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VARIETY DIFFERENCES IN GRAIN QUALITY ATTRIBUTES OF RICE

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INTRODUCTION

Rice (*Oryza sativa* L.) being the staple food of Sri Lankans, is found in different varieties in the local market due to the release of many high yielding cultivars which has led to increase the rice production in the island (Abeysiriwardena, 2003). Despite the increased production, consumer demand exists for specific preferences on its pericarp colour, grain size and shape, and processing which are collectively known as grain quality attributes. The preference and the demand which were created locally had rated these varieties to relevant prices. Samba varieties (Short round in shape) fetch a higher price over the medium sized varieties (Juliano and Villareal, 1993). Parboiled rice is preferred by most of the consumers (RCMD, 1987) and consumers in Kandy district prefer under milled red parboiled rice with medium grain size (Brekenridge, 1979). Most of the local consumers believe that the red raw rice is nutritious and is considered the most nutritious of them all. Different varieties of rice show differences in grain quality attributes and these could be physically, sensory or nutritionally observed.

De-husked red and white rice can be distinguished through their pericap colour and both are collectively called brown rice. Dehulling (dehusking) separates the hull (husk) from the brown rice and abrasive milling removes the outer tissues (the bran/pericarp) to improve palatability of milled rice. Bran which is removed during milling consists most of the nutrients such as protein, fat, fiber, vitamins and minerals (Champagne *et al.*, 2004). Pigments in coloured rice are in the pericarp or the seed coat (Juliano and Bechtel, 1985).

With respect to grain quality in rice, the general consensus is that the improved rice varieties are poor while the traditional rice varieties are good in grain quality. However, varietal improvement has led to the loss of diversity in grain quality of improved varieties (Abeysiriwardena, 2003). Perera (2003), pointed out that our traditional varieties have excellent quality characters such as oiliness, flavour etc, which could be incorporated into new varieties during variety improvement.

A study was carried out to investigate the differences in physical, milling, cooking, eating and nutritive qualities among some of the rice varieties including, improved, traditional and red and white pericarp rice in Sri Lanka in order to provide information on grain quality attributes of rice to the public and rice breeders.

MATERIALS AND METHODS

A study was carried out at the Rice Research and Development Institute (RRDI), Batalagoda with some of the improved, traditional and red and white pericarp rice varieties namely Bw 400, H4, suduheenati, hondarawalu, rathel, Bg300, Bg352, Bg359, Bg379-2 and Bg403. Treatments were arranged in a Completely Randomized Block Design with three replicates and the experiment was conducted in *maha* 2005/06. Samples collected at maturity were threshed and shade dried until it reached the equilibrium moisture content of 13%.

Each sample was tested for grain quality attributes, such as the percentage of brown rice (BR%), percentage of removed bran (Bran %), percentage of head grain (HG%), specific gravity (SG), hardness (RG), whiteness (Wh), amylose content, crude ash content and crude fat content. Specific gravity was measured with paddy and then brown rice (de-husked paddy through a "Satake" laboratory husker) was utilized to analyse RG, ash and fat content. To estimate whiteness and amylose content, brown rice was polished in a Mc Gill sample mill for 50 seconds. BR%, Bran %, HG% and amylose content of each variety were measured according to Cruz and Kush (2000) and the density was determined according to Bhattacharya *et al.* (1972). The KETT digital whiteness meter (modle C-300) which was calibrated using the standard plate which has a value of 83.4, was used to measure whiteness. Ten undamaged brown rice grains, without cracks were selected by a grain scope (TX 200-KETT) and placed one by one in 'Satake' Hardness Tester (No. 174886) to measure the hardness value. Crude ash and crude fat contents were measured by method no. 08-01(AACC, 1983) and 30-20 (AACC, 1983), respectively. Data was analysed to distinguish the differences between varieties with respect to the grain quality attributes recorded.

RESULTS AND DISCUSSION

Grain quality attributes of ten rice varieties recorded at RRDI, Batalagoda in *maha* 2005/06 are represented in Table 1. Variety differences in all the grain quality attributes, physical, nutritional and eating and cooking quality were found to be significant.

