPTION)

Kernel at low MC exposed to a high-RH environment (ADSORPTION)

Research gaps

Limited research has addressed:

1. Impacts of moisture adsorption fissuring on the physical and functional characteristics of broken kernels.

2. Correlation between the number of fissures/kernel at the rough rice stage to the particle-size distribution and functionality of broken kernels produced during milling.

Objectives

- Evaluate the impacts of rapid moisture adsorption on the extent of kernel fissuring and resultant milling yield.

- Relate the impacts of rapid moisture adsorption on the physical and functional characteristics of broken kernels.

- Correlate the number of fissures/kernel at the rough rice stage to the particle-size distribution and functionality of broken kernels produced during milling.

Recent effort

One pureline, long-grain cultivar, Roy J, at two initial MCs – results presented at IA Meeting, 2015.

The present study was undertaken to expand these findings.

Process flowchart

BULK LOTS (30 lb each)
Roy J (HMC = 17.1%), CL XL745 (HMC = 19.1%), and Jupiter (HMC = 20.6%)

Cleaned

Stored at 39°F

Equilibrated at 72 ± 1°F for 24 h
(divided into 6 sub-lots)

9% 11% 13% 15% 17%
4.5 lb each

12% (control)
7.5 lb
Materials and methods
- Fissure enumeration and milling yields

Fissure enumeration on brown rice kernels
- 300 randomly-selected rough rice kernels/replicate
- Manually dehulled
- Fissures of brown rice kernels enumerated
- Data presented as number-percentage of fissured kernels and number of fissures/kernel

Milling analyses
- 150-g rough rice sample/replicate
- Dehulled in laboratory huller, milled to 0.4% surface lipid content
- Data presented as milled rice yield and head rice yield

Statistical analyses
JMP Pro software, Ver. 12.0.1, SAS Institute, Inc., Cary, NC
Analysis of variance (ANOVA, α=0.05)
Fishers Least Significant Difference procedure (LSD, P=0.05)
Enumeration of fissures

Initial Moisture Content

Milling yields

Initial Moisture Content

Frequency distribution of fissures per kernel

Initial Moisture Content
Materials and methods
- Physical and functional characteristics of broken-kernel fractions

- Sieve analysis of brokens
  - Brokens divided into small, medium, and large fractions
  - Data presented as mass-percentages of each fraction
  (ASAE, 2004)

- Sieve analysis of brokens
  - "Large"
  - "Medium"
  - "Small"

- Viscosity profile
  - ~7 g from each kernel fraction ground into flour
  - Functional properties of flour from head rice and each broken-kernel fraction analyzed using a rapid visco-analyzer
  - Data presented as (i) peak viscosity, and (ii) final viscosity
  (AACC, 2000)

- Viscosity profile

- Results and discussion
- Physical and functional characteristics of broken-kernel fractions

- Mass percentages of small, medium, and large brokens

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- Mass percentages of small, medium, and large brokens
Correlation between the # of fissures/kernel to the particle-size distribution of broken kernels

Peak viscosities of different kernel fractions

Final viscosities of different kernel fractions

Conclusions and Significance

1. Do not allow rice to dry to MC below 15% in the field in order to avoid moisture re-adsorption fissuring, and thus, HRY reduction.

2. Size-distribution of broken kernels - different between LG and MG cultivar lots and also slightly between the two LG cultivar lots.

3. PV and FV were the greatest for head rice, and both decreased significantly with decreasing size of brokens.

4. Should broken kernels with different physical and functional characteristics be directed to different end-use applications?
Thank you

References


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