

Effect of Different Bran Removal Degrees on Quality Attributes of Stored Parboiled Rice

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Abstract

This study was undertaken to determine the effect of different degrees of bran removal on physical, chemical, biological storage parameters and eating qualities of parboiled rice stored under ambient condition for six months. Four bran removal degrees 0%, 4%, 6% and 8% were used as treatments. Replicated were stored in poly sack bags. The effects of degree of bran removal on moisture content, grain and ambient temperature, grain hardness, fungal infestation, cooking qualities and sensory qualities during storage period were determined. Cooking quality attributes comprised cooking time, water uptake ratio, and volume expansion ratio and alkali digestion. Panel test results were used to determine sensory quality of the rice. Results indicated that storage parameters varied significantly ($p \leq 0.05$) among the bran removal degrees during storage period. The moisture content, temperature and sensory qualities were significantly higher in bran removal degree 6%. Cooking qualities were significantly higher in bran removal degree 4%, 6% and 8% than unpolished rice. The grain hardness was significantly higher in unpolished rice. Any fungal infestation or insect damage was not observed on stored rice kernels during the entire storage period. Based on the variation of the parameters during storage, it can be concluded that the optimal bran removal degree which assures the best quality and safety for parboiled rice storage in polysack bags is 6%.

Key words: Parboiling, Bran removal, Brown rice, Rice storage

Introduction

Rice (*Oryza sativa*) is the staple food and plays a vital role in the economy and livelihood of people in Sri Lanka. The rice market of Sri Lanka fluctuates during the year with a surplus of rice during harvesting period and low supply during the rest of year. Because of the seasonality of the production, it is needed to store the harvest for the use of less production periods or off season. Rice is stored as rough rice in Sri Lanka and most of the tropical countries. But countries like Japan and China store rice as brown rice.

In Sri Lanka paddy storage duration is around 6 month (Adikarinyake, 2005). But in the case of milled rice, it is restricted to a short time period and people do not practice it for long period of time. Parboiling process toughen of the endosperm and results less breakage during milling and also minerals and vitamins present in the bran and embryo move into the rice kernel up to some extent (Wasala *et al*, 2009). Therefore, parboiled rice contains important nutrients than rice milled

without such treatment. In commercial level rice production, 7-8% of rice bran is removed by polishing. The degree of bran removal may have an effect on the storage parameters of physical, chemical, biochemical, microbiological, cooking and eating quality concerns. This study was carried out to investigate the effect of degree of bran removal on storage behavior of parboiled rice during storage period and to recommend the optimum bran removal range which assures the best quality and safety for parboiled rice stored under ambient condition.

Materials and Methods

Sample Preparation: Paddy variety Bg 352 was used for the experiment. Paddy sample was cleaned and then subjected to the parboiling process as mentioned by Adikarinyake and Swarnasiri (1988) followed by drying up to 14% moisture content.

De-husking and Polishing of Paddy to Different

Bran Removal Degrees: Homogeneous bulk paddy samples were divided into three replicates and de-husked using a rubber roll sheller (Model, LM24 2C). Brown rice was polished using a friction polisher model no N 70. The polisher was adjusted to obtain a 0%, 4%, 6%, and 8% bran removal samples separately using reference sample obtained from laboratory scale rice polisher model McGill No.02.

Storage: Three rice samples of each bran removal category were stored for six months under ambient conditions (temperature: $29 \pm 3^{\circ}\text{C}$ and relative humidity: $65 \pm 5\%$) in 5 kg polysack bags at the main grain store of Institute of Post Harvest Technology, and proper sanitation conditions were maintained during this period. Before storing, rice samples were fumigated using Aluminum Phosphide. Physical, biological, cooking and eating parameters of rice were measured at the beginning, during and at the end of the storage period. During the storage period, data were collected at two weeks intervals.

Physical and biological properties: The moisture content of rice was determined by the standard oven method. Grain hardness was measured by using a Satake hardness tester (Model No 174886). Inside temperature of the poly sack was measured by using digital

thermometer (S-506 K (CA) model) and ambient temperature by using a normal thermometer, at same time. Mold growth was measured by means of stranded plate count (SPC). Insect infestations to stored rice kernels were observed.

