

Effect of humidified polisher on the physical quality of milled rice during storage

(Kesan penggilap yang dilembapkan terhadap mutu beras ketika penyimpanan)

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Abstract

A study was conducted to evaluate the effect of humidified polisher (as treatment) and friction polisher (as control) on milled rice quality.

Dried paddy, Q34 variety was milled using a middle scale commercial mill of 2 t, paddy per hour capacity, located at MARDI Station, Bukit Raya, Kedah. The brown rice produced was further processed by horizontal abrasive whitener and followed by humidified polisher (as treatment) or friction polisher to produce milled rice. Using the cylindrical grader, the head rice was separated from the milled rice. A total of 48 kg of head rice (2 kg per bag for each treatment and control) was packed in polyethylene bags, and stored for 6 months. Samples were taken at monthly intervals for analysis of moisture content, bulk density, head rice, damaged grain, cracked grain, whiteness and insect infestation.

In general, all stored samples showed gradual increase in moisture content, but milled rice polished by the humidified polisher had the lowest with significant difference at $p = 0.01$. The head rice content in treated milled rice ($94.41 \pm 0.55\%$) was significantly higher than the control ($92.88 \pm 0.77\%$) at $p = 0.01$. Insect infestation was serious in all samples after 4 months of storage. Cracked grain in treated milled rice was significantly lower than the control at $p = 0.01$. The whiteness degree of treated milled rice was slightly higher than the control, but not significantly different. No significant difference was found for bulk density and damage between treated and control samples.

Introduction

Paddy cultivation still remains a very important agricultural activity in Malaysia (Othman 2001). At present, the paddy industry supplies some 65–70% of total national requirement estimated to be around 1.93 million tonnes.

Rice mills in Asia ranged from a single-pass Engelberg mill to the multipass systems. In the Engelberg type mill, dehulling and whitening are performed in one step with greater grain breakage and its by-product is a coarse mixture of husk and bran. In modern mills, the milling operation involves several steps, with the bran and brewers rice collected separately. In Japan,

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coin-operated mills are becoming quite popular to handle the daily requirements of a family. Milled rice containing more head rice has higher value (Juliano 1985). Good rice milling operation is crucially important to produce maximum yield of edible rice.

Two types of commercial milling systems are the conventional and Japanese types, each has a milling capacity of more than 2 t/h. About 79% of these mills were contributed by private millers (Anon. 1987). Most of the rice produced is consumed as white rice or polished rice. The term 'polished rice' refers to milled rice in which the loose bran adhering to the surface had been removed and thus improves its translucency. The rice is normally polished with the friction polisher or a cone-type vertical gadget covered with leather strips. However, most recently the humidified polisher (also called mist polisher) has been introduced. Polishing rice using the humidified polisher, also known as 'high degree refining of milled rice', involves a process of spraying a mist of water (20 litres/h) through the hollow shaft with high-pressure air (1 kg/cm²) during polishing. Water is evaporated during polishing and keeps the grain temperature lower than in friction polishing.

The high-tech capability of the mist polisher improves the milling performance, quality, taste, storability and translucency or brilliance of the milled rice product (Shigeharu 2004). Humidified polishing resulted in an extremely clean and glossy white appearance to the kernels, a distinct advantage over traditional milling methods (Anon. 2002).

This study was carried out with the objective of upgrading the quality of milled rice using the humidified or mist polisher and to extend the storage life of milled rice.

Materials and methods

Milled rice processing

A high quality paddy, Q34 was milled using the middle scale commercial, 2-tonne capacity of MARDI rice mill located at

MARDI Station, Bukit Raya. The studies were conducted during the off-season (November 1996) and main season (May–June 1997) respectively. The milling operations comprise cleaning, destoning, husking, separating of paddy and brown rice, whitening, polishing (friction or humidified), grading and packing. The polished rice was produced either from friction polisher or humidified polisher. The milled rice with loose bran from the whitening process was further polished by humidified polisher (as treatment), *Plate 1* or friction polisher (as control), *Plate 2*.