Highest BR% was recorded in Bw400 with a value of 82.4 (Table 1). When HG% of varieties was high, hardness appeared low. Rice grains, with high hardness values, appeared comparatively more prone to breakages during polishing. However, Bg403 was an exception. Most of the improved varieties had high HG% (Bg403, Bg352 and Bg300) and low RG values (Bg352, Bg300, Bg359 and Bg379-2). Except suduheenati, the other two traditional varieties had the lowest HG%. The lowest SG was found in variety Bw 400 while Bg 300, Bg 359 and bg 379-2 rated the highest.

According to Champagne *et al.* (2004), bran consists most of the nutrients such as protein, fat, fiber, vitamins and minerals. However, total ash and fat contents of Bg300 were not comparatively lower though the bran removal was contrastingly higher in Bg300 than all the other varieties. Whiteness of Bg300 was also not significantly higher compared to that of other white pericarp varieties.

Among white pericarp varieties, only Bg379-2 recorded a higher whiteness value than that of Bg403. Except Bw400, all the red pericarp varieties scored similar bran removal values. However, all red rice scored similar whiteness values. Though the bran removal was lowest in Bg359 and Bg379-2, whiteness values of both of them were in the highest range. Therefore, it was evident that there was no relationship between grain whiteness and the bran removal percentage at the same polishing intensity and thus grain whiteness appeared variety specific.

All the varieties tested were in the high amylose group, amylase content ranging from 26.1 to 34.7. However, H_4 was the only variety that was included only in the highest non-significant group of the amylase content. According to Denyer (2005), food containing high amylose has low Glycaemic Index (GI) which helps to reduce the risk in obesity, diabetics, heart diseases, etc. All the varieties which were taken for the study recorded a high amylose content which has been identified as a desirable grain quality characteristic. Although amylose is considered under cooking and eating quality aspect, its relationship to GI has made it to be considered under nutritional aspect as well. Ash content which represents the total mineral and crude fat contents varied among varieties without any relationship to pericarp colour or level of variety improvement. Bg379-2 and rathel together scored the highest ash content, differing significantly only from Bw400 and Bg403. Highest fat content was observed in suduheenati but the values of Bw400, H4, rathel, Bg300 and Bg352 did not differ significantly from that of suduheenati.

Even with a sample size of ten varieties, significant variability among varieties with respect to each of the grain quality attribute studied could be found.

Table 1.Grain quality attributes of ten rice varieties recorded at RRDI, Batalagoda in *maha* 2005/06.

Variety	*State of improvement*	*Pericarp colour*	*Brown rice (BR %) **	*Removed bran %**	*Head grain (HG%)**	*Hardness (RG) (kg)**	*Specific gravity (SG)**	*Whiteness**	*Amylose content (%)**	*Ash %**	*Fat %**
Bw 400	New improved	red	82.4_{a}	6.1_{b}	54.0_{c}	6.2_{d}	1.184_{e}	23.2_{c}	31.9_{bc}	1.10_{b}	2.2_{abcd}
H_4	Old improved	red	80.3_{d}	5.2_{c}	50.8_{d}	7.5_{a}	1.213_{cd}	22.8_{c}	34.7_{a}	1.43_{ab}	2.4_{abc}
Suduheenati	Traditional	red	80.7_{cd}	4.9_{c}	53.7_{c}	7.1_{b}	1.220_{bc}	25.1_{c}	32.4_{abc}	1.45_{ab}	3.0_{a}
Hondarawalu	Traditional	red	80.6_{cd}	5.2_{c}	46.5_{e}	$6.8b_{c}$	1.214_{cd}	26.7_{c}	26.1_{d}	1.48_{ab}	1.8_{bcd}
Rathal	Traditional	red	80.7_{cd}	5.3_{c}	49.6_{d}	6.3_{d}	1.205_{d}	25.5_{c}	29.8_{c}	1.67_{a}	2.2_{abcd}
Bg 300	New improved	white	80.1_{d}	7.1_{a}	55.0_{bc}	4.8_{f}	1.230_{ab}	35.9_{ab}	26.8_{d}	1.50_{ab}	2.6_{ab}
Bg 352	New improved	white	81.5_{d}	5.4_{c}	57.8_{ab}	4.6_{f}	1.222_{bc}	36.1_{ab}	31.6_{bc}	1.44_{ab}	2.5_{ab}
Bg 359	New improved	white	80.7_{cd}	4.1_{d}	53.4_{c}	4.6_{f}	1.228_{ab}	35.2_{ab}	33.9_{ab}	1.27_{ab}	1.7_{bcd}
Bg 379-2	Old improved	white	81.1_{bc}	4.4_{d}	51.8_{d}	5.7_{e}	1.235_{a}	37.7_{a}	26.3_{d}	1.74_{a}	1.5_{cd}
Bg 403	New improved	white	81.6_{b}	4.3_{d}	59.2_{a}	6.4_{cd}	1.219_{bc}	32.5_{b}	31.0_{c}	1.02_{b}	1.4_{d}