Cooking qualities: Cooking time, water uptake ratio and volume expansion ratio during cooking and also alkali spreading ratio and clearing in KOH were determined as mentioned by Juliano, (1971).

Sensory qualities: A five point Hedonic scale was used to conducting sensory evaluation with 15 trained panelists to determine the consumers/individuals level of performance in relation to the taste, odour and texture of cooked rice of each bran removal category at two week intervals.

Data analysis: Data related to storage parameters and cooking qualities obtained from replicates of each bran removal degree were fitted in to a completely randomized design (CRD) and were analyzed using SAS for Windows version 6.12. Data relating to the sensory qualities of cooked rice was fitted in to a Friedman test using MINTAB version 11.

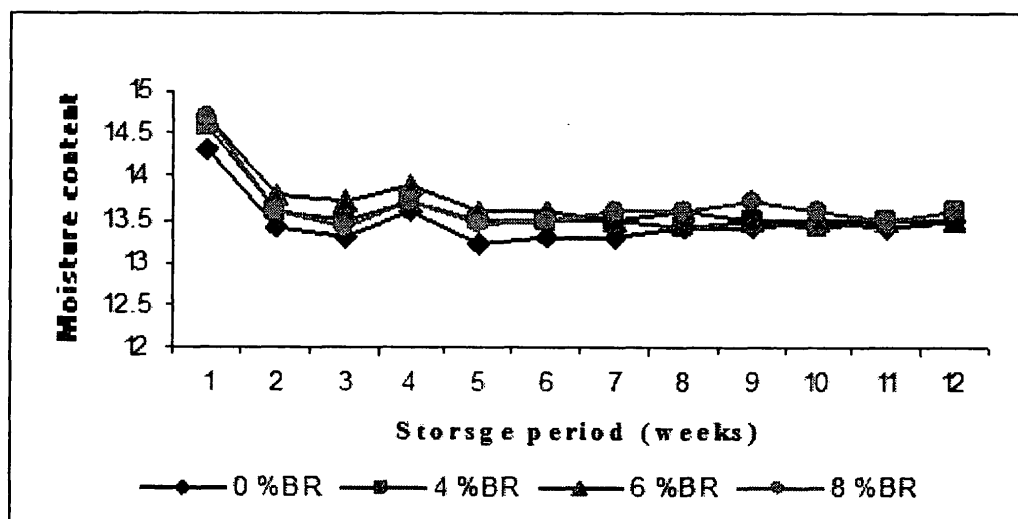


Figure 1. Changes in moisture content during storage

Results and Discussion

Variation of the moisture content of parboiled

Moisture content of rice stored initially decreased and then it was stable below 14 % in all bran removal categories. Results revealed that bran removal did not any effect on equilibrium moisture content of parboiled rice during the storage period.

Temperature of grain

Results indicated that variation of temperature in 0% bran removal degree was significantly different from other bran removal degrees ($P < 0.05$). It was further showed that there was no effect of degree of bran removal on the variation of temperature in rice bags. Therefore, it can be concluded that degree of bran removal does not affect considerably the changes in rice kernels..

Hardness of grain

Parboiled rice hardness increased significantly ($P < 0.05$) during the storage period and also was different among the bran removal degrees. A marked difference in the hardness was observed in unpolished rice (0% BR) and it was higher than other bran removal degrees. Indudhara swamy *et al.*, (1978) reported that during ageing, brown rice becomes progressively harder and also harder grain resistant to the pest attack.

Cooking qualities

Most of the cooking qualities are related to the amylose content of rice varieties. The differences observed in the cooking qualities of parboiled rice are brought forth by retro-gradation of starch (Lii *et al* 1996).

Volume expansion ratio: During the storage period, the volume expansion ratio of cooked rice increased significantly. There were no significant differences in the volume expansion ratio of bran removal degree 4%, 6% and 8 % ($P < 0.05$). Furthermore, variation in 0 % bran removal degree was significantly different from variations in other degrees. Volume expansion ratio of 4, 6 and 8 % degrees showed higher values which are desirable in rice cooking.

