

# Genetic Enhancement of Zinc Content in Rice Grains

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## INTRODUCTION

Major nutritional problems common in rice-consuming countries are protein-energy malnutrition and Fe, Zn, I, and vitamin A deficiencies. Billions of people are at risk of Zn deficiency, and it is ranked as the 5<sup>th</sup> leading risk factor for diseases such as diarrhoea and pneumonia in children. Zinc is vital for many biological functions and is essential for survival. Its deficiency has serious consequences for health such as stunted growth and impaired development. Zinc deficiency is more extensive in developing countries where over 60% of the population can be at risk. The costs of these micronutrient deficiencies in terms of lost lives and erosion of quality of life are enormous. Since rice is the dominant cereal crop in most Asian countries and is the staple food for more than half of the world population, even a small increase of Zn content in polished rice grains would be highly beneficial for human health. Several strategies, including supplementation and fortification programs, address the problems of micronutrient deficiencies. Recently, breeding staples, including rice, with high micronutrient content - 'biofortification' - has evolved as a new strategy to address micronutrient malnutrition. The current status of our efforts to breed micronutrient-dense rice, especially Zn-enriched rice varieties, will be presented.

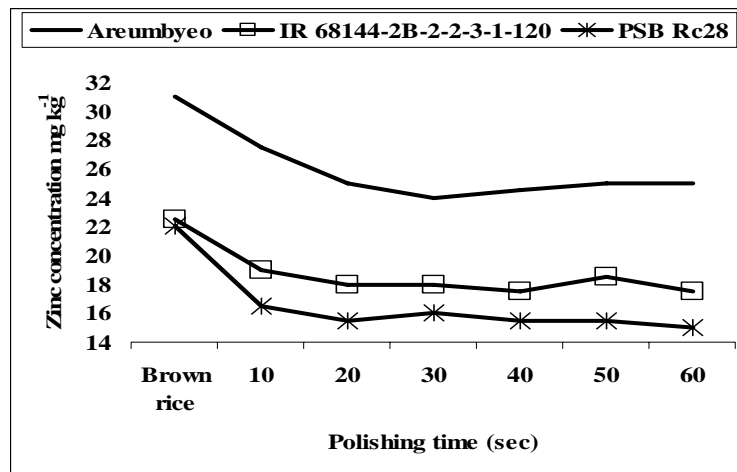
## METHODS

Fifteen lines/varieties of rice were evaluated in the field at two locations (Maligaya and IRRI) using a randomized complete block design with three replications during two seasons. Rice grains were dehulled with a modified Satake's dehusker. The rubber rollers on the Satake's dehusker were replaced with polyurethane coated rollers to avoid contamination. Brown rice samples were polished in a Grainman No. 2 laboratory mill for 60 sec. The milling degree of polished rice samples was monitored with a Satake milling meter. Rice samples were analysed for Zn using Inductively Coupled Argon Plasma-Atomic Emission Spectroscopy (ICP-AES). The protocol was developed at the Department of Plant Sciences, University of Adelaide, Australia.

## RESULTS AND DISCUSSION

### Effect of milling on Zn content

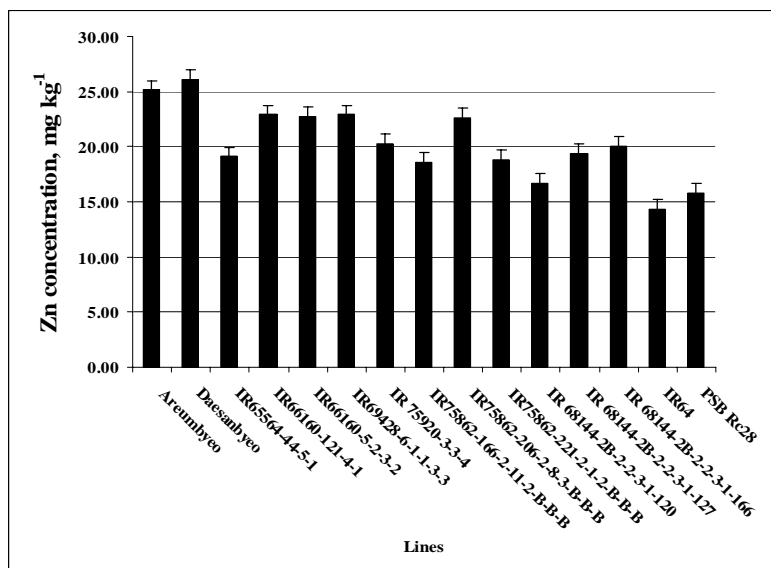
Most rice is consumed in a polished state without outer layers (pericarp, tegmen and aleurone etc.) due to the removal during milling. In this process, most of the nutrients that are concentrated in the outer layers of brown rice get lost. We performed differential polishing for three genotypes (1 *japonica* and 2 *indicas*) to study the losses during polishing. Our results showed that an average of 24% Zn is lost during milling (Fig.1).



**Fig. 1. Zinc concentration in rice grains subjected to differential milling times**

### Genetic variability for Zn content in rice grains

Zinc content in polished rice grains was determined for 15 genotypes evaluated at two locations during dry and wet seasons. The average Zn content in the polished rice grains varied from 14 to 26 mg kg<sup>-1</sup> (Fig. 2). Apparently, there was ample genetic variability for Zn content. The best genotype had an 85% higher Zn content than the baseline in a popular *indica* variety (IR64).



**Fig. 2. Average Zn content in rice grains for 15 genotypes evaluated at two locations for two seasons**

### CONCLUSIONS

There was sufficient genetic variation for Zn content in the rice grains which can be exploited to breed new rice varieties with enhanced Zn content.

### ACKNOWLEDGEMENTS

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