Plate 1. Humidified polisher (treatment)



Plate 2. Friction polisher (control)

With humidified polisher, the rice was polished with an atomized water (20 litres/h) injected through the hollow shaft with high-pressure air (1 kg/cm²). The head rice was then separated using the indented cylindrical grader, no. 4.75

Packaging and storage

The head rice from both control and treatment was packed in polyethylene (PE) film bag (0.2 mm thickness is the currently used for bagging rice). Rice samples of 2 kg/bag were placed on the wooden pallet and stored at ambient conditions for 6 months. At monthly intervals, duplicate samples for each treatment and control were taken at random for quality analysis.

Physical quality analysis

Analyses were done to determine the moisture content (% wet basis), head rice (%), bulk density (kg/hl), damaged grain (%), cracked grain (%), rice whiteness and living insects. Moisture was measured by calibrated Kett moisture meter. The head rice was determined using the Satake rotating indented cylinder grader 4.75 with 2 min rotating time and a catch trough plate at 0 degree. Bulk density was measured using the Ohaus hectolitre-weight. Damaged grain was determined by hand picking

method from 50 g of head rice sample. The cracked grain was inspected by a crack grain detector. About 300 whole grains were laid on perforated tray (100 grains each tray) and light was allowed to get through the kernel. Using a magnifying glass, cracked grains can be observed and counted. The rice whiteness was measured by Kett whiteness meter, with a calibrated plate number of 86.8. The living insects were manually counted from 500 g of head rice sample.

Statistical analysis

For data analysis, t-Test: paired two samples for means was used.

Results and discussion

Physical quality

The moisture content for most samples gradually increased during storage (*Figure 1*). The humidified treatment had the lowest values which were very significantly different at $p = 0.05$ (*Table 1*). The results apparently showed that the mist polisher did not increase the moisture content in milled rice during the polishing process.

Humidified milled rice had more head rice than friction milled rice throughout the storage period (*Figure 1*). This was found to be significantly different at $p = 0.05$ (*Table 1*). It was probably due to the higher

Table 1. Quality characteristics of milled rice during 6 months of storage

	Polishers	
	Humidified [#]	Friction [#]
Moisture content (% wet basis)	13.01b ± 0.44	13.62a ± 0.33
Bulk density (kg/hl)	76.57a ± 0.43	76.54a ± 0.67
Head rice (%)	94.41a ± 0.55	92.88b ± 0.77
Damaged grain (%)	4.45a ± 2.02	5.21a ± 0.81
Cracked grain (%)	3.68b ± 2.85	6.52a ± 0.93
Whiteness number	41.43a ± 1.43	41.04a ± 0.43
Milling degree (%)	Higher	Lower
Insects number	144 ⁺	168 ⁺
	Uncountable	Uncountable

Mean values within the same row with the same letters are not significantly different at $p = 0.05$

[#]Both were carried out in November 1996 (off-season) and May–June 1997 (main season)

⁺A total number of insects for 3 months of storage

number of insects in control sample. With humidified polisher in modern rice milling (Wahid et al. 1992), the head rice recovery was increased (cone polisher: 65.9%; friction polisher: 68.8%; humidified polisher: 72.9%). The hexagonal shape of its polishing chamber and its length may contribute to low friction force to the rice resulting in less rice breakage and cracks during processing. The cracked grain in humidified milled rice was also consistently

lower throughout the storage (*Figure 1*) and significantly different at $p = 0.05$ to that of the friction milled rice.

The small increase in head rice by 1.65% provides a great value to the millers. Based on 25,000 t paddy milling capacity (5 t/h x 20 h/day x 25 days/month x 10 months/year) and 68% milling yield, at 92.9% head rice recovery the millers will get about 16,624 t super graded rice with 5% broken (worth RM28.3 million).