Water uptake ratio: The water uptake ratio of cooked rice examined was found to be significantly increased in all bran removal degrees, during the storage period (Figure 2). Zhou *et al.*, (2001) reported increase in water uptake for up to 1 year during storage. The water uptake ratio of unpolished rice (0% BR) resulted significantly lower value than to other bran removal degrees. There were no significant difference of water uptake ratio of bran removal degree 4%, 6% and 8%.

Alkali spreading and clearing (Alkali Digestion):

The Alkali digestion values of cooked rice were

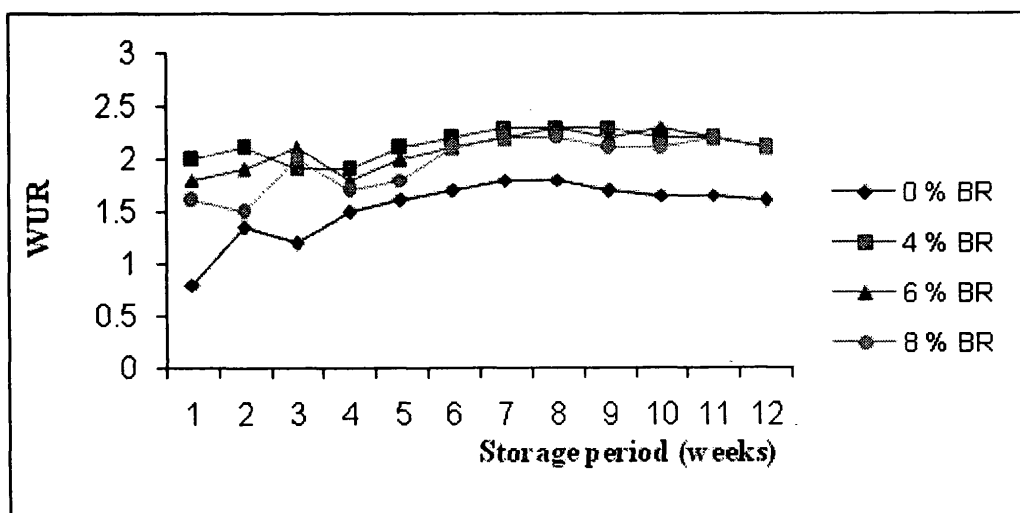


Figure 2. Water uptake ratio of rice during the storage

significantly different among bran removal degrees of 4%, 6% and 8% during the storage period and it increased. Alkali digestion values were significantly different between the bran removal degree 0% and other three bran removal degrees.

Sensory qualities

Taste: the consumers' acceptability for cooked rice based on taste during the storage period decreased substantially in all rice categories except in bran removal degree of 6% which was increased during the storage period from 1st week to 6th week. Result of taste of cooked rice showed that there was also a significant difference ($P<0.05$) between the bran removal degrees. Total score earned at two week intervals for sensory evaluation for taste of cooked rice has increased substantially in all rice categories other than in unpolished rice.

Odour: consumer preference for odour of cooked rice decreased slightly in all bran removal degrees. Result of odour of cooked rice showed that there was also a significant difference ($P<0.05$) between the bran removal degree 0% and others. Bran removal degrees 4%, 6% and 8% have gained higher consumer preference for odour of cooked rice. Zhou *et al*, (2001) reported the odour of milled rice changes very rapidly during storage

Texture: Results showed that there was a significant difference in consumers' acceptability for texture of cooked rice, during the storage period. Sum of ranks earned for texture of cooked rice was increased substantially in all rice categories other than in unpolished rice (0% BR), which was declined during the storage period.

Overall acceptability: The overall acceptability clearly shows that the consumer preference decreased slightly

in all bran removal degrees other than the bran removal degree 6%. The overall acceptability showed that bran removal degree 6% gained higher consumer preference and unpolished rice became the least preferred one.

Insect infestation and mould growth: Any insect damage to rice kernels during the storage period was not observed, and also fungal growth on rice was not found.

Based on the variation of the parameters during storage, the optimum bran removal degree which assures the best quality and safety for parboiled rice storage in polysack bags is 6% bran removal. Storing of parboiled brown rice under ambient conditions minimize the insect infestations and mould growth.

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