

**Rice Research and Promotion Board
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Title: The Effect of Harvest Conditions on Kernel Damage Effects and Milled Rice Free Fatty Acid Quality

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Summary: *Harvesting rice at low (13%) moisture content at low cylinder speed (550rpm) was most effective in maintaining low milled rice free fatty acid (FFA) levels and was independent of harvester type and rice variety. This was not related to the total amount of harvest damaged rice, but the type of damage produced. Harvesting regimes that produced damaged kernels with little bran remaining did not contribute to FFA development. Consequently, high moisture high cylinder speed kernels produced most FFA because the immature damaged kernels retained the bran easily and the high cylinder speed ruptured the bran to aid in FFA formation. Identification and removal of high bran- harvest damaged kernels would significantly reduce the rice FFA problem*

Introduction

The effect of harvesting conditions on rough rice damage and subsequent milled rice free fatty acid (FFA) levels after rough rice storage is being investigated. Milled rice FFA levels are a critical factor in determining milled rice acceptability for brewers, as off flavors derived from rice FFA reduces beer quality. Oxidation of FFA and rice bran oil is a rapid autocatalytic process which rapidly accelerates off-flavor production. An earlier study showed that a proportion of harvest damaged rough rice, i.e. rice with hull removed with bran damage, is present in almost all rough rice and is responsible for FFA development. (Feliz et al. 2005; Proctor and Lam 2005) The goal of this research is to determine the harvest conditions that will produce the minimum harvest-damaged rice and lowest milled rice free fatty acid levels, for optimal brewing quality.

Objectives:

1. Determine the effect of rice variety on rough rice damage, milled rice surface oil and free fatty acid content
2. Determine the effect of combine harvester type and speed of harvesting on rough rice damage, milled rice surface oil and free fatty acid content
3. Determine the effect of harvest rice moisture on rough rice damage, milled rice surface oil and free fatty acid content

Methods

Rice was harvested to determine the effect of variety (Bengal and Cocodrie) harvest moisture content (20%, 16% and 13%), harvester type (John Deere and Case), and harvester cylinder speed (550rpm, 850rpm and 1000rpm) on rough rice damage and milled rice free fatty acid (FFA) during storage.

The percent weight of harvest damaged rough rice from each harvesting condition was determined by manual separation. The rough rice was dried to 12% moisture on

harvesting and stored for 6 months at ~20°C. Rough rice from each harvesting regime was sampled each month. The rice was milled and milled rice surface oil and FFA determined by the method of Lam and Proctor (2001).

Results

FFA development: High harvest moisture produced the greatest milled FFA development. Harvest moisture effects on increasing milled rice FFA were most marked at high cylinder speeds. **Harvesting at lowest moisture and low cylinder speed were most effective in reducing milled rice FFA development during 6 months storage at ~20°C.** However, there were no varietal differences in milled FFA development during 6 months storage and no statistical difference between milled rice FFA produced by Case and John Deere harvesters.

Milled rice FFA increased until 4-5 months of rough rice storage and then declined, in rice from all harvesting regimes. This is most likely due to breakdown of FFA, producing rancid off-flavors. However, only samples harvested at high moisture content and high cylinder speed produced milled rice FFA levels close to the 0.1% FFA limit for brewing. The reason only these samples produced low FFA levels is probably because of the modest storage temperature (~20°C) which limited FFA development. High summer storage temperatures would likely increase the rate of formation and levels of milled rice FFA of rice obtained by the various harvesting conditions.

Kernel damage: The Case harvester produced more harvest damaged rice (9-15%) than the John Deere harvester (4-9%). However, this difference was not reflected in FFA levels. This is because we observed that the 'type of damage' is important in determining if harvest damaged kernels are a significant source of FFA. Harvest damaged kernels with almost all the bran removed are not a significant source of FFA but lightly damaged kernels that have lost the hulls with but a significant bran layer intact and slight abrasion is the main source of FFA. The Case harvester damaged kernels had little surface bran and so were not a greater source of FFA than John Deere harvested rice.

However, high moisture harvested damaged kernels (20%), which retained much of their bran layer, produced more damaged kernels and higher FFA than rice harvested at lower moisture levels. More immature high moisture kernels retained the bran longer on losing their hulls and thus produce more FFA. There was no varietal differences in kernel damage.

Harvesting at lowest moisture and low cylinder speed was most effective in reducing milled rice FFA development because low moisture rice more easily loses its bran, if the hull is removed, thus eliminating the source of FFA and low cylinder speed limits the forces of hull and bran removal. Therefore, identifying and removing high bran harvest damaged rice would significantly reduce the FFA problem.

Publications:

1. Feliz, D. J., Proctor, A., Monsoor, M. A. and Eason, R. L. 2005. The effects of damage kernels caused by combine harvester settings on milled rice free fatty acid levels. *J. Food Sci.* 70:376-379.
2. A. Proctor and S. H. Lam. 2005 Impact of free fatty acid formation and off flavor formation on milled rice brewing quality'; Chapter *In 'Grain based Products: Health and Flavor and Safety Aspects'* American Chemical Society. *In review.*
3. Lam, H.S. and Proctor, A. 2001. Rapid methods for milled rice surface total lipid and free fatty acid determination. *Cereal Chemistry.* 78:498-499.