*Means with the same letter within a column are not significantly different at 5% probability level.

Variability among varieties appeared adequate for useful utilization and identifying varieties with desired combinations of grain quality attributes depending on the purpose even within the observed variability would be possible. Extending the present study to compare grain quality attributes between red and white pericarp varieties and traditional and improved varieties would be interesting.

CONCLUSIONS

Quality attributes differed significantly among rice varieties irrespective of their level of improvement. Variety differences observed within each grain quality attribute appeared adequate for useful utilization.

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REFERENCES

Abeysiriwardene, D.S.De Z. 2003. Rice varietial improvement for future challenges. In proceedings of Rice Symposium on 14-15th Dceembr 2000. Eds. D.S.De Z. Abeysiriwardene, D.M.N Dissanayake and L. Nugaliyadde. Rice Congress, Department of Agriculture, Peradeniya, Sri Lanka.

AACC, American Association of Cereal Chemists, 1983. Approved Methods of the American Association of Cereal Chemists. 8th edition, American Association of Cereal Chemists, Inc., St. Paul, Minnesota.

Bhattacharya, K.R., C.M. Sowbhagya and Y.M. Indudhara Swamy. 1972. Some physical properties of paddy and their interrelation. Journal of Science Food and Agriculture 23:171-186.

Breckenridge, C. 1979. Rice grain evaluation in Sri Lanka. In Proceedings of the Workshop on Chemical Aspects of Rice Grain Quality. International Rice Research Institute. Manilla, the Phillippines. 175-181 p.

Champagne, E.T., D.F. Wood, B.O. Juliano and D.B.Bechtel. 2004. The rice grain and its gross composition. In Rice Chemisty and Technology, 3rd edition, Eds. E. T. Champagne. Pp 77-107. The American Association of Cereal Chemists. Inc. USA.

Cruz, N.D. and G.S. Kush. 2000. Rice grain quality evaluation procedures. In Aromatic Rices. Eds. R.K. Singh and G. S. Khush. Pp 15-27. Oxford and I.B.H publishing Co. pvt. Ltd., New Delhi.

Denyer, G. 2005. The glycaemic index. Invited presentations. In Seventh Annual Congress of Postgraduate Instittute of Agriculture, University of Peradeniya, Sri Lanka held on 24-25th 2005. 1-5 p.

Juliano, B.O. and C.P. Villareal. 1993. Grain quality evaluation of world rice. International Rice Research Institute, Manila, the Philippines. 205p

Juliano, B.O. and D.B. Bechtel. 1985. The rice grain and its gross composition. In Rice Chemisty and Technology. 2nd edition, Eds. B. O. Juliano. Pp 17-57. The American Association of Cereal Chemists. Inc. USA.

Perera, A.L.T. 2003. Potential of biotechnological tools for rice improvement. In proceedings of Rice Symposium on 14-15th December 2000, Eds. D. S. De Z. Abeysiriwardene, D. M. N Dissanayake and L. Nugaliyadde. Rice Congress. Department of Agriculture, Peradeniya, Sri Lanka.

RCMD-Rice Council for Market Development, 1987. Evaluation of world rice varieties and types. Update 1. Houston, Texas. 98 p.