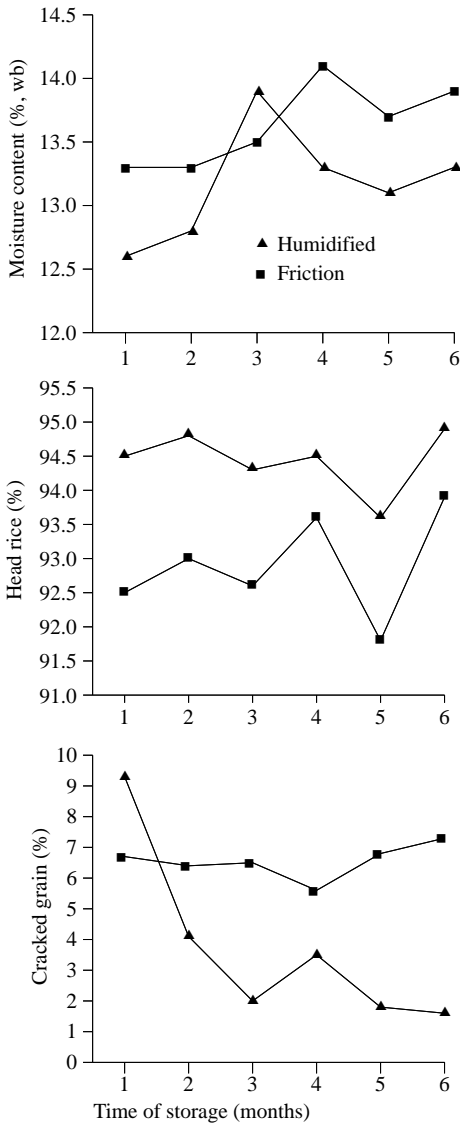


Figure 1. Moisture content, head rice and cracked grain during 6 months of storage

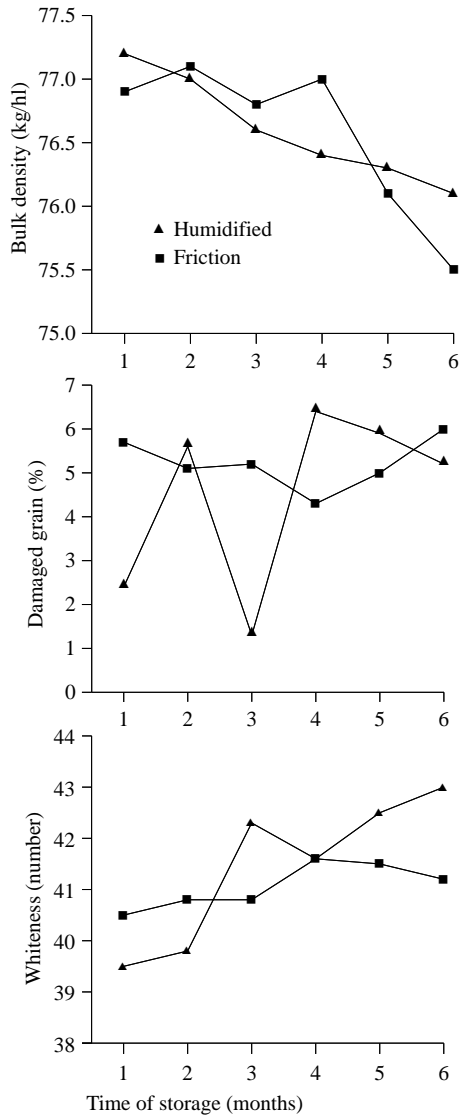


Figure 2. Bulk density, damaged grain and whiteness number during 6 months of storage

An increase to 94.4% head rice recovery (by humidified polisher), the millers will get 16,893 t super graded rice (worth RM28.7 million). The gate price of super graded rice 5% broken was RM1,700/t.

Humidified polisher gave a slightly higher bulk density, whiteness number and lower in damaged grain compared to friction polisher (*Figure 2*) but not significantly different at $p = 0.05$ (*Table 1*). Higher in whiteness number and lower in damaged grain were results of humidifying process. The bulk density was higher because the higher content of head rice.

Insect infestation

Both samples of friction milled rice and humidified milled rice in polyethylene film bag were apparently infested after 3 months of storage (lower number of insects in treatment sample) and was seriously affected after 4 months. The incidence of infestation may be caused by the film characteristics (Wahid et al. 2003) of high water vapour transmission rate (22 g/m². 24 h, 40 °C, 90% RH) and high oxygen permeability (2,900 cm³/m². 24 h.). Physically, the infested rice of both samples still had moderately good appearance and needed reprocessing to remove insects, viz. fumigate and repolish for consumption. Most of the local rice millers conduct these activities for repacking process and then distribution.

