

This thesis has been accepted by the University of Kelaniya for the award of the Degree of Doctor of Philosophy (D.Phil.) It is not allowed to publish this as a thesis accepted for the Degree of Doctor of Philosophy without the authority of the University

Deputy Registrar/Examinations



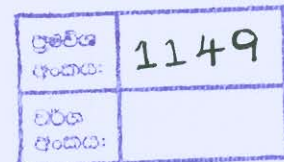
**LEVELS OF IRON, ZINC, PHOSPHORUS AND  
BIO-AVAILABILITY OF IRON IN SELECTED  
VARIETIES OF RICE GROWN IN SRI LANKA**

by

**Herath Mudiyanseelage Theja Herath**

**B.Sc. (Peradeniya), M. Phil. (Sri Jayewardenepura)**

**FGS/01/01/02/2008/01**



**A thesis submitted to the Degree of  
Doctor of Philosophy at University of Kelaniya, Sri  
Lanka**

**December, 2013**

## ABSTRACT

Rice is the staple food consumed by Sri Lankans. The main objective of the present study was to identify rice varieties, that are rich in iron and zinc while showing high bio-availability of iron in order to recommend for consumption and breeding to combat prevailing iron deficiency anaemia.

Thirty nine rice varieties from two sites in Rice Research Institutes at Bombuwala (iron rich soil ~500 ppm) and Bathalagoda (iron non-rich soil ~100 ppm) during two seasons of *Yala* (2006, 2007) and *Maha* (2006/2007) were analyzed. The overall iron content and zinc content (mg /100 g db) varied from 1.75 (Bg 406) - 3.23 (Kalu Bala Wee) and 2.51 (Masuran) - 3.91 (Kalu Bala Wee) with overall mean values of  $2.49 \pm 0.54$  and  $3.18 \pm 0.45$  respectively. A significant difference ( $p \leq 0.05$ ) was observed in both mean values of iron and zinc with respect to site, season and variety. Further significant interactions ( $p \leq 0.05$ ) were observed in site\*var and ses\*var in two-away analysis while site\*ses\*var in three-way analysis. Overall phosphorus content (mg /100 g db) varied from 322.0 (Masuran) - 444.8 (Dahanala) with mean value of  $376.4 \pm 29$ . A significant difference ( $p \leq 0.05$ ) was observed in mean phosphorus content with respect to variety, site and interaction var\*site. Kalu Bala Wee, Rathu Heenati, Dahanala, Rathal, Suwanda Samba and Kalu Heenati had high iron and zinc contents. A percentage reduction of iron, zinc and phytic acid contents on polishing (at 8-10% degree of polishing) varied from 84.6 - 93.6%, 39.3% - 81.8% and 18.8 - 40.8% respectively. Significant positive correlations were not observed between iron vs. zinc, iron vs. phytic acid, and zinc vs. phytic acid, phytic vs. phosphorus, iron vs. phosphorus and zinc vs. phosphorus content in brown rice as well as iron vs. zinc, iron vs. phytic acid and zinc vs. phytic acid in polished rice.

*In-vitro* percentage dialyzability varied from 1.73 (Rathu Heenati) - 8.71 (Kalu Heenati) in selected endospermic high iron rice varieties. *In-vivo* animal studies using rat models fed with experimental diets formulated from Bg 300, Suduru Samba, Kalu Heenati and Rathu Heenati showed the %Haemoglobin gain from  $3.6 \pm 2.7$  -  $18.1 \pm 10.9$  while %Fe Haemoglobin gain were 39.6, 44.9, 33.8 and 31.9 respectively. Iron bio-availability expressed as term of %Haemoglobin Regeneration Efficiency (HRE) showed significantly high values ( $p \leq 0.05$ ) in white pericarp varieties namely Suduru Samba and Bg 300 (i.e  $4.6 \pm 1.1$  and  $4.1 \pm 1.9$ ) than other red pericarp varieties studied (i.e.  $2.3 \pm 0.6$  and  $1.9 \pm 0.5$ ).

**Key words:** iron, zinc, phosphorus, rice and iron bio-availability