Conclusion

The results indicated that milled rice packaged in polyethylene film bags and stored at ambient conditions was heavily infested after 4 months of storage. Fumigation can be applied before packing to eliminate insects during storage. However, most physical quality in terms of bulk

density, damaged grain and whiteness number was maintained and not significantly different throughout the six months of storage. Humidified polisher was better than the friction polisher with significantly higher head rice and lower moisture content and cracked grain. The increase in head rice recovery was beneficial to millers where earnings can be increased by 1.4%. Milled rice polished using the humidified polisher gave better head rice recovery (significantly different at $p = 0.05$), lower in moisture content, $13.01 \pm 0.44\%$ (friction polisher: $13.62 \pm 0.33\%$) and cracked grains, $3.68 \pm 2.85\%$ (friction: $6.52 \pm 0.93\%$). The higher milling degree of humidified milled rice most probably can be stored longer than 6 months.

References

- Anon. (1987). Maklumat mengenai status kilang padi komersial di Malaysia. Lembaga Padi dan Beras Negara (sekarang BERNAS) Alor Setar, Kedah
- (2002). Supplier of super Basmati rice. Retrieved from <http://barkatrice.com>
- Juliano, B.D. (1985). Rice properties and processing. *Food Reviews International* 1(3): 423–25
- Othman, O. (2001). Agronomic factors affecting rice quality. Paper presented at Seminar and Workshop on Paddy and Rice Quality, 3–4 Nov. 2001, Alor Setar, Kedah. Organiser: MARDI-MITCO
- Shigeharu, K. (2004). New concept in rice processing. Paper presented at Rice Milling Technology Seminar, 17 Oct. 2004, Alor Setar, Kedah. Organiser: Satake Corporation
- Wahid, S., Ibni Hajar, R. and Hashifah, M.A. (1992). Peranan kilang padi perintis MARDI. *Tekno. Makanan* 11: 29–37
- Wahid, S., Rosniyana, A., Hashifah, M.A. and Sharifah Norin, S.A. (2003). Packaging techniques to prolong the shelf life of brown rice and partially milled rice at ambient storage. *J. Trop. Agric. and Fd. Sc.* 31(2): 225–33

Abstrak

Kajian telah dijalankan bagi menilai kesan penggilap yang dilembapkan (rawatan) dengan pengilat geseran (kawalan) terhadap mutu beras kisar.

Padi varieti Q34 diproses di kilang komersial berskala sederhana MARDI yang berkeupayaan 2 tan sejam terletak di Stesen MARDI Bukit Raya, Kedah. Beras perang yang dihasilkan diputihkan dengan pemutih pelelas mendarat seterusnya digilap dengan penggilap yang dilembapkan atau penggilap geseran untuk menghasilkan beras kisar. Beras kisar diproses seterusnya dengan menggunakan silinder penggred untuk menghasilkan kepala beras. Sejumlah 48 kg kepala beras (24 kg setiap rawatan dan kawalan) dibungkus di dalam beg plastik polietilena (PE) seberat 2 kg setiap satu dan disimpan selama enam bulan. Pensampelan dijalankan setiap bulan dan dianalisis untuk kandungan lembapan, ketumpatan pukal, kepala beras, beras rosak, biji retak, keputihan dan serangga.

Semasa penyimpanan terdapat peningkatan bagi kandungan lembapan dengan nilai terendah ialah sampel rawatan mempunyai kandungan lembapan terendah dengan nilai perbezaan bererti pada $p = 0.01$. Kandungan kepala beras rawatan ($94.41 \pm 0.55\%$) adalah lebih tinggi (perbezaan bererti pada $p = 0.01$) berbanding dengan beras kawalan ($92.88 \pm 0.77\%$). Serangan serangga yang serius berlaku setelah 3 bulan penyimpanan terhadap beras kawalan dan beras rawatan. Biji retak dalam beras rawatan lebih rendah (perbezaan bererti pada $p = 0.01$) berbanding dengan beras kawalan. Keputihan beras rawatan adalah lebih tinggi jika dibandingkan dengan beras kawalan, bagaimanapun tiada perbezaan bererti. Juga menunjukkan tiada perbezaan bererti untuk ketumpatan pukal dan beras rosak antara sampel rawatan dengan sampel kawalan.